Whitehead Tyee Site

Remedial Investigation Work Plan

Prepared for

730 Myrtle, LLC
and
Seattle Iron & Metals Corp.
601 S. Myrtle St.
Seattle, Washington

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FINAL

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The interpretations and conclusions contained in this report are based in part on site characterization data collected by others or obtained by publicly available sources. Floyd|Snider cannot assure the accuracy of this information.

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List of Abbreviations

Abbreviation	Definition
AO	Agreed Order
ARAR	Applicable or Relevant and Appropriate Requirement
bgs	Below ground surface
BMP	Best management practice

Abbreviation	Definition
BTEX	Benzene, toluene, ethylbenzene, and xylene
CAP	Cleanup Action Plan
City	City of Seattle
COC	Chemical of concern
COI	Chemical of interest
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
CPOC	Conditional point of compliance
CSBC	Crushed surfacing base course
CSM	Conceptual site model
CUL	Cleanup level
cVOC	Chlorinated volatile organic compound
CY	Cubic yard
DCE	Dichloroethene
DRO	Diesel-range organics
Ecology	Washington State Department of Ecology
EPH	Extractable petroleum hydrocarbons
ERH	Electrical resistance heating
ERD	Enhanced reductive dechlorination
Fox Avenue Site	Fox Avenue MTCA Cleanup Site
FS	Feasibility Study
GRO	Gasoline-range organics
GWCC	Great Western Chemical Company
IA	Interim action
IAWP	Interim Action Work Plan
ISGP	Industrial Stormwater General Permit
LDW	Lower Duwamish Waterway
µg/L	Micrograms per liter
MCL	Maximum contaminant level
mg/kg	Milligrams per kilogram
MTCA	Model Toxics Control Act
ng/kg	Nanograms per kilogram
ORO	Oil-range organics
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PCUL	Preliminary cleanup level
penta	Pentachlorophenol

Abbreviation	Definition
pg/L	Picograms per liter
PID	Photoionization detector
PQL	Practical quantitation limit
Property	730 S. Myrtle Street property
PSL	Preliminary screening level
QAPP	Quality Assurance Project Plan
RAL	Remedial action level
RAO	Remedial Action Objective
Reliable	Reliable Transfer & Storage Company
RI	Remedial Investigation
RI Work Plan	Remedial Investigation Work Plan
RL	Remediation level
ROD	Record of Decision
ROW	Right-of-way
SAP	Sampling and Analysis Plan
SES	SoundEarth Strategies
SIM	Seattle Iron & Metals Corporation
Site	Whitehead Tyee Site
SMS	Sediment Management Standards
SVOC	Semivolatile organic compound
TCE	Trichloroethene
TEE	Terrestrial ecological evaluation
TEQ	Toxic equivalent
TPH	Total petroleum hydrocarbons
Tyee Lumber	Tyee Lumber and Manufacturing Company
USEPA	U.S. Environmental Protection Agency
UST	Underground storage tank
VCP	Voluntary Cleanup Plan
VOC	Volatile organic compound
VPH	Volatile petroleum hydrocarbons
WAC	Washington Administrative Code
WBZ	Water-bearing zone
Whitehead	The Whitehead Company, Inc.

1.0 Introduction

This Remedial Investigation Work Plan (RI Work Plan) was prepared by Floyd|Snider at the request of 730 Myrtle, LLC, and Seattle Iron & Metals Corporation (SIM), pursuant to Agreed Order (AO) No. DE 13458. This RI Work Plan documents the scope, technical approach, and implementation details for completing the RI at and around the former Tyee Lumber and Manufacturing Company (Tyee Lumber) facility located at 730 S. Myrtle Street in Seattle, Washington, referred to as the Whitehead Tyee Site (Site). The Site is currently on the Washington State Department of Ecology's (Ecology's) database of confirmed and suspected contaminated sites under Facility/Site ID #9809 and Cleanup Site ID #12115.

Per the Washington State Model Toxics Control Act (MTCA; Washington Administrative Code [WAC] 173-340-100), the term "Site" can be defined as where hazardous substances have come to be located. The Site boundary will be refined as part of the remedial investigation (RI) work and will be documented in the RI/Feasibility Study (FS) report. Figure 1.1 presents the geographic location of the Site and Figure 1.2 shows the 730 S. Myrtle Street property (Property) and adjacent properties. For clarity in this report, "Site" will be used when referring to the area of known contamination, which extends off-Property, and "Property" will be used when referring to the 730 S. Myrtle Street parcel only.

1.1 PURPOSE OF THE REMEDIAL INVESTIGATION WORK PLAN

The purpose of this RI Work Plan is to describe the investigation activities that will be completed to characterize the nature and extent (both vertically and horizontally) of contamination in soil and groundwater to provide sufficient information to evaluate and select cleanup actions. The RI Work Plan is a specific requirement of the AO between 730 Myrtle, LLC (the Property owner), SIM as the operator, and Ecology, and complies with MTCA requirements (WAC 173-340-350). It also incorporates existing information collected as part of previous environmental investigation efforts at the Site and includes pertinent data[1] collected as part of the adjacent Fox Avenue MTCA Cleanup Site (Fox Avenue Site). The RI Work Plan includes a Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) that describe the organization, objectives, and specific quality assurance/quality control procedures for field and laboratory activities associated with sample collection proposed for the RI data collection and analyses.

1.2 REGULATORY BACKGROUND

The following sections summarize the Site's regulatory history, including a brief summary of the interim action (IA) that was implemented in 2017/2018 to fulfill regulatory requirements.

[1] Pertinent data include soil and groundwater data collected on the Property and immediately adjacent to or downgradient from the Site as part of Fox Avenue Site activities.

1.2.1 Toxics Cleanup Program

Contamination at the Site was identified as early as 1991 during off-site investigations conducted for the Fox Avenue Site, which is located immediately adjacent to and north of the Property (refer to Figure 1.2). Since then, information regarding known contamination has been reported to Ecology's Toxics Cleanup Program. Chlorinated volatile organic compounds (cVOCs) associated with the Fox Avenue Site are present in the subsurface in the north/northwestern portion of the Property and are being addressed as part of Fox Avenue Site cleanup actions (further described in Section 2.1.1). Chemicals of interest (COIs) that have been identified in soil and groundwater at the Site include pentachlorophenol (penta) and total petroleum hydrocarbons (TPH), both as Stoddard solvent and heavy oil. Dioxins/furans presumably associated with penta have also been detected in vadose zone soil at the Site. Elevated concentrations of Stoddard solvent and penta primarily exist in soil and groundwater near the former penta dip tank and penta underground storage tank (UST) source area located adjacent to the Property to the south in the S. Myrtle Street right-of-way (ROW), with groundwater and limited soil contamination extending north inside the Property boundary. In addition, localized elevated concentrations of oil-range organics (ORO) were detected in soil on the east central portion of the Property.

In April 2013, the previous Property owner, The Whitehead Company, Inc. (Whitehead), received an Early Notice Letter from Ecology related to the release of hazardous substances. This Letter indicated that Ecology intended to add the Site to the known or suspected contaminated sites list (Ecology 2013a). In response, Whitehead submitted an application and was enrolled in Ecology's Voluntary Cleanup Plan (VCP) program in October 2013.

In December 2015, 730 Myrtle, LLC, purchased the Property, and Ecology subsequently issued a Draft AO to SIM and 730 Myrtle, LLC, in June 2016 to address Site contamination. AO No. DE 13458 was finalized and executed on August 25, 2016.

1.2.2 Water Quality

SIM's operations on the Property are covered by an Industrial Stormwater General Permit (ISGP; WAR-125002), issued to SIM on May 31, 2011, by Ecology's Water Quality Program, and modified on May 16, 2012. SIM had been out of compliance with the ISGP since it was issued and has been working cooperatively with the Water Quality Program toward a comprehensive stormwater solution for the Property. The Water Quality Program issued Administrative Order No. 13739 to SIM on September 20, 2016, to complete stormwater improvements at the Property. Prior to the completion of Phase 1 improvements under this order, the Property had a gravel ground surface with no stormwater conveyance system. To bring the Property back into compliance with the ISGP, the Property was graded and paved, and a stormwater conveyance and treatment system (including pre-treatment) was installed in late 2017. Construction was completed in early summer 2018 with final connection to the City of Seattle (City) storm drain system. This stormwater improvement construction project was completed in conjunction with an Ecology-approved IA to concurrently remove contaminated soil, which is described in further detail in Section 3.2.

2.0 Site Description

The Site is located at 730 S. Myrtle Street and includes the S. Myrtle Street ROW where the former penta dip tank and UST operations occurred. The limits of the Site will be further defined as part of the RI. The Property is a 3.22-acre paved lot used for empty container and truck storage by SIM. Pertinent Site features are shown on Figure 2.1.

The majority of the Property is secured by perimeter fencing and includes internal fencing and gates to separate operation areas. An open-air metal shed is located on the northeast portion of the Property and is the only structure present. This shed is used for light maintenance activities on containers, such as spot welding. The Property's geographic, geologic, and hydrogeologic settings, as well as current and former uses, are described in further detail in the following sections.

2.1 PROPERTY LOCATION AND ADJACENT PROPERTIES

The Property is bounded by E. Marginal Way to the east, S. Myrtle Street to the south, and Fox Avenue S. to the west, and is bordered by Cascade Columbia Distribution (the Fox Avenue Site) to the north. The Property is located in a mixed commercial and industrial use area of Seattle, consistent with the area's zoning. Surrounding buildings include Seattle Boiler Works to the west (across Fox Avenue S.); SIM to the southwest (across S. Myrtle Street); a vacant former nightclub/tavern that abuts the Property to the southeast (historically a gasoline station); and Seattle Sprinter & RV Service Center, Caffe D'Arte Roasting Plant, Sea Native USA WA (seafood processing), and United Rentals Trench Safety to the south (all located in the parcel currently identified as Whitehead Block LLC across S. Myrtle Street on Figure 1.2).

2.1.1 Fox Avenue Cleanup Site

The Fox Avenue Site has documented contamination in groundwater and soil resulting from chemical storage and handling operations during the former Great Western Chemical Company (GWCC) operations. Soil and groundwater at the Fox Avenue Site have been contaminated by past releases of solvents and other chemicals, including cVOCs, petroleum compounds, benzene, and penta, as documented in the RI for the Fox Avenue Site (Floyd|Snider 2011). A groundwater contaminant plume emanating from the Fox Avenue Site crosses the western third of the Property toward the S. Myrtle Street Embayment, where groundwater discharges into the Lower Duwamish Waterway (LDW) as shown on Figure 2.2. A conditional point of compliance (CPOC) for groundwater was established for the Fox Avenue Site that is along the western boundary of the Property adjacent to Fox Avenue (Figure 2.2).

In accordance with a Cleanup Action Plan (CAP; Ecology 2012), the Fox Avenue Site has undergone active source removal via electrical resistance heating (ERH) and soil vapor extraction, which were completed in 2013, and is currently in the post-thermal polishing phase, which includes enhanced reductive dechlorination (ERD) and long-term groundwater monitoring. The most recent annual report for the Fox Avenue Site was submitted for the year 2022 (CALIBRE 2022). The annual report documented ongoing ERD injections on the Property and concluded that groundwater contaminant concentrations continue to decrease in response to ongoing ERD treatment; however, the plume remains in the downgradient areas to the southwest of the Fox Avenue Site, including on the northwestern portion of the Whitehead Tyee Property. Historical and current conditions at the Fox Avenue Site are discussed in further detail in Section 3.1.1.

2.1.2 Lower Duwamish Waterway

The Property is located approximately 450 feet east-northeast of the LDW, which is the portion of the Duwamish River that extends from downstream of the upper turning basin at River Mile 4.8 to its outlet into Elliott Bay. The entire segment of the LDW in the vicinity of the SIM facility is designated as a Superfund Site by the U.S. Environmental Protection Agency (USEPA) due to sediment contamination and is also on the 303(d) list of impaired water bodies in Washington State.

While the Property is not immediately adjacent to the LDW, groundwater from the Site has the potential to be transported through the subsurface soil and discharge to the LDW. The water table at the Site is located at depths of approximately 8 to 11 feet below ground surface (bgs). Stormwater runoff from adjacent streets, including the S. Myrtle Street ROW, discharge to the LDW. Historically, stormwater runoff from the Property was also discharged untreated to the LDW via two separate stormwater outfalls, one at the end of S. Myrtle Street and one at the end of S. Brighton Street (located approximately 1,500 feet northwest of the Property). As described in Section 1.2.2, a stormwater conveyance and treatment system was constructed on the Property to address the discharge of untreated stormwater discharge to the LDW. The stormwater system, which includes pre-treatment and enhanced treatment, has been installed, was put on-line in July 2018, and has been operational since January 2019. Stormwater from the Property is captured and treated prior to discharge to the LDW.

2.1.2.1 Sediments

The *Final Lower Duwamish Waterway Remedial Investigation Report* (Windward 2010) and *Final Lower Duwamish Waterway Feasibility Study* (AECOM 2012), known collectively as the LDW RI/FS under Superfund Order with USEPA, focus on sediment contamination in the LDW. In sediments, identified chemicals of concern (COCs) include polychlorinated biphenyls (PCBs), carcinogenic polycyclic aromatic hydrocarbons (cPAHs), arsenic, and dioxins/furans as the four main "risk-driver" contaminants in the LDW sediments based on human health, plus all chemicals regulated by the benthic Sediment Cleanup Objectives under Washington State's Sediment Management Standards (SMS) in WAC 173-204 (Ecology 2013b). The Record of Decision (ROD) for the LDW Superfund Site was issued by USEPA in November 2014 and outlines the final sediment cleanup plan for the LDW (USEPA 2014). For each of the COCs, remedial action levels (RALs) were selected to develop the final remedial areas targeted in the cleanup plan. This cleanup plan requires multiple parties to remediate the LDW and to complete source control actions (primarily stormwater upgrades) to prevent recontamination of the sediments.

In the S. Myrtle Street Embayment, where stormwater and groundwater from the Site are discharged (along with discharge from a number of industrial properties and roadways in the immediate vicinity), the LDW RI/FS identifies only one exceedance of a RAL in the vicinity of the shoreline, for dioxin/furan toxic equivalent (TEQ). The S. Myrtle Street Embayment also contains a sediment sample with no RAL exceedances, per the LDW RI/FS. An additional sediment sample collected by Ecology in 2011 immediately adjacent to the S. Myrtle Street Outfall (after the issuance of the LDW RI/FS) had exceedances of RALs for bis(2-ethylhexylphthalate), butyl benzyl phthalate, mercury, total PCBs, and zinc (SAIC 2011).

2.1.2.2 Surface Water

The LDW is also listed on the federally approved Section 303(d) list of impaired water bodies in Washington State. The waters in the S. Myrtle Street Embayment are considered impaired because of the detection of polycyclic aromatic hydrocarbons (PAHs) in upstream and downstream samples of clam tissue (Ecology 2016a). Therefore, the listing is not based on direct measurement of surface water quality.

2.2 HISTORICAL OWNERSHIP AND OPERATIONS

The Property was historically used for lumber mill operations under several transitioning ownerships from 1918 to 1986. The former Corson Avenue historically passed from northeast to southwest through the eastern portion of the Property dividing it into a larger western portion and a smaller eastern portion. Figure 2.3 and Table 2.1 summarize dates of construction and operations in each former building or structure to document operational history at the Property.

Various historical sources were used to develop the operational and ownership history on the Property. These sources include the following:

- Historical facility building plans and records
- Historical building plans and records from the City Department of Planning of Development
- Surveys, plats, deeds, lease, and easement records from the King County Recorder's office
- Sanborn Fire Insurance Rate maps
- Historical aerial photographs
- Historical property record cards from the Puget Sound Regional Archives
- Newspaper articles from the Seattle Times archives

2.2.1 Pre-Tyee Lumber Operations

The western portion of the Property was originally developed with a 1918 vintage sawmill that included a 17,010-square-foot mill building, a 13,973-square-foot lumber warehouse (the former window sash manufacturing and frame shop), a boiler house, and a lumber shed. The boiler was fueled by a sawdust/refuse burner. By the early 1920s, the sawmill, which was operated by Williams Fir Finish Company, was expanded to include a shop and storage, an office, and a lunch room. A dry kiln was built on the western portion of the Property in 1928 and a second dry kiln was added in 1947. These kilns were heated by steam from the boiler house.

By 1929, the eastern portion of the Property was developed with residential properties and a garage. An automotive and truck repair shop operated from 1949 to the early 1950s and was later removed in 1966 when use was transitioned to a lumber sorting yard. Details regarding garage ownership/operation was not located in available records reviewed.

2.2.2 Tyee Lumber and Manufacturing Operations

Tyee Lumber operated a sawmill and wood finishing operation on the Property from 1929 until 1986. Sometime between 1929 and 1949, Tyee Lumber & Manufacturing Co., later renamed Tyee Industries (hereafter referred to as Tyee Lumber I), took over operations on the western portion of the Property. Tyee Lumber I purchased the eastern portion of the Property in 1950 and constructed additional warehousing and manufacturing space. By the early 1950s, Tyee Lumber I operated on both the western and eastern portions of the Property. The western portion of the Property was leased from King County until 1953 when the land transferred to Mesher Supply Co., who subsequently sold the western portion of the Property to Tyee Lumber I in 1955. Tyee Lumber I used the Corson Avenue ROW for material laydown until abandonment of the road by the City occurred in 1963. In the late-1950s Tyee Lumber I expanded south of S. Myrtle Street. This expansion included construction of the main office building located at 701 S. Myrtle Street and additional warehouse space at 765 S. Myrtle Street. These operations south of S. Myrtle Street were limited to warehousing and office space.

Tyee Lumber I operated on the Property until 1981 when mill operations were taken over by a new Delaware company also called Tyee Lumber & Manufacturing Company (hereafter referred to as Tyee Lumber II, a different legal entity than Tyee Lumber I). Tyee Lumber II operated on the Property until 1986.

The facility layout remained similar throughout Tyee Lumber I and II's respective operational timeframes. From at least 1953 until 1981, Tyee Lumber I operated a sawmill and wood finishing operation, which included the treatment of lumber in the former penta dip tank, located south of the Property line boundary in the S. Myrtle Street ROW. Tyee Lumber I operations included dipping green lumber (i.e., lumber with a moisture content greater than 19 percent) in the dip tank and subsequently drying it in a storage shed located in the northwest corner of the Property. The lumber was then processed and dried for a second time in a dry kiln using steam heat from the boiler house, and then air dried or stored outside the dry kilns. It could not be confirmed if Tyee Lumber II also used the dip tank when it took over operations in 1981. The former penta dip tank is described in more detail in Section 2.2.3.

The dry kilns were located in the central portion of the Property (Figure 2.3) and were used for drying both untreated and treated lumber. The only point during the drying process where chemicals could be introduced was during the initial treatment of the wood in the former penta dip tank. Air emissions associated with untreated lumber were unlikely, but, based on literature research, could have included low levels of volatile organic compounds (VOCs), such as methanol and phenol.

Tyee Lumber I also had a gluing operation located in the Finger Jointing Mill. Machines used to support operations for gluing and drying dipped lumber were located in the eastern portion of the building. Interviews conducted in 1992 with former employees of GWCC (now Cascade Columbia Distribution/the Fox Avenue Site) indicated that a whitish liquid would run along the building and pond in the transfer shed (lumber shed) along Fox Avenue S., often overflowing onto the former GWCC property to the north (currently the Fox Avenue Site). In 1986, prior to the closure of Tyee Lumber II operations, Ecology collected a sample of the discharge for analyses; the material was determined to be non-toxic polyvinyl acetate.

2.2.3 City of Seattle S. Myrtle Street Right-of-Way

Tyee Lumber I (and possibly Tyee Lumber II) wood treatment and preservation operations associated with the former penta dip tank occurred between approximately 1953 and 1981 within the S. Myrtle Street ROW located south of the Property line. Ecology records indicate that a 300-gallon penta UST was located adjacent to the dip tank. The dip tank, which was covered by an open shed, measured 10 to 15 feet long, 5 feet wide, and 5 to 6 feet deep. The penta UST was reportedly decommissioned in 1986 when Whitehead and Reliable Transfer & Storage Company (Reliable) purchased the Property from William Paul and Ann Duncan (after W. Paul Duncan purchased the Property from Tyee Industries, Inc. in 1982).[2] The former penta dip tank and UST source area is known to be a source of subsurface contamination including TPH, specifically Stoddard solvent, penta, and dioxins/furans associated with historical operations.

2.2.4 Whitehead and Reliable Transport & Storage Operations

Whitehead and Reliable acquired the Property in 1986 for trucking and storage operations. Decommissioning and removal of the former penta dip tank and UST, and related equipment, and improvements to the Property were required prior to acquisition. Whitehead and Reliable operated on the Property until SIM began leasing it in 1999.

2.3 CURRENT OWNERSHIP AND OPERATIONS AT THE PROPERTY

The Property is currently owned by 730 Myrtle, LLC, and operated by SIM. SIM previously leased the Property from Whitehead and Reliable from 1999 to 2015 for truck and container storage before 730 Myrtle, LLC, purchased the Property in December 2015. The layout of the Property during SIM operations between 1999 and 2016 is shown on Figure 2.4. The Property had a ground cover of crushed gravel through 2016. In 2017 and 2018, the Property was paved with a combination of reinforced concrete (the majority of the Property) and asphalt as part of

[2] Floyd|Snider conducted significant supplemental historical research in March 2019 at the City archives, King County archives, Washington State archives, Puget Sound Regional archives, local newspaper archives, and Ecology. Additional information regarding the penta UST installation, operation, or decommissioning from these sources was not located.

stormwater improvement and IA construction, as described in Section 3.2 (refer to Figure 2.1). Currently, SIM continues to use the Property for truck and container storage and light maintenance on containers. No metal processing has ever occurred on the Property. Prior to redevelopment and paving, SIM customers were observed sweeping out trucks onto the ground surface, introducing the potential for non-metallic debris. However, since redevelopment, SIM customers are no longer permitted to sweep out trucks on-Property.

The Property is generally divided into three operational areas by internal fencing and/or usage areas running north to south (Figure 2.1) and SIM's operational areas and activities have been fairly consistent since 1999. The westernmost area is used as an equipment staging yard, typically for truck, chassis, container, or car parking. The center area is used as the export yard. The eastern most area is used as the empty container storage yard. Normal operations consist of trucks and trailers entering from S. Myrtle Street through the unfenced equipment staging yard and proceeding into the fenced export yard. Trucks and trailers can also enter the export yard from S. Myrtle Street through the entrance gate of the container storage yard. The export yard in the central portion of the Property is used for staging loaded shipping containers containing processed metal originating from the SIM main processing yard for outbound delivery. Trucks enter the export yard via the S. Myrtle Street gate primarily to drop-off or pick-up loaded shipping containers. Light maintenance, including tire changes and spot welding, are completed in the maintenance shed on the northeast portion of the Property.

Best management practices (BMPs) are implemented at the Property to minimize the potential for impacts to stormwater quality. A detailed description of BMPs is provided in the Stormwater Pollution Prevention Plan for the Property. Generally, these include housekeeping, regular inspections and maintenance of the stormwater treatment system, spill prevention, and employee training.

2.4 GEOLOGY AND HYDROGEOLOGY

This section summarizes the aspects of geologic and hydrogeologic setting of the Site that are pertinent to assessing the nature and extent of contamination and potential pathways for contaminant migration. These include the composition of subsurface soils including fill and native soil, groundwater occurrence, and groundwater flow. Additional details regarding Site and regional geology and hydrogeology will be included in the RI.

The Property is located in the Duwamish Valley within the Puget Sound Basin. Regional geology in the Duwamish Valley is characterized by sedimentary bedrock of Tertiary age mantled by glacial drift deposits. More recent river and estuarine deposits composed of interbedded fine sands and silts and coarser sands and gravels overlie the bedrock and glacial deposits. The youngest alluvial deposits in the vicinity of the LDW (i.e., the Lower Duwamish Valley), consisting of silt, sand, and sandy silt with abundant wood and organics, represent channel and floodplain deposits laid down by the modern Duwamish River. In the Lower Duwamish Valley, native sandy and silty alluvial deposits are often overlain by fill consisting of hydraulically dredged material from the waterway placed for the purpose of land development, as well as fill materials from various uplands sources (Troost and Booth 2008). This understanding of regional geology in the

Duwamish Valley informs the interpretation of the lithology of Site soils including the determination of fill and native soils.

Soils at the Site consist of a layer of fill soil approximately 6 to 10 feet thick composed of hydraulic dredge material with minor contributions from potential uplands sources and anthropogenic debris. The fill soils are underlain by native alluvium consisting of dark gray, medium to fine sand and silty sand. Although soil borings at the Site have generally not been advanced beyond a depth of approximately 20 feet bgs, deeper borings at the main SIM facility across S. Myrtle Street to the south, as well as at the adjacent Fox Avenue Site to the north, have encountered a discontinuous silt layer underlying the sandy recent alluvium deposits at depths of 15 to 20 feet bgs (AGRA 1988; Floyd|Snider 2011). Below the recent alluvium and silt layer (where present) lie older, downward-fining alluvial deposits of sand grading to fine silty sand. Previous geotechnical borings conducted at the main SIM facility to the south suggest that the older alluvial deposits extend to at least 100 feet bgs (AGRA 1988).

The occurrence of groundwater at the Site informs the assessment of the potential for contaminant migration in the subsurface. Groundwater is first encountered at the Site in an unconfined “water table” aquifer within the Lower Duwamish Valley alluvial deposits, at depths ranging from 8 to 11 feet bgs. The groundwater that occurs within the Lower Duwamish Valley alluvial deposits is generally considered to be a single large aquifer system (Booth and Herman 1998); however, hydrogeologic studies conducted at other sites in the LDW area, including the adjacent Fox Avenue Site and the Boeing Plant 2 Site located approximately 1 mile to the south of the Site on East Marginal Way, have differentiated between water-bearing zones (WBZs) within the larger aquifer based on characteristics such as hydraulic conductivity, vertical gradients, or salinity.

At the adjacent Fox Avenue Site to the north, an upper groundwater WBZ consisting of both sandy alluvial deposits and a lower groundwater WBZ consisting of fine silty sand and silt have been identified. The upper groundwater WBZ is further differentiated into first (water table) and second WBZs which are separated by a silt layer that is encountered between approximately 15 to 20 feet bgs. The alluvial aquifer at several sites in the LDW has been determined to be non-potable due to several factors, including the risk of saltwater intrusion from pumping, natural background concentrations of organic and inorganic constituents, and various Washington State and King County policies and statutes that prohibit the use of groundwater as a potable supply in the area (Floyd|Snider 2011; EPI 2015). A site-specific assessment of Site groundwater potability will be included in the RI.

Recharge to the shallow aquifer in the vicinity of the Site is primarily via infiltration of surface water through unpaved surfaces and discharge from upland aquifers to the valley. Horizontal groundwater gradients measured at Site monitoring wells are relatively flat with an overall flow direction from the northeast to southwest, ultimately discharging to the LDW to the southwest at the S. Myrtle Street Embayment. Tidal variations in the LDW, however, have also been shown to cause temporary reversals in flow direction in the uppermost WBZs in areas immediately adjacent to the LDW (Booth and Herman 1998). In the vicinity of the Site, temporary reversals in flow have been observed in both WBZs west of Fox Avenue S. However, flow reversals were not observed on either the Site or the Fox Avenue Site east of Fox Avenue S. Rather, the magnitude of the horizontal flow gradient on both sites appeared to fluctuate due to tidal influence instead of reversing altogether (Floyd|Snider 2011).

Horizontal hydraulic gradients in the upper and lower WBZs measured during the Fox Avenue Site RI ranged from 0.006 to 0.013 feet per foot during high and low tides (Floyd|Snider 2011). Horizontal gradients were generally flat, reflecting the topography, but were impacted locally by tides and variations in hydraulic conductivity. Horizontal gradients in the upper WBZ were approximately an order of magnitude higher in the area west of the Fox Avenue S., compared to gradients measured to the east.

During the Fox Avenue RI, measurements from specific well pairs were used to estimate vertical hydraulic gradients between the upper and lower WBZs, but tidal imprinting made it difficult to calculate gradients. Generally, downward gradients were observed farther from the LDW and upward gradients were observed closer to the LDW, likely due to saltwater intrusion from the LDW forming a higher density saline groundwater wedge, forcing freshwater upward (Floyd|Snider 2011).

2.5 ECOLOGICAL SETTING

The Site is located in an industrial area of Seattle with no significant undisturbed habitat for wildlife. The Property is covered with relatively new impervious surfaces, including asphalt and concrete pavement, which will be maintained for current and future operations. The highly industrial nature of the Site and vicinity makes it unlikely that ecological receptors will encounter contaminated soil at the Site. However, it is possible that vermin (rats, raccoons, etc.) use the area, especially near the LDW. According to the Washington State Department of Natural Resources' Natural Heritage Program, there is currently no rare plant or high-quality ecosystem in the vicinity of the Site (DNR 2021).

2.5.1 Terrestrial Ecological Evaluation

In accordance with WAC 173-340-7491, the Site does not qualify for a terrestrial ecological evaluation (TEE) exclusion because (1) contamination in soil is present above the standard point of compliance (15 feet bgs) and the CPOC for TEE (6 feet bgs) and (2) contamination is present off-property where an institutional control cannot be applied by the property owner.

On this basis, a Simplified TEE was considered for the Site. A Simplified TEE is appropriate because the Site is not a designated habitat area, is not used by threatened or endangered species, and is not located adjacent to significant vegetated areas greater than 10 acres in size (WAC 173-340-7491(2)(b)). This approach is consistent with the recommendation from Ecology in the *Whitehead Tyee Site: Response to Terrestrial Ecological Evaluation* memorandum (Ecology 2020).

To evaluate the Site for a Simplified TEE, the Simplified TEE Exposure Analysis Procedures under WAC 173-340-7491(2)(a)(ii)), as presented in Table 749-1 of MTCA, were completed. Table 2.2 presents this evaluation, and Figure 2.5 presents the TEE buffers centered on the Property and the approximate area of dioxin/furan TEQ contamination. Based on the evaluation in Table 2.2

and the recommendations from Ecology in the *Whitehead Tyee Site: Response to Terrestrial Ecological Evaluation* memorandum (Ecology 2020) regarding overall habitat quality, the Simplified TEE may be ended and no additional evaluation to address terrestrial ecological receptors is required at the Site.

2.6 CULTURAL RESOURCES

The Site is located approximately 450 feet east-northeast of the LDW, which is considered to be located within a high-probability area for encountering historic and pre-contact archaeological sites by the Washington State Department of Archaeology and Historic Preservation. Cultural resource monitoring protocols for RI fieldwork are detailed in Section 5.3 of the SAP/QAPP (Appendix C).

3.0 Summary of Previous Investigations and Interim Actions

This section provides a summary of environmental investigations and IAs that have been completed to date, which resulted in the collection of a significant amount of subsurface data as well as more limited surface data. This section provides a summary of the objectives and field activities for each of the investigations. A comprehensive discussion of the data resulting from these investigations is presented in Section 4.3.

Soil sample locations are shown on Figure 3.1, monitoring well locations are shown on Figure 3.2, Site soil boring and monitoring well completion details are presented in Table 3.1a, and Site soil boring and monitoring well completion logs are included in Appendix A. The completion details for the subset of Fox Avenue Site monitoring wells shown on Figure 3.2 are presented in Table 3.1b.

3.1 SUMMARY OF PREVIOUS ENVIRONMENTAL INVESTIGATIONS

Relevant data collection and investigations described in this section include those associated with the adjacent Fox Avenue Site conducted by various consultants between 1991 and 2016, subsurface investigations conducted at the Site by SoundEarth Strategies (SES) in December 2013 and January/April 2014, and subsurface and surface investigations conducted at the Site by Floyd|Snider in March 2013, December 2015, March 2016, and March 2017. The results of these investigations were summarized in several reports and data summaries that were provided to Ecology, including the following:

- *Fox Avenue Site RI/FS* (Floyd|Snider 2011) and Fox Avenue Site Annual Reports, the most recent being the 2022 Annual Report (CALIBRE 2022)
- *Summary of Subsurface Investigation Activities* (SES 2014a)
- *Whitehead/Reliable Property-Off-Property Subsurface Investigation* (SES 2014b; report not generated, data provided to Floyd|Snider by SES and included in Floyd|Snider 2015 and 2017a)
- *730 S. Myrtle Street Current Situation Report and Subsurface Investigation Work Plan* (Floyd|Snider 2015)
- Memorandum Re: 730 S. Myrtle Street Soil and Groundwater Characterization Summary (Floyd|Snider 2016a)
- *Whitehead Tyee Site Data Summary Report* (Floyd|Snider 2016b)
- Memorandum Re: Whitehead Tyee Site: 730 S. Myrtle Street Shallow Soil Characterization Data Summary (Floyd|Snider 2017b)

Since the investigations discussed in this section were conducted, both soil boring and monitoring well names have been updated to distinguish borings and wells that were installed for the Site, and those that were installed as part of Fox Avenue Site investigations. Soil borings and Site monitoring wells now all have the prefix WT-, as shown on Figures 3.1 and 3.2, respectively.

3.1.1 Fox Avenue Site (1991−Present)

The Fox Avenue Site has been under investigation and cleanup since 1991, due to past releases of solvents and other chemicals during the former GWCC operations. Chemicals handled by GWCC included chlorinated solvents, mineral spirits/petroleum solvents, and penta, among others. As a result of GWCC activities, contamination was identified in both soil and groundwater at the Fox Avenue Site and has been well characterized over the years. As part of site characterization, investigations characterizing the nature and extent of contamination on adjacent properties were also conducted and included limited soil and groundwater data collection at the Fox Avenue Site (prior to it being listed as a Toxics Cleanup Site). On May 6, 2009, Fox Avenue Building, LLC and Ecology entered into AO No. DE 6486. Under the AO, Fox Avenue Building, LLC was required to complete an RI/FS, which involved collection and consolidation of all of the information necessary to adequately characterize the Fox Avenue Site and develop and evaluate appropriate cleanup alternatives to address cVOC [primary COCs] contamination. The RI/FS also included information regarding sources of penta contamination at the Fox Avenue Site and surrounding properties. Note that discussions of cVOC distribution and trends is relative to Fox Avenue Site data, cleanup levels (CULs), and remediation levels (RLs); later sections of this document evaluate additional data relative to preliminary screening levels (PSLs) for the Fox Avenue Site.

The *Fox Avenue Site RI/FS* (Floyd|Snider 2011) identified cVOCs, petroleum compounds, benzene, toluene, ethylbenzene, and xylene (BTEX) compounds, and penta as COCs in soil and groundwater. The RI/FS established site-specific CULs for cVOCs and benzene in groundwater and based compliance with soil cleanup objectives on empirical demonstration of groundwater protection (i.e., site-specific soil CULs were not established). The groundwater plume exceeding the Fox Avenue Site CULs was found to extend to the southwest, across the western portion of the Property and onto Fox Avenue S. and S. Myrtle Street. In groundwater samples collected between 2008 and 2010, Fox Avenue Site COCs, including cVOCs and penta, were detected in shallow groundwater wells located on the Property including B-49, MW-07, and MW-09. cVOCs were also detected in groundwater samples collected from wells screened in the lower WBZ, including B-45, MW-08, and MW-10. Soil borings advanced along the property line at the northwest corner of the Property also found cVOCs including tetrachloroethene (PCE) and trichloroethene (TCE) in unsaturated soils from approximately 3 to 8 feet bgs, as well as in deeper saturated zone soils.

cVOCs and benzene were found to be most concentrated in the first WBZ and extended below to the second WBZ; the mechanism for migration of the lighter benzene product was attributed to the presence of droplets of denser oily products that transported benzene downward into deeper groundwater. The RI/FS concluded that cVOCs were the most significant contaminant in terms of mass and distribution, with concentrations exceeding the CULs, extending southwest to the S. Myrtle Street Embayment of the LDW. Penta was detected sporadically and at low concentrations relative to the selected CUL in groundwater southwest of the Fox Avenue Site at wells B-18, B-20A, and MW-03. In the S. Myrtle Street ROW immediately to the south of the former penta dip tank and UST, penta concentrations greater than the Fox Avenue Site CUL were detected in groundwater collected from monitoring well B-38. These elevated concentrations, as well as penta detections to the west and southwest, were attributed to the former penta dip tank and UST and were not further delineated as part of the Fox Avenue Site RI.

The selected remedial action for the Fox Avenue Site (as documented in the CAP for the Fox Avenue Site (Ecology 2012) was ERH to remove the primary contaminant mass, followed with post-thermal bio-polishing by ERD to remediate the downgradient groundwater plume. As of 2021, post-thermal bio-polishing is still ongoing and is anticipated to continue through 2023. These cleanup actions were targeted to remediate cVOCs and other COCs with low boiling points (i.e., benzene). Penta was not specifically targeted due to its more limited impact area and mobility relative to the other COCs. RLs were established for soil and groundwater in the CAP.

Compliance monitoring for groundwater at the Fox Avenue Site has been conducted biannually or annually since the completion of ERH in 2013 and includes collection of samples from downgradient wells and embayment seeps for cVOC and benzene analysis. Per the CAP, bio-polishing is to be performed until the established RLs for cVOCs in groundwater are achieved. A CPOC was also established in the Fox Avenue CAP at the western boundary of the Property, along Fox Avenue. The most recent annual report was issued in October 2022 for sampling performed in July and August 2022 (CALIBRE 2022).

From 2014 to 2022, total cVOC concentrations have generally continued to decline at two wells on the Property within the Fox Avenue plume, B-49 and MW-07. In these wells, the concentrations of vinyl chloride, which is a breakdown product of PCE, were less than the Fox Avenue Site CUL (2.4 micrograms per liter [µg/L]) since 2020 (B-49) and 2021 (MW-07). While total cVOC concentrations have also generally decreased over time at a third well within the plume, MW-09, the concentration of vinyl chloride increased from a non-detect value of <0.2 µg/L in 2019 to 43 µg/L in 2020 and remained above the Fox Avenue Site CUL in the most recent 2021 and 2022 sampling results, likely resulting from ERD. However, concentrations of total cVOCs at the three wells located on the Property are less than the Fox Avenue Site RL of 250 µg/L. Concentrations of total cVOCs in embayment seeps SP-03 and SP-03b have also decreased over time.

Benzene concentrations in on-Property monitoring wells and the embayment seeps are less than the Fox Avenue Site CUL (51 µg/L) in this area. Penta analysis is not conducted for Fox Avenue Site compliance monitoring. Per the Fox Avenue CAP, RLs were expected to be achieved at the CPOC within 10 years of thermal treatment and the Fox Avenue Site CULs were expected to be met at the Myrtle Street Embayment seeps within 15 years of thermal treatment. Compliance with the Fox Avenue Site CULs for cVOCs and benzene at the seeps was achieved in 2020. Compliance monitoring data for 2016 to 2022 from Fox Avenue Site annual reports, along with applicable CULs and RLs from the Fox Avenue CAP, are presented in Appendix B.

3.1.2 Floyd|Snider Subsurface Soil Investigation (2013)

In March 2013, Floyd|Snider completed a subsurface soil investigation to evaluate soil quality in advance of the installation of the stormwater conveyance system, including twelve soil borings (WT-GP-1 through WT-GP-12). Samples were analyzed from borings WT-GP-1 through WT-GP-11.

The primary focus of this investigation was to chemically characterize the soils that would be excavated during the installation of the stormwater conveyance system for disposal characterization. Locations and depths chosen for soil sample collection were determined entirely by the proposed system alignment and estimated depth of excavations required to install the system. A total of 30 soil samples were collected during this investigation and 22 were analyzed for common contaminants useful for disposal profiling including diesel-range organics (DRO) and gasoline-range organics (GRO), metals, semivolatile organic compounds (SVOCs), and/or VOCs, with both discrete and composite soil samples analyzed. Eight samples were collected but not analyzed because field screening using a photoionization detector (PID) indicated no evidence of volatile constituents, such as TPH/Stoddard solvent.

Soil results from this investigation indicated that the majority of contamination (TPH quantified as Stoddard solvent and penta) was in the three samples collected from saturated soils north of the former penta dip tank and UST source area (borings WT-GP-2, WT-GP-3, and WT-GP-4), indicative of a release migrating on the water table in a halo surrounding the former penta dip tank and UST. ORO was detected in shallow soil above 5 feet bgs at WT-GP-10 in the vicinity of the former auto repair facility on the south-central portion of the Property, indicating a separate, but what appeared to be localized, source. PCE, which is a Fox Avenue Site COC, was detected in shallow soil samples between 2 and 5 feet bgs on the western portion of the Property. Other VOCs and SVOCs were not detected in any samples and metals were not detected or were detected at ubiquitous concentrations and generally consistent with urban background.

3.1.3 SoundEarth Strategies Subsurface Investigations (2013−2014)

In December 2013, January 2014, and April 2014, SES, on behalf of Whitehead, completed subsurface investigations to assess impacts to soil and groundwater from recognized environmental conditions identified (SES 2013). Data were previously provided to SIM in the *Summary of Subsurface Investigation Activities* (SES 2014a) and *Whitehead/Reliable Property-Off-Property Subsurface Investigation* (SES 2014b, report not generated). These data were made available to 730 Myrtle, LLC, as part of the Property transaction.

In December 2013 and April 2014, 14 soil borings (WT-MW-01 through WT-MW-04, WT-B05 through WT-B11, and WT-B15 through WT-B17) were advanced at the Site to depths of 15 to 20 feet bgs. Boring locations were selected to assess potential source areas that may have affected soil and groundwater quality at the Site, including to the north of the former penta dip tank and UST source area in the vicinity of the former on-site auto repair facilities on the south-central portion of the Site, along the eastern boundary of the Site adjacent to the former off-site gasoline station, and in the northeast corner of the Site. Soil samples were analyzed for penta and TPH/Stoddard solvent. SES did not analyze soil samples collected from borings WT-B10 and WT-B11 for TPH/Stoddard solvent because there were no field indications of contamination (odor, sheen, or PID readings) observed. Additionally, SES collected groundwater samples from newly installed monitoring wells WT-MW-01 through WT-MW-04 and existing Fox Avenue Site monitoring wells MW-07 and B-38.

In April 2014, SES advanced three soil borings (WT-B15 to WT-B17) in the former penta dip tank and UST source area, each to a depth of 15 feet bgs. The locations of the borings were selected to assess source soils for Stoddard solvent and penta and were also analyzed for cVOCs. In addition, boring WT-B17 was analyzed for dioxins/furans. Additionally, three soil borings (WT-B12 through WT-B-14) completed as monitoring wells (WT-MW-05, WT-MW-06, and WT-MW-07) were installed along the south side of S. Myrtle Street to assess off-Property groundwater impacts. Soil and groundwater samples from the monitoring well installation were analyzed for TPH, including Stoddard solvent, penta, and cVOCs.

These investigations confirmed that Stoddard solvent and penta in soil were present in the former penta dip tank and UST source area and in the halo immediately north of the former penta dip tank and UST source area on the Property, typically at depths below 7 feet bgs and consistent with the smear zone. Dioxins/furans were also confirmed to be present in the source area. Consistent with the previous Floyd|Snider investigation, other VOCs, SVOCs, and elevated metals were not detected in soil samples. The Stoddard solvent (with lesser concentrations of penta) groundwater plume was confirmed to extend south of S. Myrtle Street but appeared to be fairly well bounded. Other source areas were not identified as part of these investigations.

3.1.4 Floyd|Snider Subsurface Investigations (2015–2016)

In December 2015 and March 2016, Floyd|Snider completed additional subsurface investigations to fill key data gaps related to potential subsurface impacts prior to the installation of the stormwater conveyance system, which was required under Administrative Order No. 13739 issued by Ecology's Water Quality Program. The investigations were intended to delineate the nature and extent of groundwater and soil contamination, primarily focused on Stoddard solvent and penta contamination. The results of these investigations, as well as prior data collected by Floyd|Snider and SES, were presented in the *Whitehead Tyee Site Data Summary Report* (Floyd|Snider 2016b).

In December 2015, Floyd|Snider collected surface and subsurface soil samples on the Property and downgradient of the Property from 12 boring locations (WT-SB-01, WT-SB-02, WT-SB-04 through WT-SB-10, WT-SB-12, WT-MW-108, and WT-MW-110) and installed three monitoring wells (WT-MW-108 through WT-MW-110).

Borings were installed in the Property interior to assess general soil quality and potential commingling of soil contamination between the Site and the adjacent Fox Avenue Site and were analyzed for TPH/Stoddard solvent and penta. Selected borings advanced within the anticipated trenching and excavation areas for the stormwater system and were used to assess general soil quality for disposal purposes. Additional borings were installed upgradient, cross-gradient, and downgradient from the former penta dip tank and UST source area in order to delineate the extents of TPH/Stoddard solvent, penta, and/or dioxins/furans. Borings were also installed in the vicinity of the former auto service operation area on the eastern portion of the Property to assess potential soil impacts from these operations and were analyzed for TPH/Stoddard solvent, penta, dioxins/furans, and metals.

Groundwater samples were collected from the newly installed wells and existing Site wells, including WT-MW-01, WT-MW-02, WT-MW-03, WT-MW-05, WT-MW-06, and WT-MW-07, and

Fox Avenue Site wells B-36, B-38, B-49, MW-07, and MW-09. Existing Site well WT-MW-04[3] could not be located and was presumed to be destroyed. The samples were analyzed for TPH/Stoddard solvent and penta. Additionally, samples from selected wells in the vicinity of the former penta dip tank and UST (WT-MW-01, WT-MW-05, and WT-MW-108) were analyzed for dioxins/furans, because dioxins/furans are known to be associated with penta.

In March 2016, Floyd|Snider advanced eight additional soil borings (WT-SB-13 through WT-SB-20) to further delineate ORO detected at WT-MW-110, in the vicinity of the former auto repair shop. These borings were located in and adjacent to planned stormwater system trenching and excavation areas in order to characterize soil for disposal purposes.

These investigations confirmed that Stoddard solvent and penta contamination in soil were adequately bounded for the purposes of performing the IA. The ORO contamination area was also adequately bounded and limited in depth and lateral extent. The results of these investigations were ultimately used to delineate the proposed IA excavations. Data also confirmed that dioxins/furans were present in both soil and groundwater, in close proximity to the former penta dip tank and UST source area. Consistent with prior events, other SVOCs and metals were detected in soil at concentrations generally consistent throughout the Site (with minor variations), indicating that metals and SVOCs may be ubiquitous and potentially associated with fill soils rather than a point source.

3.1.5 Floyd|Snider Surface Soil Investigation (2017)

In March 2017, Floyd|Snider collected eight surface soil samples at Ecology's request (Ecology 2016b) to evaluate the presence of PCBs and metals in shallow soil prior to construction for the IA and installation of the stormwater conveyance system, which included substantial surface grading prior to paving. The purpose of collecting these samples was to characterize soil for anticipated disposal required after grading and to assess the potential for current operations on the property to cause PCB or metals impacts to surface soil. The results of this investigation were presented in a memorandum Re: Whitehead Tyee Site: 730 S. Myrtle Street Shallow Soil Characterization Data Summary (Floyd|Snider 2017b).

All eight surface soil samples were analyzed for PCB Aroclors, and samples from four of the eight locations (WT-SS-01, WT-SS-04, WT-SS-06, and WT-SS-08) were additionally analyzed for the Resource Conservation and Recovery Act list of 8 metals, which includes arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Additional analysis was conducted to determine whether chromium (VI; hexavalent chromium) was present in samples from stations WT-SS-04 and WT-SS-06.

Metals were detected at all locations. Detected metals concentrations are generally consistent throughout the Site with minor variations, indicating potential association with the fill soils. PCBs were not detected or were detected at concentrations less than the MTCA Method A CUL. Hexavalent chromium was not detected.

3 WT-MW-04 was subsequently located during IA construction and decommissioned; refer to Section 3.2 for details regarding well decommissioning.

3.2 INTERIM ACTION

IA construction began at the Property in August 2017 to address on-Property soil contamination, in coordination with installation of a stormwater conveyance and treatment system. Installation of the stormwater conveyance and treatment system was undertaken to address the Administrative Order issued by the Water Quality Program, and the IA was designed to address known soil contamination under an AO with Ecology's Toxics Cleanup Program while simultaneously addressing ISGP compliance. The IA was conducted in accordance with an Ecology-approved IA Work Plan (IAWP; Floyd|Snider 2017a), was completed in 2018, and is summarized in an Interim Action Completion Report (Floyd|Snider 2019). The IA excavation areas and stormwater system components are shown on Figure 3.3.

The stormwater system includes subsurface conveyance piping, a paved ground surface graded to direct stormwater flow toward the Property interior, a network of catch basins to collect stormwater and convey the water via gravity flow to a central detention structure, and a pre-treatment unit to reduce total suspended solids in order to meet the requirements for discharge under the ISGP. Enhanced treatment was also installed ahead of Phase 2 requirements. The treated stormwater is conveyed to the storm sewer system in the S. Myrtle Street ROW, which ultimately discharges to the LDW.

The design for the stormwater system included installation of subsurface components in areas of known soil contamination. In the east-central portion of the Property, a run of conveyance piping intersected an area of known ORO contamination in shallow soil that was presumed to be associated with a former auto repair shop. In the southwest portion of the Property, the detention structure was located adjacent to soils contaminated by Stoddard solvent and penta due to northward migration of those contaminants in the saturated zone from the former penta dip tank and UST source area. In order to prevent disturbance to the stormwater system during potential future remediation, the contaminated on-Property soils were removed as an IA concurrently with stormwater system construction.

IA COCs were defined as those contaminants that resulted from prior operations and were present on-Property at concentrations greater than their respective MTCA CULs. Based on the analytical data collected to date, the IA COCs included Stoddard solvent, penta, and ORO. CULs have not yet been established for the Site; therefore, RLs were established for the IA, as appropriate per MTCA (WAC 173-340-355). The rationale for each RL is laid out in the IAWP and summarized below.

Chemical	Remediation Level Concentration	Remediation Level Basis
Stoddard solvent	1,000 mg/kg	Residual saturation screening level for weathered gasoline
Penta	2.5 mg/kg (cancer)	MTCA Method B Direct Contact
ORO	2,000 mg/kg	MTCA Method A Unrestricted and Industrial

Abbreviation:
mg/kg Milligrams per kilogram

Prior to IA construction, two Site wells were decommissioned, including WT-MW-110, which was located within the heavy ORO-focused excavation area, and WT-MW-04, which was located adjacent to the planned excavation for installation of the stormwater detention structure and was found to have pre-existing damage. Both Site wells will be re-installed, as described in Section 6.2.5 of this RI Work Plan.

In the heavy ORO excavation area, soils were found to be most heavily impacted from approximately 3 to 5 feet bgs during previous investigations and were not impacted below 6 feet bgs. Soils were excavated to a depth of 6 feet bgs based on existing sample data at locations WT-MW-110 and WT-SB-20. The full lateral extents of the contaminated soil were removed, as demonstrated by three existing sample locations (WT-SB-14, WT-SB-15, and WT-SB-18) and one additional confirmation sample collected at the eastern extent of the excavation (HO-SE1-4’). A total of 441 tons of soil were removed from the heavy ORO excavation area and disposed at a Subtitle D landfill. Refer to Figure 3.3 for the heavy ORO excavation area extents and confirmation sample locations.

In the Stoddard solvent excavation area, soils were found during previous investigations to be contaminated in the saturated zone below approximately 8 feet bgs and extending to approximately 16 feet bgs. Due to the mechanism of contaminant migration in the saturated zone, approximately 8 feet of un-impacted overburden overlaid the contaminated soils. The IA in this area included excavation of on-Property Stoddard solvent and penta beyond the limits necessary for installation of the stormwater detention structure to allow for future remediation of contaminated soils extending off-Property without disturbing the subsurface structure. The buffer required for potential future remediation was determined to be 7 lateral feet from the detention structure, based on the distance from the toe of the slope beneath the structure to a depth of 16 feet bgs, with an additional allowance for potential recontamination of placed backfill material.

The Stoddard solvent excavation was advanced until field indications of contamination (such as odor, sheen, or elevated headspace volatiles concentrations measured with a PID) were no longer present, corresponding to a depth of 16 feet bgs in the western and eastern/northeastern portions of the excavation and 17 feet bgs in the central portion of the excavation closest to the former penta dip tank and UST source area. Excavation base samples SS-B1 through SS-B4, collected between 16 and 17 feet bgs, demonstrated that detectable Stoddard solvent was not present at the base of the excavation.

The lateral limits of the Stoddard solvent excavation were delineated by non-detect results or concentrations less than the RL for Stoddard solvent at existing pre-construction sample locations and excavation sidewall samples. These included WT-GP-3 and SS-S1W-10.5’ on the western sidewall, SS-S2E-12’ on the eastern sidewall, and SS-S3N-12’ on the northeastern sidewall. Along the northern sidewall, samples could not be collected due to the use of trench box shoring to maintain vertical sidewalls adjacent to the S. Myrtle Street ROW; however, both the base sample collected from the north-central portion of the excavation (SS-B2-17’) and the pre-construction sample WT-SB-06 within the footprint of the detention structure to the north did not have detectable Stoddard solvent. Selected excavation confirmation samples were also analyzed for penta, which was not detected. A total of approximately 400 cubic yards (CY) of clean overburden soils were removed from the Stoddard solvent excavation and determined to be suitable for on-Property reuse as backfill above 8 feet bgs based on the backfill testing requirements specified in the IAWP. A total of 923 tons of Stoddard solvent- and penta-contaminated soil were excavated and disposed at a Subtitle D landfill. Refer to Figure 3.3 for the limits of the Stoddard solvent excavation and confirmation sample locations.

In addition to excavating to remove contaminated soils and for the installation of stormwater system components, surface soils were also removed throughout the Property in order to grade the subsurface of the Property and prepare the subgrade for pavement. During surface grading, asphalt and concrete pavement and structures were encountered below the crushed gravel ground surface across almost all of the Property. Although some asphalt and concrete were anticipated, the Property was found to be almost entirely covered in asphalt and concrete. This pavement was also removed, resulting in removal of approximately the top 2 feet of soil/surface material Property-wide. Based on surface soil data and landfill acceptance criteria, surface soils were disposed off-Property at a permitted landfill that accepts soils categorized as Class 2 (i.e., suitable for reuse as commercial fill above the water table) according to Ecology's *Guidelines for Reuse of Petroleum-Contaminated Soil* (Ecology 2016c). A total of 13,060 tons of soil were disposed of as Class 2 soil. In addition, there was a localized area in the vicinity of the pump station (location WT-SB-01) that contained TPH at concentration greater than the acceptance criteria for the Class 2 landfill; therefore, 321 tons of excess soil were disposed of at a Subtitle D landfill.

Soils were also field screened for indications of contamination outside the areas of known contamination during trenching and excavation for the stormwater system installation as part of the IA. Trench composite samples were collected per the IAWP and analyzed for all the IA COCs, including ORO, Stoddard solvent, and penta. Field indications of contamination were not observed during trenching and IA COCs were not detected in any trench bottom samples.

Soils excavated during stormwater system installation were stockpiled and evaluated for reuse as backfill based on the IAWP testing requirements. Approximately 560 CY of soil generated by stormwater system installation were determined to be suitable for reuse. Soils were reused as backfill above the water table primarily in the areas where they originated; for example, stockpiled soil excavated from trench segments was reused to backfill these segments above the pipe bedding material, and soil from excavations for structures was used to backfill around the structures.

Concentrations of PCE slightly exceeded the reuse criterion (MTCA Method A CUL) in a subset of samples collected from Stockpile 2, excavated from the stormwater detention structure (from approximately 2 to 8 feet bgs) and Trench A2 (from approximately 2 to 5 feet bgs). The segment of stockpiled soil exceeding the reuse criterion consisted of approximately 90 CY and was segregated between the closest adjacent sample locations with concentrations less than the reuse criterion and hauled off-site for landfill disposal. The remaining soil with PCE less than the reuse criterion was reused in Trenches A2, D, E1, and E2.

On-site soil reuse is summarized in Figure 3.4 and discussed in detail in Section 3.5.3 of the Interim Action Completion Report.

The sample results for all IA confirmation and stockpile samples are presented in the detailed discussion of Site-wide soil quality in Section 4.3.1.

3.3 SUMMARY OF PREVIOUS INVESTIGATION FINDINGS

The primary COIs identified at the Site as part of previous investigations are Stoddard solvent, penta, dioxins/furans, which are associated with the former penta dip tank and UST, and TPH (both DRO and ORO), which are associated with former auto repair operations. These COIs have been identified in both soil and shallow groundwater at the Site and their distribution is generally consistent with releases from the identified sources to the upper WBZ. The majority of Stoddard solvent-, penta-, and TPH-impacted soils were removed as part of the IA described in Section 3.2. In addition, cVOCs and benzene are present on the western portion of the Site and are being addressed as part of on-going cleanup actions being conducted at the Fox Avenue Site. Penta has also been identified as a COC for the Fox Avenue Site and has been identified in groundwater in the northwest portion of the Property. These Fox Avenue Site COCs are considered COIs, the nature and extent of which will be further evaluated as part of the RI, as described in Section 6.0.

4.0 Preliminary Screening Level Development and Evaluation of Existing Data

This section provides a summary of the approach used to identify the PSLs for each medium based on Applicable or Relevant and Appropriate Requirements (ARARs) and the potential exposure pathways, described as part of the preliminary conceptual site model (CSM) in Section 5.0. Importantly, at this Site, Ecology has directed that there should be a single PSL per analyte per medium, regardless of whether the pathway is complete and/or applicable.

Once PSLs for each medium were developed, existing data were compared against the most stringent PSL by media to determine a list of chemicals for further evaluation. In addition, Site history was assessed to determine other contaminants that have the potential to be present for further evaluation.

The outcome of this section is a list of applicable PSLs for various pathways and chemicals for further evaluation in both soil and groundwater. Finally, this section provides a summary of select existing data compared against the PSLs in soil and groundwater.

4.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Compliance with ARARs is a MTCA threshold requirement. Under WAC 173-340-350 and 173-340-710, the term “applicable requirements” refers to regulatory cleanup standards; standards of control; and other environmental requirements, criteria, or limitations established under state or federal law that specifically address a COC, remedial action, location, or other circumstance at the Site. The relevant and appropriate requirements are regulatory requirements or guidance that do not apply to the Site under law but have been determined to be appropriate for use by Ecology.

ARARs are often categorized as chemical-specific, location-specific, or action-specific. Chemical-specific ARARs include regulatory CULs for the relevant chemicals of concern. Location-specific ARARs include any regulations or guidance relevant to a specific location at the Site. Action-specific ARARs include regulations or guidance governing any activities proposed to remediate a Site. Chemical-, location-, and action-specific ARARs that may be directly relevant to the development and evaluation of remedial alternatives will be presented in the RI/FS report.

4.2 DEVELOPMENT OF PRELIMINARY SCREENING LEVELS BY MEDIA

The primary cleanup regulations (chemical-specific ARARs) that apply to this Site are MTCA, SMS (WAC 173-204), Water Quality Standards for Surface Waters of the State of Washington (WAC 173-201A), and federal surface water quality ARARs for protection of the adjacent groundwater receiving waterbody, the LDW.

Ecology has developed comprehensive preliminary cleanup level (PCUL) summary tables for soil, groundwater, and indoor air for sites near or adjacent to the LDW consistent with these cleanup regulations (Ecology 2021). Ecology has requested that these PCUL workbook tables be used as the basis for the PSLs at the Site. The PSL tables present criteria protective of numerous potential exposure pathways, described further in the following sections. Ecology has requested that all exposure pathways be evaluated as part of this RI Work Plan regardless of whether the exposure pathway is complete at the Site.

Existing Site data were screened using the version of the PCUL workbook that was available in April 2021. The workbook was most recently updated in February 2023. Most of the updates, however, have had minor impacts on PCUL values. A few chemicals had moderate to significant changes in PCUL values, but these chemicals are not expected to drive decision-making at the Site. After the RI data collected during the implementation of this RI Work Plan are available, the entire data set will be re-screened using the most current version of the PCUL workbook, and Site-specific cleanup standards will be developed and established during the RI/FS, in conjunction with Ecology. It was considered unnecessary to update the screening process for the purposes of this RI Work Plan.

Important to note is that the PSL tables do not include practical quantitation limits (PQLs). The PQL is the lowest concentration that can be reliably measured within specified limits of precision, accuracy, representativeness, completeness, and comparability during routine laboratory operating conditions, using department-approved methods. Often, the PSLs based on the hypothetical exposure pathways described below are much less than a routinely achievable PQL. In these cases, the PSL should be adjusted upward to the PQL, consistent with MTCA (WAC 173-340-700(6)(d)). It is critically important that the PQLs are achievable using routine laboratory methodology. However, for the PSLs developed below, upward adjustment to the PQL was disallowed by Ecology. This has the effect of complicating the screening process, which is described further in Section 4.4.

4.2.1 Preliminary Screening Level Development for Soil

Table 4.1 presents the PSLs for soil for each of the potential exposure pathways for all chemicals that have been analyzed at the Site to date, and the most stringent PSL is identified for each chemical. The exposure pathways considered in developing the PSLs for soil are presented below. As previously described in Section 2.2, the Simplified TEE was ended; therefore, exposure to terrestrial ecological receptors is not required to be further considered at the Site.

- **Protection of Human Health Direct Contact.** As discussed in Section 2.1, the Site is an industrial facility in active use in an area zoned for industrial use. However, Ecology's PCUL workbook tables present criteria based on unrestricted land use. To be conservative, the unrestricted land use criteria are also applied in this RI Work Plan as PSLs but will be further evaluated in the RI/FS for appropriateness for this industrial site.
- **Protection of Groundwater Quality.** Contaminants within both the saturated and vadose soil have the potential for leaching to the groundwater. PSLs that are protective of contaminants leaching from soil to groundwater were calculated using the fixed parameter three-phase partitioning model, MTCA Equation 747-1. PSLs were developed to protect drinking water, discharge to surface water, discharge to sediments, and volatilization to indoor air. As requested by Ecology, saturated zone

PSLs are applied Site-wide. The basis of the groundwater PSLs used in the calculation is described in Section 4.2.2.

Additionally, natural background was considered in establishing PSLs. A number of the chemicals detected at the Site are naturally occurring in the environment and it is inappropriate to establish a PSL lower than the natural background concentrations. In soil, background concentrations for some metals and dioxins/furans have established statewide background concentrations. Values from Ecology's *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994) are used for the metals, and the value from Ecology's *Natural Background for Dioxins/Furans in Washington Soils—Technical Memorandum #8* (Ecology 2010) is used as a natural background number for dioxins/furans. Where the PSLs protective of direct contact or groundwater quality are less than the natural background value, the PSL is adjusted upward to natural background.

4.2.2 Preliminary Screening Level Development for Groundwater

Table 4.2 presents the PSLs for groundwater for each of the exposure pathways for all chemicals that have been analyzed at the Site, and the most stringent PSL for each chemical is identified. The exposure pathways included in developing PSLs for groundwater are presented below.

- **Protection of Drinking Water.** Although groundwater is generally considered non-potable in the Site vicinity, drinking water PSLs have been retained as a conservative measure for the purposes of screening. A site-specific assessment of Site groundwater potability will be included in the RI. ARARs for the protection of drinking water include maximum contaminant levels (MCLs) from the National Primary Drinking Water Regulations and MTCA Method B CULs. MCLs are selected as the PSLs (adjusted to a cancer risk no greater than 1 in 100,000 or a hazard quotient of 1 as needed). If MCLs are not available, the minimum value from MTCA Equations 720-1 and 720-2 is selected as the PSL.
- **Protection of Surface Water.** Groundwater at the Site has the potential to migrate to the shoreline and discharge into the LDW. Consistent with requirements in MTCA, groundwater that discharges into surface water must meet the surface water quality standards (Water Quality Standards for Surface Waters of the State of Washington [WAC 173-201A] and federal surface water quality ARARs for protection of the adjacent groundwater receiving waterbody) at the point where the discharge occurs, without taking dilution into account.
- **Protection of Sediment.** Sediment quality must be protected at the point where groundwater is discharged to the marine sediment. In their PCUL development, Ecology used a modified MTCA three-phase model to calculate the groundwater concentration protective of sediments, using assumptions about theoretical partitioning between soil to groundwater and then theoretical groundwater partitioning to sediments. The minimum sediment CULs in the ROD were identified as target sediment concentrations protective of potential benthic and human health

effects. These target sediment concentrations were used to back-calculate a groundwater concentration protective of these sediments.

- **Protection of Indoor Air Quality.** The indoor air exposure pathway is not complete at the Site because there are currently no buildings or structures on the Property or in the S. Myrtle Street ROW; the only structure is a three-sided open-air maintenance shed. Therefore, the indoor air exposure pathway is incomplete under current Site use.[4] However, as a conservative measure, PSLs protective of indoor air have been included for screening purposes. PSLs for this pathway are based on MTCA Method B values (WAC 173-340-750).

As with soil, natural background is considered in establishing PSLs. The Puget Sound Basin background value from Ecology's *Natural Background Groundwater Arsenic Concentrations in Washington State* (Ecology 2022) is the basis of the PSL for arsenic.

4.3 COMPARISON OF EXISTING DATA TO PRELIMINARY SCREENING LEVELS

Existing soil and groundwater samples from previous investigations at the Site described in Section 3.0 were evaluated by comparison to the PSLs to identify chemicals for further evaluation.

For TPH, it is important to note that a number of samples were quantified relative to a Stoddard solvent standard as well as other petroleum compound standards including GRO, DRO, and/or ORO. When GRO and DRO were quantified in addition to Stoddard solvent, elevated Stoddard solvent concentrations generally corresponded with elevated GRO and DRO concentrations, which is expected because Stoddard solvent is a hydrocarbon mixture that spans these two TPH ranges. In the most highly Stoddard solvent-contaminated soils within the former penta dip tank and UST source area, the heavier alkanes in the Stoddard solvent mixture were also present at detectable levels when quantified against the ORO standard. However, all samples with elevated GRO, DRO, or ORO detections in the former penta dip tank and UST source area were associated with corresponding elevated Stoddard solvent and are considered to be Stoddard solvent-contaminated for the purposes of data review in the following sections, the preliminary CSM presented in Section 5.0, and the data gaps analysis presented in Section 6.0.

4.3.1 Soil

The existing soil data for the Site are presented in the following sections. The Site soil data discussed below were collected during the 2013 Floyd|Snider subsurface soil investigation, the 2013 to 2014 SES subsurface investigations, and the 2015 to 2017 Floyd|Snider subsurface and surface soil investigations.

It is important to note, as described in Section 3.2, that a significant amount of contaminated or unsuitable surface soil was removed from the Property as part of the 2017 IA. In situ soil data are compared to PSLs below to describe current Site conditions. The data for removed samples are

4 Vapor intrusion will be considered as part of the FS to address potential future exposure scenarios.

included in the data tables for reference but are denoted as "removed" and are no longer representative of current conditions. Figures 4.1 to 4.6 present soil analytical data. Where analytical results from removed samples are shown on figures, the results are also designated with an "(R)," symbolizing "removed." Stations where all samples were removed are also noted in the symbology of these figures. Site-wide soil analytical data are presented in Tables 4.3 through 4.6.

Table 4.7 presents soil analytical data for trench composite samples collected during the IA. All composite samples were analyzed for the IA COCs, including Stoddard solvent, penta, and ORO. The composite sample from trench segment A2 was additionally analyzed for dioxins/furans. IA COCs were not detected in any trench or structure excavation area composite sample at the reporting limits, and discrete sample analysis was, therefore, not necessary per the criteria established in the IAWP.

4.3.1.1 Stoddard Solvent and Pentachlorophenol

Stoddard solvent has been analyzed in 68 soil samples, collected from depths between 0 and 17 feet bgs. Of these samples, 60 remain in situ. The majority of the Stoddard solvent and penta on the Property was excavated as part of the IA. Concentrations of Stoddard solvent detected from in situ Site soil range from 140 mg/kg to 25,000 mg/kg. Figure 4.1 depicts the soil data for Stoddard solvent. In situ samples on the Property with Stoddard solvent concentrations exceeding the PSL of 2,000 mg/kg were generally located within and downgradient of the former penta dip tank and UST source area. Detected in situ Stoddard solvent concentrations exceeding the PSL within and downgradient of the former penta dip tank and UST source area range from 3,300 to 25,000 mg/kg. The concentration of Stoddard solvent in one in situ sample collected directly north of the former penta dip tank and UST source area, on the southern wall of the IA excavation, exceeded the PSL.

Penta has been analyzed in 60 soil samples, collected from depths between 0 and 17 feet bgs. Of these samples, 49 remain in situ. In situ detected penta concentrations ranged from 0.079 mg/kg to 340 mg/kg. Figure 4.2 depicts the soil data for penta. All detected penta concentrations exceed the PSL of 0.0000018 mg/kg. Elevated concentrations are generally present in the vicinity of the former penta dip tank and UST source area. Detected penta concentrations exceeding the PSL at in situ sample locations within the halo to the north of the former penta dip tank and UST source area had values ranging from 0.45 to 15 mg/kg. In situ detected penta concentrations exceeding the PSL located within, adjacent to, and downgradient of the former penta dip tank and UST source area range from 0.079 to 340 mg/kg. Only one in situ sample location at which concentrations of penta exceeded the PSL is located on-Property. Non-detect exceedances of the penta PSL are widespread across the Site due to the PSL's conservatism, which is approximately 28,000 times less than the PQL. It is important to note, however, that the source of penta is associated with Stoddard solvent contamination.

4.3.1.2 Diesel- and Oil-Range Organics

DRO and ORO have been analyzed in 69 and 67 soil samples, respectively, collected from depths between 0 and 15 feet bgs. Of these, 54 DRO and 63 ORO samples remain in situ. Figure 4.3 depicts the soil data for DRO and ORO. The majority of DRO and ORO contamination exceeding PSLs on the Property was excavated as part of the IA. For a number of samples, the chromatograms do not match a standard pattern for petroleum distillates; therefore, the DRO and ORO sum was not calculated (refer to Table 4.3). Summed total DRO and ORO concentrations are discussed in this section. DRO and ORO sums were not calculated for samples where the DRO fraction was determined to be Stoddard solvent. In these instances, the ORO and DRO fractions are compared to the PSLs separately.

In situ detected concentrations of summed total DRO and ORO range from 80 to 3,000 mg/kg. Total DRO and ORO were detected at a concentration exceeding the PSL of 2,000 mg/kg in one in situ sample (WT-B17) located within the former penta dip tank and UST source area, at a depth of 7.5 feet bgs. In this sample, the DRO fraction was determined to most likely be Stoddard solvent, and therefore was not included in the sum.

4.3.1.3 Dioxins/Furans

Dioxins/furans have been analyzed in seven samples from five discrete locations and one trench composite location, all of which remain in situ. The discrete samples were collected in the vicinity of the former penta dip tank and UST source area. Figure 4.4 depicts the soil data for dioxins/furans. Exceedances of the PSL of 5.2 nanograms per kilogram (ng/kg) occurred in four samples from three locations within the footprint of the former penta dip tank and UST and immediately to the east of the former penta dip tank, with detected concentrations ranging from 8.59 to 8,930 ng/kg.

4.3.1.4 Volatile Organic Compounds

VOCs, excluding BTEX and select cVOCs, were analyzed and not detected in 20 removed or in situ soil samples at depths ranging from 2 to 13 feet bgs. For the non-detect results, PQLs for VOC analysis ranged from approximately 0.02 to 0.5 mg/kg, which are greater than their respective PSLs.

cVOCs, including PCE, TCE, and breakdown products *cis*- and *trans*-1,2-dichloroethene (DCE), 1,1-DCE, and vinyl chloride, were analyzed in 21 soil samples. Of these, 15 locations remain in situ. The breakdown products of PCE and TCE were not detected at PQLs of approximately 0.02 to 0.05 mg/kg; however, PCE and TCE were detected at some locations at concentrations greater than the PSL. For the non-detect results, PQLs were greater than their respective PSLs.

PCE was detected at concentrations exceeding the PSL of 0.0016 mg/kg in four samples located throughout the Property, at depths between 3 and 5 feet bgs. Figure 4.5 depicts the soil data for PCE. PCE concentrations ranged from 0.026 to 0.16 mg/kg. PCE was also detected at concentrations exceeding the PSL in two samples located within the former penta dip tank and

UST source area, at depths between 7.5 and 10 feet bgs (0.06 and 0.067 mg/kg). All non-detect results had PQLs greater than the PSL.

PCE was detected at concentrations exceeding the PSL in samples collected from Stockpiles 1 and 2 during the IA (refer to Figure 3.4 for stockpile locations and soil reuse destinations). The PSL for PCE is 0.0016 mg/kg, which is substantially less than the reuse criterion (MTCA Method A CUL) of 0.050 mg/kg. Each composited sample from the stockpiles was composed of three discrete sub-samples. PCE was detected in two of five composite samples collected from Stockpile 1, with concentrations of 0.033 and 0.042 mg/kg. PCE was detected in four of five composite samples from Stockpile 2, with concentrations ranging from 0.029 to 0.054 mg/kg. All detected concentrations of PCE in stockpile samples exceed the PSL. Consistent with the reuse criteria in the IAWP, soil from Stockpiles 1 and 2 were reused on-site as backfill above the water table, with the exception of approximately 90 CY of soil in Stockpile 2 that was segregated for off-site disposal due to an exceedance of the reuse criterion. All backfilled soil was subsequently covered with a minimum of 12 inches of concrete.

TCE was detected at 0.021 mg/kg in one in situ sample (WT-MW-06) collected downgradient of the former penta dip tank and UST source area at 10 feet bgs, exceeding the PSL of 0.00027 mg/kg (Table 4.4). All other non-detect results had PQLs that were greater than the PSL.

4.3.1.5 Benzene, Toluene, Ethylbenzene, and Total Xylenes

Benzene was analyzed in 29 samples from 19 locations from depths between 4 and 13 feet bgs. Toluene, ethylbenzene, and total xylenes were analyzed in 18 samples from 11 locations. Results are as follows:

- Benzene was not detected in any in situ or removed samples at PQLs between approximately 0.02 and 1 mg/kg. PQLs in all samples were greater than the PSL of 0.00056 mg/kg. Figure 4.6 depicts the soil data for benzene.
- Toluene was not detected in any in situ or removed samples at PQLs between approximately 0.02 and 1 mg/kg. Non-detect results with PQLs greater than the PSL of 0.044 mg/kg were reported in several sample locations located within and downgradient of the former penta dip tank and UST source area.
- Ethylbenzene was analyzed in all 18 in situ samples and detected at concentrations exceeding the PSL of 0.010 mg/kg in WT-B16 and WT-MW-05, located within the footprint and downgradient of the former penta dip tank and UST source area, respectively. The samples with exceedances were collected at a depth of 10 feet bgs, with concentrations of 3.9 mg/kg at WT-B16 and 2.1 mg/kg at WT-MW-05. All other non-detect results had PQLs greater than the PSL.
- Total xylenes were detected in 5 of 17 in situ samples at concentrations exceeding the PSL of 0.055 mg/kg at locations WT-B15 through WT-B17 and WT-MW-05, which are located in the footprint and downgradient of the former penta dip tank and UST source area. The samples with exceedances were collected at depths of 7.5 to 10 feet bgs, with detected concentrations ranging from 1.3 to 68 mg/kg.

4.3.1.6 Polychlorinated Biphenyls

PCBs were analyzed in 13 soil samples collected from 12 locations primarily at depths ranging from 0 to 2 feet bgs, with one sample collected at a depth of 10 feet bgs (SB-01). PCBs were detected at concentrations exceeding the PSL of 0.0000022 mg/kg, ranging from 0.051 to 0.25 mg/kg, in shallow surface samples SS-01 to SS-08 located throughout the Property. All shallow soil samples with detected PCB exceedances were removed during the IA and thus are not presented on a figure. PCBs had non-detect results in the remaining five samples, with PQLs of approximately 0.1 mg/kg, which is greater than the PSL.

4.3.1.7 Metals

Metals, including arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver, were analyzed in 21 soil samples collected from 17 locations at depths ranging from 0 to 13 feet bgs. All metals exceeded their respective PSLs in at least one location and are summarized below. All shallow soil samples with detected metals exceedances were removed during the IA and thus are not presented on a figure. Generally, elevated metals concentrations do not appear associated with a specific source area and are located throughout the Property.

- Arsenic was detected at concentrations ranging from 1.5 to 10 mg/kg. Exceedances of the PSL of 7.3 mg/kg were detected in SS-01, SS-06, and WT-MW-110, all of which were removed during the IA.
- Barium was detected at concentrations ranging from 12 to 140 mg/kg; all results exceeded the PSL of 8.3 mg/kg.
- Chromium was detected at concentrations ranging from 9.3 to 260 mg/kg. Concentrations exceeded the PSL of 27 mg/kg in shallow surface samples only (SS-01, SS-04, SS-06, and SS-08), all of which were removed during the IA. The species of chromium present at the Site has been determined by laboratory analysis to be chromium (III).
- Cadmium, lead, and mercury exceeded their respective PSLs at shallow surface locations only (SS-01 for all; SS-04 and SS-08 for cadmium only), which were removed during the IA. Mercury had non-detect results at PQLs ranging from 0.22 mg/kg to 1.0 mg/kg, which are greater than the PSL of 0.07 mg/kg.
- Selenium was detected at concentrations ranging from 0.21 to 1.4 mg/kg and had detected exceedances greater than the PSL of 0.26 mg/kg at all locations except the shallow surface samples (SS-01, SS-04, SS-06, and SS-08). Selenium also had one non-detect result with a PQL greater than the PSL at HO-SE1.
- Silver was detected at concentrations ranging from 0.13 to 0.47 mg/kg. Concentrations exceeded the PSL of 0.016 mg/kg in shallow surface samples (SS-01, SS-04, SS-06, and SS-08) and in a composite sample from 0 to 10 feet bgs at WT-GP-02, all of which were removed during the IA. The remainder of the samples were non-detect at PQLs ranging from 0.08 to 1.0 mg/kg, which are greater than the PSL.

4.3.1.8 SVOCs

SVOCs, excluding penta (discussed in Section 4.3.1.1), were analyzed in 16 soil samples collected from 13 locations at depths ranging from 0 to 13 feet bgs. Detected concentrations of a limited number of SVOCs exceeded their respective PSLs in two locations, both removed during the 2017 IA. PQLs for SVOC analysis ranged from approximately 0.06 to 0.6 mg/kg. Exceedances of select PAHs (total cPAH TEQ, fluoranthene, and pyrene), bis(2-ethylhexyl)phthalate, and butyl benzyl phthalate were detected in WT-MW-110 at 0 to 2 feet bgs in the IA heavy ORO excavation area, and an exceedance of bis(2-ethylhexyl)phthalate was detected at WT-SB-01 on the western portion of the Property. The majority of SVOC exceedances at the Site were non-detect results with PQLs greater than the PSL; refer to Table 4.6.

4.3.2 Groundwater

This section provides an overview of Site groundwater data for Stoddard solvent, penta, cVOCs, and BTEX, most of which were collected through 2015, the year of the most recent comprehensive groundwater dataset for Site COIs. These data encompass groundwater monitoring events conducted at the Site and at the Fox Avenue Site. Dioxin/furan data collected by Floyd|Snider during the 2016 subsurface investigations and PCB data collected by Ecology in 2017 (Leidos 2017) are also summarized below. Figures 4.7 through 4.13 display the maximum and most recent analytical results for selected COIs measured at monitoring wells screened in the upper WBZ located on-site, cross-gradient, and downgradient of the Site.

Data from the lower WBZ were collected exclusively during Fox Avenue Site investigations to evaluate the nature and extent of contamination associated with that site. Although PSL exceedances in monitoring wells screened in the both upper and lower WBZs are summarized below, the data from wells screened in the lower WBZ are not presented on Figures 4.7 through 4.13. The occurrence of COIs in the upper and lower WBZ will be assessed during the RI to resolve the data gaps described in Section 6.0 of this RI Work Plan. Tables 4.8a and 4.8b present the groundwater analytical data from the upper and lower WBZs, respectively.

Fox Avenue Site annual monitoring is conducted on a small subset of Site wells for only benzene and cVOCs. Post-2015 Fox Avenue annual monitoring data are not included in the data tables for this RI Work Plan, but they are included in Appendix B and summarized below.

4.3.2.1 Stoddard Solvent and Pentachlorophenol

Stoddard solvent and penta have been analyzed in groundwater during several monitoring events completed from 2003 through 2015. Stoddard solvent was analyzed in 39 samples collected from wells located on, cross-gradient of, or downgradient of the Property. Figure 4.7 depicts the most recent and maximum groundwater concentrations for Stoddard solvent from 2010 through 2015. Detected Stoddard solvent concentrations ranged from 80 µg/L to 16,000 µg/L. Stoddard solvent concentrations from Fox Avenue Site and Site monitoring in 2014 and 2015 exceeded the PSL of 500 µg/L at monitoring wells located in the northwestern corner of the Site, in wells located in the vicinity of the halo area upgradient and downgradient of the former penta dip tank and UST source area, and in wells installed within the former penta dip tank and UST source area. The analytical results with the greatest magnitude and frequency of exceedance were in samples collected from wells in the vicinity of the former penta dip tank and UST source area and are screened in the upper WBZ.

Penta was analyzed in 67 samples collected between 2003 and 2015. Figure 4.8 depicts the most recent and maximum groundwater monitoring concentrations measured from 2003 through 2015 for penta. Detected penta concentrations range from 0.24 µg/L to a maximum of 11,500 µg/L at B-38 in 2007. Detected penta concentrations in the Fox Avenue Site and Site samples collected in 2014 and 2015 exceeded the PSL of 0.002 µg/L at monitoring wells located in the northwestern corner of the Site, in wells located in the vicinity of the halo upgradient and downgradient of the former penta dip tank and UST source area, and in wells installed within the former penta dip tank and UST source area. The exceedances occurred in well pairs screened in the upper and lower WBZs; however, results from wells screened in the lower WBZs were significantly lower in most instances (e.g., B-37 and B-38, within the former penta dip tank and UST source area). Non-detect results with PQLs greater than the PSL occurred in 22 samples, most of which were collected in 2003.

4.3.2.2 Diesel- and Oil-Range Organics

DRO and ORO have been analyzed in groundwater during several monitoring events completed between 2010 and 2015. DRO and ORO were analyzed in 39 samples, and total DRO and ORO sums were calculated for 32 samples. Figure 4.9 depicts the most recent and maximum groundwater monitoring concentrations measured between 2010 and 2015 for DRO and ORO. Summed total DRO and ORO concentrations ranged from 56 µg/L to a maximum of 4,300 µg/L at WT-MW-02 in 2014. For a number of samples, the chromatograms do not match a standard pattern for petroleum distillates; therefore, the DRO and ORO sum was not calculated (refer to Tables 4.8a and 4.8b); however, this quantitation does not affect the general distribution of exceedances of DRO and ORO (i.e., where a sum was not calculated, DRO and/or ORO separately exceeded the PSL). The sample concentrations from Fox Avenue Site and Site monitoring in 2014 and 2015 exceeded the PSL of 500 µg/L in wells located in the northwest portion of the Site, in the area updgradient of the former penta dip tank and UST source area, as well as within and downgradient of the source area in the 7th Avenue S. ROW. PSL exceedances for total DRO and ORO in the 2014 to 2015 dataset occurred exclusively in wells screened in the upper WBZ. Concentrations in several of these wells greatly decreased from 2014 to 2015 monitoring events. Additional monitoring events conducted as part of the RI will evaluate these trends.

4.3.2.3 Dioxins/Furans

Dioxins/furans were analyzed during one monitoring event conducted in 2016, at two wells on the Property (WT-MW-01 and WT-MW-108) and at one well in the S. Myrtle Street ROW (WT-MW-05). All of these wells are screened in the upper WBZ. Figure 4.10 depicts the available groundwater monitoring data for dioxins/furans. Dioxin/furan TEQ (with non-detect values set to one-half the detection limit for calculation of the TEQ), ranged from 1.32 to 91 picograms per liter (pg/L) and were greatest at WT-MW-01, located in the halo north of the former penta dip tank and UST source area, and at WT-MW-05, downgradient of the source area. All results were greater than the PSL of 0.0051 pg/L. The two greatest dioxin/furan TEQ results were correlated with field measurements of turbidity greater than 5 nephelometric turbidity units, whereas the sample collected from WT-MW-108 did not have measurable turbidity, indicating that dioxins/furans adsorbed to soil particles present in the groundwater samples may have caused the elevated concentrations.

4.3.2.4 Chlorinated Volatile Organic Compounds

cVOCs, including PCE, TCE, and vinyl chloride, have been analyzed at least once at most Site monitoring wells between 2003 and 2015. cVOCs are also analyzed annually or biannually during Fox Avenue Site compliance monitoring from the complete Fox Avenue Site compliance monitoring well network. Data from this compliance monitoring for 2016 to 2022 are presented in Appendix B and are not included in the following bulleted summary of Site data. These data will be evaluated along with RI data collected from Site wells as part of the RI.

- Detected PCE concentrations ranged from 0.27 µg/L to a maximum of 65,000 µg/L measured at B-49 in 2009. Detected concentrations in the Fox Avenue Site and Site data collected in 2014 and 2015 exceeded the PSL of 2.9 µg/L in monitoring wells located on the northern boundary with the Fox Avenue Site and in the northwest corner and downgradient of the Site. Exceedances in the 2014 to 2015 dataset typically occurred in wells screened in the upper WBZ. Figure 4.11 depicts the most recent and maximum groundwater PCE concentration at each monitoring location measured between 2003 and 2015.
- Detected TCE concentrations ranged 0.49 µg/L to a maximum of 62,000 µg/L measured at B-49 in 2009. Detected concentrations in the most recent Fox Avenue Site and Site data collected in 2014 and 2015 exceeded the PSL of 0.7 µg/L at several monitoring wells in the Fox Avenue S. ROW, the western half of the Property, and downgradient of the Property. Exceedances in the 2014 to 2015 dataset typically occurred in wells screened in the upper WBZ. Where TCE was not detected in more recent Site data, non-detect results had PQLs that were greater than the PSL.
- Detected *cis*-1,2-DCE concentrations ranged from 1.5 µg/L to a maximum of 55,000 µg/L measured at B-44 in 2004. Detected concentrations in the Fox Avenue Site and Site data collected in 2014 and 2015 exceeded the PSL of 16 µg/L at the majority of locations monitored as part of the Fox Avenue Site investigations. Detected concentrations in a subset of Site wells exceeded the PSL at a location in the northwest corner of the Property and in two downgradient locations. Exceedances in the 2014 to 2015 dataset typically occurred in wells screened in the upper WBZ.

Detected vinyl chloride concentrations ranged from 0.27 µg/L to a maximum of 18,000 µg/L measured at PTM-2U in 2006. Detected concentrations in the Fox Avenue Site and Site data collected in 2014 and 2015 exceeded the PSL of 0.18 µg/L at most locations associated with the Fox Avenue Site monitoring network. All non-detect results for vinyl chloride had PQLs greater than the PSL.

It is important to note that active ERD injections are still occurring at the Fox Avenue Site, including a recent injection into on-Property wells MW-07 and MW-09 in July 2021. cVOCs continue to be detected in these wells. During the July 2021 Fox Avenue Site compliance monitoring event, total cVOC concentrations in well MW-09 (15.0 µg/L) were less than the Fox Avenue Site RL of 250 µg/L, as they have been since 2019 (refer to Appendix B). Total cVOC concentrations at other on-site wells (e.g., MW-10, MW-07, and B-49) have been less than the RL since at least 2017. Concentrations of cVOCs met the Fox Avenue Site CULs in embayment seeps for the first time in 2020 and again in 2021 and 2022.

4.3.2.5 Benzene, Toluene, Ethylbenzene, and Total Xylenes

BTEX compounds have been analyzed at least once at most Site monitoring wells between 2009 and 2015. Benzene is also a Fox Avenue Site COC and is analyzed annually or biannually during Fox Avenue Site compliance monitoring. Data from this compliance monitoring for 2016 to 2022 are presented in Appendix B and are not included in the following bulleted summary of Site data. It is important to note that there have been numerous IAs and remedial activities at the Fox Avenue Site that may have affected the overall distribution of these constituents in downgradient groundwater.

- Detected benzene concentrations ranged from 1 µg/L to a maximum of 61 µg/L at MW-10 in 2009. Detected concentrations in the Fox Avenue Site and Site data collected in 2014 and 2015 exceeded the PSL of 1.6 µg/L at monitoring wells in the northwest corner of the Site and downgradient, across Fox Avenue S. Exceedances in the 2014 to 2015 dataset typically occurred in wells screened in the upper WBZ. Figure 4.12 depicts the most recent and maximum groundwater monitoring concentrations measured between 2009 and 2015 for benzene.
- Detected ethylbenzene concentrations ranged from 1 µg/L to a maximum of 1,000 µg/L at MW-10 in 2009. Concentrations of ethylbenzene in the Site data collected in 2014 and 2015 were less than the PSL of 21 µg/L.
- Detected toluene concentrations ranged from 0.49 µg/L to a maximum of 2,200 µg/L at MW-10 in 2009. Concentrations of toluene in the Site data collected in 2014 and 2015 were less than the PSL of 100 µg/L.
- Detected total xylenes concentrations ranged from 0.70 µg/L to a maximum of 820 µg/L at MW-10 in 2009. Concentrations of toluene in the Site data collected in 2014 and 2015 were less than the PSL of 110 µg/L.

Benzene was not detected in on-Property wells (B-49, MW-07, and MW-09) monitored as part of Fox Avenue Site annual compliance monitoring from 2018 through 2022 (refer to Appendix B). Concentrations of benzene in embayment seeps also monitored as part of Fox Avenue Site annual compliance monitoring were non-detect or less than the Fox Avenue Site CUL (51 µg/L) over the same time frame.

4.3.2.6 Polychlorinated Biphenyls

PCBs were not analyzed in groundwater during previous Site investigations. However, groundwater samples were collected for PCB analysis in 2017 from three wells on the Property (WT-MW-06, WT-MW-108, and WT-MW-110) as part of an LDW-wide groundwater sampling study conducted on behalf of Ecology by Leidos (Leidos 2017). Both PCB Aroclors and congeners were analyzed as part of this study. Total PCB Aroclors were not detected in the three groundwater samples at a PQL of 0.01 µg/L. Total PCB congeners were detected in these samples with total PCB congener results ranging from 66.7 pg/L to 4,450 pg/L. All total PCB congener results were greater than the PSL of 7 pg/L. Figure 4.13 depicts the 2017 groundwater monitoring data for total PCB Aroclor and total PCB congener results.

4.4 SUMMARY INFORMATION FOR EXISTING DATA

Summary information for soil and groundwater has been presented in Tables 4.9 through 4.11. Tables 4.9 and 4.10 present summary information in soil for detect and non-detect results, respectively. All soil results are included in these tables, both in situ and those locations removed during the IA; Table 4.9 additionally presents in situ soil results separately to represent current Site conditions. Table 4.11 presents summary information for all groundwater data collected as part of Site investigations. For each chemical, these tables present the most stringent PSL; information about the number of results; the maximum result; and the location and date of the maximum result.

Based on the investigations to date and the Site history, the following chemicals will be further evaluated in the RI:

- TPH (GRO, total DRO and ORO, Stoddard solvent)
- Metals (As, Ba, Cd, Cr, Pb, Hg, Se, and Ag)
- Total PCB Aroclors and total PCB congeners
- Dioxin/furan TEQ
- VOCs including cVOCs and BTEX
- SVOCs, including penta and PAHs

5.0 Preliminary Conceptual Site Model

The preliminary CSM was developed for the Site based on findings from previous site investigations and has been used to identify data gaps that will be discussed in Sections 6.1 and 6.2. The CSM will be revised upon completion of the RI field activities and will inform the selection of appropriate cleanup actions for the Site.

5.1 PHYSICAL SETTING, GEOLOGY, AND HYDROGEOLOGY

The Site is located in the Lower Duwamish Valley, approximately 450 feet east-northeast of the LDW. Geology in the vicinity is characterized by 6 to 10 feet of fill soil composed of hydraulically dredged sediments with minor contributions from upland fill sources, overlying native Lower Duwamish Valley alluvial sand and silt deposits. Groundwater is present in an unconfined aquifer as shallow as 8 feet bgs and discharges generally to the southwest toward the S. Myrtle Street Embayment of the LDW under relatively flat gradients. Further hydrogeologic data are needed to assess Site-wide horizontal gradients and to refine groundwater flow direction.

Soils on the Property are covered with impervious surfaces including asphalt and concrete pavement. It is important to note that although the Property was previously assumed to be unpaved, the majority of the Property was found to be underlain by either asphalt or concrete during the IA. The underlying pavement was covered by approximately 4 to 8 inches of gravel and dirt, as observed during IA construction. All subsurface concrete and asphalt encountered during excavation and grading were removed prior to installation of subsurface stormwater conveyance and final concrete and asphalt pavement.

Stormwater on the Property is collected through a stormwater conveyance system and treated prior to discharge to the LDW via the Seattle Public Utilities storm sewer system in the S. Myrtle Street ROW. The adjacent S. Myrtle Street ROW is partially unpaved and allows limited infiltration of stormwater to soil. Stormwater runoff generated from the paved portion of S. Myrtle Street discharges untreated to the LDW through the S. Myrtle Street Outfall.

5.2 POTENTIAL MEDIA OF CONCERN

Potential media of concern include soil, groundwater, and air. Air is not considered a medium of potential concern at the Site under current conditions because enclosed buildings are not present, so vapor from subsurface volatile contamination cannot accumulate. Air as a potential future medium of concern (i.e., if a building is built on the Property) will be addressed in the FS and final CAP for the Site.

5.3 RELEASE MECHANISMS AND CONTAMINANT DISTRIBUTION

Potential release mechanisms for contaminants at the Site may include historical lumber mill operations and other Property operations and historical sources, and post-lumber mill trucking and storage operations. These potential release mechanisms are discussed in the following sections.

5.3.1 Known Historical Contaminant Sources

Known historical sources for specific areas of contamination include the former penta dip tank and UST in the S. Myrtle Street ROW and the former auto repair shop in the south-central portion of the Property.

5.3.1.1 Former Penta Dip Tank and Underground Storage Tank Source

Historical wood treatment operations at the Site have caused Stoddard solvent, penta, and dioxin/furan impacts to soil and groundwater, although the dioxins/furans are likely to be adsorbed to fine soil particles in the groundwater.

A commonly used wood treatment product used by Tyee Lumber on their finished wood products consisted of a blend of Stoddard solvent and penta. The exact penta concentration used by Tyee Lumber is unknown; however, the mixture was likely 90 to 95 percent Stoddard solvent and 5 to 10 percent penta based on available information (USFS 1948). The release of Stoddard solvent and penta from a UST could have occurred over time during routine filling and/or a leak in the UST. This historical lumber treatment has resulted in impacts from both Stoddard solvent and penta to Site soil and groundwater.

Stoddard solvent and penta occurrences in soil are primarily focused in the former penta dip tank and UST source area in the S. Myrtle Street ROW and extend in a halo around this source area, including on-Property. Contamination was likely released within the vadose zone surrounding the UST with lesser contributions from the ground surface surrounding the dip tank. Contaminants would have migrated downward in the vadose zone and dispersed laterally when the product reached the water table at approximately 8 to 10 feet bgs in the S. Myrtle Street ROW.

Stoddard solvent, which is the lightest and most mobile of the wood treatment-related chemicals and would have likely represented 90 to 95 percent of the wood treatment solution, has been transported the farthest laterally and to the southwest in the downgradient direction. Penta, which would have likely represented 5 to 10 percent of the wood treatment solution, has been dispersed similarly to Stoddard solvent. Vadose zone soils are generally not impacted by the Stoddard solvent and penta release; Stoddard solvent has not been detected at concentrations exceeding the PSL in soil samples collected above approximately 12 feet bgs within the Property, with the exception of WT-SB-10, located in the heavy ORO-focused excavation area. Concentrations exceeding the PSL were detected in shallower soils below approximately 5 feet bgs within the former penta dip tank and UST source area. Likewise, penta is predominantly detected in vadose soils within the former penta dip tank and UST source area.

The greatest concentrations of both Stoddard solvent and penta are found in the smear zone, immediately above and below the water table, and the vertical impact zone primarily extends from approximately 7 to 15 feet bgs. Both chemicals are present in a roughly 5- to 8-foot-thick layer of soil at the water table interface/smear zone based on field indications of contamination, which is likely representative of seasonal fluctuations in the water table elevation.

In the smear zone and saturated zone soils, the lateral and vertical extents of Stoddard solvent and penta contamination in the on-Property halo to the north of the source area have been delineated by excavation base and sidewall samples. Data from these samples demonstrated that the IA excavation removed the northern, eastern, and western on-Property extents of Stoddard solvent and penta, leaving a well-defined area of residual contamination on the Property to the south of the IA excavation. In the S. Myrtle Street ROW, the lateral extents of Stoddard solvent and penta have been largely delineated to the west and southwest but are not well delineated to the east and south. Soil samples have not been collected in the S. Myrtle Street ROW to the east of the former penta dip tank and UST source area, and elevated Stoddard solvent concentrations were not detected in soil samples collected from WT-MW-06, which was the boring advanced farthest to the southwest in the Site.

Dioxins/furans are also present in soil in the former penta dip tank and UST source area; dioxins/furans are a known byproduct of the penta manufacturing process and are often detected in areas with elevated levels of penta contamination, including subsurface soil as a result of operations associated with the former penta dip tank and UST. Dixons/furans have low solubility in water and partition strongly to soil particles, and, therefore, are not expected to be present in areas outside of the former penta dip tank and UST source area, coincident with penta impacts. Dioxins/furans associated with penta, however, have not been fully delineated.

Additionally, during prior investigations, analysis of heavily contaminated soil samples in the vicinity of the former penta dip tank and UST resulted in exceedances of PSLs of DRO and ORO in addition to Stoddard solvent. According to the laboratory reports, these exceedances are attributed to chromatographic overlap between the Stoddard solvent and other petroleum standards.

In groundwater, Stoddard solvent and penta are associated with soil contamination and are present in the halo to the north of the former penta dip tank and UST, as well as downgradient to the southwest. Dioxins/furans are also present in groundwater surrounding the former penta dip tank and UST but are likely to be adsorbed to fine soil particles in the groundwater. Stoddard solvent, penta and dioxins/furans associated with penta in groundwater have not been delineated in the downgradient direction to the southwest. Additionally, as noted for soil, presumed chromatographic overlap has resulted in detection of DRO and ORO in groundwater that is impacted by Stoddard solvent. These exceedances are also likely attributed to chromatographic overlap between the Stoddard solvent standard and other petroleum standards.

5.3.1.2 Former Auto Repair Facility Source

Historical auto repair operations in the south-central portion of the Property caused localized ORO impacts to shallow soils. The precise mechanism of release is unknown, but the localized nature of contamination suggests incidental spills that would have occurred during storage and use of small quantities of petroleum products. Historical research for the Property did not identify the presence of former USTs or aboveground storage tanks associated with auto repair operations. Heavy oil does not migrate readily, and these impacts were limited to a small area of vadose zone soil from approximately 3 to 5 feet bgs. Surface soils were generally more permeable sand and gravels (fill), with less permeable silty sand and sandy silt below 6 feet. The presence of heavy oil appeared to be localized at this transition from fill to native soil and was likely a result of a minor historical surface or shallow subsurface release. Groundwater in the shallow aquifer occurs on-site at depths ranging from 8 to 11 feet bgs, which is deeper than the zone of contaminated soil. Therefore, the groundwater was not in physical contact with ORO-contaminated soil in the vicinity of the former auto repair station. Concentrations of ORO and DRO in a 2015 groundwater sample collected from WT-MW-110, which was located adjacent to the historic automotive repair facility and was decommissioned as part of the IA excavation, were less than the PSL (500 µg/L).

The full extents of ORO from the historical auto repair facility source were delineated prior to the IA and removed as part of the IA, as described in previous sections.

5.3.2 Potential Historical Sources Related to Property Operations

Former lumber mill operations on the Property that were secondary to the penta treatment included dry kilns in the northeast portion of the Property; wood-drying and storage platforms in the south-central and northeastern portions of the Property; planing, cutting, and joining of lumber; and storage and burning of sawdust and wood chips. Other former operations at the Property included an auto repair facility in the southeast corner near the current truck entrance.

As discussed in previous sections, the likely contaminants resulting from other lumber mill operations are generally associated with drying and storage of penta-treated wood, which may have released Stoddard solvent, penta, and dioxins/furans to surface soil. Potential areas where treated wood would have been stored include areas immediately surrounding the location of the former penta dip tank and UST and the wood platform on the northeast portion of the Property. The dry kilns may have produced minor volatile air emissions but are not a likely source of contamination to soil or groundwater. Low levels of VOCs, SVOCs, and penta, all associated with drying penta-treated lumber, could have been present around the former dry kiln areas as a result of air emission deposition. There is evidence that the majority of the facility was covered with concrete or asphalt, at least in the later years of operation, so surface or subsurface impacts associated with historical air emissions from the dry kilns is unlikely. Other sawing and cutting operations would also not likely have resulted in contamination. Soil in these areas, however, has not been fully assessed for potential impacts from dry kilns or sawing and cutting.

Outside of the lumber mill operations, a former auto repair facility located in the southeast corner of the Property may have handled GRO, DRO, or ORO products that had the potential to be released to surface soil. Soil in this area has not been fully assessed for potential impacts from former auto repair operations.

5.3.3 Potential Historical Sources Not Related to Property Operations

An estimated 6-to 10-foot-thick layer of fill soil is present on the Property. Although the majority of the fill soil has been assumed to be hydraulically dredged material, the fill is heterogeneous and its origins are unknown. Therefore, pre-existing contaminants in imported fill soil are also a possible historical source of contamination at the Site.

Fill soils were analyzed for the IA COCs and other common industrial contaminants in preparation for IA construction. The IA COCs and additional contaminants, including metals, PCBs, PAHs, and several VOCs, were analyzed in soils outside the IA area and were generally not detected at the laboratory PQLs (or in the case of metals, were detected at levels consistent with background concentrations in the Puget Sound Region [Ecology 1994]).

During this pre-characterization sampling, the cVOC PCE was detected at concentrations that exceeded the most stringent MTCA Method A CUL for unrestricted use (which was the IA criterion used for soil reuse) in fill soil by less than 2 times. These scattered PCE detections were encountered from depths of approximately 2 to 5 feet bgs in the western portion of the Property and within (i.e., at WT-GP-5 and WT-GP-7) or immediately adjacent to (i.e., WT-GP-8) the Fox Avenue Site cleanup action area (refer to Figure 2.2). PCE was also detected in soil below approximately 3 feet bgs in the northwest corner of the Property during previous Fox Avenue Site investigations. The source of the PCE in vadose zone soil has not been clearly identified, because it was not believed to be used during former operations on the Property and was concluded to potentially have migrated in the vadose zone in areas downgradient of the Fox Avenue Site. Additionally, in the S. Myrtle Street ROW, PCE was detected in deeper soils from approximately 7.5 to 10 feet bgs in the former penta dip tank and UST source area (also within the Fox Avenue Site plume extents). PCE was also detected at 4 feet bgs in the heavy ORO-focused excavation area.

Site-wide groundwater has been impacted by cVOCs, benzene, and penta due to historical sources of contamination at the adjacent Fox Avenue Site to the north. Residual contamination in groundwater originating from the Fox Avenue Site has migrated from the main source area on the Fox Avenue Site downgradient to the southwest and is present on the western portion of the Property. The cVOC and benzene contamination attenuates to concentrations less than the Fox Avenue Site CULs to the southwest of the Site in monitoring wells and embankment seeps. The extent of penta contamination in groundwater due to the Fox Avenue Site is not well delineated, as there is the potential for commingling between the southern extent of the Fox Avenue Site plume and the northern extent of the former penta dip tank and UST source area plume. Additionally, penta has been detected in groundwater to the northeast of the former penta dip tank and UST in the presumed upgradient direction but has not been directly correlated to a potential soil source.

Groundwater quality has not been evaluated in the north-central and eastern portions of the Property because there is not a known or suspected source of contamination that may impact groundwater. In addition, the general quality of groundwater flowing onto the Property from the upgradient direction has not been assessed.

5.3.4 Potential Sources from Post-Mill Operations

After the cessation of lumber mill operations in 1986, the Property was used for trucking and container storage. Potential sources of contaminants from these operations likely include DRO and ORO from trucks and heavy equipment. Although scrap metal traces potentially associated with empty scrap metal container handling were visibly intermixed with surface soil, metals analyses did not indicate that metals were a primary COI. In addition, during the IA, the Property was found to be largely paved below the crushed gravel surfacing and the top approximately 2 feet of surface material (including the pavement) were removed during surface grading. Therefore, any contaminants resulting from trucking and empty container storage would have been removed during IA construction and are unlikely to be present in the subsurface at the Site.

5.4 POTENTIAL MIGRATION PATHWAYS AND TRANSPORT

Contaminants in soil and groundwater at the Site have the potential to migrate through natural mechanisms that may result in exposure to human and ecological receptors. The primary potential migration pathways include the following:

- **Soil to Groundwater.** Releases of contamination to the surface and subsurface that occurred during historical Site operations could result in a continued release, or leaching, of contaminants entrained in soil to groundwater. This pathway is considered complete in soil that is saturated by groundwater. Although this pathway may have been historically complete from shallower unsaturated soil to groundwater, it is not currently complete because the property is fully covered with impermeable pavement that prevents the infiltration of surface water that is necessary to transport contaminants from shallow soil to groundwater. Despite current paved conditions, the PSLs selected to represent this pathway conservatively assume leaching may occur from both unsaturated and saturated soils.
- **Groundwater to Surface Water/Sediments.** The Site is located to the east of the LDW, although not directly adjacent to it. Contaminated groundwater beneath the Site has the potential to migrate through groundwater flow to the LDW. This pathway is considered complete pending empirical demonstration to determine whether contaminants from the Site extend to the LDW.

5.5 POTENTIAL EXPOSURE PATHWAYS AND RECEPTORS

Potential receptors exposed to soil, groundwater, surface water, and sediment contamination include both human and ecological receptors. As previously described in Section 2.2, the Simplified TEE was ended; therefore, exposure to terrestrial ecological receptors is not required to be further considered at the Site. The potential exposure pathways and receptors at the Site include the following:

- **Human Exposure via Direct Contact.** Contamination at the Site is primarily located in the subsurface in smear zone and saturated soil and groundwater (at depths ranging from approximately 8 to 15 feet bgs). Because contamination is in the subsurface, this pathway focuses on direct contact exposure to contaminated soil and/or groundwater by utility or construction workers entering the subsurface for construction, maintenance, or remediation activities.

- **Human Exposure via Seafood Consumption.** This pathway evaluates the ingestion by humans of aquatic species (seafood) that may have accumulated toxic chemicals during their life cycle. The primary concern is the presence of persistent contamination in LDW sediments that can accumulate in organisms over a long period of time. Because the Site is not directly adjacent to the LDW and the primary bioaccumulative COI at the Site (dioxins/furans) that is also an LDW COC is not mobile in groundwater, this exposure pathway is not expected to be of concern. This assumption will be evaluated as part of the RI.
- **Human Exposure via Air Inhalation.** Volatile contaminants in shallow soil and groundwater have the potential to volatilize and rise through the soil column and discharge into indoor air. Air inhalation is not a complete pathway at the Site under current conditions because enclosed buildings are not present, so vapor from subsurface volatile contamination cannot accumulate.
- **Human Exposure via Drinking Water.** Humans have the potential to be exposed to contamination if using groundwater as a drinking water source at the Site. The potability of the groundwater at the Site has not yet been determined. A site-specific assessment of Site groundwater potability to determine if this pathway is complete will be included in the RI.
- **Aquatic Receptor Exposure via Groundwater Discharge to Surface Water.** Contamination has the ability to be transported via groundwater to discharge to the LDW. Chemical discharge to the LDW has the potential to expose aquatic species in surface water to acute or chronic health effects.
- **Benthic Receptor Exposure via Groundwater Discharge to Sediment.** Chemical discharge to the LDW has the potential to expose benthic species in sediments to acute or chronic health effects. Preliminary groundwater data suggest that this is not an exposure pathway of concern.

6.0 Proposed Remedial Investigation

The proposed RI field investigation will be completed to collect soil and groundwater data to prepare a comprehensive RI/FS for the Site. Objectives for data collection at the Site, identified data gaps, and the proposed sample collection to fulfill data gaps are presented in the following sections.

6.1 DATA COLLECTION OBJECTIVES

Per WAC 173-340-350(1), the overarching objective of the RI/FS is to collect sufficient data and information to evaluate remedial alternatives and develop and select a cleanup action for the Site. The anticipated data needs to fulfill this objective include the following.

- Defining the presence and extent of COIs at concentrations exceeding PSLs to determine current risks to receptors via the complete and potentially complete exposure pathways described in Section 5.5, for:
  - Chemicals that were historically used at, and originate from, the Site
  - Chemicals associated with adjacent cleanup sites where they have come to be commingled with releases of chemicals at the Site
- Collecting data at sufficient density, and with sufficient analytical sensitivity, to define Site COCs and areas of concern for remediation
- Collecting additional information regarding the CSM, such as hydrogeologic and geochemical data, to support the CSM and the evaluation of remedial technologies for the Site

Soil and groundwater data have been collected from the Site over the past several decades as described in Section 3.1. These existing data contribute significantly to the fulfillment of the above objectives. A thorough review of the existing data relative to the data collection objectives was completed to determine remaining data gaps for the RI/FS. Data gaps analysis is presented in Section 6.2.

6.2 DATA GAPS EVALUATION

Several data gaps have been identified based on a review of existing data and will be further evaluated as part of the RI. Additionally, several data needs were identified by Ecology in comments issued pursuant to their review of a prior VCP application (Ecology 2014), the *Phase 2 Current Situation Report* (Ecology 2015), and the IAWP (Ecology 2016b). An evaluation of these potential data gaps is presented in Table 6.1. To meet the objectives of the RI/FS, the data gaps that require further investigation during the RI have been assigned identification numbers (DG-1 through DG-6).

- **DG-1: Former Penta Dip Tank and Underground Storage Tank Source Area Evaluation.** This data gap includes delineation of COIs associated with the Site. Additional soil and groundwater data are needed to better delineate the nature and extent of Stoddard solvent, penta, and associated COIs resulting from former wood treatment with penta at the Site.

- **DG-2: Other Historical Mill Operation Area Evaluation.** This data gap concerns data density. Additional soil and groundwater data are needed on the Site to evaluate potential impacts from other former Site operations (i.e., lumber mill, automotive repair shop, and automotive service shop).
- **DG-3: Fox Avenue Site Overlap.** This data gap includes a more thorough evaluation of COIs associated with the adjacent Fox Avenue Site. Chemicals associated with historical releases at the north-adjacent Fox Avenue Site include penta, cVOCs, and benzene. Because these chemicals are also COIs for the Site due to detections greater than the PSLs, additional data are needed to determine the magnitude and spatial distribution of these COIs to define if there is a separate and distinct on-site source for these COIs and, if so, the extent of overlap between the releases associated with each site. It is important to note that the Fox Avenue Site CULs for these COIs are greater than the Site PSLs, and the Fox Avenue Site cleanup is still ongoing.
- **DG-4: Property-Wide Soil Quality Evaluation.** This data gap concerns data density and data quality of fill soils at the Property. Additional vadose zone soil data collection is needed to further evaluate general fill quality on the Property.
- **DG-5: Site-Wide Groundwater Quality Evaluation.** This data gap concerns delineation of COIs associated with the Site and data density. Additional groundwater data are necessary to gain a more current and complete understanding of groundwater conditions.
- **DG-6: Hydrogeological Data Collection.** This data gap concerns the CSM. Additional hydrogeologic data are necessary to better understand fluctuations in the magnitude and direction of shallow groundwater flow.

The proposed data collection to fill these data gaps and to meet the data collection objectives of the RI/FS is described in the following sections.

6.3 PROPOSED REMEDIAL INVESTIGATION

The objective of the RI is to collect additional soil and groundwater characterization data, which will fill the data gaps identified in Section 6.2 and adequately define the nature and extent of contamination at the Site.

6.3.1 Data Collection Approach

RI data will be collected using a phased approach, in which data are evaluated and incorporated into the current understanding of the Site as they are received. After the first phase of data collection (Tier 1), an additional data gaps analysis will be performed in coordination with Ecology to determine the scope of additional phase(s) of investigation (i.e., Tier 2), if warranted. The proposed Tier 1 RI activities are described in detail in Section 6.3.2. Objectives for additional phases of RI are described in Section 6.3.3.

6.3.2 Tier 1 Remedial Investigation

The locations of the proposed soil boring and monitoring well locations are shown on Figures 6.1 and 6.2, respectively. A total of 14 soil borings, with 6 borings completed with monitoring wells, are initially proposed during Tier 1 to complete the RI. In addition, there are 8 existing Site monitoring wells (WT-MW-01, WT-MW-02, WT-MW-03, WT-MW-05, WT-MW-06, WT-MW-07, WT-MW-108, and WT-MW-109) and 13 existing Fox Avenue Site monitoring wells (B-18, B-19, B-20A, B-36, B-37, B-38, B-49, B-60, B-64, MW-07, MW-08, MW-09, and MW-10)[5] that will be included as part of the monitoring well network for the RI. Details regarding sample collection field protocols, laboratory analysis methods, and data quality objectives are presented in the SAP/QAPP provided in Appendix C. All work will be performed in accordance with the Site-specific Health and Safety Plan provided in Appendix D.

Soil data will be collected and analyzed in accordance with Table 6.2. Soil samples will be collected for immediate analysis or archival at the laboratory (for additional analysis if necessary to delineate PSL exceedances) at 1-foot intervals wherever the recovered sample volume is sufficient for the required laboratory analyses specified in Table 6.2. Soil sample intervals may be adjusted in the field to thicknesses of up to 2 feet to obtain sufficient sample volume for laboratory analysis. In all cases, field staff will ensure that the soils in the interval sampled have consistent composition and field indications of contamination (e.g., odors, sheen, staining, presence of light non-aqueous phase liquid, elevated PID readings). Therefore, sample intervals may be adjusted to target field indications of contamination and may result in intervals less than 1 foot thick. Samples for analysis of VOCs will be collected directly from the soil sample core, targeting material with the most elevated PID readings if observed, prior to homogenizing the sample interval for collection of volume for other analyses, in accordance with Ecology guidance (Ecology 2004).

Subsurface soil horizons will be targeted to resolve data gaps associated with specific lithology and/or periods of Site operational history. Samples collected from uppermost fill soil will be used to characterize relatively recent Site operational impacts to soil since 1991, as well as general fill soil quality. Soil impacts from historic mill operations will be evaluated in samples collected from lowermost fill soil because, as described in Section 5.3.1.1, penta and Stoddard solvent have not typically been detected in vadose zone soils shallower than 12 feet bgs. Samples will be collected from native vadose and saturated soils to further characterize the distribution of COIs in the subsurface, according to the objectives specified in Table 6.2.

Samples will be collected beginning immediately below the interface between the imported crushed surfacing base course (CSBC) that was placed as pavement subgrade during the IA and the underlying fill material that existed at the Site prior to the IA.[6] Unless specified otherwise in Table 6.2, borings will be advanced and samples collected to a depth below the deepest field

[5] Access to the Fox Avenue Site wells will be coordinated with the owner of the Fox Avenue Site prior to sample collection. Certain monitoring wells that have not been accessed or sampled in recent years will need to be inspected and possibly redeveloped to confirm that the wells are viable.

[6] CSBC is composed of gray, well-graded angular gravel with sand that is readily distinguished from preexisting fill material at the Site, which is composed of brown, fine silty sand with few rounded gravels.

indications of contamination. If field indications of contamination are not present, the boring will be completed to a minimum depth of 15 feet bgs, below the depth of detectable contamination from analytical sample results exceeding PSLs in the existing soil dataset and the depth threshold for evaluating direct contact with COIs in soil. The field team may archive the sample collected at 15 feet bgs for analysis, pending the results of field screening from overlying samples. If concentrations of COIs in shallower soils are less than the direct contact screening levels, the direct contact pathway will be sufficiently characterized.

Groundwater monitoring wells will be screened to span the observed water table unless otherwise noted in Table 6.3. Well screen intervals are anticipated to be 10 feet in length; however, well screen intervals may also be adjusted in the field to target specific intervals based on soil observations or the suitability of the soil (i.e., grain size, water content) for construction of a monitoring well.

The condition of existing monitoring wells will be assessed prior to groundwater monitoring. If evidence of damage to the casing such as an obstruction or the presence of soil or debris are observed, an alternate approach to collecting the necessary groundwater data at that location will be proposed to Ecology. If excessive sedimentation or turbidity is observed, wells may be redeveloped before collecting samples. Additionally, collection of groundwater samples from Fox Avenue Site wells is contingent upon being granted access and well condition. Although the proposed groundwater sampling will utilize regularly sampled wells to the extent possible, it is expected that some proposed Fox Avenue Site wells may be in poor condition due to age or disuse. If a proposed Fox Avenue Site well is found to be in unacceptable condition for sampling, an approach to obtaining the necessary groundwater data at that location will be proposed in coordination with Ecology and the Fox Avenue Site owner.

Groundwater data will be collected and analyzed in accordance with Table 6.3. Groundwater samples will be collected from new and existing Site and select Fox Avenue Site monitoring wells for laboratory analysis during four quarterly monitoring events for 1 year. After the four quarters of groundwater monitoring are complete, additional Tier 2 data collection may be necessary to delineate nature and extent of contamination (refer to Section 6.3.3).

6.3.2.1 Former Penta Dip Tank and Underground Storage Tank Source Area Evaluation (DG-1)

Soil and groundwater samples will be collected to determine the lateral and vertical extents of Stoddard solvent and penta contamination to effectively evaluate remedial alternatives in the RI/FS. Activities associated with resolving DG-1 in the former penta dip tank and UST source area are summarized as follows.

- The lateral and vertical extent of Stoddard solvent and penta contamination in soil will be characterized and the extent of the groundwater plume will be defined, including to the south and west in the presumed downgradient direction in the S. Myrtle Street or 7th Avenue S. ROW. Five additional soil borings will be advanced in this area (WT-SB-27 through WT-SB-30 and WT-MW-113) to assess the lateral and vertical extents of Stoddard solvent and penta to the east, south, and west of the former penta dip tank and UST source area, and one additional monitoring well (WT-MW-113) will be installed in the presumed downgradient direction. Samples for Stoddard solvent and penta analysis will be collected from the new wells WT-MW-04R and WT-MW-113; existing wells WT-MW-01 through WT-MW-03, WT-MW-05 through WT-MW-07, and WT-MW-108; and Fox Avenue Site wells MW-07, B-18, and B-36.

- The extent of chromatographic overlap between Stoddard solvent and GRO, DRO, and ORO will be clarified, and the extractable petroleum hydrocarbon (EPH) and volatile petroleum hydrocarbon (VPH) fractions in Stoddard solvent-contaminated soil and groundwater will be characterized. Representative soil samples with indications of contamination will be analyzed by both NWTPH-Gx and NWTPH-Dx to evaluate and clarify the extent of chromatographic overlap of these analyses in contaminated source area soil, and to determine the distribution of EPH and VPH alkanes in Stoddard solvent-contaminated soil (WT-SB-27 and WT-SB-28). Groundwater samples will be collected for NWTPH-Gx, NWTPH-Dx, and EPH/VPH analyses at selected wells where Stoddard solvent has previously been detected at elevated concentrations. These selected wells include B-38, located within the source area; WT-MW-04R, located upgradient and north of the source area; and WT-MW-07, located downgradient of the source area to the south. These data will be used in coordination with chromatogram review to determine which TPH detections are attributable to weathered Stoddard solvent contamination and whether any TPH detections in the source area are attributable to other petroleum products. EPH and VPH data may additionally be used to determine site-specific TPH toxicity for the purposes of evaluating FS alternatives.

- The nature and extent of dioxins/furans in areas with penta contamination will be assessed. Soil samples for dioxin/furan analyses will be collected from native soil at the three borings surrounding the former penta dip tank and UST source area (WT-SB-28, WT-SB-30 and WT-MW-113). Additional sample volume of lowermost fill and uppermost native soil will be collected for total organic carbon analysis at locations that are outside of the penta source area and are geologically representative (WT-SB-24 and WT-MW-111). Data from this analysis will be used to calculate the fraction of organic carbon in soil and thus the mobility of dioxins/furans in Site soils. Additionally, in the area immediately downgradient of the former penta dip tank and UST source area, groundwater samples will be collected to determine the potential for dioxins/furans in areas where penta is present. Samples for dioxins/furans will be collected from WT-MW-06, B-36, and B-38 and analyzed immediately at B-38. If the dioxin/furan result from B-38 exceeds the PSL, then the samples from WT-MW-06 and B-36 will be analyzed. This data collection overlaps with DG-2, described in Section 6.3.2.2.

- The extent of commingling of the Fox Avenue Site penta plume in the lower WBZ has not been fully characterized at the Site. Existing Fox Avenue Site wells with screened intervals within the lower WBZ (B-19, B-37, MW-08, and MW-10) will be sampled and analyzed for penta. This data collection overlaps with DG-3, described in Section 6.3.2.3.

6.3.2.2 Other Historical Mill Operation Area Evaluation (DG-2)

Soil and groundwater samples will be collected to determine the potential impacts from former lumber mill operations (wood drying, sawmilling, wood storage, and boiler house and dry kiln operations), former automotive repair operations in the southeastern portion of the Property, and former service station operations off-Property and east of the Property. Activities associated with resolving DG-2 in other historical operational areas are summarized as follows.

- Former lumber mill operational areas will be characterized by proposed borings WT-MW-04R (hog fuel bin and window sash manufacturing and frame shop), WT-MW-110R (previous penta detections in groundwater), WT-SB-23 (planning and cutting mill), WT-SB-24 (dry kilns), WT-SB-26 (sawdust bin/boiler house area and previous penta detections in groundwater), WT-MW-111 (wood platform where drying or storage may have occurred and previous penta detections in groundwater), WT-MW-112 (storage shed), and WT-MW-114 (for characterization in areas without prior sample data, including the finger-jointing mill). The contaminants resulting from former lumber mill operations include penta and TPH (including Stoddard solvent, as well as DRO and ORO used for equipment); dioxins/furans also have the potential to be present in areas with penta contamination.[7] These likely contaminants will be analyzed in lowermost fill and uppermost native soil intervals above the water table (Table 6.2). Groundwater samples will be collected from wells WT-MW-109, WT-MW-110R, WT-MW-111, and WT-MW-112 to confirm prior penta detections in groundwater and assess potential penta impacts from former lumber mill operations.
- Soil in the vicinity of the former automotive repair facility in the southeast corner of the Property and the former service station off-Property to the east will be characterized by proposed boring WT-SB-25. The presumed contaminant resulting from the former auto repair and service station facilities are TPH, BTEX, PCBs, cPAHs, and metals.[8] These likely contaminants will be analyzed in fill soil. Groundwater is not expected to be impacted by fill contamination related to the former service station and UST; however, soil borings will be advanced to one sample interval (i.e., 1 to 2 feet) below the water table, and samples of saturated native soil will be collected, archived, and analyzed if needed to confirm that contaminants do not extend below the fill. If groundwater contamination is determined to be likely based on soil sampling results, a contingency well may be added in coordination with Ecology to evaluate groundwater in this area.

7 This data gap overlaps with DG-1. Dioxins/furans will also be analyzed in unsaturated (and saturated) native soils to address the nature and extend of dioxins/furans in areas with penta contamination as described in Section 6.3.2.1.

8 Total PCB Aroclors will be analyzed in samples targeted for PCB analysis via EPA Method 8082A. Upon receipt of PCB Aroclor results, the two samples with the minimum and maximum concentrations will be re-analyzed for Total PCB Congeners via EPA Method 1668 for correlation with Aroclor results.

6.3.2.3 Fox Avenue Site Overlap (DG-3)

Additional soil and groundwater data are warranted to evaluate the distribution of adjacent Fox Avenue Site COCs and to determine the extent of potential commingling of overlapping constituents in groundwater between the two sites. It is important to note that the western portion of the Property is part of the ongoing Fox Avenue Site cleanup and long-term groundwater monitoring program. In addition, there is a CPOC at the western Property boundary along Fox Avenue (refer to Figure 2.2). Per the Fox Avenue Site CAP, the groundwater RLs must be met at the CPOC, which was initially projected by 2023. For reference, the RL for total cVOCs is 250 µg/L. Per the Fox Avenue Site CAP, the groundwater CULs were projected to be met at the Myrtle Street Embayment seeps 15 years after thermal treatment (or by 2028), and the CULs were projected to be met in the site-wide groundwater plume within 50 years (or by the end of 2063). For reference, the Fox Avenue Site groundwater CULs for PCE and benzene are 3.3 and 51 µg/L, respectively, and the PSLs for the Site for PCE and benzene are 2.9 and 1.6 µg/L, respectively.

Activities associated with assessing groundwater quality to resolve DG-3 are summarized as follows.

- Additional data are needed to further evaluate the distribution of penta, cVOCs, and benzene in groundwater associated with the Fox Avenue Site.
    - The extent of commingling of Site groundwater with the Fox Avenue Site penta plume will be further evaluated by sampling the Site-wide monitoring well network for penta. These activities overlap with sampling of the lower WBZ described in Section 6.3.2.1 (DG-1).
    - The following wells along the inferred southern and eastern extents of the Fox Avenue Site plume will additionally be sampled for VOCs (including cVOCs), and a subset will also be analyzed for benzene to more precisely delineate the plume boundaries relative to the Property and the Site for these constituents: B-18, B-36, B-64, WT-MW-01, WT-MW-02, WT-MW-03, WT-MW-04R, WT-MW-05, WT-MW-06, WT-MW-07, WT-MW-109, WT-MW-110R, WT-MW-111, and WT-MW-113.[9]
    - Data are also needed to evaluate upgradient groundwater quality along the property line with the Fox Avenue Site to better determine the quality of groundwater that is flowing onto the Property. Groundwater data will be collected for cVOCs, BTEX, DRO and ORO, and penta from newly proposed monitoring wells WT-MW-112 and WT-MW-114 and existing monitoring wells B-49 and WT-MW-109.

The groundwater data collected during the RI will be evaluated along with the most recent cVOC and benzene data available from Fox Avenue Site compliance monitoring (reported annually). There have been many remedial actions at the Fox Avenue Site over the years, including IAs and

[9] Annual monitoring for the Fox Avenue Site is focused on the western and downgradient portions of the Fox Avenue Site and will not be verified as part of this RI.

the ongoing cleanup action, which have affected groundwater plume dynamics, so it will be important to evaluate a comprehensive data set. The most recent ERD substrate injections on the Property occurred in July 2021 (at wells MW-07 and MW-09) to target elevated cVOC concentrations, as documented in the 2021 Annual Report (CALIBRE 2021). Key tables and figures associated with the Fox Avenue Site, specifically post-thermal groundwater monitoring data from 2016 through 2022, are included in Appendix B for reference.

Activities associated with assessing soil quality to resolve DG-3 are summarized as follows.

- Additional data are needed to define the magnitude and spatial distribution of PCE in soil and to determine whether detections of PCE in shallow soils at the Site are associated with the Fox Avenue Site. This data collection overlaps with DG-4 described in Section 6.3.2.4.

6.3.2.4 Property-Wide Soil Quality Evaluation (DG-4)

General Site-wide soil quality to assess post-mill operational impacts, fill quality, and post-IA soil quality will be further evaluated for the purposes of preparing a comprehensive Site RI/FS. Activities associated with evaluating Site-wide soil quality to resolve DG-4 are summarized as follows.

- PCE is present in scattered shallow vadose zone soil. Additional soil borings are proposed to evaluate the potential source and extent of low-level PCE in vadose zone soil including lower fill soils and upper native soils (WT-MW-04R, WT-SB-23, WT-SB-24, WT-SB-26, WT-SB-27, WT-SB-30, WT-MW-111, and WT-MW-114). Samples from WT-SB-30 will additionally be analyzed for the potential presence of other cVOCs in vadose zone soil. This data collection overlaps with the evaluation of PCE in shallow soil needed to address DG-3, described in Section 6.3.2.3.
- Additional soil data are needed to further evaluate if general industrial use of the Property from approximately 1991 to present is a source of TPH, metals, or PCBs in uppermost fill soil.[10] Surface soils removed during the IA contained metals and PCBs exceeding the PSLs, but very limited data for metals and PCBs were collected in underlying soils during previous investigations. Selected soil samples will be analyzed for additional chemicals potentially associated with general industrial property use (i.e., TPH, metals, and PCBs). General fill soil quality related to recent industrial operations will be characterized by borings WT-SB-23, WT-SB-25, WT-MW-04R, WT-MW-111, and WT-MW-114.
- General fill soil quality on the Property will be evaluated to determine if fill soils are a source of subsurface contamination. Soil borings will be advanced in the northern, central, and southeast portions of the Property (WT-SB-23 through WT-SB-26, WT-MW-04R, WT-MW-111, and WT-MW-112) and in the S. Myrtle Street and 7th Avenue S. ROWs (WT-SB-27 through WT-SB-30 and WT-MW-113) to assess

10 It is important to note that all surface soil was removed as part of the IA; the target zone for this evaluation will be below the newly backfilled surface area.

general soil quality in areas not related to historical operations. General fill soil contaminants are likely to include TPH, VOCs (including PCE and BTEX), metals, and PCBs. Soil samples collected WT-MW-110R will also be used to assess the effectiveness of the IA soil removal in those areas. Borings will be advanced beyond the fill/native interface and the lower fill soil, and underlying native soil samples will additionally be analyzed to obtain information about fill soil quality and native soil quality relative to fill.

- Certain chemicals identified in Tables 4.9 and 4.10 have non-detect results from some or all prior investigations with PQLs that were greater than PSLs (i.e., select VOCs and SVOCs, PCBs, and mercury) and require additional evaluation using lower PQLs as practical.[11] The presence of these chemicals will be further characterized in soil in select locations by chemical, including borings WT-MW-04R, WT-SB-23, WT-SB-24, WT-SB-25, WT-SB-26, WT-SB-28, and WT-SB-30.

6.3.2.5 Site-Wide Groundwater Quality Evaluation (DG-5)

To establish a complete groundwater monitoring well network, the two Site wells that were decommissioned during the IA (WT-MW-04 and WT-MW-110) will be re-installed at their prior locations (WT-MW-04R and WT-MW-110R) and will be screened below the clean fill zone placed during the IA. Additionally, three upgradient monitoring wells (WT-MW-111, WT-MW-112, and WT-MW-114) will be installed in the northern portion of the Property to evaluate upgradient groundwater quality, and one well (WT-MW-113) will be installed to the south of the former penta dip tank and UST source area to assess downgradient water quality. The newly installed wells will be developed prior to sampling. Existing Site wells and Fox Avenue Site wells that have not been accessed for sample collection within the past 3 years will also be redeveloped to the extent practical prior to sample collection, in coordination with the Fox Avenue Site owner/consultant and Ecology. The standard guideline for well development is presented in Appendix C.

Groundwater samples will be collected from the monitoring well network to identify COCs, define the nature and extent of COCs, and complete a comprehensive Site RI/FS. Groundwater sampling will occur on a quarterly basis for 1 year after the completion of Tier 1 monitoring well installation to capture seasonal variation in COC concentrations. The activities associated with assessing general Site-wide groundwater quality to resolve DG-5 are summarized as follows.

- Groundwater quality will be evaluated to determine the effectiveness of the IA. Groundwater samples will be collected in areas within or immediately adjacent to the IA excavation areas and analyzed for IA COCs (ORO, Stoddard solvent, and penta), including monitoring wells WT-MW-01 through WT-MW-03, WT-MW-04R, WT-MW-110R, and WT-MW-108.
- Certain chemicals identified in Table 4.10 have non-detect results in soil from prior investigations (i.e., VOCs, SVOCs, and PCBs). The presence of these chemicals will also be characterized in groundwater by analyzing VOCs in selected wells (WT-MW-01,

[11] For many of these chemicals, PQLs that are consistent with the PSLs cannot be achieved.

WT-MW-02, WT-MW-03, WT-MW-04R, WT-MW-05, WT-MW-06, WT-MW-07, WT-MW-109, WT-MW-111, and WT-MW-113), and SVOCs and PCBs from selected on-Property wells WT-MW-06, WT-MW-108, and WT-MW-110R.

Groundwater data collection proposed for DG-3 (described in Section 6.3.2.3) will be used to supplement the Site-wide groundwater quality characterization.

6.3.2.6 Hydrogeological Data Collection (DG-6)

Additional hydrogeologic data are necessary to better understand fluctuations in the magnitude and direction of shallow groundwater flow, including hydraulic gradients and potential areas of tidal influence, and to refine the overall groundwater flow direction. Hydrogeological data will be collected from the monitoring well network identified in Section 6.3.2.5 and shown in Figure 6.2 to resolve DG-6.

- During the quarterly groundwater monitoring events, the depth to groundwater for each well will be collected prior to sampling to determine groundwater elevations, refine groundwater flow direction, and determine the magnitude of lateral and vertical hydraulic gradients at the Site.

The geometric mean hydraulic conductivity of 7.5 x 10^{-3} centimeters per second measured during slug tests at the Fox Avenue Site (Floyd|Snider 2011) will be used in conjunction with Site-specific hydraulic gradient data and conservative literature values for effective porosity to calculate groundwater flow velocity at the Site.

Depth to groundwater in selected wells to the south/southwest of the Property and in the Property interior (i.e., WT-MW-03, WT-MW-06, WT-MW-108, WT-MW-109, and WT-MW-113) will be measured using pressure transducers for a period of 1 week following each sampling event. Depth to water measurements will be collected at 10-minute intervals over several tidal cycles to evaluate potential tidal fluctuations in groundwater gradients. To constrain potential tidal influence on groundwater fluctuations, seasonal periods with the greatest expected tidal shifts will be targeted for data collection.

The findings of the Tier 1 hydrogeological analysis will be supplemented, as needed, with previous findings from the Fox Avenue Site RI (Floyd|Snider 2011).

6.3.3 Tier 2 Remedial Investigation

Additional phase(s) of RI may be necessary to achieve the overall objective of Site characterization sufficient to support development of a FS for the Site. After a review of Tier 1 data, it may be determined that Tier 2 data (i.e., soil borings and/or monitoring wells) are needed to define the nature and extent of soil and/or groundwater contamination; Tier 2 sampling locations would be determined based on field observations of contamination in Tier 1 borings and/or after a review of analytical data indicates that additional delineation is warranted. Tier 2 sampling may also include sampling of additional existing Fox Avenue Site monitoring wells.

Additional phases of RI may be needed to:

- Further delineate, laterally or vertically, areas of soil or groundwater where COIs exceed PSLs due to releases at the Site.
- Further delineate any additionally identified “hotspot” areas of soil or groundwater contamination where concentrations of COIs are found to be present at concentrations significantly greater than those observed elsewhere at the Site, such that the area may be of particular concern for development of remedial alternatives. Further evaluation of groundwater may be needed if soil hotspot areas are identified at locations without collocated monitoring wells.
- Gain additional information regarding Site geochemical or hydrogeologic conditions (such as additional hydraulic conductivity or tidal study data) that may be necessary to determine applicable remedial technologies at the Site.

Additional phase(s) of RI would be proposed, in coordination and after consultation with Ecology. Proposed Tier 2 investigation details would be provided to Ecology in a technical memorandum as a supplement to this RI Work Plan. The Tier 2 investigation would be initiated within 30 days of Ecology approval of the technical memorandum.

7.0 Feasibility Study

Additional data will be gathered as part of the RI to further characterize upland soil and groundwater conditions to fill existing data gaps. The additional Site characterization outlined in Section 6.0 will provide sufficient information for a comprehensive understanding of the nature and extent of contamination and will inform development of an updated CSM. The complete Site characterization will allow definition of chemicals of concern and identification of areas of concern relative to cleanup standards.

The RI/FS will define Remedial Action Objectives (RAOs) for the Site as a mechanism for meeting the requirements of the MTCA Cleanup Regulations (WAC 173-340). RAOs define the objectives that must be met by the selected remedy to ensure substantive compliance with the cleanup goals established for the Site. RAOs are simple statements that clearly define what the remedy must accomplish to address the concerns identified in the CSM. RAOs are used to facilitate development and evaluation of remedial alternatives. Preliminary RAOs for the Site include the following:

- Remediate soil and groundwater, as necessary, to meet MTCA cleanup standards and other standards applicable to the Site
- Control contaminant migration pathways
- Select remedial actions that can be implemented and effectively maintained in conjunction with the anticipated future Site use

These preliminary RAOs will be developed further in the RI/FS report, following completion of the RI activities proposed in this RI Work Plan. To support the definition of RAOs, the FS will define areas of concern that can be characterized by specific physical and contaminant conditions.

The results of the RI will be used in the FS to establish CULs for future cleanup actions at the Site. Remedial technologies will be identified and screened for each impacted media to determine applicability to the individual areas of concern. Remedial alternatives will be screened and those that meet MTCA threshold criteria and the Site-specific RAOs will be further evaluated. A preferred alternative will be selected for the Site based on this evaluation and will be presented in the FS along with remedy selection criteria.

8.0 Reporting and Schedule

The schedule presented below provides anticipated submittal dates for field investigation activities and major deliverables associated with the RI/FS. In addition to the milestones in the schedule, all analytical data will be submitted to Ecology in both printed and electronic formats in accordance with Section VII of the AO (Work to be Performed), Toxics Cleanup Program Policy 840 (Data Submittal Requirements), and/or any subsequent procedures specified by Ecology for data submittal.

Deliverable/Milestone	Date
Progress Reports	Monthly on the 15th of the month following the reporting period
Final RI Work Plan	30 calendar days after receipt of Ecology comments
Implement RI Work Plan	30 calendar days after receipt of Ecology written approval of the RI Work Plan
Agency Review RI/FS	120 calendar days after the receipt of validated RI data
Public Review RI/FS	30 calendar days after receipt of Ecology comments on agency review draft RI/FS
Agency Review Draft CAP	90 days following Ecology approval of the RI/FS
Public Review Draft CAP	Ecology-produced document, following Ecology approval of draft CAP

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Whitehead Tyee Site

Remedial Investigation Work Plan

Tables

Table 2.1
Historical Site Operations [1]

Building/ Structure Number [2]	Name of Building/Structure	Date Constructed [3]	Tyee Lumber Historical Operations	Other Historical Operations
1	Former Lumber Shed and Material Finishing	1918	Contained a 6,868-square-foot structure and 5,220 square feet of awning roof. The warehouse had a railroad spur under a covered roof area. Lumber was stored in the area and finished.	Formerly Williams Fir Finish Company operations.
2	Former Office	1922	This building consisted of a 400-square-foot area for the mill's Superintendent's office.	Formerly Williams Fir Finish Company operations.
3	Former Finger-Jointing Mill	1950s	The finger-jointing mill was added on in the 1950s between the former lumber shed and former planing and cutting mill. Gluing operations occurred in this building. Finger-joint gluing machines were located in the eastern portion of the building used for drying dipped lumber. The glue was reportedly a polyvinyl acetate glue called "Duro-Lok" manufactured by National Starch and Chemical.	Not applicable.
4	Former Planing and Cutting Mill	1918	Lumber was plane-finished and rough lumber was re-sawed for use in finished millwork.	Formerly Williams Fir Finish Company operations.
5	Former Window Sash Manufacturing and Frame Shop	1918	The structure was originally used as a lumber warehouse in 1918 and then a planing mill from at least 1929 until the 1940s. By 1949, the building had been added on to and was used for window sash manufacturing.	Formerly Williams Fir Finish Company operations.
6	Former Hog Fuel Bin	Pre-1929	The hog fuel bin and conveyor appear to have been attached to and located south of the main planing mill.	Formerly Williams Fir Finish Company operations.
7	Former Pentachlorophenol Dip Tank, Former Pentachlorophenol Underground Storage Tank, and the Former Shed Over Dip Tank	Pre-1956	The dip tank shed was formerly used for dipping green lumber for treatment in a tank containing pentachlorophenol. The lumber was then moved to the lumber shed in the northwest corner of the property for drying. The lumber was then processed and dry-kilned. Dipped lumber was also reportedly air dried or stored outside within close proximity to the kilns, along the eastern portion of the abandoned Frontenac Street right-of-way. Historical records indicated that the condition of the dip tank building appeared to be wet painted and new in 1956.	Not applicable.
8	Former Dry Kilns	1928	This structure consisted of a 3,740-square-foot area, constructed with hollow tile and concrete footings. The structure contained fans, heating equipment, machinery, and tracks. The structure was steam heated from coils in the boiler room as a result of burning hog fuel in the former hog fuel bin.	Formerly Williams Fir Finish Company operations.
9	Former Dry Kilns	1947	This structure consisted of a 2,937-square-foot area with hollow tile construction and concrete footings. The structure contained fans, heating equipment, heating coils from the main boiler, machinery, and tracks located in the building. The structure was steam heated from coils in the boiler room as a result of burning hog fuel in the former hog fuel bin.	Not applicable.
10	Former Sawdust Bin	1925	This structure consisted of an approximately 1,170-square-foot area located adjacent to the boiler house. The structure was steam heated from coils in the boiler room as a result of burning hog fuel in the former hog fuel bin.	Not applicable.
11	Former Bunker	Pre-1966	It is unknown what was stored in this building.	
12	Former Boiler House	1918	The boiler house consisted of a two-story building and contained boiler machinery and equipment. The building was steam heated from coils in the boiler room as a result of burning hog fuel in the former hog fuel bin. The boiler house had an associated 60-foot-tall and 32-inch-diameter stack. Two 2,000-gallon tanks were reportedly associated with a former building located proximal to the former refuse burner, which may have been the boiler house building.	Formerly Williams Fir Finish Company operations.

Table 2.1
Historical Site Operations (1)

Building/ Structure Number (2)	Name of Building/Structure	Date Constructed (3)	Tyee Lumber Historical Operations	Other Historical Operations
13	Former Shop	1918	It is unknown what operations occurred in this building.	Not applicable.
14	Former Refuse Burner	Pre-1929	This building consisted of a 38-foot-high tower used for burning refuse lumber.	Formerly Williams Fir Finish Company operations.
15	Former Shop and Storage	1920s	This building was used for general maintenance and storage.	Not applicable.
16	Former Automotive Repair Facility	Post-1949 Pre-1966	Automotive repair activities are depicted in a small structure on the southern portion of the property east of the boiler house in a 1966 Sanborn Map.	Not applicable.
17	Former Wood Platform	Pre-1929	It is presumed that this structure was used for additional lumber storage.	Formerly Williams Fir Finish Company operations.
18	Former Shed	Unknown	It is unknown what material was stored in this structure.	Not applicable.
19	Former Re-Sawing Mill	1951	This building consisted of a two-story, 504-square-foot structure. The structure contained machinery and equipment. It is assumed that rough lumber was re-sawed for use in finished millwork. This building was attached to a lunchroom, which was also connected to the pre-1985 vintage storage shed (#22).	Not applicable.
20	Former Material Storage	Unknown	It is unknown what material was stored in this building.	Not applicable.
21	Former Automotive Repair Facility	Post-1929 Pre-1949	The 1949 Sanborn Map depicts an automotive and truck repair shop that was removed from the property by 1966 when the area was in use as a lumber sorting yard.	Not applicable.
22	Pre-1985 Vintage Storage Shed	1980	A steel framed storage shed used for lumber storage has been located on the property since 1980. It is unknown what other operations occurred in the structure prior to 1980. This shed was attached to a lunchroom, which was also connected to the re-sawing mill (#19).	Not applicable.
23	Former Gasoline Station	1918	The former gasoline station was not part of the Tyee Lumber property but was located on the east-adjacent property, at 7047 or 7051 East Marginal Way. The gasoline station was established in 1918 and operated until 1951. The gas station building was subsequently used as a nightclub/tavern and is currently vacant. Washington State Department of Ecology's UST database indicates that closure was in process for two USTs in December 1999.	Other early development on the property, as shown on the 1929 and 1949 Sanborn Maps, include residential properties, a restaurant, and possibly an automotive-related structure, which were located on the most eastern portion of the property. A blacksmith shop with an earthen floor was also located on the property at the corner of S. Myrtle Street and East Marginal Way.
24	Former Tyee Lumber Main Office and Former Tyee Lumber Warehouse Space	1950s	Tyee Lumber expanded in the late 1950s and occupied 701 and 765 S. Myrtle Street. This property is located across (south) S. Myrtle Street from the 730 S. Myrtle Street property. This 701 property was used as the main office for Tyee Lumber and consisted of three general offices, five private offices, and a reception entrance. The building was heated by U.S. Boiler and was oil-fired and also had perimeter baseboard heating. The rear of the main office building included a lumber shelter and there was reportedly a gasoline tank and pump located behind the shelter. The property was paved during this time. The former Tyee Lumber Warehouse Space was located at 765 S. Myrtle Street.	A 1929 Sanborn Map shows that Washington Excelsior & Manufacturing Company, Box & Shook Factory, and Fox River Butter Company were located on the property. Operations included a grain warehouse, a feed mill, box nailing shop, and two veneer drying sheds. A 1949 Sanborn Map shows that the Borden Company Chemical Division Powdered Glue Factory was located on the property prior to Tyee Lumber operations. Operations included milling, grinding, and product finishing. It is noted on the main warehouse building that fuel oil was used for electricity.

Notes:

1 The following sources were reviewed in the preparation of this table:
- Historical company building plans and records, historical county building plans and records, historical property record cards, and newspaper articles from archives.
- Tyee Lumber Appraisal Report, 1956.
- SoundEarth Strategies. 2013. *Phase I Environmental Site Assessment*. Prepared for the Whitehead Company and Reliable Transfer and Storage Company. 12 December.
- 1937, 1965, 1969 aerial photographs and 1929, 1949, and 1966 Sanborn Maps.

2 Building/structure numbers match those referenced on Figure 2.3.

3 Unless otherwise stated, all structures were demolished in 1986.

Table 2.2
Simplified Terrestrial Ecological Evaluation—Exposure Analysis Procedure under WAC 173-340-7491(2)(a)(ii)

Box	Criteria	Discussion	Score
1	Estimate the area of contiguous (connected) undeveloped land on the site or within 500 feet of any area of the site to the nearest 1/2 acre (1/4 acre if the area is less than 0.5 acre). Find the number of points corresponding to the area and enter this number in the box to the right.	A 500-foot perimeter was identified around the Site property boundary, as shown on Figure 2.5 and consistent with WAC-173-340-7491(1)(c)(i). Two areas of undeveloped contiguous land were identified: • One 1.5-acre area of undeveloped land to the northeast of the Site associated with South Seattle Community College. • One 0.13-acre area of undeveloped contiguous land to the southwest of the site, adjacent to the Myrtle Street Embayment. Per Table 749-1, the 1.5-acre contiguous area is designated a score of 7.	7
2	Is this an industrial or commercial property? If yes, enter a score of 3 in the box to the right. If no, enter a score of 1.	Yes	3
3	Enter a score in the box to the right for the habitat quality of the site, using the following rating system: High = 1, Intermediate = 2, Low = 3	A detailed habitat evaluation has not been undertaken, therefore despite the highly industrial land use at the Site, the habitat quality of the Myrtle Street Embayment in the vicinity of the Site is conservatively assumed to be intermediate.	2
4	Is the undeveloped land likely to attract wildlife? If yes, enter a score of 1 in the box to the right. If no, enter a score of 2.	No	2
5	Are there any of the following soil contaminants present: Dioxins/furans, PCB mixtures, DDT, DDE, DDD, aldrin, chlordane, dieldrin, endosulfan, endrin, heptachlor, benzene hexachloride, toxaphene, hexachlorobenzene, pentachlorophenol, pentachlorobenzene? If yes, enter a score of 1 in the box to the right. If no, enter a score of 4.	Dioxins/furans and pentachlorophenol are known to be present on the Site. A 500-foot perimeter was identified around the area of the Site presently known to be affected by dioxins/furans in soil, as shown on Figure 2.5 and consistent with WAC-173-340-7491(1)(c)(ii). No areas of undeveloped land were identified within the 500-foot perimeter.	1
	Add the numbers in the boxes on lines 2 through 5. If this number is larger than the number in the box on line 1, the simplified terrestrial ecological evaluation may be ended under WAC 173-340-7492 (2)(a)(ii).	The total is greater than the Box 1 score of 7, therefore the simplified terrestrial ecological evaluation may be ended under WAC 173-340-7492 (2)(a)(ii).	8

Table 3.1a

Whitehead Tyee Site—Summary of Soil Boring and Monitoring Well Completion Details

Well ID	Boring ID	Completion Date	Consultant	Boring Depth (feet bgs) (1)	Well Depth (feet bgs)	Screen Interval (feet bgs) (2)	Diameter and Type	Well Status
WT-MW-01	WT-B01	12/27/2013	SES	20	20	5–20	2-inch PVC	Active
WT-MW-02	WT-B02	12/27/2013	SES	20	20	5–20	2-inch PVC	Active
WT-MW-03	WT-B03	12/27/2013	SES	20	20	5–20	2-inch PVC	Active
WT-MW-04	WT-B04	12/27/2013	SES	20	20	5–20	2-inch PVC	Decommissioned in 2017
--	WT-B05	12/26/2013	SES	20	--	--	--	--
--	WT-B06	12/26/2013	SES	20	--	--	--	--
--	WT-B07	12/26/2013	SES	20	--	--	--	--
--	WT-B08	12/26/2013	SES	20	--	--	--	--
--	WT-B09	12/26/2013	SES	20	--	--	--	--
--	WT-B10	12/26/2013	SES	20	--	--	--	--
--	WT-B11	12/26/2013	SES	20	--	--	--	--
WT-MW-05	WT-B12	4/5/2014	SES	22	20	5–20	2-inch PVC	Active
WT-MW-06	WT-B13	4/5/2014	SES	22	20	5–20	2-inch PVC	Active
WT-MW-07	WT-B14	4/5/2014	SES	22	20	5–20	2-inch PVC	Active
--	WT-B15	4/5/2014	SES	17	--	--	--	--
--	WT-B16	4/5/2014	SES	17	--	--	--	--
--	WT-B17	4/5/2014	SES	17	--	--	--	--
--	WT-GP-1	3/26/2013	Floyd|Snider	7	--	--	--	--
--	WT-GP-2	3/26/2013	Floyd|Snider	13	--	--	--	--
--	WT-GP-3	3/26/2013	Floyd|Snider	13	--	--	--	--
--	WT-GP-4	3/26/2013	Floyd|Snider	13	--	--	--	--
--	WT-GP-5	3/26/2013	Floyd|Snider	5	--	--	--	--
--	WT-GP-6	3/26/2013	Floyd|Snider	8	--	--	--	--
--	WT-GP-7	3/26/2013	Floyd|Snider	5	--	--	--	--
--	WT-GP-8	3/26/2013	Floyd|Snider	5	--	--	--	--
--	WT-GP-9	3/26/2013	Floyd|Snider	5	--	--	--	--
--	WT-GP-10	3/26/2013	Floyd|Snider	5	--	--	--	--
--	WT-GP-11	3/26/2013	Floyd|Snider	5	--	--	--	--
--	WT-GP-12	3/26/2013	Floyd|Snider	8	--	--	--	--
--	WT-SB-01	12/7/2015	Floyd|Snider	10	--	--	--	--
--	WT-SB-02	12/7/2015	Floyd|Snider	5	--	--	--	--
WT-MW-108	WT-SB-03	12/7/2015	Floyd|Snider	15	16	6–16	2-inch PVC	Active
--	WT-SB-04	12/7/2015	Floyd|Snider	15	--	--	--	--
--	WT-SB-05	12/7/2015	Floyd|Snider	20	--	--	--	--
--	WT-SB-06	12/7/2015	Floyd|Snider	15	--	--	--	--
--	WT-SB-07	12/7/2015	Floyd|Snider	20	--	--	--	--
WT-MW-109	WT-SB-08	12/7/2015	Floyd|Snider	15	16	6–16	2-inch PVC	Active
--	WT-SB-09	12/7/2015	Floyd|Snider	20	--	--	--	--
--	WT-SB-10	12/7/2015	Floyd|Snider	15	--	--	--	--
WT-MW-110	WT-SB-11	12/7/2015	Floyd|Snider	15	16	6–16	2-inch PVC	Decommissioned in 2017
--	WT-SB-12	12/7/2015	Floyd|Snider	15	--	--	--	--
--	WT-SB-13	3/29/2016	Floyd|Snider	10	--	--	--	--
--	WT-SB-14	3/29/2016	Floyd|Snider	10	--	--	--	--
--	WT-SB-15	3/29/2016	Floyd|Snider	10	--	--	--	--
--	WT-SB-16	3/29/2016	Floyd|Snider	10	--	--	--	--
--	WT-SB-17	3/29/2016	Floyd|Snider	10	--	--	--	--
--	WT-SB-18	3/29/2016	Floyd|Snider	10	--	--	--	--
--	WT-SB-19	3/29/2016	Floyd|Snider	10	--	--	--	--
--	WT-SB-20	3/29/2016	Floyd|Snider	10	--	--	--	--

Notes:

-- Not applicable.

1 A survey of all monitoring well casing elevations and horizontal positions will be completed at the time of the remedial investigation.

2 Monitoring wells screened in upper waterbearing zone.

Abbreviations:

bgs below ground surface

PVC Polyvinyl chloride

SES SoundEarth Strategies

Table 3.1b
Fox Avenue Site—Summary of Monitoring Well Completion Details

Well ID	Water Bearing Zone	Completion Date	Consultant	Boring Depth (feet bgs) [1]	Well Depth (feet bgs)	Screen Interval (feet bgs)	Diameter and Type	Well Status
B-18	1st	3/29/1992	Hart Crowser	16.5	15.70	6–16	2-inch PVC	Active
B-19	2nd	4/7/1992	Hart Crowser	50.5	46.60	37.5–47.5	2-inch PVC	Active
B-20A	1st	9/10/1999	Terra Vac	21	12.25	6–16	2-inch PVC	Active
B-21	2nd	4/8/1992	Hart Crowser	51	40.10	38–43	2-inch PVC	Decomissioned in 2018
B-35	2nd	8/26/1992	Hart Crowser	50	27.95	19.5–29.5	2-inch PVC	Active
B-36	1st	8/26/1992	Hart Crowser	13	10.60	6–11	2-inch PVC	Active
B-37	2nd	8/27/1992	Hart Crowser	32	27.80	23–28	2-inch PVC	Unknown
B-38	1st	8/27/1992	Hart Crowser	19	15.69	6–16	2-inch PVC	Unknown
B-44	1st	6/25/1993	Hart Crowser	16	15.12	9.5–15.5	2-inch PVC	Active
B-45	2nd	6/25/1993	Hart Crowser	48	46.18	37–47	2-inch PVC	Active
B-49	1st	7/6/1993	Hart Crowser	16	14.52	9.5–15.5	2-inch PVC	Active
B-58	1st	7/7/1999	Terra Vac	14	11.66	7–12	2-inch PVC	Active
B-59	2nd	7/9/1999	Terra Vac	35	29.02	25–30	2-inch PVC	Active
B-60	1st	7/7/1999	Terra Vac	16.5	11.92	7–12	2-inch PVC	Active
B-61	2nd	7/9/1999	Terra Vac	45	44.40	39–44	2-inch PVC	Active
B-62	1st	7/9/1999	Terra Vac	16.5	13.00	8–13	2-inch PVC	Active
B-63	2nd	7/8/1999	Terra Vac	45	43.20	39–44	2-inch PVC	Active
B-64	1st	7/6/1999	Terra Vac	13	11.62	7–12	2-inch PVC	Active
B-65	2nd	7/6/1999	Terra Vac	35.5	33.95	30–35	2-inch PVC	Active
MW-03	1st	10/28/2003	ERM	15	14.00	4–14	2-inch PVC	Active
MW-04	2nd	10/28/2003	ERM	41.5	40.00	20–40	2-inch PVC	Active
MW-07	1st	12/2/2003	ERM	14	13.80	4–14	2-inch PVC	Active
MW-08	2nd	12/3/2003	ERM	30	28.92	20–30	2-inch PVC	Active
MW-09	1st	8/15/2005	ERM	13	12.62	8–13	2-inch PVC	Active
MW-10	2nd	8/16/2005	ERM	30	29.13	20–30	2-inch PVC	Active
PTM2U	1st	12/3/2003	ERM	30	30.00	20–30	2-inch PVC	Decomissioned in 2017
PTM2L	2nd	12/3/2003	ERM	48	38.65	35–45	2-inch PVC	Decomissioned in 2017

Note:

1 A survey of all monitoring well casing elevations and horizontal positions will be completed at the time of the remedial investigation.

Abbreviations:

bgs Below ground surface

PVC Polyvinyl chloride

Table 4.1
Soil Preliminary Screening Levels [1,2]

Analyte	CAS No.	Protection of Direct Contact	Protection of Leaching to Groundwater	Natural Background Ecology (Ecology 1994 and 2010)	Most Stringent PSLs
Petroleum Hydrocarbons					
Gasoline-range organics [3]	TPHG	1,500	30	na	30
Gasoline-range organics, weathered	TPHGW	1,500	100	na	100
Diesel-range organics	TPHD	na	2,000	na	2,000
Diesel-range organics, weathered	TPHDW	na	2,000	na	2,000
Oil-range organics	TPHO	na	2,000	na	2,000
Stoddard solvent	TPHSS	na	2,000	na	2,000
Total DRO + ORO	TPHDO	na	2,000	na	2,000
Metals					
Aluminum	7429-90-5	80,000	24,000	33,000	33,000
Antimony	7440-36-0	32	0.27	na	0.27
Arsenic	7440-38-2	0.67	0.0041	7.3	7.3
Barium	7440-39-3	16,000	8.3	na	8.3
Beryllium	7440-41-7	160	3.2	0.61	3.2
Cadmium	7440-43-9	80	0.0083	0.77	0.77
Chromium, total	TCHR	na	na	48	48
Chromium, trivalent	7440-47-3	120,000	27	na	27
Chromium, hexavalent	18540-29-9	240	0.93	na	0.93
Cobalt	7440-48-4	24	0.22	na	0.22
Copper	7440-50-8	3,200	0.069	36	36
Iron	7439-89-6	56,000	7.6	36,000	36,000
Lead	7439-92-1	250	56	17	56
Manganese	7439-96-5	3,700	3.3	1,100	1,100
Mercury, inorganic	7439-97-6	24	0.0013	0.070	0.070
Methylmercury	16056-34-1	8.0	na	na	8.0
Molybdenum	7439-98-7	400	1.6	na	1.6
Nickel	7440-02-0	1,600	0.54	38	38
Selenium	7782-49-2	400	0.26	na	0.26
Silver	7440-22-4	400	0.016	na	0.016
Thallium	7440-28-0	0.80	0.0044	na	0.0044
Tin	7440-31-5	48,000	2,400	na	2,400
Vanadium	7440-62-2	720	140	na	140
Zinc	7440-66-6	24,000	5.0	85	85
Polychlorinated Biphneyls (PCBs)					
Total PCB Aroclors	1336-36-3	1.0	0.0000022	na	0.0000022
Total PCB congeners	PCBCON	1.0	0.0000022	na	0.0000022
Dioxins/Furans					
Total dioxin/furan TEQ	DFTEQ	0.000013	0.0000000013	0.0000052	0.0000052
Semivolatile Organic Compounds/Polycyclic Aromatic Hydrocarbons					
Acenaphthene	83-32-9	4,800	0.028	na	0.028
Acenaphthylene	208-96-8	na	na	na	na
Anthracene	120-12-7	24,000	0.051	na	0.051
Benzo(a)anthracene	56-55-3	na	na	na	na
Benzo(b)fluoranthene	205-99-2	na	na	na	na
Total benzofluoranthenes	NA	na	na	na	na
Benzo(g,h,i)perylene	191-24-2	na	na	na	na
Benzo(a)pyrene	50-32-8	na	na	na	na
Benzo(k)fluoranthene	207-08-9	na	na	na	na
Chrysene	218-01-9	na	na	na	na
Dibenz(a,h)anthracene	53-70-3	na	na	na	na
Dibenzofuran	132-64-9	80	0.029	na	0.029
Fluoranthene	206-44-0	3,200	0.090	na	0.090
Fluorene	86-73-7	3,200	0.029	na	0.029
Indeno(1,2,3-c,d)pyrene	193-39-5	na	na	na	na
Methyl isopropyl phenanthrene	483-65-8	na	na	na	na
1-Methylnaphthalene	90-12-0	34	0.0042	na	0.0042
2-Methylnaphthalene	91-57-6	320	0.039	na	0.039
Naphthalene	91-20-3	1,600	0.0021	na	0.0021
Phenanthrene	85-01-8	na	na	na	na
Pyrene	129-00-0	2,400	0.14	na	0.14
Total LPAHs	LPAH	na	na	na	na
Total HPAHs	HPAH	na	na	na	na
Total PAHs	TPAH	na	na	na	na
Total cPAH TEQ	CPAHTEQ	0.19	0.000016	na	0.000016
Other Semivolatile Organic Compounds					
Aniline	62-53-3	180	0.0027	na	0.0027
Azobenzene	103-33-3	9.1	na	na	9.1
Benzidine	92-87-5	0.0043	0.000000034	na	0.000000034
Benzoic acid	65-85-0	320,000	0.17	na	0.17
Benzyl alcohol	100-51-6	8,000	0.017	na	0.017
Bis(2-chloroethoxy)methane	111-91-1	na	na	na	na
Bis(2-chloroethyl)ether	111-44-4	0.91	0.000014	na	0.000014
Bis(chloromethyl)ether	542-88-1	0.0045	na	na	0.0045
Bis(2-chloro-1-methylethyl)ether	108-60-1	3,200	0.12	na	0.12
2,6-Bis(1,1-dimethylethyl) phenol	128-39-2	na	na	na	na
Bis(2-ethylhexyl) phthalate	117-81-7	71	0.0051	na	0.0051
4-Bromophenyl phenyl ether	101-55-3	na	na	na	na
Butyl benzyl phthalate	85-68-7	530	0.00018	na	0.00018
Butyl diphenyl phosphate	2752-95-6	na	na	na	na
Carbazole	86-74-8	na	na	na	na

Table 4.1
Soil Preliminary Screening Levels [1,2]

Analyte	CAS No.	Protection of Direct Contact	Protection of Leaching to Groundwater	Natural Background Ecology (Ecology 1994 and 2010)	Most Stringent PSLs
Other Semivolatile Organic Compounds (cont.)					
4-Chloroaniline	106-47-8	5.0	0.000077	na	0.000077
4-Chloro-3-methylphenol	59-50-7	na	0.028	na	0.028
2-Chloronaphthalene	91-58-7	6,400	0.28	na	0.28
2-Chlorophenol	95-57-8	400	0.011	na	0.011
4-Chlorophenyl phenyl ether	7005-72-3	na	na	na	na
Dibutyl phthalate	84-74-2	8,000	0.015	na	0.015
Dibutyl phenyl phosphate	2528-36-1	na	na	na	na
1,2-Dichlorobenzene	95-50-1	7,200	0.0031	na	0.0031
1,3-Dichlorobenzene	541-73-1	na	0.0013	na	0.0013
1,4-Dichlorobenzene	106-46-7	190	0.0081	na	0.0081
3,3'-Dichlorobenzidine	91-94-1	2.2	0.0000033	na	0.0000033
2,4-Dichlorophenol	120-83-2	240	0.0043	na	0.0043
Diethyl phthalate	84-66-2	64,000	0.034	na	0.034
Dimethyl phthalate	131-11-3	na	0.019	na	0.019
2,4-Dimethylphenol	105-67-9	1,600	0.0031	na	0.0031
1,2-Dinitrobenzene	528-29-0	8.0	na	na	8.0
1,3-Dinitrobenzene	99-65-0	8.0	na	na	8.0
1,4-Dinitrobenzene	100-25-4	8.0	na	na	8.0
4,6-Dinitro-2-methylphenol	534-52-1	na	0.0073	na	0.0073
2,4-Dinitrophenol	51-28-5	160	0.0092	na	0.0092
2,4-Dinitrotoluene	121-14-2	3.2	0.00016	na	0.00016
2,6-Dinitrotoluene	606-20-2	0.67	0.000051	na	0.000051
Di-n-octyl phthalate	117-84-0	800	0.33	na	0.33
1,4-Dioxane	123-91-1	10	0.00013	na	0.00013
1,2-Diphenylhydrazine	122-66-7	1.3	0.000036	na	0.000036
Hexachlorobenzene	118-74-1	0.63	0.00000040	na	0.00000040
Hexachlorobutadiene	87-68-3	13	0.00054	na	0.00054
Hexachlorocyclopentadiene	77-47-4	480	0.20	na	0.20
Hexachloroethane	67-72-1	25	0.000041	na	0.000041
Isophorone	78-59-1	1,100	0.015	na	0.015
2-Methoxynaphthalene	93-04-9	na	na	na	na
2-Methylphenol	95-48-7	4,000	0.010	na	0.010
3-Methylphenol	108-39-4	4,000	na	na	4,000
4-Methylphenol	106-44-5	8,000	0.062	na	0.062
2-Nitroaniline	88-74-4	800	0.064	na	0.064
3-Nitroaniline	99-09-2	na	na	na	na
4-Nitroaniline	100-01-6	50	0.0013	na	0.0013
Nitrobenzene	98-95-3	160	0.0065	na	0.0065
2-Nitrophenol	88-75-5	na	na	na	na
4-Nitrophenol	100-02-7	na	na	na	na
n-Nitrosodimethylamine	62-75-9	0.020	0.00000027	na	0.00000027
n-Nitrosodiphenylamine	86-30-6	200	0.0011	na	0.0011
n-Nitrosodi-n-propylamine	621-64-7	0.14	0.0000039	na	0.0000039
Pentachlorophenol	87-86-5	2.5	0.0000018	na	0.0000018
Phenol	108-95-2	24,000	0.12	na	0.12
Pyridine	110-86-1	80	0.0029	na	0.0029
2,3,4,5-Tetrachlorophenol	4901-51-3	na	na	na	na
2,3,4,6-Tetrachlorophenol	58-90-2	2,400	na	na	2,400
1,2,4-Trichlorobenzene	120-82-1	34	0.0019	na	0.0019
2,4,5-Trichlorophenol	95-95-4	8,000	0.000070	na	0.000070
2,4,6-Trichlorophenol	88-06-2	80	0.0027	na	0.0027
Volatile Organic Compounds					
Acetone	67-64-1	72,000	2.1	na	2.1
Acrolein	107-02-8	40	0.00032	na	0.00032
Acrylonitrile	107-13-1	1.9	0.0000083	na	0.0000083
Benzaldehyde	100-52-7	250	0.0033	na	0.0033
Benzene	71-43-2	18	0.00056	na	0.00056
Bromochloromethane	74-97-5	na	na	na	na
Bromoethane	74-96-4	na	na	na	na
Bromoform	75-25-2	130	0.0050	na	0.0050
Bromobenzene	108-86-1	640	0.033	na	0.033
Bromomethane	74-83-9	110	0.0033	na	0.0033
2-Butoxyethanol	111-76-2	8,000	0.23	na	0.23
n-Butylbenzene	104-51-8	4,000	0.71	na	0.71
sec-Butylbenzene	135-98-8	8,000	1.3	na	1.3
tert-Butylbenzene	98-06-6	8,000	1.0	na	1.0
Carbon disulfide	75-15-0	8,000	0.27	na	0.27
Carbon tetrachloride	56-23-5	14	0.00015	na	0.00015
Chlorobenzene	108-90-7	1,600	0.051	na	0.051
Chloroethane	75-00-3	na	na	na	na
2-Chloroethyl vinyl ether	110-75-8	na	na	na	na
Chloroform	67-66-3	32	0.0048	na	0.0048
Chloromethane	74-87-3	na	na	na	na
3-Chloro-1-propene	107-05-1	48	0.00068	na	0.00068
2-Chlorotoluene	95-49-8	1,600	0.11	na	0.11
4-Chlorotoluene	106-43-4	na	na	na	na
Dibromochloromethane	124-48-1	12	0.00077	na	0.00077
1,2-Dibromo-3-chloropropane	96-12-8	1.3	0.000081	na	0.000081
Dibromomethane	74-95-3	800	0.028	na	0.028
Dichlorobromomethane	75-27-4	16	0.00096	na	0.00096
trans-1,4-Dichloro-2-butene	110-57-6	na	na	na	na
Dichlorodifluoromethane	75-71-8	16,000	0.53	na	0.53

Table 4.1
Soil Preliminary Screening Levels (1,2)

Analyte	CAS No.	Protection of Direct Contact	Protection of Leaching to Groundwater	Natural Background Ecology (Ecology 1994 and 2010)	Most Stringent PSLs
Volatile Organic Compounds (cont.)					
1,1-Dichloroethane	75-34-3	180	0.0026	na	0.0026
1,2-Dichloroethane	107-06-2	11	0.0016	na	0.0016
1,1-Dichloroethylene	75-35-4	4,000	0.0025	na	0.0025
cis-1,2-Dichloroethylene	156-59-2	160	0.0052	na	0.0052
trans-1,2-Dichloroethylene	156-60-5	1,600	0.032	na	0.032
1,2-Dichloroethylene (mixed isomers)	540-59-0	720	0.023	na	0.023
1,2-Dichloropropane	78-87-5	27	0.0010	na	0.0010
1,3-Dichloropropane	142-28-9	1,600	0.057	na	0.057
2,2-Dichloropropane	594-20-7	na	na	na	na
1,1-Dichloropropene	563-58-6	na	na	na	na
cis-1,3-Dichloropropene	10061-01-5	10	0.00014	na	0.00014
trans-1,3-Dichloropropene	10061-02-6	10	0.00014	na	0.00014
Ethane	74-84-0	na	na	na	na
Ethylbenzene	100-41-4	8,000	0.010	na	0.010
Ethylene oxide	75-21-8	3.2	0.000041	na	0.000041
Ethyl ether	60-29-7	16,000	0.47	na	0.47
Ethylene dibromide	106-93-4	0.50	0.000018	na	0.000018
Formaldehyde	50-00-0	48	0.00060	na	0.00060
n-Hexane	110-54-3	4,800	1.8	na	1.8
2-Hexanone	591-78-6	400	0.012	na	0.012
Isopropylbenzene	98-82-8	8,000	0.79	na	0.79
4-Isopropyltoluene	99-87-6	na	na	na	na
Methane	74-82-8	na	na	na	na
Methyl ethyl ketone	78-93-3	48,000	1.4	na	1.4
Methyl iodide	74-88-4	na	na	na	na
Methyl isobutyl ketone	108-10-1	6,400	0.19	na	0.19
Methyl tert-butyl ether	1634-04-4	560	0.0072	na	0.0072
Methylene chloride	75-09-2	94	0.0015	na	0.0015
2-Pentanone	107-87-9	na	na	na	na
n-Propylbenzene	103-65-1	8,000	0.88	na	0.88
Styrene	100-42-5	16,000	0.12	na	0.12
1,1,1,2-Tetrachloroethane	630-20-6	38	0.00063	na	0.00063
1,1,2,2-Tetrachloroethane	79-34-5	5.0	0.000080	na	0.000080
Tetrachloroethylene	127-18-4	480	0.0016	na	0.0016
Toluene	108-88-3	6,400	0.044	na	0.044
1,2,3-Trichlorobenzene	87-61-6	na	na	na	na
1,1,1-Trichloroethane	71-55-6	160,000	0.084	na	0.084
1,1,2-Trichloroethane	79-00-5	18	0.00033	na	0.00033
Trichloroethylene	79-01-6	12	0.00027	na	0.00027
Trichlorofluoroethane	27154-33-2	na	na	na	na
Trichlorofluoromethane	75-69-4	24,000	0.79	na	0.79
1,2,3-Trichloropropane	96-18-4	0.0063	0.00000015	na	0.00000015
Trichlorotrifluoroethane	76-13-1	2,400,000	120	na	120
1,2,3-Trimethylbenzene	526-73-8	800	0.073	na	0.073
1,2,4-Trimethylbenzene	95-63-6	800	0.072	na	0.072
1,3,5-Trimethylbenzene	108-67-8	800	0.071	na	0.071
Vinyl acetate	108-05-4	80,000	2.3	na	2.3
Vinyl chloride	75-01-4	0.67	0.000055	na	0.000055
Total xylenes	1330-20-7	16,000	0.055	na	0.055

Notes:

1 All PSLs are derived from the Lower Duwamish Waterway Preliminary Cleanup Level Workbook (Ecology 2021).
2 Concentrations are presented in mg/kg. Criteria have been rounded to two significant digits.
3 PSLs for gasoline-range organics assume the presence of benzene.

Abbreviations:

CAS Chemical Abstracts Service
cPAH Carcinogenic polycyclic aromatic hydrocarbon
DRO Diesel-range organics
HPAH High molecular weight polycyclic aromatic hydrocarbon
LPAH Low molecular weight polycyclic aromatic hydrocarbon
mg/kg Milligrams per kilogram
na Not available
ORO Oil-range organics
PAH Polycyclic aromatic hydrocarbon
PSL Preliminary screening level
TEQ Toxic equivalent

Table 4.2
Groundwater Preliminary Screening Levels [1,2]

Analyte	CAS No.	Protection of Drinking Water	Protection of Surface Water	Protection of Sediment	Protection of Indoor Air	Natural Background	Most Stringent PSL
Petroleum Hydrocarbons							
Gasoline-range organics, fresh	TPHG	800	800	na	na	na	800
Gasoline-range organics, weathered	TPHGW	1,000	1,000	na	na	na	1,000
Diesel-range organics, fresh	TPHD	500	50	na	na	na	50
Diesel-range organics, weathered	TPHDW	500	500	na	na	na	500
Oil-range organics	TPHO	500	500	na	na	na	500
Stoddard solvent	TPHSS	500	na	na	na	na	500
Total DRO + ORO	TPHDO	500	500	na	na	na	500
Metals							
Aluminum	7429-90-5	16,000	na	na	na	na	16,000
Antimony	7440-36-0	6.0	90	na	na	na	6.0
Arsenic	7440-38-2	0.58	0.14	220	na	8.0	8.0
Barium	7440-39-3	2,000	200	930,000	na	na	200
Beryllium	7440-41-7	4.0	76	4.9	na	na	4.0
Cadmium	7440-43-9	5.0	7.9	1.2	na	na	1.2
Chromium, total	TCHR	100	na	na	na	na	100
Chromium, trivalent	7440-47-3	24,000	27	85	na	na	27
Chromium, hexavalent	18540-29-9	48	50	50,000	na	na	48
Cobalt	7440-48-4	4.8	na	na	na	na	4.8
Copper	7440-50-8	640	3.1	14	na	na	3.1
Iron	7439-89-6	300	na	na	na	na	300
Lead	7439-92-1	15	5.6	19	na	na	5.6
Manganese	7439-96-5	50	100	na	na	na	50
Mercury, inorganic	7439-97-6	2.0	0.025	2.0	0.83	na	0.025
Methylmercury	16056-34-1	1.6	0.030	na	na	na	0.030
Molybdenum	7439-98-7	80	na	na	na	na	80
Nickel	7440-02-0	100	8.2	2,600	na	na	8.2
Selenium	7782-49-2	50	71	430,000	na	na	50
Silver	7440-22-4	80	1.9	55	na	na	1.9
Thallium	7440-28-0	0.16	0.062	25	na	na	0.062
Tin	7440-31-5	9,600	na	na	na	na	9,600
Vanadium	7440-62-2	140	na	na	na	na	140
Zinc	7440-66-6	4,800	81	770	na	na	81
Polychlorinated Biphenyls (PCBs)							
Total PCB Aroclors	1336-36-3	0.44	0.0000070	0.022	na	na	0.0000070
Total PCB congeners	PCBCON	0.44	0.0000070	0.00034	na	na	0.0000070
Dioxins/Furans							
Total dioxin/furan TEQ	DFTEQ	0.0000067	0.0000000051	0.00000042	na	na	0.0000000051
Semivolatile Organic Compounds and Polycyclic Aromatic Hydrocarbons							
Acenaphthene	83-32-9	960	30	5.3	na	na	5.3
Acenaphthylene	208-96-8	na	na	na	na	na	na
Anthracene	120-12-7	4,800	100	2.1	na	na	2.1
Benzo(a)anthracene	56-55-3	na	0.00016	0.19	na	na	0.00016
Benzo(b)fluoranthene	205-99-2	na	0.00016	na	na	na	0.00016
Benzo(k)fluoranthene	207-08-9	na	0.0016	na	na	na	0.0016
Total benzofluoranthenes	TBFLUO	na	na	na	na	na	na
Benzo(g,h,i)perylene	191-24-2	na	na	na	na	na	na
Benzo(a)pyrene	50-32-8	0.20	0.000016	0.087	na	na	0.000016
Chrysene	218-01-9	na	0.016	0.19	na	na	0.016
Dibenz(a,h)anthracene	53-70-3	na	0.000016	0.0068	na	na	0.000016
Dibenzofuran	132-64-9	16	na	3.1	na	na	3.1
Fluoranthene	206-44-0	640	6.0	1.8	na	na	1.8
Fluorene	86-73-7	640	10	3.7	na	na	3.7
Indeno(1,2,3-c,d)pyrene	193-39-5	na	0.00016	0.0091	na	na	0.00016
Methyl isopropyl phenanthrene	483-65-8	na	na	na	na	na	na
1-Methylnaphthalene	90-12-0	1.5	na	800	na	na	1.5
2-Methylnaphthalene	91-57-6	32	na	14	na	na	14
Naphthalene	91-20-3	160	1.4	90	8.9	na	1.4
Phenanthrene	85-01-8	na	na	na	na	na	na
Pyrene	129-00-0	480	8.0	2.0	na	na	2.0
Total cPAH TEQ	CPAHTEQ	0.023	0.0097	0.0049	na	na	0.0049
Other Semivolatile Organic Compounds							
Aniline	62-53-3	7.7	na	120,000	na	na	7.7
Azobenzene	103-33-3	0.80	na	na	na	na	0.80
Benzidine	92-87-5	0.00038	0.000023	0.25	na	na	0.000023
Benzoic acid	65-85-0	64,000	na	590	na	na	590
Benzyl alcohol	100-51-6	800	na	56	na	na	56
Bis(2-chloroethoxy)methane	111-91-1	na	na	na	na	na	na
Bis(2-chloroethyl)ether	111-44-4	0.040	0.060	590	na	na	0.040
Bis(chloromethyl)ether	542-88-1	0.00020	0.017	7.6	na		0.00020
Bis(2-chloro-1-methylethyl)ether	108-60-1	320	900	3,700,000	na	na	320
2,6-Bis(1,1-dimethylethyl) phenol	128-39-2	na	na	na	na	na	na
Bis(2-ethylhexyl) phthalate	117-81-7	6.0	0.046	0.62	na	na	0.046
4-Bromophenyl phenyl ether	101-55-3	na	na	na	na	na	na
Butyl benzyl phthalate	85-68-7	46	0.013	0.24	na	na	0.013
Butyl diphenyl phosphate	2752-95-6	na	na	na	na	na	na
Carbazole	86-74-8	na	na	na	na	na	na
4-Chloroaniline	106-47-8	0.22	na	3,600	na	na	0.22
4-Chloro-3-methylphenol	59-50-7	na	36	na	na	na	36
2-Chloronaphthalene	91-58-7	640	100	330,000	na	na	100
2-Chlorophenol	95-57-8	40	17	3,500	na	na	17

Table 4.2
Groundwater Preliminary Screening Levels [1,2]

Analyte	CAS No.	Protection of Drinking Water	Protection of Surface Water	Protection of Sediment	Protection of Indoor Air	Natural Background	Most Stringent PSL
Other Semivolatile Organic Compounds (cont.)							
4-Chlorophenyl phenyl ether	7005-72-3	na	na	na	na	na	na
Dibutyl phthalate	84-74-2	1,600	8.0	46	na	na	8.0
Dibutyl phenyl phosphate	2528-36-1	na	na	na	na	na	na
1,2-Dichlorobenzene	95-50-1	600	800	4.6	2,500	na	4.6
1,3-Dichlorobenzene	541-73-1	na	2.0	na	na	na	2.0
1,4-Dichlorobenzene	106-46-7	75	60	8.9	4.9	na	4.9
3,3'-Dichlorobenzidine	91-94-1	0.19	0.0033	200	na	na	0.0033
2,4-Dichlorophenol	120-83-2	24	10	8,200	na	na	10
Diethyl phthalate	84-66-2	13,000	200	93	na	na	93
Dimethyl phthalate	131-11-3	na	600	59	na	na	59
2,4-Dimethylphenol	105-67-9	160	97	6.3	na	na	6.3
1,2-Dinitrobenzene	528-29-0	1.6	na	na	na	na	1.6
1,3-Dinitrobenzene	99-65-0	1.6	na	na	na	na	1.6
1,4-Dinitrobenzene	100-25-4	1.6	na	na	na	na	1.6
4,6-Dinitro-2-methylphenol	534-52-1	na	na	na	na	na	na
2,4-Dinitrophenol	51-28-5	32	100	650,000	na	na	32
2,4-Dinitrotoluene	121-14-2	0.28	0.18	360	na	na	0.18
2,6-Dinitrotoluene	606-20-2	na	7.0	na	na	na	7.0
Di-n-octyl phthalate	117-84-0	160	na	0.0039	na	na	0.0039
1,4-Dioxane	123-91-1	0.44	na	20000	na	na	0.44
1,2-Diphenylhydrazine	122-66-7	0.11	0.020	56	na	na	0.020
Hexachlorobenzene	118-74-1	0.55	0.0000050	0.014	0.31	na	0.0000050
Hexachlorobutadiene	87-68-3	0.56	0.010	0.011	0.81	na	0.010
Hexachlorocyclopentadiene	77-47-4	48	1.0	310	4.2	na	1.0
Hexachloroethane	67-72-1	1.1	0.020	960	3.8	na	0.020
Isophorone	78-59-1	46	110	930,000	na	na	46
2-Methoxynaphthalene	93-04-9	na	na	na	na	na	na
2-Methylphenol	95-48-7	400	na	27	na	na	27
3-Methylphenol	108-39-4	400	na	na	na	na	400
4-Methylphenol	106-44-5	800	na	110	na	na	110
2-Nitroaniline	88-74-4	160	na	740,000	na	na	160
3-Nitroaniline	99-09-2	na	na	na	na	na	na
4-Nitroaniline	100-01-6	4.4	na	110,000	na	na	4.4
Nitrobenzene	98-95-3	16	100	140,000	na	na	16
2-Nitrophenol	88-75-5	na	na	na	na	na	na
4-Nitrophenol	100-02-7	na	na	na	na	na	na
n-Nitrosodimethylamine	62-75-9	0.00086	0.34	25	na	na	0.00086
n-Nitrosodiphenylamine	86-30-6	18	0.69	1.1	na	na	0.69
n-Nitrosodi-n-propylamine	621-64-7	0.013	0.058	180	na	na	0.013
Pentachlorophenol	87-86-5	1.0	0.0020	0.88	na	na	0.0020
Phenol	108-95-2	2,400	70,000	370	na	na	370
Pyridine	110-86-1	8.0	na	100,000	na	na	8.0
2,3,4,5-Tetrachlorophenol	4901-51-3	na	na	na	na	na	na
2,3,4,6-Tetrachlorophenol	58-90-2	480	na	na	na	na	480
1,2,4-Trichlorobenzene	120-82-1	15	na	0.96	38	na	0.96
2,4,5-Trichlorophenol	95-95-4	800	0.037	67,000	na	na	0.037
2,4,6-Trichlorophenol	88-06-2	4.0	600	910	na	na	4.0
Volatile Organic Compounds							
Acetone	67-64-1	7,200	na	360,000,000	15,000,000	na	7,200
Acrolein	107-02-8	4.0	1.1	200,000	2.9	na	1.1
Acrylonitrile	107-13-1	0.081	0.028	7100	12	na	0.028
Benzaldehyde	100-52-7	11	na	900,000	na	na	11
Benzene	71-43-2	5.0	1.6	30,000	2.4	na	1.6
Bromobenzene	108-86-1	64	na	390,000	630	na	64
Bromochloromethane	74-97-5	na	na	na	na	na	na
Bromoethane	74-96-4	na	na	na	na	na	na
Bromoform	75-25-2	55	12	120,000	220	na	12
Bromomethane	74-83-9	11	270	440,000	13	na	11
2-Butoxyethanol	111-76-2	800	na	37,000,000	na	na	800
n-Butylbenzene	104-51-8	400	na	420,000	na	na	400
sec-Butylbenzene	135-98-8	800	na	940,000	na	na	800
tert-Butylbenzene	98-06-6	800	na	1,200,000	na	na	800
Carbon disulfide	75-15-0	800	na	17,000,000	400	na	400
Carbon tetrachloride	56-23-5	5.0	0.35	12,000	0.56	na	0.35
Chlorobenzene	108-90-7	100	200	1,000,000	290	na	100
Chloroethane	75-00-3	na	na	na	15,000	na	15,000
2-Chloroethyl vinyl ether	110-75-8	na	na	na	na	na	na
Chloroform	67-66-3	14	150	58,000	1.2	na	1.2
Chloromethane	74-87-3	na	na	na	150	na	150
3-Chloro-1-propene	107-05-1	2.1	na	100,000	na	na	2.1
2-Chlorotoluene	95-49-8	160	na	620,000	na	na	160
4-Chlorotoluene	106-43-4	na	na	na	na	na	na
Dibromochloromethane	124-48-1	5.2	2.2	19,000	na	na	2.2
1,2-Dibromo-3-chloropropane	96-12-8	0.20	na	1300	0.16	na	0.16
Dibromomethane	74-95-3	80	na	1,400,000	86	na	80
Dichlorobromomethane	75-27-4	7.1	2.8	29,000	1.8	na	1.8
trans-1,4-Dichloro-2-butene	110-57-6	na	na	na	na	na	na
Dichlorodifluoromethane	75-71-8	1,600	na	34,000,000	4.2	na	4.2
1,1-Dichloroethane	75-34-3	7.7	na	320,000	11	na	7.7
1,2-Dichloroethane	107-06-2	4.8	73	24,000	4.2	na	4.2
1,1-Dichloroethylene	75-35-4	7.0	4,000	6,600,000	130	na	7.0
cis-1,2-Dichloroethylene	156-59-2	16	na	380,000	na	na	16
trans-1,2-Dichloroethylene	156-60-5	100	1,000	3,700,000	77	na	77

Table 4.2
Groundwater Preliminary Screening Levels [1,2]

Analyte	CAS No.	Protection of Drinking Water	Protection of Surface Water	Protection of Sediment	Protection of Indoor Air	Natural Background	Most Stringent PSL
Volatile Organic Compounds (cont.)							
1,2-Dichloroethylene (mixed isomers)	540-59-0	72	na	1,700,000	na	na	72
1,2-Dichloropropane	78-87-5	5.0	3.1	53,000	10	na	3.1
1,3-Dichloropropane	142-28-9	160	na	2,500,000	na	na	160
2,2-Dichloropropane	594-20-7	na	na	na	na	na	na
1,1-Dichloropropene	563-58-6	na	na	na	na	na	na
cis-1,3-Dichloropropene	10061-01-5	0.44	1.2	26,000	na	na	0.44
trans-1,3-Dichloropropene	10061-02-6	0.44	1.2	26,000	na	na	0.44
Ethane	74-84-0	na	na	na	na	na	na
Ethylbenzene	100-41-4	700	21	5,400,000	2,800	na	21
Ethylene	74-85-1	0.14	na	14,000	0.054	na	0.054
Ethyl ether	60-29-7	1,600	na	62,000,000	na	na	1,600
Ethylene dibromide	106-93-4	0.050	na	790	0.30	na	0.050
Formaldehyde	50-00-0	2.1	na	220,000	na	na	2.1
n-Hexane	110-54-3	480	na	220,000	4.1	na	4.1
2-Hexanone	591-78-6	40	na	2,000,000	7,300	na	40
Isopropylbenzene	98-82-8	800	na	1,800,000	910	na	800
4-Isopropyltoluene	99-87-6	na	na	na	na	na	na
Methane	74-82-8	na	na	na	na	na	na
Methyl ethyl ketone	78-93-3	4,800	na	210,000,000	1,700,000	na	4,800
Methyl iodide	74-88-4	na	na	na	na	na	na
Methyl isobutyl ketone	108-10-1	640	na	23,000,000	470,000	na	640
Methyl tert-butyl ether	1634-04-4	24	na	2,000,000	800	na	24
Methylene chloride	75-09-2	5.0	100	1,800,000	1,200	na	5.0
2-Pentanone	107-87-9	na	na	na	na	na	na
n-Propylbenzene	103-65-1	800	na	1,500,000	2,300	na	800
Styrene	100-42-5	100	na	2,700,000	8,100	na	100
1,1,1,2-Tetrachloroethane	630-20-6	1.7	na	50,000	7.1	na	1.7
1,1,2,2-Tetrachloroethane	79-34-5	0.22	0.30	6,900	6.2	na	0.22
Tetrachloroethylene	127-18-4	5.0	2.9	250,000	24	na	2.9
Toluene	108-88-3	640	100	6,000,000	15,000	na	100
1,2,3-Trichlorobenzene	87-61-6	na	na	na	na	na	na
1,1,1-Trichloroethane	71-55-6	200	50000	150,000,000	5,400	na	200
1,1,2-Trichloroethane	79-00-5	3.0	0.90	25,000	4.6	na	0.90
Trichloroethylene	79-01-6	4.0	0.70	26,000	1.4	na	0.70
Trichlorofluoroethane	27154-33-2	na	na	na	na	na	na
Trichlorofluoromethane	75-69-4	2,400	na	51,000,000	120	na	120
1,2,3-Trichloropropane	96-18-4	0.00038	na	35	na	na	0.00038
Trichlorotrifluoroethane	76-13-1	240,000	na	1,700,000,000	170	na	170
1,2,3-Trimethylbenzene	526-73-8	80	na	190,000	410	na	80
1,2,4-Trimethylbenzene	95-63-6	80	na	200,000	240	na	80
1,3,5-Trimethylbenzene	108-67-8	80	na	200,000	170	na	80
Vinyl acetate	108-05-4	8,000	na	350,000,000	7,700	na	7,700
Vinyl chloride	75-01-4	0.29	0.18	2,000	0.34	na	0.18
Total xylenes	1330-20-7	1,600	110	9,700,000	320	na	110

Notes:

1 All PSLs are derived from the Lower Duwamish Waterway Preliminary Cleanup Level Workbook (Ecology 2021).

2 Concentrations are presented in µg/L. Criteria have been rounded to two significant digits.

Abbreviations:

CAS Chemical Abstracts Service
DRO Diesel-range organics
cPAH Carcinogenic polycyclic aromatic hydrocarbon
µg/L Micrograms per liter
na Not available
ORO Oil-range organics
PSL Preliminary screening level
TEQ Toxic equivalent

Table 4.3
Soil Analytical Results for TPH, Polychlorinated Biphenyls, Pentachlorophenol, and Dioxins/Furans

		Location	HO-SE1	SS-01	SS-02	SS-03	SS-04	SS-05	SS-06	SS-07	SS-08	SS-B1		SS-B2	SS-B3	SS-B4	SS-S1W	SS-S2E
		Sample ID	**HO-SE1-4'**	**WT-SS-01-0-6"**	**WT-SS-02-0-6"**	**WT-SS-03-0-3"**	**WT-SS-04-0-6"**	**WT-SS-05-0-6"**	**WT-SS-06-0-6"**	**WT-SS-07-0-6"**	**WT-SS-08-0-6"**	**SS-B1-16'**	**SS-B1-16'-D**	**SS-B2-17'**	**SS-B3-17'**	**SS-B4-16'**	**SS-S1W-10.5'**	**SS-S2E-12'**
		Sample Date	**8/30/17**	**4/11/17**	**4/11/17**	**4/11/17**	**4/11/17**	**4/11/17**	**4/11/17**	**4/11/17**	**4/11/17**	**9/7/17**	**9/7/17**	**9/11/17**	**9/11/17**	**9/14/17**	**9/6/17**	**9/14/17**
		Depth	**4 ft**	**0–6 in**	**0–6 in**	**0–3 in**	**0–6 in**	**0–6 in**	**0–6 in**	**0–6 in**	**0–6 in**	**16 ft**	**16 ft**	**17 ft**	**17 ft**	**16 ft**	**10.5 ft**	**12 ft**
		Status	**In Situ**	**Removed**	**Removed**	**Removed**	**Removed**	**Removed**	**Removed**	**Removed**	**Removed**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**
Analyte	**Unit**	**PSL**																
Total Petroleum Hydrocarbons (TPH)																		
Gasoline-range organics	mg/kg	30																
Diesel-range organics	mg/kg	2,000	50 U															
Oil-range organics	mg/kg	2,000	250 U															
Stoddard solvent	mg/kg	2,000										50 U	50 U	50 U	50 U	50 U		50 U
Total DRO + ORO	mg/kg	2,000	250 U															
Polychlorinated Biphenyls (PCBs)																		
Total PCB Aroclors	mg/kg	0.0000022		**0.25**	**0.16**	**0.11**	**0.069**	**0.051**	**0.083**	**0.13**	**0.13**							
Dioxins/Furans																		
Total dioxins/furans TEQ (4)	ng/kg	5.2														1.19 J		
Pentachlorophenol																		
Pentachlorophenol	mg/kg	0.0000018												***0.10 U***		***0.10 U***	***0.10 U***	

Notes:

Results have been rounded to two significant digits, except for dioxin/furan TEQ results, which have been rounded to three significant digits.

Empty cells are intentional.

RED/BOLD Detection exceeds PSL.

BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

1 Per the laboratory, the material quantified for the gasoline range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.

2 Per the laboratory, the material quantified for the diesel range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.

3 The DRO + ORO sum does not include the DRO result in the sum because the laboratory noted that the DRO result was likely Stoddard solvent.

4 Calculated using detected dioxin/furan concentrations plus one-half the detection limit for dioxins/furans that were not detected.

Abbreviations:

DRO Diesel-range organics
ft Feet
in Inches
mg/kg Miligrams per kilgram
ng/kg Nanograms per kilogram
ORO Oil-range organics
PSL Preliminary Screening Level
TEQ Toxic equivalent

Qualifiers:

J Analyte was detected, concentration is considered an estimate.
U Analyte was not detected, concentration given is the reporting limit.
UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.3
Soil Analytical Results for TPH, Polychlorinated Biphenyls, Pentachlorophenol, and Dioxins/Furans

		Location	SS-S3N	WT-B05	WT-B06		WT-B07		WT-B08		WT-B09		WT-B15		WT-B16		WT-B17	
		Sample ID	**SS-S3N-12'**	**B05-08**	**B06-05**	**B06-12**	**B07-05**	**B07-11.5**	**B08-05**	**B08-11**	**B09-05**	**B09-13**	**B15-05.0**	**B15-10.0**	**B16-05.0**	**B16-10.0**	**B17-07.5**	**B17-10.0**
		Sample Date	**9/14/17**	**12/26/13**	**12/26/13**	**12/26/13**	**12/26/13**	**12/26/13**	**12/26/13**	**12/26/13**	**12/26/13**	**12/26/13**	**4/5/14**	**4/5/14**	**4/5/14**	**4/5/14**	**4/5/14**	**4/5/14**
		Depth	**12 ft**	**8 ft**	**5 ft**	**12 ft**	**5 ft**	**11.5 ft**	**5 ft**	**11 ft**	**5 ft**	**13 ft**	**5 ft**	**10 ft**	**5 ft**	**10 ft**	**7.5 ft**	**10 ft**
		Status	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**
Analyte	**Unit**	**PSL**																
Total Petroleum Hydrocarbons (TPH)																		
Gasoline-range organics	mg/kg	30			2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**2,600** (1)	2.0 U	**4,600** (1)	**10,000** (1)	**160** (1)
Diesel-range organics	mg/kg	2,000		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	**2,300** (2)	**5,700** (2)	50 U	**6,900** (2)	**23,000** (2)	**1,700** (2)
Oil-range organics	mg/kg	2,000		250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	1,100	460	250 U	250 U	**3,000**	250 U
Stoddard solvent	mg/kg	2,000	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	2,000	**6,600**	50 U	**8,200**	**25,000**	1,800
Total DRO + ORO	mg/kg	2,000		250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	1,100 (3)	460 (3)	250 U	250 U (3)	**3,000** (3)	250 U (3)
Polychlorinated Biphenyls (PCBs)																		
Total PCB Aroclors	mg/kg	0.0000022																
Dioxins/Furans																		
Total dioxin/furan TEQ (4)	ng/kg	5.2															**8,930 J**	
Pentachlorophenol																		
Pentachlorophenol	mg/kg	0.0000018		***0.050 U***									**31**	**140**	***0.050 U***	**22**	**340**	**85**

Notes:

Results have been rounded to two significant digits, except for dioxin/furan TEQ results, which have been rounded to three significant digits.
Empty cells are intentional.
RED/BOLD Detection exceeds PSL.
BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.
1 Per the laboratory, the material quantified for the gasoline range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.
2 Per the laboratory, the material quantified for the diesel range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.
3 The DRO + ORO sum does not include the DRO result in the sum because the laboratory noted that the DRO result was likely Stoddard solvent.
4 Calculated using detected dioxin/furan concentrations plus one-half the detection limit for dioxins/furans that were not detected.

Abbreviations:
DRO Diesel-range organics
ft Feet
in Inches
mg/kg Miligrams per kilgram
ng/kg Nanograms per kilogram
ORO Oil-range organics
PSL Preliminary Screening Level
TEQ Toxic equivalent

Qualifiers:
J Analyte was detected, concentration is considered an estimate.
U Analyte was not detected, concentration given is the reporting limit.
UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.3
Soil Analytical Results for TPH, Polychlorinated Biphenyls, Pentachlorophenol, and Dioxins/Furans

		Location	WT-GP-10		WT-GP-11		WT-GP-2				WT-GP-3				WT-GP-4			
		Sample ID	GP-10 (0-5)	GP-10 (4-5)	GP-11 (0-5)	GP-11 (4-5)	GP-2 (0-10)	GP-2 (7-8)	GP-2 (10-13)	GP-2 (12-13)	GP-3 (0-10)	GP-3 (8-9)	GP-3 (10-13)	GP-3 (12-13)	GP-4 (0-10)	GP-4 (4-5)	GP-4 (10-13)	GP-4 (12-13)
		Sample Date	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13
		Depth	0–5 ft	4–5 ft	0–5 ft	4–5 ft	0–10 ft	7–8 ft	10–13 ft	12–13 ft	0–10 ft	8–9 ft	10–13 ft	12–13 ft	0–10 ft	4–5 ft	10–13 ft	12–13 ft
		Status	Removed	Removed	In Situ	In Situ	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	In Situ	In Situ	In Situ	In Situ
Analyte	**Unit**	**PSL**																
Total Petroleum Hydrocarbons (TPH)																		
Gasoline-range organics	mg/kg	30		6.3 U		7.2 U		7.0 U		6.3 U		5.6 U		5.8 U		6.7 U		6.3 U
Diesel-range organics	mg/kg	2,000	22 U		21 U		23 U		300 (2)		23 U		130 (2)		23 U		310 (2)	
Oil-range organics	mg/kg	2,000	**7,900**		53 U		150		88		57 U		57 U		58 U		190	
Stoddard solvent	mg/kg	2,000		200						**5,300**				110				**4,000**
Total DRO + ORO	mg/kg	2,000	**7,900**		53 U		150		88 (3)		57 U		57 U (3)		58 U		190 (3)	
Polychlorinated Biphenyls (PCBs)																		
Total PCB Aroclors	mg/kg	0.0000022																
Dioxins/Furans																		
Total dioxin/furan TEQ (4)	ng/kg	5.2																
Pentachlorophenol																		
Pentachlorophenol	mg/kg	0.0000018	**0.19**		***0.096 U***		***0.11 U***		**9.0**		***0.11 U***		**7.1**		***0.11 U***		**9.8**	

Notes:

Results have been rounded to two significant digits, except for dioxin/furan TEQ results, which have been rounded to three significant digits.

Empty cells are intentional.

RED/BOLD Detection exceeds PSL.

BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

1 Per the laboratory, the material quantified for the gasoline range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.

2 Per the laboratory, the material quantified for the diesel range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.

3 The DRO + ORO sum does not include the DRO result in the sum because the laboratory noted that the DRO result was likely Stoddard solvent.

4 Calculated using detected dioxin/furan concentrations plus one-half the detection limit for dioxins/furans that were not detected.

Abbreviations:

DRO Diesel-range organics
ft Feet
in Inches
mg/kg Miligrams per kilgram
ng/kg Nanograms per kilogram
ORO Oil-range organics
PSL Preliminary Screening Level
TEQ Toxic equivalent

Qualifiers:

J Analyte was detected, concentration is considered an estimate.
U Analyte was not detected, concentration given is the reporting limit.
UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.3
Soil Analytical Results for TPH, Polychlorinated Biphenyls, Pentachlorophenol, and Dioxins/Furans

		Location	WT-GP-5		WT-GP-7		WT-GP-8		WT-MW-01			WT-MW-02			WT-MW-03		WT-MW-04		WT-MW-05	WT-MW-06
		Sample ID	GP-5 (0-5)	GP-5 (2)	GP-7 (0-5)	GP-7 (3)	GP-8 (0-5)	GP-8 (4-5)	B01-10	B01-12	B01-15	B02-05	B02-10	B02-15	B03-05	B03-10	B04-05	B04-10	B12-10.0	B13-10.0
		Sample Date	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	12/27/13	12/27/13	12/27/13	12/27/13	12/27/13	12/27/13	12/27/13	12/27/13	12/27/13	12/27/13	4/5/14	4/5/14
		Depth	0–5 ft	2 ft	0–5 ft	3 ft	0–5 ft	4–5 ft	10 ft	12 ft	15 ft	5 ft	10 ft	15 ft	5 ft	10 ft	5 ft	10 ft	10 ft	10 ft
		Status	Removed	Removed	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ
Analyte	**Unit**	**PSL**																		
Total Petroleum Hydrocarbons (TPH)																				
Gasoline-range organics	mg/kg	30		6.6 U		7.0 U		6.1 U											**1,500** (1)	2.0 U
Diesel-range organics	mg/kg	2,000	23 U		25 U		20 U		50 U	120	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	**2,900** (2)	50 U
Oil-range organics	mg/kg	2,000	56 U		63 U		380		250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Stoddard solvent	mg/kg	2,000							50 U	140	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	**3,300**	50 U
Total DRO + ORO	mg/kg	2,000	56 U		63 U		380		250 U	120	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U (3)	250 U
Polychlorinated Biphenyls (PCBs)																				
Total PCB Aroclors	mg/kg	0.0000022																		
Dioxins/Furans																				
Total dioxin/furan TEQ (4)	ng/kg	5.2																		
Pentachlorophenol																				
Pentachlorophenol	mg/kg	0.0000018	***0.11 U***		***0.12 U***		***0.10 U***		***0.050 U***	**0.45**	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.50 U***	***0.050 U***	**0.079**	***0.050 U***

Notes:

Results have been rounded to two significant digits, except for dioxin/furan TEQ results, which have been rounded to three significant digits.

Empty cells are intentional.

RED/BOLD Detection exceeds PSL.

BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

1 Per the laboratory, the material quantified for the gasoline range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.

2 Per the laboratory, the material quantified for the diesel range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.

3 The DRO + ORO sum does not include the DRO result in the sum because the laboratory noted that the DRO result was likely Stoddard solvent.

4 Calculated using detected dioxin/furan concentrations plus one-half the detection limit for dioxins/furans that were not detected.

Abbreviations:

DRO Diesel-range organics
ft Feet
in Inches
mg/kg Miligrams per kilgram
ng/kg Nanograms per kilogram
ORO Oil-range organics
PSL Preliminary Screening Level
TEQ Toxic equivalent

Qualifiers:

J Analyte was detected, concentration is considered an estimate.
U Analyte was not detected, concentration given is the reporting limit.
UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.3
Soil Analytical Results for TPH, Polychlorinated Biphenyls, Pentachlorophenol, and Dioxins/Furans

		Location	WT-MW-07	WT-MW-108	WT-MW-110				WT-SB-01		WT-SB-02	WT-SB-04	WT-SB-05		WT-SB-06	WT-SB-07		WT-SB-08	
		Sample ID	**B14-10.0**	**SB-03-10-11**	**SB-11-0-2**	**SB-11-4-5**	**SB-11-6-7**	**SB-11-10-11**	**SB-01-0-2**	**SB-01-10**	**SB-02-0-2**	**SB-04-9-10**	**SB-05-0-2**	**SB-05-9-10**	**SB-06-10-11**	**SB-07-12-13**	**SB-07-14-15**	**SB-08-0-2**	**SB-08-10-11**
		Sample Date	**4/5/14**	**12/7/15**	**12/7/15**	**12/7/15**	**12/7/15**	**12/7/15**	**12/7/15**	**12/7/15**	**12/7/15**	**12/7/15**	**12/9/15**	**12/9/15**	**12/7/15**	**12/9/15**	**12/9/15**	**12/7/15**	**12/7/15**
		Depth	**10 ft**	**10–11 ft**	**0–2 ft**	**4–5 ft**	**6–7 ft**	**10–11 ft**	**0–2 ft**	**10 ft**	**0–2 ft**	**9–10 ft**	**0–2 ft**	**9–10 ft**	**10–11 ft**	**12–13 ft**	**14–15 ft**	**0–2 ft**	**10–11 ft**
		Status	**In Situ**	**In Situ**	**Removed**	**Removed**	**In Situ**	**In Situ**	**Removed**	**In Situ**	**Removed**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**Removed**	**In Situ**
Analyte	**Unit**	**PSL**																	
Total Petroleum Hydrocarbons (TPH)																			
Gasoline-range organics	mg/kg	30	2.0 U																
Diesel-range organics	mg/kg	2,000	50 U	24 U	22 UJ	24 U	21 UJ	22 U	23 U	19 U	21 U	23 U		23 U	22 U	110	23 UJ		24 U
Oil-range organics	mg/kg	2,000	250 U	59 U	300 J	**23,000**	80 J	340	1100	48 U	450	57 U		57 U	56 U	180	58 UJ		680
Stoddard solvent	mg/kg	2,000	50 U	24 UJ	22 UJ	24 UJ	21 UJ	22 UJ	23 UJ	19 UJ	21 UJ	23 UJ		23 UJ	22 UJ	**6,600 J**	23 UJ		24 UJ
Total DRO + ORO	mg/kg	2,000	250 U	59 U	300 J	**23,000**	80 J	340	1100	48 U	450	57 U		57 U	56 U	290	58 U		680
Polychlorinated Biphenyls (PCBs)																			
Total PCB Aroclors	mg/kg	0.0000022			***0.10 U***				***0.12 U***	***0.099 U***			***0.12 U***					***0.11 U***	
Dioxins/Furans																			
Total dioxin/furan TEQ (4)	ng/kg	5.2												1.98 J		**892 J**			
Pentachlorophenol																			
Pentachlorophenol	mg/kg	0.0000018	***0.050 U***	***0.022 U***	***0.11 U***				**0.13**	***0.10 U***	***0.022 U***	***0.022 U***	***0.11 U***	**0.33**	***0.023 U***	**12**		***0.10 U***	***0.025 U***

Notes:
Results have been rounded to two significant digits, except for dioxin/furan TEQ results, which have been rounded to three significant digits.
Empty cells are intentional.
RED/BOLD Detection exceeds PSL.
BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.
1 Per the laboratory, the material quantified for the gasoline range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.
2 Per the laboratory, the material quantified for the diesel range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.
3 The DRO + ORO sum does not include the DRO result in the sum because the laboratory noted that the DRO result was likely Stoddard solvent.
4 Calculated using detected dioxin/furan concentrations plus one-half the detection limit for dioxins/furans that were not detected.

Abbreviations:
DRO Diesel-range organics
ft Feet
in Inches
mg/kg Miligrams per kilgram
ng/kg Nanograms per kilogram
ORO Oil-range organics
PSL Preliminary Screening Level
TEQ Toxic equivalent

Qualifiers:
J Analyte was detected, concentration is considered an estimate.
U Analyte was not detected, concentration given is the reporting limit.
UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.3
Soil Analytical Results for TPH, Polychlorinated Biphenyls, Pentachlorophenol, and Dioxins/Furans

		Location	WT-SB-09	WT-SB-10		WT-SB-12	WT-SB-13	WT-SB-14	WT-SB-15		WT-SB-16	WT-SB-18	WT-SB-20	
		Sample ID	SB-09-13-14	SB-10-12.5-13	SB-10-14-15	SB-12-10-11	SB-13-4-5	SB-14-4-5	SB-15-4-5	SB-15-4-5-D	SB-16-4-5	SB-18-4-5	SB-20-4-5	SB-20-5-6
		Sample Date	12/7/15	12/7/15	12/7/15	12/7/15	3/29/16	3/29/16	3/29/16	3/29/16	3/29/16	3/29/16	3/29/16	3/29/16
		Depth	13–14 ft	12.5–13 ft	14–15 ft	10–11 ft	4–5 ft	4–5 ft	4–5 ft	4–5 ft	4–5 ft	4–5 ft	4–5 ft	5–6 ft
		Status	Removed	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	Removed	Removed
Analyte	**Unit**	**PSL**												
Total Petroleum Hydrocarbons (TPH)														
Gasoline-range organics	mg/kg	30												
Diesel-range organics	mg/kg	2,000	24 U	23 U	23 UJ	21 U	21 U	24 U	26 U	24 U	25 U	27 U	23 U	22 UJ
Oil-range organics	mg/kg	2,000	60 U	390	58 UJ	110	52 U	60 U	66 U	60 U	62 U	67 U	**3,000**	540 J
Stoddard solvent	mg/kg	2,000	**3,000 J**	**8,500 J**	23 UJ	21 UJ								
Total DRO + ORO	mg/kg	2,000	60 U	390	58 U	110	52 U	60 U	66 U	60 U	62 U	67 U	**3,000**	540 J
Polychlorinated Biphenyls (PCBs)														
Total PCB Aroclors	mg/kg	0.0000022												
Dioxins/Furans														
Total dioxin/furan TEQ (4)	ng/kg	5.2		**3130 J**	**8.59 J**									
Pentachlorophenol														
Pentachlorophenol	mg/kg	0.0000018	**2.5**	**15**		***0.020 U***								

Notes:

Results have been rounded to two significant digits, except for dioxin/furan TEQ results, which have been rounded to three significant digits.

Empty cells are intentional.

RED/BOLD Detection exceeds PSL.

BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

1 Per the laboratory, the material quantified for the gasoline range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.

2 Per the laboratory, the material quantified for the diesel range does not resemble the standards used for calibration; the chromatograms show the material is likely Stoddard solvent.

3 The DRO + ORO sum does not include the DRO result in the sum because the laboratory noted that the DRO result was likely Stoddard solvent.

4 Calculated using detected dioxin/furan concentrations plus one-half the detection limit for dioxins/furans that were not detected.

Abbreviations:

DRO Diesel-range organics
ft Feet
in Inches
mg/kg Miligrams per kilgram
ng/kg Nanograms per kilogram
ORO Oil-range organics
PSL Preliminary Screening Level
TEQ Toxic equivalent

Qualifiers:

J Analyte was detected, concentration is considered an estimate.
U Analyte was not detected, concentration given is the reporting limit.
UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.4
Soil Analytical Results for Volatile Organic Compounds

		Location	HO-SE1	WT-B06		WT-B07		WT-B08		WT-B09		WT-B15		WT-B16		WT-B17	
		Sample ID	HO-SE1-4'	B06-05	B06-12	B07-05	B07-11.5	B08-05	B08-11	B09-05	B09-13	B15-05.0	B15-10.0	B16-05.0	B16-10.0	B17-07.5	B17-10.0
		Sample Date	8/30/17	12/26/13	12/26/13	12/26/13	12/26/13	12/26/13	12/26/13	12/26/13	12/26/13	4/5/14	4/5/14	4/5/14	4/5/14	4/5/14	4/5/14
		Depth	4 ft	5 ft	12 ft	5 ft	11.5 ft	5 ft	11 ft	5 ft	13 ft	5 ft	10 ft	5 ft	10 ft	7.5 ft	10 ft
		Status	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ	In Situ
Analyte	Unit	PSL															
Volatile Organic Compounds																	
Acetone	mg/kg	2.1	0.50 U														
Benzene	mg/kg	0.00056	***0.030 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***1.0 U***	***0.020 U***	***1.0 U***	***1.0 U***	***0.020 UJ***
Bromoform	mg/kg	0.0050	***0.050 U***														
Bromobenzene	mg/kg	0.033	***0.050 U***														
Bromomethane	mg/kg	0.0033	***0.50 U***														
sec-Butylbenzene	mg/kg	1.3	0.050 U														
tert-Butylbenzene	mg/kg	1.0	0.050 U														
Carbon tetrachloride	mg/kg	0.00015	***0.050 U***														
Chlorobenzene	mg/kg	0.051	0.050 U														
Chloroethane	mg/kg	--	0.50 UJ									0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Chloroform	mg/kg	0.0048	***0.050 U***														
Chloromethane	mg/kg	--	0.50 U														
2-Chlorotoluene	mg/kg	0.11	0.050 U														
4-Chlorotoluene	mg/kg	--	0.050 U														
Dibromochloromethane	mg/kg	0.00077	***0.050 U***														
1,2-Dibromo-3-chloropropane	mg/kg	0.000081	***0.50 U***														
Dibromomethane	mg/kg	0.028	***0.050 U***														
Dichlorobromomethane	mg/kg	0.00096	***0.050 U***														
Dichlorodifluoromethane	mg/kg	0.53	0.50 U														
1,1-Dichloroethane	mg/kg	0.0026	***0.050 U***									***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***
1,2-Dichloroethane	mg/kg	0.0016	***0.050 U***									***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***
1,1-Dichloroethylene	mg/kg	0.0025	***0.050 U***									***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***
cis-1,2-Dichloroethylene	mg/kg	0.0052	***0.050 U***									***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***
trans-1,2-Dichloroethylene	mg/kg	0.032	***0.050 U***									***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***
1,2-Dichloropropane	mg/kg	0.0010	***0.050 U***														
1,3-Dichloropropane	mg/kg	0.057	0.050 U														
2,2-Dichloropropane	mg/kg	--	0.050 U														
1,1-Dichloropropene	mg/kg	--	0.050 U														
cis-1,3-Dichloropropene	mg/kg	0.00014	***0.050 U***														
trans-1,3-Dichloropropene	mg/kg	0.00014	***0.050 U***														
Ethylbenzene	mg/kg	0.010	***0.050 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***1.0 U***	***0.020 U***	3.9	***1.0 U***	***0.10 U***
Ethylene dibromide	mg/kg	0.000018	***0.050 U***														
2-Hexanone	mg/kg	0.012	***0.50 U***														
Isopropylbenzene	mg/kg	0.79	0.050 U														
4-Isopropyltoluene	mg/kg	--	0.050 U														
Methyl ethyl ketone	mg/kg	1.4	0.50 U														
Methyl isobutyl ketone	mg/kg	0.19	***0.50 U***														
Methyl tert-butyl ether	mg/kg	0.0072	***0.050 U***														
Methylene chloride	mg/kg	0.0015	***0.50 U***									***0.50 U***	***0.50 U***	***0.50 U***	***0.50 U***	***0.50 U***	***0.50 U***
n-Propylbenzene	mg/kg	0.88	0.050 U														
Styrene	mg/kg	0.12	0.050 U														
1,1,1,2-Tetrachloroethane	mg/kg	0.00063	0.050 U														
1,1,2,2-Tetrachloroethane	mg/kg	0.000080	***0.050 U***														
Tetrachloroethylene	mg/kg	0.0016	0.026									***0.025 U***	0.067	***0.025 U***	***0.025 U***	0.060	***0.025 U***
Toluene	mg/kg	0.044	***0.050 U***	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U	***1.0 U***	0.020 U	***1.0 U***	***1.0 U***	***0.10 U***
1,2,3-Trichlorobenzene	mg/kg	--	0.25 U														
1,1,1-Trichloroethane	mg/kg	0.084	0.050 U									0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U

Table 4.4
Soil Analytical Results for Volatile Organic Compounds

		Location	HO-SE1	WT-B06		WT-B07		WT-B08		WT-B09		WT-B15		WT-B16		WT-B17	
		Sample ID	**HO-SE1-4'**	**B06-05**	**B06-12**	**B07-05**	**B07-11.5**	**B08-05**	**B08-11**	**B09-05**	**B09-13**	**B15-05.0**	**B15-10.0**	**B16-05.0**	**B16-10.0**	**B17-07.5**	**B17-10.0**
		Sample Date	**8/30/17**	**12/26/13**	**12/26/13**	**12/26/13**	**12/26/13**	**12/26/13**	**12/26/13**	**12/26/13**	**12/26/13**	**4/5/14**	**4/5/14**	**4/5/14**	**4/5/14**	**4/5/14**	**4/5/14**
		Depth	**4 ft**	**5 ft**	**12 ft**	**5 ft**	**11.5 ft**	**5 ft**	**11 ft**	**5 ft**	**13 ft**	**5 ft**	**10 ft**	**5 ft**	**10 ft**	**7.5 ft**	**10 ft**
		Status	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**	**In Situ**
Analyte	**Unit**	**PSL**															
Volatile Organic Compounds (cont.)																	
1,1,2-Trichloroethane	mg/kg	0.00033	***0.050 U***														
Trichloroethylene	mg/kg	0.00027	***0.020 U***									***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***	***0.020 U***
Trichlorofluoromethane	mg/kg	0.79	0.50 U														
1,2,3-Trichloropropane	mg/kg	0.00000015	***0.050 U***														
1,2,4-Trimethylbenzene	mg/kg	0.072	0.050 U														
1,3,5-Trimethylbenzene	mg/kg	0.071	0.050 U														
Vinyl chloride	mg/kg	0.000055	***0.050 U***									***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***	***0.050 U***
m,p-Xylene	mg/kg	--	0.10 U														
o-Xylene	mg/kg	--	0.050 U														
Total xylenes	mg/kg	0.055	***0.10 U***	***0.060 U***	***0.060 U***	***0.060 U***	***0.060 U***	***0.060 U***	***0.060 U***	***0.060 U***	***0.060 U***	***0.060 U***	**17**	***0.060 U***	**53**	**68**	**1.3**

Notes:
Results have been rounded to two significant digits.
Empty cells are intentional.
-- Not available.
RED/BOLD Detection exceeds PSL.
BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

Abbreviations:
ft Feet
in Inches
mg/kg Milligrams per kilogram
PSL Preliminary Screening Level

Qualifiers:
U Analyte was not detected, concentration given is the reporting limit.
UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.4
Soil Analytical Results for Volatile Organic Compounds

		Location	WT-GP-2		WT-GP-3		WT-GP-4		WT-GP-5	WT-GP-7	WT-GP-8	WT-GP-10	WT-GP-11	WT-MW-05	WT-MW-06	WT-MW-07
		Sample ID	GP-2 (7-8)	GP-2 (12-13)	GP-3 (8-9)	GP-3 (12-13)	GP-4 (4-5)	GP-4 (12-13)	GP-5 (2)	GP-7 (3)	GP-8 (4-5)	GP-10 (4-5)	GP-11 (4-5)	B12-10.0	B13-10.0	B14-10.0
		Sample Date	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	4/5/14	4/5/14	4/5/14
		Depth	7–8 ft	12–13 ft	8–9 ft	12–13 ft	4–5 ft	12–13 ft	2 ft	3 ft	4–5 ft	4–5 ft	4–5 ft	10 ft	10 ft	10 ft
		Status	Removed	Removed	Removed	Removed	In Situ	In Situ	Removed	In Situ	In Situ	Removed	In Situ	In Situ	In Situ	In Situ
Analyte	**Unit**	**PSL**														
Volatile Organic Compounds																
Acetone	mg/kg	2.1														
Benzene	mg/kg	0.00056	***0.028 U***	***0.025 U***	***0.022 U***	***0.023 U***	***0.027 U***	***0.025 U***	***0.027 U***	***0.028 U***	***0.024 U***	***0.025 U***	***0.029 U***	***0.40 U***	***0.020 U***	***0.020 U***
Bromoform	mg/kg	0.0050														
Bromobenzene	mg/kg	0.033														
Bromomethane	mg/kg	0.0033														
sec-Butylbenzene	mg/kg	1.3														
tert-Butylbenzene	mg/kg	1.0														
Carbon tetrachloride	mg/kg	0.00015	***0.028 U***	***0.025 U***	***0.022 U***	***0.023 U***	***0.027 U***	***0.025 U***	***0.027 U***	***0.028 U***	***0.024 U***	***0.025 U***	***0.029 U***			
Chlorobenzene	mg/kg	0.051	0.028 U	0.025 U	0.022 U	0.023 U	0.027 U	0.025 U	0.027 U	0.028 U	0.024 U	0.025 U	0.029 U			
Chloroethane	mg/kg	--												0.50 U	0.50 U	0.50 U
Chloroform	mg/kg	0.0048	***0.028 U***	***0.025 U***	***0.022 U***	***0.023 U***	***0.027 U***	***0.025 U***	***0.027 U***	***0.028 U***	***0.024 U***	***0.025 U***	***0.029 U***			
Chloromethane	mg/kg	--														
2-Chlorotoluene	mg/kg	0.11														
4-Chlorotoluene	mg/kg	--														
Dibromochloromethane	mg/kg	0.00077														
1,2-Dibromo-3-chloropropane	mg/kg	0.000081														
Dibromomethane	mg/kg	0.028														
Dichlorobromomethane	mg/kg	0.00096														
Dichlorodifluoromethane	mg/kg	0.53														
1,1-Dichloroethane	mg/kg	0.0026												***0.050 U***	***0.050 U***	***0.050 U***
1,2-Dichloroethane	mg/kg	0.0016	***0.042 U***	***0.038 U***	***0.034 U***	***0.035 U***	***0.040 U***	***0.038 U***	***0.040 U***	***0.042 U***	***0.037 U***	***0.038 U***	***0.043 U***	***0.050 U***	***0.050 U***	***0.050 U***
1,1-Dichloroethylene	mg/kg	0.0025	***0.070 U***	***0.063 U***	***0.056 U***	***0.058 U***	***0.067 U***	***0.063 U***	***0.066 U***	***0.070 U***	***0.061 U***	***0.063 U***	***0.072 U***	***0.050 U***	***0.050 U***	***0.050 U***
cis-1,2-Dichloroethylene	mg/kg	0.0052												***0.050 U***	***0.050 U***	***0.050 U***
trans-1,2-Dichloroethylene	mg/kg	0.032												***0.050 U***	***0.050 U***	***0.050 U***
1,2-Dichloropropane	mg/kg	0.0010														
1,3-Dichloropropane	mg/kg	0.057														
2,2-Dichloropropane	mg/kg	--														
1,1-Dichloropropene	mg/kg	--														
cis-1,3-Dichloropropene	mg/kg	0.00014														
trans-1,3-Dichloropropene	mg/kg	0.00014														
Ethylbenzene	mg/kg	0.010												**2.1**	***0.020 U***	***0.020 U***
Ethylene dibromide	mg/kg	0.000018														
2-Hexanone	mg/kg	0.012														
Isopropylbenzene	mg/kg	0.79														
4-Isopropyltoluene	mg/kg	--														
Methyl ethyl ketone	mg/kg	1.4	0.088 U	0.079 U	0.070 U	0.073 U	0.083 U	0.079 U	0.083 U	0.088 U	0.076 U	0.079 U	0.090 U			
Methyl isobutyl ketone	mg/kg	0.19														
Methyl tert-butyl ether	mg/kg	0.0072														
Methylene chloride	mg/kg	0.0015												***0.50 U***	***0.50 U***	***0.50 U***
n-Propylbenzene	mg/kg	0.88														
Styrene	mg/kg	0.12														
1,1,1,2-Tetrachloroethane	mg/kg	0.00063														
1,1,2,2-Tetrachloroethane	mg/kg	0.000080														
Tetrachloroethylene	mg/kg	0.0016	***0.028 U***	***0.025 U***	***0.022 U***	***0.023 U***	***0.027 U***	***0.025 U***	**0.14**	**0.16**	**0.13**	***0.025 U***	***0.029 U***	***0.025 U***	***0.025 U***	***0.025 U***
Toluene	mg/kg	0.044												***0.40 U***	0.020 U	0.020 U
1,2,3-Trichlorobenzene	mg/kg	--														
1,1,1-Trichloroethane	mg/kg	0.084												0.050 U	0.050 U	0.050 U

Table 4.4
Soil Analytical Results for Volatile Organic Compounds

		Location	WT-GP-2		WT-GP-3		WT-GP-4		WT-GP-5	WT-GP-7	WT-GP-8	WT-GP-10	WT-GP-11	WT-MW-05	WT-MW-06	WT-MW-07
		Sample ID	**GP-2 (7-8)**	**GP-2 (12-13)**	**GP-3 (8-9)**	**GP-3 (12-13)**	**GP-4 (4-5)**	**GP-4 (12-13)**	**GP-5 (2)**	**GP-7 (3)**	**GP-8 (4-5)**	**GP-10 (4-5)**	**GP-11 (4-5)**	**B12-10.0**	**B13-10.0**	**B14-10.0**
		Sample Date	**3/26/13**	**3/26/13**	**3/26/13**	**3/26/13**	**3/26/13**	**3/26/13**	**3/26/13**	**3/26/13**	**3/26/13**	**3/26/13**	**3/26/13**	**4/5/14**	**4/5/14**	**4/5/14**
		Depth	**7–8 ft**	**12–13 ft**	**8–9 ft**	**12–13 ft**	**4–5 ft**	**12–13 ft**	**2 ft**	**3 ft**	**4–5 ft**	**4–5 ft**	**4–5 ft**	**10 ft**	**10 ft**	**10 ft**
		Status	**Removed**	**Removed**	**Removed**	**Removed**	**In Situ**	**In Situ**	**Removed**	**In Situ**	**In Situ**	**Removed**	**In Situ**	**In Situ**	**In Situ**	**In Situ**
Analyte	**Unit**	**PSL**														
Volatile Organic Compounds (cont.)																
1,1,2-Trichloroethane	mg/kg	0.00033														
Trichloroethylene	mg/kg	0.00027	***0.042 U***	***0.038 U***	***0.034 U***	***0.035 U***	***0.040 U***	***0.038 U***	***0.040 U***	***0.042 U***	***0.037 U***	***0.038 U***	***0.043 U***	***0.020 U***	**0.021**	***0.020 U***
Trichlorofluoromethane	mg/kg	0.79														
1,2,3-Trichloropropane	mg/kg	0.00000015														
1,2,4-Trimethylbenzene	mg/kg	0.072														
1,3,5-Trimethylbenzene	mg/kg	0.071														
Vinyl chloride	mg/kg	0.000055	***0.0028 U***	***0.0025 U***	***0.0022 U***	***0.0023 U***	***0.0027 U***	***0.0025 U***	***0.0027 U***	***0.0028 U***	***0.0024 U***	***0.0025 U***	***0.0029 U***	***0.050 U***	***0.050 U***	***0.050 U***
m,p-Xylene	mg/kg	--														
o-Xylene	mg/kg	--														
Total xylenes	mg/kg	0.055												**5.6**	***0.060 U***	***0.060 U***

Notes:
Results have been rounded to two significant digits.
Empty cells are intentional.
-- Not available.
RED/BOLD Detection exceeds PSL.
BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

Abbreviations:
ft Feet
in Inches
mg/kg Milligrams per kilogram
PSL Preliminary Screening Level

Qualifiers:
U Analyte was not detected, concentration given is the reporting limit.
UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.5
Soil Analytical Results for Metals

Location			HO-SE1	SS-01	SS-04	SS-06	SS-08	WT-GP-2		WT-GP-3		WT-GP-4		WT-GP-5	WT-GP-7	WT-GP-8
Sample ID			HO-SE1-4'	WT-SS-01-0-6"	WT-SS-04-0-6"	WT-SS-06-0-6"	WT-SS-08-0-6"	GP-2 (0-10)	GP-2 (10-13)	GP-3 (0-10)	GP-3 (10-13)	GP-4 (0-10)	GP-4 (10-13)	GP-5 (0-5)	GP-7 (0-5)	GP-8 (0-5)
Sample Date			8/30/17	4/11/17	4/11/17	4/11/17	4/11/17	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13
Depth			4–4 ft	0–6 in	0–6 in	0–6 in	0–6 in	0–10 ft	10–13 ft	0–10 ft	10–13 ft	0–10 ft	10–13 ft	0–5 ft	0–5 ft	0–5 ft
Status			In Situ	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	In Situ	In Situ	Removed	In Situ	In Situ
Analyte	Unit	PSL														
Metals																
Arsenic	mg/kg	7.3	4.2	**8.9**	4.4	**10**	6.2	3.1	1.5	3.4	1.7	3.5	1.8	3.2	4.9	3.2
Barium	mg/kg	8.3	**31**	**53**	**140**	**46**	**30**	**26**	**12**	**42**	**15**	**26**	**13**	**23**	**31**	**29**
Cadmium	mg/kg	0.77	***1.0 U***	**1.6**	**1.2**	0.36	**0.80**	0.20 U	0.20 U	0.20 U	0.19 U	0.18 U	0.19 U	0.18 U	0.21 U	0.17 U
Chromium, total	mg/kg	48	9.3	**140**	**260**	**240**	**150**	12	11	14	12	13	13	13	16	18
Chromium, trivalent	mg/kg	27	9.3	**140**	**260**	**240**	**150**	12	11	14	12	13	13	13	16	18
Lead	mg/kg	56	3.1	**110**	41	43	42	6.1	1.1	11	1.3	2.7	2.7	4.0	3.3	10
Mercury, inorganic	mg/kg	0.070	***1.0 U***	**0.16**	***0.40 U***	***0.40 U***	***0.40 U***	***0.31 U***	***0.27 U***	***0.35 U***	***0.33 U***	***0.31 U***	***0.27 U***	***0.31 U***	***0.39 U***	***0.30 U***
Selenium	mg/kg	0.26	***1.0 U***	0.20 U	0.20 U	0.20 U	0.21	**1.1**	**0.92**	**0.92**	**1.1**	**1.3**	**0.85**	**0.85**	**1.1**	**1.00**
Silver	mg/kg	0.016	***1.0 U***	**0.47**	**0.32**	**0.28**	**0.37**	**0.13**	***0.10 U***	***0.10 U***	***0.096 U***	***0.091 U***	***0.095 U***	***0.088 U***	***0.10 U***	***0.083 U***

Notes:
Results have been rounded to two significant digits.
Empty cells are intentional.
RED/BOLD Detection exceeds PSL.
BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

Abbreviations:
ft Feet
in Inches
mg/kg Milligrams per kilogram
PSL Preliminary Screening Level

Qualifiers:
U Analyte was not detected, concentration given is the reporting limit.

Table 4.5
Soil Analytical Results for Metals

		Location	WT-GP-10	WT-GP-11	WT-MW-110	WT-SB-01		WT-SB-05	WT-SB-08
		Sample ID	GP-10 (0-5)	GP-11 (0-5)	SB-11-0-2	SB-01-0-2	SB-01-10	SB-05-0-2	SB-08-0-2
		Sample Date	3/26/13	3/26/13	12/7/15	12/7/15	12/7/15	12/9/15	12/7/15
		Depth	0–5 ft	0–5 ft	0–2 ft	0–2 ft	10–10 ft	0–2 ft	0–2 ft
		Status	Removed	In Situ	Removed	Removed	In Situ	In Situ	Removed
Analyte	**Unit**	**PSL**							
Metals									
Arsenic	mg/kg	7.3	3.3	3.6	**8.1**	5.0	1.9	3.2	2.9
Barium	mg/kg	8.3	**34**	**57**	**56**	**42**	**13**	**28**	**20**
Cadmium	mg/kg	0.77	0.18	0.18 U	0.39	0.29	0.17 U	0.20 U	0.16 U
Chromium, total	mg/kg	48	11	15	24	20	10	14	11
Chromium, trivalent	mg/kg	27	11	15	24	20	10	14	11
Lead	mg/kg	56	5.6	16	36	30 J	0.98	6.2	12
Mercury, inorganic	mg/kg	0.070	***0.26 U***	***0.22 U***	***0.26 U***	***0.26 U***	***0.23 U***	***0.27 U***	***0.25 U***
Selenium	mg/kg	0.26	**0.90**	**0.91**	**0.84**	**1.4**	**0.82**	**1.2**	**0.86**
Silver	mg/kg	0.016	***0.084 U***	***0.087 U***	***0.085 U***	***0.095 U***	***0.085 U***	***0.099 U***	***0.080 U***

Notes:

Results have been rounded to two significant digits.

Empty cells are intentional.

RED/BOLD Detection exceeds PSL.

BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

Abbreviations:

ft Feet

in Inches

mg/kg Milligrams per kilogram

PSL Preliminary Screening Level

Qualifiers:

U Analyte was not detected, concentration given is the reporting limit.

Table 4.6
Soil Analytical Results for Semivolatile Organic Compounds

		Location	HO-SE1	WT-GP-2		WT-GP-3		WT-GP-4		WT-GP-5	WT-GP-7	WT-GP-8	WT-GP-10	WT-GP-11
		Sample ID	HO-SE1-4’	GP-2 (0-10)	GP-2 (10-13)	GP-3 (0-10)	GP-3 (10-13)	GP-4 (0-10)	GP-4 (10-13)	GP-5 (0-5)	GP-7 (0-5)	GP-8 (0-5)	GP-10 (0-5)	GP-11 (0-5)
		Sample Date	8/30/17	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13
		Depth	4–4 ft	0–10 ft	10–13 ft	0–10 ft	10–13 ft	0–10 ft	10–13 ft	0–5 ft	0–5 ft	0–5 ft	0–5 ft	0–5 ft
		Status	In Situ	Removed	Removed	Removed	Removed	In Situ	In Situ	Removed	In Situ	In Situ	Removed	In Situ
Analyte	**Unit**	**PSL**												
Semivolatile Organic Compounds														
Polycyclic Aromatic Hydrocarbons														
Acenaphthene	mg/kg	0.028												
Acenaphthylene	mg/kg	--												
Anthracene	mg/kg	0.051												
Benzo(a)anthracene	mg/kg	--	0.010 U											
Benzo(b)fluoranthene	mg/kg	--	0.010 U											
Benzo(g,h,i)perylene	mg/kg	--												
Benzo(a)pyrene	mg/kg	--	0.010 U											
Benzo(k)fluoranthene	mg/kg	--	0.010 U											
Chrysene	mg/kg	--	0.010 U											
Dibenz(a,h)anthracene	mg/kg	--	0.010 U											
Dibenzofuran	mg/kg	0.029												
Fluoranthene	mg/kg	0.09												
Fluorene	mg/kg	0.029												
Indeno(1,2,3-c,d)pyrene	mg/kg	--	0.010 U											
1-Methylnaphthalene	mg/kg	0.0042												
2-Methylnaphthalene	mg/kg	0.039												
Naphthalene	mg/kg	0.0021	***0.050 U***											
Phenanthrene	mg/kg	--												
Pyrene	mg/kg	0.14												
Total cPAH TEQ	mg/kg	0.000016												
Other Semivolatile Organic Compounds														
Benzyl alcohol	mg/kg	0.017												
Bis(2-chloroethoxy)methane	mg/kg	--												
Bis(2-chloroethyl)ether	mg/kg	0.000014												
Bis(2-ethylhexyl) phthalate	mg/kg	0.0051												
4-Bromophenyl phenyl ether	mg/kg	--												
Butyl benzyl phthalate	mg/kg	0.00018												
Carbazole	mg/kg	--												
4-Chloroaniline	mg/kg	0.000077												
4-Chloro-3-methylphenol	mg/kg	--												
2-Chloronaphthalene	mg/kg	0.28												
2-Chlorophenol	mg/kg	0.011												
4-Chlorophenyl phenyl ether	mg/kg	--												
Dibutyl phthalate	mg/kg	0.015												
1,2-Dichlorobenzene	mg/kg	0.0031	***0.050 U***											
1,4-Dichlorobenzene	mg/kg	0.0081	***0.050 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.12 U***	***0.11 U***	***0.12 U***	***0.10 U***	***0.10 U***	***0.096 U***
2,4-Dichlorophenol	mg/kg	0.0043												
1,3-Dichlorobenzene	mg/kg	0.0013	***0.050 U***											
Diethyl phthalate	mg/kg	0.034												
Dimethyl phthalate	mg/kg	0.019												
2,4-Dimethylphenol	mg/kg	0.0031												
4,6-Dinitro-2-methylphenol	mg/kg	0.0073												
2,4-Dinitrophenol	mg/kg	0.0092												
2,4-Dinitrotoluene	mg/kg	0.00016		***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.12 U***	***0.11 U***	***0.12 U***	***0.10 U***	***0.10 U***	***0.096 U***
2,6-Dinitrotoluene	mg/kg	0.000051												
Di-n-octyl phthalate	mg/kg	0.33												

Table 4.6
Soil Analytical Results for Semivolatile Organic Compounds

		Location	HO-SE1	WT-GP-2		WT-GP-3		WT-GP-4		WT-GP-5	WT-GP-7	WT-GP-8	WT-GP-10	WT-GP-11
		Sample ID	HO-SE1-4'	GP-2 (0-10)	GP-2 (10-13)	GP-3 (0-10)	GP-3 (10-13)	GP-4 (0-10)	GP-4 (10-13)	GP-5 (0-5)	GP-7 (0-5)	GP-8 (0-5)	GP-10 (0-5)	GP-11 (0-5)
		Sample Date	8/30/17	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13	3/26/13
		Depth	4–4 ft	0–10 ft	10–13 ft	0–10 ft	10–13 ft	0–10 ft	10–13 ft	0–5 ft	0–5 ft	0–5 ft	0–5 ft	0–5 ft
		Status	In Situ	Removed	Removed	Removed	Removed	In Situ	In Situ	Removed	In Situ	In Situ	Removed	In Situ
Analyte	**Unit**	**PSL**												
Semivolatile Organic Compounds (cont.)														
Other Semivolatile Organic Compounds (cont.)														
Hexachlorobenzene	mg/kg	0.0000004		***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.12 U***	***0.11 U***	***0.12 U***	***0.10 U***	***0.10 U***	***0.096 U***
Hexachlorobutadiene	mg/kg	0.00054	***0.25 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.12 U***	***0.11 U***	***0.12 U***	***0.10 U***	***0.10 U***	***0.096 U***
Hexachlorocyclopentadiene	mg/kg	0.2												
Hexachloroethane	mg/kg	0.000041		***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.12 U***	***0.11 U***	***0.12 U***	***0.10 U***	***0.10 U***	***0.096 U***
Isophorone	mg/kg	0.015												
2-Methylphenol	mg/kg	0.01		***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.12 U***	***0.11 U***	***0.12 U***	***0.10 U***	***0.10 U***	***0.096 U***
4-Methylphenol	mg/kg	0.062		***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.11 U***	***0.12 U***	***0.11 U***	***0.12 U***	***0.10 U***	***0.10 U***	***0.096 U***
2-Nitroaniline	mg/kg	0.064												
Nitrobenzene	mg/kg	0.0065		***0.22 U***	***0.23 U***	***0.22 U***	***0.22 U***	***0.23 U***	***0.23 U***	***0.22 U***	***0.23 U***	***0.20 U***	***0.20 U***	***0.19 U***
2-Nitrophenol	mg/kg	--												
4-Nitrophenol	mg/kg	--												
n-Nitrosodi-n-propylamine	mg/kg	0.0000039												
Phenol	mg/kg	0.12												
Pyridine	mg/kg	0.0029		***0.22 U***	***0.23 U***	***0.22 U***	***0.22 U***	***0.23 U***	***0.23 U***	***0.22 U***	***0.23 U***	***0.20 U***	***0.20 U***	***0.19 U***
1,2,4-Trichlorobenzene	mg/kg	0.0019	***0.25 U***											
2,4,5-Trichlorophenol	mg/kg	0.000070		***0.22 U***	***0.23 U***	***0.22 U***	***0.22 U***	***0.23 U***	***0.23 U***	***0.22 U***	***0.23 U***	***0.20 U***	***0.20 U***	***0.19 U***
2,4,6-Trichlorophenol	mg/kg	0.0027		***0.22 U***	***0.23 U***	***0.22 U***	***0.22 U***	***0.23 U***	***0.23 U***	***0.22 U***	***0.23 U***	***0.20 U***	***0.20 U***	***0.19 U***

Notes:

Results have been rounded to two significant digits.
Empty cells are intentional.
-- Not available.
RED/BOLD Detection exceeds PSL.
BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

Abbreviations:

cPAH Carcinogenic polycyclic aromatic hydrocarbon
ft Feet
mg/kg Milligrams per kilogram
PSL Preliminary Screening Level
TEQ Toxic equivalent

Qualifier:

U Analyte was not detected, concentration given is the reporting limit.

Table 4.6
Soil Analytical Results for Semivolatile Organic Compounds

		Location	WT-MW-110	WT-SB-01		WT-SB-05	WT-SB-08
		Sample ID	**SB-11-0-2**	**SB-01-0-2**	**SB-01-10**	**SB-05-0-2**	**SB-08-0-2**
		Sample Date	**12/7/15**	**12/7/15**	**12/7/15**	**12/9/15**	**12/7/15**
		Depth	**0–2 ft**	**0–2 ft**	**10–10 ft**	**0–2 ft**	**0–2 ft**
		Status	**Removed**	**Removed**	**In Situ**	**In Situ**	**Removed**
Analyte	**Unit**	**PSL**					
Semivolatile Organic Compounds							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	0.028		***0.095 U***	***0.083 U***	***0.090 U***	***0.081 U***
Acenaphthylene	mg/kg	--	0.090 U	0.095 U	0.083 U	0.090 U	0.081 U
Anthracene	mg/kg	0.051	***0.090 U***	***0.095 U***	***0.083 U***	***0.090 U***	***0.081 U***
Benzo(a)anthracene	mg/kg	--	0.46	0.095 U	0.083 U	0.090 U	0.081 U
Benzo(b)fluoranthene	mg/kg	--	0.82	0.095 U	0.083 U	0.090 U	0.081 U
Benzo(g,h,i)perylene	mg/kg	--	0.30	0.095 U	0.083 U	0.090 U	0.081 U
Benzo(a)pyrene	mg/kg	--	0.64	0.095 U	0.083 U	0.090 U	0.081 U
Benzo(k)fluoranthene	mg/kg	--	0.30	0.095 U	0.083 U	0.090 U	0.081 U
Chrysene	mg/kg	--	0.42	0.095 U	0.083 U	0.090 U	0.081 U
Dibenz(a,h)anthracene	mg/kg	--	0.090 U	0.095 U	0.083 U	0.090 U	0.081 U
Dibenzofuran	mg/kg	0.029	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
Fluoranthene	mg/kg	0.09	**0.97**	***0.095 U***	0.083 U	0.090 U	0.081 U
Fluorene	mg/kg	0.029	***0.090 U***	***0.095 U***	***0.083 U***	***0.090 U***	***0.081 U***
Indeno(1,2,3-c,d)pyrene	mg/kg	--	0.43	0.095 U	0.083 U	0.090 U	0.081 U
1-Methylnaphthalene	mg/kg	0.0042	***0.090 U***	***0.095 U***	***0.083 U***	***0.090 U***	***0.081 U***
2-Methylnaphthalene	mg/kg	0.039	***0.090 U***	***0.095 U***	***0.083 U***	***0.090 U***	***0.081 U***
Naphthalene	mg/kg	0.0021	***0.090 U***	***0.095 U***	***0.083 U***	***0.090 U***	***0.081 U***
Phenanthrene	mg/kg	--	0.38	0.095 U	0.083 U	0.090 U	0.081 U
Pyrene	mg/kg	0.14	**0.83**	0.095 U	0.083 U	0.090 U	0.081 U
Total cPAH TEQ	mg/kg	0.000016	**0.84**	***0.072 U***	***0.063 U***	***0.068 U***	***0.062 U***
Other Semivolatile Organic Compounds							
Benzyl alcohol	mg/kg	0.017	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
Bis(2-chloroethoxy)methane	mg/kg	--	0.11 U	0.12 U	0.10 U	0.11 U	0.10 U
Bis(2-chloroethyl)ether	mg/kg	0.000014	***0.23 U***	***0.24 U***	***0.21 U***	***0.22 U***	***0.20 U***
Bis(2-ethylhexyl) phthalate	mg/kg	0.0051	**2.6**	**0.14**	***0.10 U***	***0.11 U***	***0.10 U***
4-Bromophenyl phenyl ether	mg/kg	--	0.11 U	0.12 U	0.10 U	0.11 U	0.10 U
Butyl benzyl phthalate	mg/kg	0.00018	**0.86**	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
Carbazole	mg/kg	--	0.56 U	0.59 U	0.52 U	0.56 U	0.51 U
4-Chloroaniline	mg/kg	0.000077	***0.56 U***	***0.59 U***	***0.52 U***	***0.56 U***	***0.51 U***
4-Chloro-3-methylphenol	mg/kg	--	0.56 U	0.59 U	0.52 U	0.56 U	0.51 U
2-Chloronaphthalene	mg/kg	0.28	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
2-Chlorophenol	mg/kg	0.011	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
4-Chlorophenyl phenyl ether	mg/kg	--	0.11 U	0.12 U	0.10 U	0.11 U	0.10 U
Dibutyl phthalate	mg/kg	0.015	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
1,2-Dichlorobenzene	mg/kg	0.0031	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
1,4-Dichlorobenzene	mg/kg	0.0081	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
2,4-Dichlorophenol	mg/kg	0.0043	***0.23 U***	***0.24 U***	***0.21 U***	***0.22 U***	***0.20 U***
1,3-Dichlorobenzene	mg/kg	0.0013	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
Diethyl phthalate	mg/kg	0.034	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
Dimethyl phthalate	mg/kg	0.019	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
2,4-Dimethylphenol	mg/kg	0.0031	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
4,6-Dinitro-2-methylphenol	mg/kg	0.0073	***0.23 U***	***0.24 U***	***0.21 U***	***0.22 U***	***0.20 U***
2,4-Dinitrophenol	mg/kg	0.0092	***0.23 U***	***0.24 U***	***0.21 U***	***0.22 U***	***0.20 U***
2,4-Dinitrotoluene	mg/kg	0.00016	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
2,6-Dinitrotoluene	mg/kg	0.000051	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
Di-n-octyl phthalate	mg/kg	0.33	0.11 U	0.12 U	0.10 U	0.11 U	0.10 U

Table 4.6
Soil Analytical Results for Semivolatile Organic Compounds

		Location	WT-MW-110	WT-SB-01		WT-SB-05	WT-SB-08
		Sample ID	SB-11-0-2	SB-01-0-2	SB-01-10	SB-05-0-2	SB-08-0-2
		Sample Date	12/7/15	12/7/15	12/7/15	12/9/15	12/7/15
		Depth	0–2 ft	0–2 ft	10–10 ft	0–2 ft	0–2 ft
		Status	Removed	Removed	In Situ	In Situ	Removed
Analyte	**Unit**	**PSL**					
Semivolatile Organic Compounds (cont.)							
Other Semivolatile Organic Compounds (cont.)							
Hexachlorobenzene	mg/kg	0.0000004	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
Hexachlorobutadiene	mg/kg	0.00054	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
Hexachlorocyclopentadiene	mg/kg	0.2	0.11 U	0.12 U	0.10 U	0.11 U	0.10 U
Hexachloroethane	mg/kg	0.000041	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
Isophorone	mg/kg	0.015	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
2-Methylphenol	mg/kg	0.01	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
4-Methylphenol	mg/kg	0.062	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
2-Nitroaniline	mg/kg	0.064	***0.56 U***	***0.59 U***	***0.52 U***	***0.56 U***	***0.51 U***
Nitrobenzene	mg/kg	0.0065	***0.23 U***	***0.24 U***	***0.21 U***	***0.22 U***	***0.20 U***
2-Nitrophenol	mg/kg	--	0.23 U	0.24 U	0.21 U	0.22 U	0.20 U
4-Nitrophenol	mg/kg	--	0.56 U	0.59 U	0.52 U	0.56 U	0.51 U
n-Nitrosodi-n-propylamine	mg/kg	0.0000039	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
Phenol	mg/kg	0.12	***0.23 U***	***0.24 U***	***0.21 U***	***0.22 U***	***0.20 U***
Pyridine	mg/kg	0.0029					
1,2,4-Trichlorobenzene	mg/kg	0.0019	***0.11 U***	***0.12 U***	***0.10 U***	***0.11 U***	***0.10 U***
2,4,5-Trichlorophenol	mg/kg	0.000070	***0.23 U***	***0.24 U***	***0.21 U***	***0.22 U***	***0.20 U***
2,4,6-Trichlorophenol	mg/kg	0.0027	***0.23 U***	***0.24 U***	***0.21 U***	***0.22 U***	***0.20 U***

Notes:

Results have been rounded to two significant digits.
Empty cells are intentional.
-- Not available.
RED/BOLD Detection exceeds PSL.
BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

Abbreviations:

cPAH Carcinogenic polycyclic aromatic hydrocarbon
ft Feet
mg/kg Milligrams per kilogram
PSL Preliminary Screening Level
TEQ Toxic equivalent

Qualifier:

U Analyte was not detected, concentration given is the reporting limit.

Table 4.7
Stormwater System Excavation Trench Composite Sample Results

	Location	WT-A1	WT-A2	WT-A3		WT-A4	WT-A5	WT-B	WT-C	WT-D	WT-E1	WT-E2
	Sample ID	WT-A1	WT-A2	WT-A3	WT-A3-D	WT-A4	WT-A5	WT-B	WT-C	WT-D	WT-E1	WT-E2
	Sample Date	09/28/2017	09/28/2017	09/20/2017	09/20/2017	10/26/2017	4/1/2018	09/28/2017	09/19/2017	09/19/2017	09/19/2017	09/19/2017
	Sample Depth	4 ft	5 ft	9–9.5 ft	9–9.5 ft	10 ft	7–8 ft	3–5 ft	4 ft	4 ft	4 ft	4 ft
	Number of Composite Sub-Samples	5	5	3	3	3	3	3	4	4	4	5
Analyte	**Unit**											
Total Petroleum Hydrocarbons												
Oil-range organics	mg/kg	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Stoddard solvent	mg/kg	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Semivolatile Organic Compounds												
Pentachlorophenol	mg/kg	0.10 U	0.10 U	0.50 U	0.50 U	0.10 U	0.050 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Dioxins/Furans												
Dioxins/furans TEQ (1,2)	ng/g		0.000834 J									

Notes:

Results have been rounded to two significant digits, except for dioxin/furan TEQ results, which have been rounded to three significant digits.
Empty cells are intentional.
1 World Health Organization 2005 Toxic Equivalency Factors were used for calculation of dioxin/furan TEQ (Van den Berg et al. 2006).
2 Calculated using detected dioxin/furan concentrations plus one-half the detection limit for dioxins/furans that were not detected.

Abbreviations:
ft Feet
mg/kg Milligrams per kilogram
pg/g Picograms per gram
TEQ Toxic equivalent

Qualifiers:
J Analyte was detected, concentration is considered an estimate.
U Analyte was not detected at the given reporting limit.

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Petroleum Hydrocarbons					Polychlorinated Biphenyls (PCBs)		Dioxins/ Furans	Other Semivolatile Organic Compounds	Volatile Organic Compounds			
		Analyte	Gasoline-Range Organics, weathered (1)	Stoddard Solvent	Diesel-Range Organics, weathered (1)	Oil-Range Organics	Total DRO + ORO	Total PCB Aroclors	Total PCB congeners	Total dioxin/furan TEQ (5)	Pentachlorophenol	Benzene	Chloroethane	1,1-Dichloroethane	1,2-Dichloroethane
		CAS No.	TPHG	TPHSS	TPHD	TPHO	TPHD+O	1336-36-3	PCBCON	DFTEQ	87-86-5	71-43-2	75-00-3	75-34-3	107-06-2
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pg/L	pg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	30	500	500	500	500	0.000007	7	0.0051	0.002	1.6	19,000	7.7	4.2
Sample Name	Sample Date	Site													
B-18															
B-18-8/18/2003	8/18/2003	Fox Avenue									3.6				
B-18-12/13/2005	12/13/2005	Fox Avenue													
B-18-8/3/2007	8/3/2007	Fox Avenue									0.47 U				
B-18-11	1/28/2009	Fox Avenue										20 U	20 U	20 U	20 U
B-18-012110	1/21/2010	Fox Avenue										1.4	1.5	12	1.0 U
B-18-11	10/21/2010	Fox Avenue	50 U	50 U	50 U	100 U	100 U (3)					1.0 U	1.0 U	1.0 U	1.0 U
B18-20140411	4/11/2014	Whitehead Tyee	100 U	50 U	260 (2)	250 U	260				0.20 U	1.1	1.0 U	1.0 U	1.0 U
B-18-051514	5/15/2014	Fox Avenue										12		1.9	1.8
B-18-052715	5/27/2015	Fox Avenue										3.8		1.0 U	1.0 U
B-20A															
B-20A-8/19/2003	8/19/2003	Fox Avenue									0.50 U				
B-20A-11/17/2004	11/17/2004	Fox Avenue													
B-20A-12/13/2005	12/13/2005	Fox Avenue									1.4				
B-20A-12/6/2006	12/6/2006	Fox Avenue													
B-20A-8/6/2007	8/6/2007	Fox Avenue									0.47 U				
B-20F-10	1/28/2009	Fox Avenue										20 U	20 U	20 U	20 U
B-20A-10	1/28/2009	Fox Avenue										20 U	20 U	20 U	20 U
DUP-1-062014	6/20/2014	Fox Avenue										12		1.0 U	1.0 U
B-20A-062014	6/20/2014	Fox Avenue										12		1.0 U	1.0 U
B-20A-051315	5/13/2015	Fox Avenue										3.6		1.0 U	1.0 U
B-20A-092915	9/29/2015	Fox Avenue										3.9		1.0 U	1.0 U
B-36															
B-36-8/18/2003	8/18/2003	Fox Avenue													
B-36-12/13/2005	12/13/2005	Fox Avenue													
B-36-8/6/2007	8/6/2007	Fox Avenue									0.47 U				
B-36-012110	1/21/2010	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-36-121815	12/18/2015	Whitehead Tyee		50 UJ	530	99 U	530				1.4				
B-38															
B-38-8/18/2003	8/18/2003	Fox Avenue									2,000				
B-38-8/9/2007	8/9/2007	Fox Avenue									12,000				
B38-20140114	1/14/2014	Whitehead Tyee		660 J	1,300 (2)	620 (2)	1,900				330				
MW99-20140114	1/14/2014	Whitehead Tyee		810 J	1,600 (2)	840 (2)	2,400				450				
B38-20140415	4/15/2014	Whitehead Tyee	7,100 (2)	11,000 (2)	16,000 (2)	1,100 (2)	NA (4)				5,300	1.0 U	1.0 U	1.0 U	1.0 U
B-38-122115	12/21/2015	Whitehead Tyee		2,000 J	50 U	200	200				2,200				
B-44															
B-44-8/20/2003	8/20/2003	Fox Avenue													
B-44-11/18/2004	11/18/2004	Fox Avenue													
B-44-1/13/2005	1/13/2005	Fox Avenue													
B-44-2/9/2005	2/9/2005	Fox Avenue													
B-44-3/9/2005	3/9/2005	Fox Avenue													
B-44-12/19/2005	12/19/2005	Fox Avenue													
B-44-2/16/2006	2/16/2006	Fox Avenue													
B-44-12/5/2006	12/5/2006	Fox Avenue									1.9 J				
B-44-8/8/2007	8/8/2007	Fox Avenue													
B-44-10	1/28/2009	Fox Avenue										200 U	200 U	200 U	200 U

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Petroleum Hydrocarbons					Polychlorinated Biphenyls (PCBs)		Dioxins/ Furans	Other Semivolatile Organic Compounds	Volatile Organic Compounds			
		Analyte	Gasoline-Range Organics, weathered (1)	Stoddard Solvent	Diesel-Range Organics, weathered (1)	Oil-Range Organics	Total DRO + ORO	Total PCB Aroclors	Total PCB congeners	Total dioxin/furan TEQ (5)	Pentachlorophenol	Benzene	Chloroethane	1,1-Dichloroethane	1,2-Dichloroethane
		CAS No.	TPHG	TPHSS	TPHD	TPHO	TPHD+O	1336-36-3	PCBCON	DFTEQ	87-86-5	71-43-2	75-00-3	75-34-3	107-06-2
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pg/L	pg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	30	500	500	500	500	0.000007	7	0.0051	0.002	1.6	19,000	7.7	4.2
Sample Name	Sample Date	Site													
B-49															
B-49-8/20/2003	8/20/2003	Fox Avenue									**600**				
B-49-12/11/2003	12/11/2003	Fox Avenue													
B-49-1/29/2004	1/29/2004	Fox Avenue													
B-49-2/27/2004	2/27/2004	Fox Avenue													
B-49-3/29/2004	3/29/2004	Fox Avenue													
B-49-4/27/2004	4/27/2004	Fox Avenue													
B-49-11/18/2004	11/18/2004	Fox Avenue									**230**				
B-49-1/13/2005	1/13/2005	Fox Avenue									**2.9**				
B-49-2/9/2005	2/9/2005	Fox Avenue									**2.5**				
B-49-3/9/2005	3/9/2005	Fox Avenue									**6.1**				
B-49-8/6/2007	8/6/2007	Fox Avenue									**120**				
B-49-051414	5/14/2014	Fox Avenue										1.0 U		1.0 U	1.0 U
B-49-102314	10/23/2014	Fox Avenue										1.5		1.0 U	1.0 U
B-49-051315	5/13/2015	Fox Avenue										1.0 U		1.0 U	1.0 U
B-49-093015	9/30/2015	Fox Avenue										1.0 U		1.0 U	1.0 U
B-49-121715	12/17/2015	Whitehead Tyee		50 UJ	50 U	100 U	100 U				***0.10 U***				
B-58															
B-58-8/19/2003	8/19/2003	Fox Avenue									**2.1**				
B-58-11/17/2004	11/17/2004	Fox Avenue													
B-58-1/11/2005	1/11/2005	Fox Avenue													
B-58-2/10/2005	2/10/2005	Fox Avenue													
B-58-3/8/2005	3/8/2005	Fox Avenue													
B-58-8/16/2005	8/16/2005	Fox Avenue													
B-58-12/14/2005	12/14/2005	Fox Avenue									**15**				
B-58-2/16/2006	2/16/2006	Fox Avenue													
B-58-12/6/2006	12/6/2006	Fox Avenue													
B-58-8/9/2007	8/9/2007	Fox Avenue													
B-58-10-B	1/28/2009	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-58-042809	4/28/2009	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-58-102609	10/26/2009	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-58-012110	1/21/2010	Fox Avenue										***10 U***	10 U	***10 U***	***10 U***
B-58-10.5	10/21/2010	Fox Avenue	***50 U***	50 U	50 U	100 U	100 U (3)					1.0 U	1.4	1.0 U	1.0 U
B-58-033011	3/30/2011	Fox Avenue										1.0 U	2.5 J	1.0 U	1.0 U
B-58-112911	11/29/2011	Fox Avenue										1.3	1.0 U	1.0 U	1.0 U
B-58-082012	8/20/2012	Fox Avenue										1.0 U		1.0	1.0 U
B-58-052913	5/29/2013	Fox Avenue										**4.7**	1.0 U	1.3	1.0 U
B-58-072213	7/22/2013	Fox Avenue										**6.1**		1.0 U	1.0 U
B-58-051514	5/15/2014	Fox Avenue										**1.7**		1.0 U	1.0 U
B-58-051315	5/13/2015	Fox Avenue										1.3		1.0 U	1.0 U
B-58S-092915	9/29/2015	Fox Avenue										1.4		1.0 U	1.0 U

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Petroleum Hydrocarbons					Polychlorinated Biphenyls (PCBs)		Dioxins/ Furans	Other Semivolatile Organic Compounds	Volatile Organic Compounds			
		Analyte	Gasoline-Range Organics, weathered (1)	Stoddard Solvent	Diesel-Range Organics, weathered (1)	Oil-Range Organics	Total DRO + ORO	Total PCB Aroclors	Total PCB congeners	Total dioxin/furan TEQ (5)	Pentachlorophenol	Benzene	Chloroethane	1,1-Dichloroethane	1,2-Dichloroethane
		CAS No.	TPHG	TPHSS	TPHD	TPHO	TPHD+O	1336-36-3	PCBCON	DFTEQ	87-86-5	71-43-2	75-00-3	75-34-3	107-06-2
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pg/L	pg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	30	500	500	500	500	0.000007	7	0.0051	0.002	1.6	19,000	7.7	4.2
Sample Name	**Sample Date**	**Site**													
B-60															
B-60-8/19/2003	8/19/2003	Fox Avenue									***0.50 U***				
B-60-12/11/2003	12/11/2003	Fox Avenue													
B-60-1/27/2004	1/27/2004	Fox Avenue													
B-60-2/26/2004	2/26/2004	Fox Avenue													
B-60-3/27/2004	3/27/2004	Fox Avenue													
B-60-4/26/2004	4/26/2004	Fox Avenue													
B-60-1/11/2005	1/11/2005	Fox Avenue													
B-60-2/10/2005	2/10/2005	Fox Avenue													
B-60-3/8/2005	3/8/2005	Fox Avenue													
B-60-8/16/2005	8/16/2005	Fox Avenue													
B-60-12/13/2005	12/13/2005	Fox Avenue													
B-60-2/16/2006	2/16/2006	Fox Avenue													
B-60-7/13/2006	7/13/2006	Fox Avenue													
B-60-12/6/2006	12/6/2006	Fox Avenue													
B-60-8/6/2007	8/6/2007	Fox Avenue									***0.48 U***				
B-60-9.7	1/27/2009	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-60-042809	4/28/2009	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-60-102609	10/26/2009	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-60-011410	1/14/2010	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-60-021610	2/16/2010	Fox Avenue										***5.0 U***	5.0 U	5.0 U	***5.0 U***
DUP1-041410	4/14/2010	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-60-041410	4/14/2010	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-60-11	10/21/2010	Fox Avenue	***50 U***	50 U	50 U	100 U	100 U (3)					1.0 U	18	0.61 J	1.0 U
B-60-033011	3/30/2011	Fox Avenue										1.0 U	13 J	1.7	1.0 U
B-60-112911	11/29/2011	Fox Avenue										1.0	12	4.6	1.0 U
B-60-082012	8/20/2012	Fox Avenue										**2.6**		**8.2**	1.0 U
B-60-052913	5/29/2013	Fox Avenue										**21**	1.0 U	2.0	1.0 U
B-60-072213	7/22/2013	Fox Avenue										**19**		1.0 U	1.0 U
B-60-051514	5/15/2014	Fox Avenue										**3.5**		1.0 U	1.0 U
B-60-051315	5/13/2015	Fox Avenue										1.5		1.0 U	1.0 U
B-60S-093015	9/30/2015	Fox Avenue										1.1		1.0 U	1.0 U
B-62															
B-62-8/18/2003	8/18/2003	Fox Avenue									**4.9**				
B-62-8/16/2005	8/16/2005	Fox Avenue													
B-62-12/13/2005	12/13/2005	Fox Avenue													
B-62-12/6/2006	12/6/2006	Fox Avenue													
B-62-8/6/2007	8/6/2007	Fox Avenue									***0.48 U***				
B-62-012110	1/21/2010	Fox Avenue										***10 U***	10 U	***10 U***	***10 U***
B-62-10.5	10/21/2010	Fox Avenue	***50 U***	230	50 U	100 U	100 U (3)					**3.8**	8.3	**16**	1.0 U
B-62-051514	5/15/2014	Fox Avenue										1.0 U		1.0 U	1.0 U

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Petroleum Hydrocarbons					Polychlorinated Biphenyls (PCBs)		Dioxins/ Furans	Other Semivolatile Organic Compounds	Volatile Organic Compounds			
		Analyte	Gasoline-Range Organics, weathered (1)	Stoddard Solvent	Diesel-Range Organics, weathered (1)	Oil-Range Organics	Total DRO + ORO	Total PCB Aroclors	Total PCB congeners	Total dioxin/furan TEQ (5)	Pentachlorophenol	Benzene	Chloroethane	1,1-Dichloroethane	1,2-Dichloroethane
		CAS No.	TPHG	TPHSS	TPHD	TPHO	TPHD+O	1336-36-3	PCBCON	DFTEQ	87-86-5	71-43-2	75-00-3	75-34-3	107-06-2
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pg/L	pg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	30	500	500	500	500	0.000007	7	0.0051	0.002	1.6	19,000	7.7	4.2
Sample Name	Sample Date	Site													
B-64															
B-64-8/18/2003	8/18/2003	Fox Avenue									***0.50 U***				
B-64-11/16/2004	11/16/2004	Fox Avenue													
B-64-3/7/2005	3/7/2005	Fox Avenue													
B-64-12/12/2005	12/12/2005	Fox Avenue													
B-64-12/6/2006	12/6/2006	Fox Avenue													
B-64-8/2/2007	8/2/2007	Fox Avenue									***0.47 U***				
B-64-8	1/26/2009	Fox Avenue										***20 U***	20 U	***20 U***	***20 U***
B-64-042809	4/28/2009	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-64-102909	10/29/2009	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-64-011410	1/14/2010	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
B-64-021610	2/16/2010	Fox Avenue										***5.0 U***	5.0 U	5.0 U	***5.0 U***
B-64-033011	3/30/2011	Fox Avenue										1.0 U	2.3 J	1.0 U	1.0 U
B-64-112811	11/28/2011	Fox Avenue										1.0 U	8.4	1.0 U	1.0 U
B-64-081712	8/17/2012	Fox Avenue										1.0 U		1.2	1.0 U
B-64-072213	7/22/2013	Fox Avenue										1.0 U		1.0 U	1.0 U
B-64-052715	5/27/2015	Fox Avenue										1.2		1.1	1.0 U
MW-03															
MW-3-11/3/2003	11/3/2003	Fox Avenue									**9.9 J**				
MW-3-11/16/2004	11/16/2004	Fox Avenue													
MW-3-2/7/2005	2/7/2005	Fox Avenue													
MW-3-3/7/2005	3/7/2005	Fox Avenue													
MW-3-12/12/2005	12/12/2005	Fox Avenue													
MW-3-2/16/2006	2/16/2006	Fox Avenue													
MW-3-12/7/2006	12/7/2006	Fox Avenue													
MW-3-8/2/2007	8/2/2007	Fox Avenue									**3.2**				
MW-3-102809	10/28/2009	Fox Avenue										***10 U***	10 U	***10 U***	***10 U***
MW-3-011510	1/15/2010	Fox Avenue										***10 U***	10 U	***10 U***	***10 U***
MW-3-042210	4/15/2010	Fox Avenue										1.0 U	1.0 U	1.0 U	1.0 U
MW-3-121312	12/13/2012	Fox Avenue										**2.0**	1.0 U	4.0	1.0 U
MW-3-052715	5/27/2015	Fox Avenue										**5.2**		2.2	1.0 U
DUP01-111615	11/16/2015	Fox Avenue										**4.7**		2.6	1.0 U
MW-3-111615	11/16/2015	Fox Avenue										**4.7**		2.5	1.0 U
MW-07															
MW-7-12/12/2003	12/12/2003	Fox Avenue									**2.4**				
MW-7-2/7/2005	2/7/2005	Fox Avenue													
MW-7-8/16/2005	8/16/2005	Fox Avenue													
MW-7-12/15/2005	12/15/2005	Fox Avenue													
MW-7-12/4/2006	12/4/2006	Fox Avenue													
MW-7-8/7/2007	8/7/2007	Fox Avenue									**3.4**				
MW-7-11	1/28/2009	Fox Avenue										***20 U***	20 U	***20 U***	***20 U***
MW07-20140102	1/2/2014	Whitehead Tyee		**16,000 (2)**	**19,000 (2)**	**3,500 (2)**	NA (4)				**150**				
MW-7 041114	4/11/2014	Fox Avenue													
MW-7-121815	12/18/2015	Whitehead Tyee		50 UJ	56	100 U	56				**1.1**				

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Petroleum Hydrocarbons					Polychlorinated Biphenyls (PCBs)		Dioxins/ Furans	Other Semivolatile Organic Compounds	Volatile Organic Compounds			
		Analyte	Gasoline-Range Organics, weathered [1]	Stoddard Solvent	Diesel-Range Organics, weathered [1]	Oil-Range Organics	Total DRO + ORO	Total PCB Aroclors	Total PCB congeners	Total dioxin/furan TEQ [5]	Pentachlorophenol	Benzene	Chloroethane	1,1-Dichloroethane	1,2-Dichloroethane
		CAS No.	TPHG	TPHSS	TPHD	TPHO	TPHD+O	1336-36-3	PCBCON	DFTEQ	87-86-5	71-43-2	75-00-3	75-34-3	107-06-2
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pg/L	pg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	30	500	500	500	500	0.000007	7	0.0051	0.002	1.6	19,000	7.7	4.2
Sample Name	**Sample Date**	**Site**													
MW-09															
MW-9-8/17/2005	8/17/2005	Fox Avenue													
MW-9-12/16/2005	12/16/2005	Fox Avenue													
MW-9-12/4/2006	12/4/2006	Fox Avenue													
MW-9-8/7/2007	8/7/2007	Fox Avenue									**3.0**				
MW-9-10.4	1/26/2009	Fox Avenue										***20 U***	20 U	***20 U***	***20 U***
MW-9-051414	5/14/2014	Fox Avenue										**8.7**		1.0 U	1.0 U
MW-9-051515	5/15/2015	Fox Avenue										**5.2**		1.0 U	1.0 U
MW-9-093015	9/30/2015	Fox Avenue										**4.6**		1.0 U	1.0 U
MW-9-122115	12/21/2015	Whitehead Tyee		50 UJ	50 U	**710**	**710**				**0.98**				
PTM-2U															
PTM-2U-12/9/2003	12/9/2003	Fox Avenue													
PTM-2U-1/28/2004	1/28/2004	Fox Avenue													
PTM-2U-2/26/2004	2/26/2004	Fox Avenue													
PTM-2U-3/27/2004	3/27/2004	Fox Avenue													
PTM-2U-4/26/2004	4/26/2004	Fox Avenue													
PTM-2U-5/28/2004	5/28/2004	Fox Avenue													
PTM-2U-2/16/2006	2/16/2006	Fox Avenue													
PTM-2U-12/4/2006	12/4/2006	Fox Avenue													
PTM-2U-8/9/2007	8/9/2007	Fox Avenue													
PTM-2U-25	4/7/2009	Fox Avenue										**27**	1.0 U	**44**	1.0 U
WT-MW-01															
MW01-20140103	1/3/2014	Whitehead Tyee		**2,300**	**2,000** [2]	250 U	**2,000**				**150**				
MW01-20140415	4/15/2014	Whitehead Tyee	**3,400** [2]	**1,600** [2]	**1,800** [2]	250 U	NA [4]				**190**	1.0 U	1.0 U	1.0 U	1.0 U
MW-01-121715	12/17/2015	Whitehead Tyee		**700 J**	50 U	100 U	100 U				**730**				
MW-01-010716	1/7/2016	Whitehead Tyee								**91.3 J**					
WT-MW-02															
MW02-20140103	1/3/2014	Whitehead Tyee		**4,800** [2]	**4,300** [2]	250 U	**4,300**				**11**				
MW02-20140415	4/15/2014	Whitehead Tyee	**9,700** [2]	**7,100** [2]	**7,800** [2]	250 U	NA [4]				**35**	1.0 U	1.0 U	1.0 U	1.0 U
MW-02-121715	12/17/2015	Whitehead Tyee		**1,300 J**	50 U	100 U	100 U				**8.8**				
WT-MW-03															
MW03-20140102	1/2/2014	Whitehead Tyee		50 U	76 [2]	250 U	76				**1.3**				
MW03-20140411	4/11/2014	Whitehead Tyee	***100 U***	50 U	63 [2]	250 U	63				**0.72**	1.0 U	1.0 U	1.0 U	1.0 U
MW-03-121715	12/17/2015	Whitehead Tyee		50 UJ	50 U	100 U	100 U				***0.10 U***				
WT-MW-04															
MW04-20140102	1/2/2014	Whitehead Tyee		310 [2]	**520** [2]	250 U	**520**				**33**				
MW04-20140411	4/11/2014	Whitehead Tyee	**170**	**1,200** [2]	**3,000** [2]	**560** [2]	NA [4]				**200**	**5.3**	1.0 U	1.0 U	1.0 U
WT-MW-05															
MW05-20140408	4/8/2014	Whitehead Tyee	**980**	**860**	**890** [2]	250 U	**890**				**1.0**	1.0 U	1.0 U	1.0 U	1.0 U
MW-05-121815	12/18/2015	Whitehead Tyee		290 J	50 U	100 U	100 U				1.3				
MW-05-010716	1/7/2016	Whitehead Tyee								**18.7 J**					

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Petroleum Hydrocarbons					Polychlorinated Biphenyls (PCBs)		Dioxins/ Furans	Other Semivolatile Organic Compounds	Volatile Organic Compounds			
		Analyte	Gasoline-Range Organics, weathered [1]	Stoddard Solvent	Diesel-Range Organics, weathered [1]	Oil-Range Organics	Total DRO + ORO	Total PCB Aroclors	Total PCB congeners	Total dioxin/furan TEQ [5]	Pentachlorophenol	Benzene	Chloroethane	1,1-Dichloroethane	1,2-Dichloroethane
		CAS No.	TPHG	TPHSS	TPHD	TPHO	TPHD+O	1336-36-3	PCBCON	DFTEQ	87-86-5	71-43-2	75-00-3	75-34-3	107-06-2
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pg/L	pg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	30	500	500	500	500	0.000007	7	0.0051	0.002	1.6	19,000	7.7	4.2
Sample Name	**Sample Date**	**Site**													
WT-MW-06															
MW06-20140408	4/8/2014	Whitehead Tyee	**110** [2]	230 [2]	**760** [2]	**1,000** [2]	NA [4]				**0.24**	**2.1**	1.0 U	1.0 U	1.0 U
MW-06-122115	12/21/2015	Whitehead Tyee		50 UJ	50 U	410	410				**1.5**				
WT-MW-06-20170327	3/27/2017	Whitehead Tyee						***0.010 U***	**160 J**						
WT-MW-07															
MW07-20140408	4/8/2014	Whitehead Tyee	***100 U***	250	340 [2]	250 U	340				***0.20 U***	1.0 U	1.0 U	1.0 U	1.0 U
MW07-20140411	4/11/2014	Whitehead Tyee	***500 U***	**1,300** [2]	**3,500** [2]	**920** [2]	NA [4]				**6.5**	**8.0**	2.0 U	2.0 U	2.0 U
MW-07-121715	12/17/2015	Whitehead Tyee		50 UJ	50 U	100 U	100 U				***0.10 U***				
MW-07-121715-D	12/17/2015	Whitehead Tyee		50 UJ	50 U	100 U	100 U				***0.10 U***				
WT-MW-108															
MW-108-121715	12/17/2015	Whitehead Tyee		50 UJ	**790**	100 U	**790**				**7.1**				
MW-108-010716	1/7/2016	Whitehead Tyee								**1.32 J**					
WT-MW-108-20170327	3/27/2017	Whitehead Tyee						***0.010 U***	**66.7 J**						
WT-MW-109															
MW-109-121815	12/18/2015	Whitehead Tyee		50 UJ	50 U	100 U	100 U				***0.10 U***				
WT-MW-110															
MW-110-121715	12/17/2015	Whitehead Tyee		50 UJ	50 U	170	170				**6.6**				
WT-MW-110-20170327	3/27/2017	Whitehead Tyee						***0.010 U***	**4,450 J**						
WT-MW-110-20170327-D	3/27/2017	Whitehead Tyee						***0.010 U***	**222 J**						

Notes:

Results have been rounded to two significant digits, except for total PCB congeners and dioxin/furan TEQ, which have been rounded to three significant digits.

Empty cells are intentional.

RED/BOLD Detection exceeds PSL.

BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

1 GRO PSL was developed assuming weathered product from historic spills, based on Lower Duwamish Preliminary Cleanup Levels.

2 The laboratory noted that the sample chromatographic pattern does not resemble the fuel standard used for quantitation.

3 Chromatograms were not reviewed for this sum; both ORO and DRO are included.

4 The chromatograms do not indicate a standard pattern for petroleum distillates; therefore, the DRO + ORO sum was not calculated.

5 Calculated using detected dioxin/furan concentrations plus one-half the detection limit for dioxins/furans that were not detected.

Abbreviations:

DRO Diesel-range organics

µg/L Micrograms per liter

NA Not applicable

ORO Oil-range organics

Qualifiers:

J Analyte was detected, concentration is considered an estimate.

JB Analyte was detected; concentration is an estimate due to potential blank contamination.

U Analyte was not detected, concentration given is the reporting limit.

UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Volatile Organic Compounds (cont.)										
		Analyte	1,1-Dichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	Ethylbenzene	Methylene chloride	Tetrachloroethylene	Toluene	1,1,1-Trichloroethane	Trichloroethylene	Vinyl chloride	Total xylenes
		CAS No.	75-35-4	156-59-2	156-60-5	100-41-4	75-09-2	127-18-4	108-88-3	71-55-6	79-01-6	75-01-4	1330-20-7
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	7	16	100	31	5	2.9	130	200	0.7	0.18	330
Sample Name	Sample Date	Site											
B-18													
B-18-8/18/2003	8/18/2003	Fox Avenue		2,300				39			22	2,700	
B-18-12/13/2005	12/13/2005	Fox Avenue		460				180			150	200	
B-18-8/3/2007	8/3/2007	Fox Avenue		330				0.20 U			2.0	520	
B-18-11	1/28/2009	Fox Avenue	9.6 J	220	12 J	20 U	20 U	150	20 U	20 U	57	3,400	20 U
B-18-012110	1/21/2010	Fox Avenue	2.2	190	8.9	1.0 U	1.0 U	24	1.0 U	1.0 U	15	1,200	1.0 U
B-18-11	10/21/2010	Fox Avenue	0.93 J	320	2.4	1.0 U	1.0 U	1.0	1.0 U	1.0 U	1.0 U	96	1.0 U
B18-20140411	4/11/2014	Whitehead Tyee	1.0 U	85	1.7	1.0 U	5.0 U	2.4	1.2	1.0 U	4.9	14	3.0 U
B-18-051514	5/15/2014	Fox Avenue	1.0 U	120	5.9	12		1.0 U	85	1.0 U	1.4	190	
B-18-052715	5/27/2015	Fox Avenue	1.0 U	33	1.0 U	3.6		1.0 U	12	1.0 U	0.50 U	140	
B-20A													
B-20A-8/19/2003	8/19/2003	Fox Avenue		630				4,500			1,100	20	
B-20A-11/17/2004	11/17/2004	Fox Avenue		290 J				2,800			600 J	2.2	
B-20A-12/13/2005	12/13/2005	Fox Avenue		69				570			150	10 U	
B-20A-12/6/2006	12/6/2006	Fox Avenue		3.4 J				140 J			13 J	1.0 UJ	
B-20A-8/6/2007	8/6/2007	Fox Avenue		69 J				430 JB			98 J	0.43 J	
B-20F-10	1/28/2009	Fox Avenue	20 U	20 U	20 U	20 U	20 U	42	20 U	20 U	20 U	4.0 U	20 U
B-20A-10	1/28/2009	Fox Avenue	20 U	20 U	20 U	20 U	20 U	42	20 U	20 U	20 U	4.0 U	20 U
DUP-1-062014	6/20/2014	Fox Avenue	2.2	1,300 J	50	31		1.0 U	32	1.0 U	12	98 J	
B-20A-062014	6/20/2014	Fox Avenue	2.2	1,300 J	51	31		1.0 U	32	1.0 U	12	100 J	
B-20A-051315	5/13/2015	Fox Avenue	1.6	1,400	21	2.1		1.0 U	8.3	1.0 U	5.2	62	
B-20A-092915	9/29/2015	Fox Avenue	1.6	970	31	1.0 U		1.0 U	2.8	1.0 U	0.50 U	180	
B-36													
B-36-8/18/2003	8/18/2003	Fox Avenue		120				38			32	9.0	
B-36-12/13/2005	12/13/2005	Fox Avenue		26				37			20	0.89	
B-36-8/6/2007	8/6/2007	Fox Avenue		150 J				150 J			38 J	4.0 J	
B-36-012110	1/21/2010	Fox Avenue	1.0 U	39	0.91 J	1.0 U	1.0 U	22	1.0 U	1.0 U	4.0	1.4	1.0 U
B-36-121815	12/18/2015	Whitehead Tyee											
B-38													
B-38-8/18/2003	8/18/2003	Fox Avenue		7.1				1.4			6.0	0.50 U	
B-38-8/9/2007	8/9/2007	Fox Avenue		7.2				2.1			2.0 U	2.0 U	
B38-20140114	1/14/2014	Whitehead Tyee											
MW99-20140114	1/14/2014	Whitehead Tyee											
B38-20140415	4/15/2014	Whitehead Tyee	1.0 U	4.7	1.0 U	9.9	5.0 U	1.0 U	5.5	1.0 U	1.0 U	0.27	93
B-38-122115	12/21/2015	Whitehead Tyee											
B-44													
B-44-8/20/2003	8/20/2003	Fox Avenue		53,000				40,000			9,800	1,900	
B-44-11/18/2004	11/18/2004	Fox Avenue		55,000				45,000 JB			12,000	1,300	
B-44-1/13/2005	1/13/2005	Fox Avenue		100 U				100 U			100 U	100 U	
B-44-2/9/2005	2/9/2005	Fox Avenue		100 U				100 U			100 U	100 U	
B-44-3/9/2005	3/9/2005	Fox Avenue		100 U				100 U			100 U	100 U	
B-44-12/19/2005	12/19/2005	Fox Avenue		7,500				16,000			6,000	25 U	
B-44-2/16/2006	2/16/2006	Fox Avenue		590				3,300			430	50 U	
B-44-12/5/2006	12/5/2006	Fox Avenue		8.0 U				8.0 U			8.0 U	8.0 U	
B-44-8/8/2007	8/8/2007	Fox Avenue		150 J				22,000 J			390 J	80 UJ	
B-44-10	1/28/2009	Fox Avenue	200 U	200 U	200 U	200 U	200 U	17,000	200 U	200 U	240	40 U	200 U

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Volatile Organic Compounds (cont.)										
		Analyte	1,1-Dichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	Ethylbenzene	Methylene chloride	Tetrachloroethylene	Toluene	1,1,1-Trichloroethane	Trichloroethylene	Vinyl chloride	Total xylenes
		CAS No.	75-35-4	156-59-2	156-60-5	100-41-4	75-09-2	127-18-4	108-88-3	71-55-6	79-01-6	75-01-4	1330-20-7
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	7	16	100	31	5	2.9	130	200	0.7	0.18	330
Sample Name	**Sample Date**	**Site**											
B-49													
B-49-8/20/2003	8/20/2003	Fox Avenue		**34,000**				**53,000**			**17,000**	***1,000 U***	
B-49-12/11/2003	12/11/2003	Fox Avenue		**26,000**				**29,000**			**8,600**	**290**	
B-49-1/29/2004	1/29/2004	Fox Avenue		**9,000**				**60,000**			**8,500**	***1,000 U***	
B-49-2/27/2004	2/27/2004	Fox Avenue		**12,000**				**42,000**			**11,000**	***500 U***	
B-49-3/29/2004	3/29/2004	Fox Avenue		**25,000**				**65,000**			**20,000**	***500 U***	
B-49-4/27/2004	4/27/2004	Fox Avenue		**36,000**				**35,000**			**62,000**	***1,000 U***	
B-49-11/18/2004	11/18/2004	Fox Avenue											
B-49-1/13/2005	1/13/2005	Fox Avenue											
B-49-2/9/2005	2/9/2005	Fox Avenue											
B-49-3/9/2005	3/9/2005	Fox Avenue											
B-49-8/6/2007	8/6/2007	Fox Avenue		**500 J**				**26,000 JB**			**1,900 J**	**0.29 J**	
B-49-051414	5/14/2014	Fox Avenue	1.2	**480**	13	1.0 U		**99**	1.1	1.0 U	**42**	**5.1**	
B-49-102314	10/23/2014	Fox Avenue	1.7	**1,200**	13	1.0 U		**13**	1.3	1.0 U	**26**	**17**	
B-49-051315	5/13/2015	Fox Avenue	1.2	**380**	2.4	2.1		**12**	6.7	1.0 U	**8.3**	**460**	
B-49-093015	9/30/2015	Fox Avenue	1.0 U	**130**	2.3	1.0 U		**17**	1.0 U	1.0 U	**17**	**35**	
B-49-121715	12/17/2015	Whitehead Tyee											
B-58													
B-58-8/19/2003	8/19/2003	Fox Avenue		**14,000**				**4,200**			**2,800**	**240**	
B-58-11/17/2004	11/17/2004	Fox Avenue		**10,000**				**1,300 J**			**950 J**	**870 J**	
B-58-1/11/2005	1/11/2005	Fox Avenue		**7,500**				**5,500**			**1,800**	**1,100**	
B-58-2/10/2005	2/10/2005	Fox Avenue		**4,700**				**5,700**			**2,100**	**600**	
B-58-3/8/2005	3/8/2005	Fox Avenue		**6,000**				**6,900**			**2,000**	**740**	
B-58-8/16/2005	8/16/2005	Fox Avenue		**3,500**				**3,300**			**680**	**990**	
B-58-12/14/2005	12/14/2005	Fox Avenue		**4,200**				**12,000**			**4,800**	**500**	
B-58-2/16/2006	2/16/2006	Fox Avenue		**640**				**1,700**			**340**	**36**	
B-58-12/6/2006	12/6/2006	Fox Avenue		2.0 U				**830**			**14**	***2.0 U***	
B-58-8/9/2007	8/9/2007	Fox Avenue		8.0 U				**2,400**			***8.0 U***	***8.0 U***	
B-58-10-B	1/28/2009	Fox Avenue	1.0 U	5.8	1.0 U	1.0 U	1.0 U	**190**	1.0 U	1.0 U	**16**	***0.20 U***	1.0 U
B-58-042809	4/28/2009	Fox Avenue	6.6	**120**	1.7	1.0 U	1.0 U	**690**	1.0 U	1.0 U	**210**	**23**	1.0 U
B-58-102609	10/26/2009	Fox Avenue	0.95 J	**60**	0.95 J	1.0 U	1.0 U	**890**	1.0 U	1.0 U	**140**	**6.3**	1.0 U
B-58-012110	1/21/2010	Fox Avenue	***10 U***	**32**	10 U	10 U	***10 U***	**670**	10 U	10 U	**69**	**5.7**	10 U
B-58-10.5	10/21/2010	Fox Avenue	3.0	**240**	2.5	1.0 U	1.0 U	**430**	1.0 U	1.0 U	**150**	**12**	1.0 U
B-58-033011	3/30/2011	Fox Avenue	3.1	**230**	2.0	1.0 U	1.0 U	**450**	1.0 U	1.0 U	**150**	**26**	
B-58-112911	11/29/2011	Fox Avenue	1.0 U	**870**	16	1.0 U	1.0 U	**170**	1.0 U	1.0 U	**59**	**370**	
B-58-082012	8/20/2012	Fox Avenue	1.0 U	**150**	3.1	1.0 U		**34**	1.3	1.0 U	**14**	**20**	
B-58-052913	5/29/2013	Fox Avenue	1.0 U	**830**	61	3.0	1.0 U	**14**	5.9	1.0 U	**4.4**	**180**	
B-58-072213	7/22/2013	Fox Avenue	1.0 U	**320**	31	14		**16**	22	1.0 U	**3.3**	**350**	
B-58-051514	5/15/2014	Fox Avenue	1.0 U	**310**	2.6	2.9		**5.4**	7.0	1.0 U	**3.0**	**150**	
B-58-051315	5/13/2015	Fox Avenue	1.0 U	**120**	1.2	1.0 U		1.0 U	1.4	1.0 U	0.50 U	**62**	
B-58S-092915	9/29/2015	Fox Avenue	1.0 U	**79**	1.8	1.0 U		1.0 U	1.0 U	1.0 U	**1.8**	**50**	

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Volatile Organic Compounds (cont.)										
		Analyte	1,1-Dichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	Ethylbenzene	Methylene chloride	Tetrachloroethylene	Toluene	1,1,1-Trichloroethane	Trichloroethylene	Vinyl chloride	Total xylenes
		CAS No.	75-35-4	156-59-2	156-60-5	100-41-4	75-09-2	127-18-4	108-88-3	71-55-6	79-01-6	75-01-4	1330-20-7
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	7	16	100	31	5	2.9	130	200	0.7	0.18	330
Sample Name	Sample Date	Site											
B-60													
B-60-8/19/2003	8/19/2003	Fox Avenue		26				520			50	1.8	
B-60-12/11/2003	12/11/2003	Fox Avenue		2,200				9,100			1,400	50 U	
B-60-1/27/2004	1/27/2004	Fox Avenue		7,100				21,000			9,700	250 U	
B-60-2/26/2004	2/26/2004	Fox Avenue		3,200				17,000			2,800	200 U	
B-60-3/27/2004	3/27/2004	Fox Avenue		2,200				10,000			1,900	100 U	
B-60-4/26/2004	4/26/2004	Fox Avenue		1,700				9,000			1,200	200 U	
B-60-1/11/2005	1/11/2005	Fox Avenue		8,000				19,000			6,200	380	
B-60-2/10/2005	2/10/2005	Fox Avenue		8,100 J				9,700 J			3,100	1,600	
B-60-3/8/2005	3/8/2005	Fox Avenue		6,600				4,400			1,200	2,400	
B-60-8/16/2005	8/16/2005	Fox Avenue		84				850			91	0.80	
B-60-12/13/2005	12/13/2005	Fox Avenue		720				1,300			250	200	
B-60-2/16/2006	2/16/2006	Fox Avenue		4,200				1,900			510	3,400	
B-60-7/13/2006	7/13/2006	Fox Avenue		190				1,700			170	0.20 U	
B-60-12/6/2006	12/6/2006	Fox Avenue		350				2,700			250	39	
B-60-8/6/2007	8/6/2007	Fox Avenue		37 J				870 JB			63 J	0.20 UJ	
B-60-9.7	1/27/2009	Fox Avenue	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	60	1.0 U	1.0 U	1.7	4.0 U	1.0 U
B-60-042809	4/28/2009	Fox Avenue	1.0 U	5.4	1.0 U	1.0 U	1.0 U	39	1.0 U	1.0 U	1.5	0.20 U	1.0 U
B-60-102609	10/26/2009	Fox Avenue	1.0 U	2.4	1.0 U	1.0 U	1.0 U	92	1.0 U	1.0 U	2.6	1.4	1.0 U
B-60-011410	1/14/2010	Fox Avenue	1.0 U	12	1.0 U	1.0 U	1.0 U	17	1.0 U	1.0 U	1.0 U	12	1.0 U
B-60-021610	2/16/2010	Fox Avenue	5.0 U	17	5.0 U	5.0 U	5.0 U	42	5.0 U	5.0 U	23	3.8	5.0 U
DUP1-041410	4/14/2010	Fox Avenue	1.0 U	7.8	1.0 U	1.5	1.0 U	28	1.0 U	1.0 U	1.3	15	0.70 J
B-60-041410	4/14/2010	Fox Avenue	1.0 U	9.7	1.0 U	3.8	1.0 U	25	1.0 U	1.0 U	1.3	15	1.7
B-60-11	10/21/2010	Fox Avenue	4.0	370	4.1	1.0 U	1.0 U	420	1.0 U	1.0 U	130	38	1.0 U
B-60-033011	3/30/2011	Fox Avenue	3.7	580	7.3	1.0 U	1.0 U	430	1.0 U	1.0 U	210	110	
B-60-112911	11/29/2011	Fox Avenue	1.3	820	12	1.0 U	1.0 U	22	1.0 U	1.0 U	12	1,700	
B-60-082012	8/20/2012	Fox Avenue	16	2,900	53	1.0 U		110	1.0 U	27	320	570	
B-60-052913	5/29/2013	Fox Avenue	1.0 U	50	6.5	69	1.0 U	1.2	110	1.0 U	3.1	640	
B-60-072213	7/22/2013	Fox Avenue	1.0 U	940	74	70		1.6	77	1.0 U	1.5	93	
B-60-051514	5/15/2014	Fox Avenue	1.0 U	1,500	15	16		1.0 U	13	1.0 U	3.5	52	
B-60-051315	5/13/2015	Fox Avenue	2.0	650	8.3	1.0 U		2.1	1.0 U	1.0 U	23	48	
B-60S-093015	9/30/2015	Fox Avenue	2.6	460	7.6	1.0 U		1.0 U	1.0 U	1.0 U	13	130	
B-62													
B-62-8/18/2003	8/18/2003	Fox Avenue		340				1,100			570	140	
B-62-8/16/2005	8/16/2005	Fox Avenue		530				610			190	200	
B-62-12/13/2005	12/13/2005	Fox Avenue		620				620			180	360	
B-62-12/6/2006	12/6/2006	Fox Avenue		32 J				180			36 J	17 J	
B-62-8/6/2007	8/6/2007	Fox Avenue		53 J				140 JB			29 J	0.93 J	
B-62-012110	1/21/2010	Fox Avenue	10 U	33	10 U	10 U	10 U	130	10 U	10 U	39	49	10 U
B-62-10.5	10/21/2010	Fox Avenue	6.7	820	16	1.0 U	1.0 U	660	1.0 U	34	330	1,400	12
B-62-051514	5/15/2014	Fox Avenue	1.0 U	5.9	1.0 U	1.0 U		1.5	1.0 U	1.0 U	1.1	0.20 U	

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Volatile Organic Compounds (cont.)										
		Analyte	1,1-Dichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	Ethylbenzene	Methylene chloride	Tetrachloroethylene	Toluene	1,1,1-Trichloroethane	Trichloroethylene	Vinyl chloride	Total xylenes
		CAS No.	75-35-4	156-59-2	156-60-5	100-41-4	75-09-2	127-18-4	108-88-3	71-55-6	79-01-6	75-01-4	1330-20-7
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	7	16	100	31	5	2.9	130	200	0.7	0.18	330
Sample Name	Sample Date	Site											
B-64													
B-64-8/18/2003	8/18/2003	Fox Avenue		**210**				**250**			**130**	***5.0 U***	
B-64-11/16/2004	11/16/2004	Fox Avenue		**130**				**150**			**67**	***4.0 U***	
B-64-3/7/2005	3/7/2005	Fox Avenue		**400**				**300**			**160**	***10 U***	
B-64-12/12/2005	12/12/2005	Fox Avenue		**870**				**350**			**120**	***10 U***	
B-64-12/6/2006	12/6/2006	Fox Avenue		**19 J**				**49 J**			**9.0 J**	***1.0 UJ***	
B-64-8/2/2007	8/2/2007	Fox Avenue		**79**				**140**			**51**	**0.22**	
B-64-8	1/26/2009	Fox Avenue	***20 U***	**110**	20 U	20 U	***20 U***	***20 U***	20 U	20 U	**48**	**20**	20 U
B-64-042809	4/28/2009	Fox Avenue	1.0 U	**55**	1.0 U	1.0 U	1.0 U	**94**	1.0 U	1.0 U	**20**	**1.7**	1.0 U
B-64-102909	10/29/2009	Fox Avenue	1.0 U	**42**	1.0 U	1.0 U	1.0 U	**150**	1.0 U	1.0 U	**29**	**7.8**	1.0 U
B-64-011410	1/14/2010	Fox Avenue	1.0 U	**23**	1.0 U	1.0 U	1.0 U	**31**	1.0 U	1.0 U	**8.3**	**12**	1.0 U
B-64-021610	2/16/2010	Fox Avenue	5.0 U	**39**	5.0 U	5.0 U	5.0 U	**22**	5.0 U	5.0 U	**11**	**11**	5.0 U
B-64-033011	3/30/2011	Fox Avenue	1.0 U	**23**	1.0 U	1.0 U	1.0 U	**35**	1.0 U	1.0 U	**18**	***0.20 U***	
B-64-112811	11/28/2011	Fox Avenue	1.0 U	15	1.0 U	1.0 U	1.0 U	**13**	1.0 U	1.0 U	**4.3**	**1.9**	
B-64-081712	8/17/2012	Fox Avenue	1.0 U	**100**	2.8	1.0 U		**43**	1.0 U	1.0 U	**22**	***0.20 U***	
B-64-072213	7/22/2013	Fox Avenue	1.0 U	**61**	1.0 U	1.0 U		**12**	1.0 U	1.0 U	**3.9**	**6.4**	
B-64-052715	5/27/2015	Fox Avenue	1.0 U	**180**	2.4	1.0 U		1.1	1.0 U	1.0 U	**1.8**	**48**	
MW-03													
MW-3-11/3/2003	11/3/2003	Fox Avenue		**2,400 J**				**4,800 J**			**1,400 J**	**320 J**	
MW-3-11/16/2004	11/16/2004	Fox Avenue		**2,100**				**1,300**			**330**	**390**	
MW-3-2/7/2005	2/7/2005	Fox Avenue		**4,800**				**3,300**			**1,000**	**830**	
MW-3-3/7/2005	3/7/2005	Fox Avenue		**5,900**				**2,200**			**590**	**1,500**	
MW-3-12/12/2005	12/12/2005	Fox Avenue		**1,100**				**1,100**			**580**	**500**	
MW-3-2/16/2006	2/16/2006	Fox Avenue		**950**				**660**			**410**	**230**	
MW-3-12/7/2006	12/7/2006	Fox Avenue		**410 J**				**380 J**			**75 J**	**170 J**	
MW-3-8/2/2007	8/2/2007	Fox Avenue		**310**				**1,400**			**280**	**77**	
MW-3-102809	10/28/2009	Fox Avenue	***10 U***	**42**	10 U	10 U	***10 U***	**270**	10 U	10 U	**52**	**12**	10 U
MW-3-011510	1/15/2010	Fox Avenue	***10 U***	**37**	10 U	10 U	***10 U***	**190**	10 U	10 U	**55**	**16**	10 U
MW-3-042210	4/15/2010	Fox Avenue	0.70 J	**31**	1.0 U	1.0 U	1.0 U	**140**	1.0 U	1.0 U	**39**	**26**	1.0 U
MW-3-121312	12/13/2012	Fox Avenue	1.0 U	**63**	1.1	1.0 U	1.0 U	**41**	1.0 U	1.0 U	**17**	**38**	
MW-3-052715	5/27/2015	Fox Avenue	1.0 U	**90**	1.0 U	1.4		1.0 U	1.8	1.0 U	**2.4**	**100**	
DUP01-111615	11/16/2015	Fox Avenue	1.0 U	**44**	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	0.50 U	**34**	
MW-3-111615	11/16/2015	Fox Avenue	1.0 U	**45**	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	0.50 U	**37**	
MW-07													
MW-7-12/12/2003	12/12/2003	Fox Avenue		**270**				**3,400**			**540**	**39**	
MW-7-2/7/2005	2/7/2005	Fox Avenue		***100 U***				**2,200**			**340**	***100 U***	
MW-7-8/16/2005	8/16/2005	Fox Avenue		**18**				**1,300**			**130**	***2.5 U***	
MW-7-12/15/2005	12/15/2005	Fox Avenue		**50**				**580**			**69**	**17**	
MW-7-12/4/2006	12/4/2006	Fox Avenue		13				**260**			**23**	**12**	
MW-7-8/7/2007	8/7/2007	Fox Avenue		7.6				**160 JB**			**20**	**10**	
MW-7-11	1/28/2009	Fox Avenue	***20 U***	15 J	20 U	20 U	***20 U***	**300**	20 U	20 U	**37**	**17**	20 U
MW07-20140102	1/2/2014	Whitehead Tyee											
MW-7 041114	4/11/2014	Fox Avenue		**500**				**56**			**66**	**10**	
MW-7-121815	12/18/2015	Whitehead Tyee											

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Volatile Organic Compounds (cont.)										
		Analyte	1,1-Dichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	Ethylbenzene	Methylene chloride	Tetrachloroethylene	Toluene	1,1,1-Trichloroethane	Trichloroethylene	Vinyl chloride	Total xylenes
		CAS No.	75-35-4	156-59-2	156-60-5	100-41-4	75-09-2	127-18-4	108-88-3	71-55-6	79-01-6	75-01-4	1330-20-7
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	7	16	100	31	5	2.9	130	200	0.7	0.18	330
Sample Name	**Sample Date**	**Site**											
MW-09													
MW-9-8/17/2005	8/17/2005	Fox Avenue		10 U				***10 U***			***10 U***	***5.0 U***	
MW-9-12/16/2005	12/16/2005	Fox Avenue		**110**				**450**			**230**	**3.5**	
MW-9-12/4/2006	12/4/2006	Fox Avenue		8.0 U				**9.2**			***8.0 U***	***8.0 U***	
MW-9-8/7/2007	8/7/2007	Fox Avenue		**90 J**				**870 JB**			**220 J**	**3.0 J**	
MW-9-10.4	1/26/2009	Fox Avenue	***20 U***	**280**	20 U	20 U	***20 U***	**3,000**	20 U	100	**680**	**20**	20 U
MW-9-051414	5/14/2014	Fox Avenue	2.5	**1,000**	20	1.0 U		**12**	12	1.0 U	**160**	**36**	
MW-9-051515	5/15/2015	Fox Avenue	1.3	**570**	6.2	1.0 U		**110**	12	1.0 U	**35**	**410**	
MW-9-093015	9/30/2015	Fox Avenue	1.8	**860**	19	1.0 U		**130**	7.5	1.0 U	**84**	**160**	
MW-9-122115	12/21/2015	Whitehead Tyee											
PTM-2U													
PTM-2U-12/9/2003	12/9/2003	Fox Avenue		**15,000**				2.2			**6.1**	**13,000**	
PTM-2U-1/28/2004	1/28/2004	Fox Avenue		**12,000**				***250 U***			***250 U***	**12,000**	
PTM-2U-2/26/2004	2/26/2004	Fox Avenue		**1,900**				***100 U***			***100 U***	**4,700**	
PTM-2U-3/27/2004	3/27/2004	Fox Avenue		**1,600**				***200 U***			***200 U***	**11,000**	
PTM-2U-4/26/2004	4/26/2004	Fox Avenue		**10,000**				***500 U***			***500 U***	**16,000**	
PTM-2U-5/28/2004	5/28/2004	Fox Avenue		**3,000**				***100 U***			**950**	**580**	
PTM-2U-2/16/2006	2/16/2006	Fox Avenue		**8,000**				***100 U***			***100 U***	**7,800**	
PTM-2U-12/4/2006	12/4/2006	Fox Avenue		**13,000**				0.27			0.49	**18,000**	
PTM-2U-8/9/2007	8/9/2007	Fox Avenue		**4,300**				***20 U***			***20 U***	**16,000**	
PTM-2U-25	4/7/2009	Fox Avenue	1.0 U	**440**	75	**220**	1.0 U	1.0 U	**310**	1.0 U	***1.0 U***	***0.20 U***	140
WT-MW-01													
MW01-20140103	1/3/2014	Whitehead Tyee											
MW01-20140415	4/15/2014	Whitehead Tyee	1.0 U	3.7	1.0 U	3.7	5.0 U	2.3	1.0 U	1.0 U	***1.0 U***	**0.29**	74
MW-01-121715	12/17/2015	Whitehead Tyee											
MW-01-010716	1/7/2016	Whitehead Tyee											
WT-MW-02													
MW02-20140103	1/3/2014	Whitehead Tyee											
MW02-20140415	4/15/2014	Whitehead Tyee	1.0 U	1.0 U	1.0 U	2.5	5.0 U	2.0	1.1	1.0 U	***1.0 U***	***0.20 U***	14
MW-02-121715	12/17/2015	Whitehead Tyee											
WT-MW-03													
MW03-20140102	1/2/2014	Whitehead Tyee											
MW03-20140411	4/11/2014	Whitehead Tyee	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	2.7	1.0 U	1.0 U	***1.0 U***	***0.20 U***	3.0 U
MW-03-121715	12/17/2015	Whitehead Tyee											
WT-MW-04													
MW04-20140102	1/2/2014	Whitehead Tyee											
MW04-20140411	4/11/2014	Whitehead Tyee	1.0 U	**460**	12	1.0 U	5.0 U	**110**	2.8	1.0 U	**47**	**38**	5.2
WT-MW-05													
MW05-20140408	4/8/2014	Whitehead Tyee	1.0 U	1.0 U	1.0 U	1.1	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	***0.20 U***	3.5
MW-05-121815	12/18/2015	Whitehead Tyee											
MW-05-010716	1/7/2016	Whitehead Tyee											

Table 4.8a
Groundwater Analytical Results—Upper Water-Bearing Zone

		Analyte Class	Volatile Organic Compounds (cont.)										
		Analyte	1,1-Dichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	Ethylbenzene	Methylene chloride	Tetrachloroethylene	Toluene	1,1,1-Trichloroethane	Trichloroethylene	Vinyl chloride	Total xylenes
		CAS No.	75-35-4	156-59-2	156-60-5	100-41-4	75-09-2	127-18-4	108-88-3	71-55-6	79-01-6	75-01-4	1330-20-7
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	7	16	100	31	5	2.9	130	200	0.7	0.18	330
Sample Name	**Sample Date**	**Site**											
WT-MW-06													
MW06-20140408	4/8/2014	Whitehead Tyee	1.0	**210**	3.3	1.0 U	5.0 U	**22**	1.0 U	1.0 U	**110**	**9.7**	3.0 U
MW-06-122115	12/21/2015	Whitehead Tyee											
WT-MW-06-20170327	3/27/2017	Whitehead Tyee											
WT-MW-07													
MW07-20140408	4/8/2014	Whitehead Tyee	1.0 U	1.6	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	***1.0 U***	**0.98**	3.0 U
MW07-20140411	4/11/2014	Whitehead Tyee	2.0 U	**500**	37	5.0 U	***10 U***	**56**	18	2.0 U	**66**	**10**	15 U
MW-07-121715	12/17/2015	Whitehead Tyee											
MW-07-121715-D	12/17/2015	Whitehead Tyee											
WT-MW-108													
MW-108-121715	12/17/2015	Whitehead Tyee											
MW-108-010716	1/7/2016	Whitehead Tyee											
WT-MW-108-20170327	3/27/2017	Whitehead Tyee											
WT-MW-109													
MW-109-121815	12/18/2015	Whitehead Tyee											
WT-MW-110													
MW-110-121715	12/17/2015	Whitehead Tyee											
WT-MW-110-20170327	3/27/2017	Whitehead Tyee											
WT-MW-110-20170327-D	3/27/2017	Whitehead Tyee											

Notes:

Results have been rounded to two significant digits, except for total PCB congeners and dioxin/furan TEQ, which have been rounded to three significant digits.

Empty cells are intentional.

RED/BOLD Detection exceeds PSL.

BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.

1 GRO PSL was developed assuming weathered product from historic spills, based on Lower Duwamish Preliminary Cleanup Levels.

2 The laboratory noted that the sample chromatographic pattern does not resemble the fuel standard used for quantitation.

3 Chromatograms were not reviewed for this sum; both ORO and DRO are included.

4 The chromatograms do not indicate a standard pattern for petroleum distillates; therefore, the DRO + ORO sum was not calculated.

5 Calculated using detected dioxin/furan concentrations plus one-half the detection limit for dioxins/furans that were not detected.

Abbreviations:

DRO Diesel-range organics

µg/L Micrograms per liter

NA Not applicable

ORO Oil-range organics

Qualifiers:

J Analyte was detected, concentration is considered an estimate.

JB Analyte was detected; concentration is an estimate due to potential blank contamination.

U Analyte was not detected, concentration given is the reporting limit.

UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.8b
Groundwater Analytical Results—Lower Water-Bearing Zone

		Analyte Class	Petroleum Hydrocarbons					Polychlorinated Biphenyls (PCBs)		Dioxins/ Furans	Other Semivolatile Organic Compounds
		Analyte	Gasoline-Range Organics, weathered [1]	Stoddard Solvent	Diesel-Range Organics, weathered [1]	Oil-Range Organics	Total DRO + ORO	Total PCB Aroclors	Total PCB congeners	Total dioxin/furan TEQ	Pentachlorophenol
		CAS No.	TPHG	TPHSS	TPHD	TPHO	TPHD+O	1336-36-3	PCBCON	DFTEQ	87-86-5
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pg/L	pg/L	µg/L
		PSL	30	500	500	500	500	0.000007	7	0.0051	0.002
Sample Name	**Sample Date**	**Site**									
B-19											
B-19-8/18/2003	8/18/2003	Fox Avenue									***0.50 U***
B-19-12/13/2005	12/13/2005	Fox Avenue									
B-19-8/3/2007	8/3/2007	Fox Avenue									
B-19-41.5	1/28/2009	Fox Avenue									
DUP2-012110	1/21/2010	Fox Avenue									
B-19-012110	1/21/2010	Fox Avenue									
B-19-051514	5/15/2014	Fox Avenue									
DUP-03-052715	5/27/2015	Fox Avenue									
B-19-052715	5/27/2015	Fox Avenue									
B-21											
B-21-8/19/2003	8/19/2003	Fox Avenue									***0.50 U***
B-21-12/11/2003	12/11/2003	Fox Avenue									
B-21-1/28/2004	1/28/2004	Fox Avenue									
B-21-2/26/2004	2/26/2004	Fox Avenue									
B-21-3/29/2004	3/29/2004	Fox Avenue									
B-21-4/27/2004	4/27/2004	Fox Avenue									
B-21-5/28/2004	5/28/2004	Fox Avenue									
B-21-1/11/2005	1/11/2005	Fox Avenue									
B-21-2/10/2005	2/10/2005	Fox Avenue									
B-21-3/8/2005	3/8/2005	Fox Avenue									
B-21-8/6/2007	8/6/2007	Fox Avenue									
B-21-39.5	1/28/2009	Fox Avenue									
B-21-44.5	1/28/2009	Fox Avenue									
B-21-062014	6/20/2014	Fox Avenue									
B-21-051315	5/13/2015	Fox Avenue									
B-21-092915	9/29/2015	Fox Avenue									
B-35											
B-35-8/18/2003	8/18/2003	Fox Avenue									
B-35-12/13/2005	12/13/2005	Fox Avenue									
B-35-12/6/2006	12/6/2006	Fox Avenue									
B-35-8/6/2007	8/6/2007	Fox Avenue									
B-35-012110	1/21/2010	Fox Avenue									
Dup1-081712	8/17/2012	Fox Avenue									
B-35-081712	8/17/2012	Fox Avenue									
B-37											
B-37-8/18/2003	8/18/2003	Fox Avenue									1.8
B-37-8/9/2007	8/9/2007	Fox Avenue									

Table 4.8b
Groundwater Analytical Results—Lower Water-Bearing Zone

		Analyte Class	Petroleum Hydrocarbons					Polychlorinated Biphenyls (PCBs)		Dioxins/ Furans	Other Semivolatile Organic Compounds
		Analyte	Gasoline-Range Organics, weathered [1]	Stoddard Solvent	Diesel-Range Organics, weathered [1]	Oil-Range Organics	Total DRO + ORO	Total PCB Aroclors	Total PCB congeners	Total dioxin/furan TEQ	Pentachlorophenol
		CAS No.	TPHG	TPHSS	TPHD	TPHO	TPHD+O	1336-36-3	PCBCON	DFTEQ	87-86-5
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pg/L	pg/L	µg/L
		PSL	30	500	500	500	500	0.000007	7	0.0051	0.002
Sample Name	**Sample Date**	**Site**									
B-45											
B-45-8/20/2003	8/20/2003	Fox Avenue									***0.50 U***
B-45-12/11/2003	12/11/2003	Fox Avenue									
B-45-1/29/2004	1/29/2004	Fox Avenue									
B-45-2/26/2004	2/26/2004	Fox Avenue									
B-45-3/29/2004	3/29/2004	Fox Avenue									
B-45-4/27/2004	4/27/2004	Fox Avenue									
B-45-5/28/2004	5/28/2004	Fox Avenue									
B-45-1/11/2005	1/11/2005	Fox Avenue									
B-45-2/9/2005	2/9/2005	Fox Avenue									
B-45-3/9/2005	3/9/2005	Fox Avenue									
B-45-2/16/2006	2/16/2006	Fox Avenue									
B-45-12/5/2006	12/5/2006	Fox Avenue									
B-45-8/6/2007	8/6/2007	Fox Avenue									
B-45-43.5	1/28/2009	Fox Avenue									
B-45-38.5	1/28/2009	Fox Avenue									
B-45-051414	5/14/2014	Fox Avenue									
B-45-102214	10/22/2014	Fox Avenue									
B-45-010915	1/9/2015	Fox Avenue									
B-45-051315	5/13/2015	Fox Avenue									
B-45-093015	9/30/2015	Fox Avenue									
B-59											
B-59-8/19/2003	8/19/2003	Fox Avenue									**1.3**
B-59-12/14/2005	12/14/2005	Fox Avenue									
B-59-12/6/2006	12/6/2006	Fox Avenue									
B-59-8/9/2007	8/9/2007	Fox Avenue									
B-59-26.5	1/27/2009	Fox Avenue									
B-59-042809	4/28/2009	Fox Avenue									
B-59-102609	10/26/2009	Fox Avenue									
B-59-012110	1/21/2010	Fox Avenue									
B-59C-27	10/21/2010	Fox Avenue	***50 U***	50 U	50 U	100 U	100 U [2]				
B-59-27.5	10/21/2010	Fox Avenue	***50 U***	50 U	50 U	100 U	100 U [2]				
B-59-033011	3/30/2011	Fox Avenue									
B-59-112911	11/29/2011	Fox Avenue									
B-59-082012	8/20/2012	Fox Avenue									
B-59-052913	5/29/2013	Fox Avenue									
B-59-072413	7/24/2013	Fox Avenue									
B-59-051514	5/15/2014	Fox Avenue									
B-59-102214	10/22/2014	Fox Avenue									
B-59-010915	1/9/2015	Fox Avenue									
B-59-051315	5/13/2015	Fox Avenue									
B-59D-092915	9/29/2015	Fox Avenue									

Table 4.8b
Groundwater Analytical Results—Lower Water-Bearing Zone

		Analyte Class	Petroleum Hydrocarbons					Polychlorinated Biphenyls (PCBs)		Dioxins/ Furans	Other Semivolatile Organic Compounds
		Analyte	Gasoline-Range Organics, weathered (1)	Stoddard Solvent	Diesel-Range Organics, weathered (1)	Oil-Range Organics	Total DRO + ORO	Total PCB Aroclors	Total PCB congeners	Total dioxin/furan TEQ	Pentachlorophenol
		CAS No.	TPHG	TPHSS	TPHD	TPHO	TPHD+O	1336-36-3	PCBCON	DFTEQ	87-86-5
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pg/L	pg/L	µg/L
		PSL	30	500	500	500	500	0.000007	7	0.0051	0.002
Sample Name	**Sample Date**	**Site**									
B-61											
B-61-8/19/2003	8/19/2003	Fox Avenue									***0.50 U***
B-61-12/11/2003	12/11/2003	Fox Avenue									
B-61-1/27/2004	1/27/2004	Fox Avenue									
B-61-2/26/2004	2/26/2004	Fox Avenue									
B-61-3/27/2004	3/27/2004	Fox Avenue									
B-61-4/26/2004	4/26/2004	Fox Avenue									
B-61-5/28/2004	5/28/2004	Fox Avenue									
B-61-1/11/2005	1/11/2005	Fox Avenue									
B-61-2/10/2005	2/10/2005	Fox Avenue									
B-61-3/8/2005	3/8/2005	Fox Avenue									
B-61-12/13/2005	12/13/2005	Fox Avenue									
B-61-12/6/2006	12/6/2006	Fox Avenue									
B-61-8/9/2007	8/9/2007	Fox Avenue									
B-61-40.5	1/27/2009	Fox Avenue									
DUP1-042809	4/28/2009	Fox Avenue									
B-61-042809	4/28/2009	Fox Avenue									
B-61-062309	6/23/2009	Fox Avenue									
B-61-072309	7/23/2009	Fox Avenue									
B-61-102609	10/26/2009	Fox Avenue									
B-61-011410	1/14/2010	Fox Avenue									
B-61-021610	2/16/2010	Fox Avenue									
B-61-041410	4/14/2010	Fox Avenue									
B-61-41.5	10/21/2010	Fox Avenue	***50 U***	80	50 U	100 U	100 U (2)				
DUP1-033011	3/30/2011	Fox Avenue									
B-61-033011	3/30/2011	Fox Avenue									
B-61-112911	11/29/2011	Fox Avenue									
Dup2-082012	8/20/2012	Fox Avenue									
B-61-082012	8/20/2012	Fox Avenue									
B-61-052913	5/29/2013	Fox Avenue									
B-61-072213	7/22/2013	Fox Avenue									
B-61-051514	5/15/2014	Fox Avenue									
B-61-102214	10/22/2014	Fox Avenue									
B-61-010915	1/9/2015	Fox Avenue									
B-61-051315	5/13/2015	Fox Avenue									
B-61D-093015	9/30/2015	Fox Avenue									
B-63											
B-63-8/18/2003	8/18/2003	Fox Avenue									***0.50 U***
B-63-12/13/2005	12/13/2005	Fox Avenue									
B-63-12/6/2006	12/6/2006	Fox Avenue									
B-63-8/6/2007	8/6/2007	Fox Avenue									
B-63-012110	1/21/2010	Fox Avenue									
B-63-40.5	10/21/2010	Fox Avenue	***50 U***	140	50 U	100 U	100 U (2)				
B-63-051514	5/15/2014	Fox Avenue									

Table 4.8b
Groundwater Analytical Results—Lower Water-Bearing Zone

		Analyte Class	Petroleum Hydrocarbons					Polychlorinated Biphenyls (PCBs)		Dioxins/ Furans	Other Semivolatile Organic Compounds
		Analyte	Gasoline-Range Organics, weathered [(1)]	Stoddard Solvent	Diesel-Range Organics, weathered [(1)]	Oil-Range Organics	Total DRO + ORO	Total PCB Aroclors	Total PCB congeners	Total dioxin/furan TEQ	Pentachlorophenol
		CAS No.	TPHG	TPHSS	TPHD	TPHO	TPHD+O	1336-36-3	PCBCON	DFTEQ	87-86-5
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pg/L	pg/L	µg/L
		PSL	30	500	500	500	500	0.000007	7	0.0051	0.002
Sample Name	**Sample Date**	**Site**									
B-65											
B-65-8/18/2003	8/18/2003	Fox Avenue									***0.50 U***
B-65-11/16/2004	11/16/2004	Fox Avenue									
B-65-3/7/2005	3/7/2005	Fox Avenue									
B-65-12/13/2005	12/13/2005	Fox Avenue									
B-65-12/6/2006	12/6/2006	Fox Avenue									
B-65-8/2/2007	8/2/2007	Fox Avenue									
B-65-31.5-PDB	1/26/2009	Fox Avenue									
B-65-31.5	1/29/2009	Fox Avenue									
B-65-042809	4/28/2009	Fox Avenue									
B-65-102909	10/29/2009	Fox Avenue									
B-65-011410	1/14/2010	Fox Avenue									
DUP1-021610	2/16/2010	Fox Avenue									
B-65-021610	2/16/2010	Fox Avenue									
B-65-033011	3/30/2011	Fox Avenue									
B-65-112811	11/28/2011	Fox Avenue									
B-65-081712	8/17/2012	Fox Avenue									
B-65-072213	7/22/2013	Fox Avenue									
B-65-052715	5/27/2015	Fox Avenue									
MW-04											
MW-4-10/31/2003	10/31/2003	Fox Avenue									
MW-4-11/16/2004	11/16/2004	Fox Avenue									
MW-4-2/7/2005	2/7/2005	Fox Avenue									
MW-4-3/7/2005	3/7/2005	Fox Avenue									
MW-4-12/12/2005	12/12/2005	Fox Avenue									
MW-4-12/7/2006	12/7/2006	Fox Avenue									
MW-4-8/2/2007	8/2/2007	Fox Avenue									
MW-4-102809	10/28/2009	Fox Avenue									
MW-4-011510	1/15/2010	Fox Avenue									
MW-4-042210	4/23/2010	Fox Avenue									
DUP1-042210	4/23/2010	Fox Avenue									
Dup1-121312	12/13/2012	Fox Avenue									
MW-4-121312	12/13/2012	Fox Avenue									
MW-4-052715	5/27/2015	Fox Avenue									
MW-4-111615	11/16/2015	Fox Avenue									
MW-08											
MW-8-12/12/2003	12/12/2003	Fox Avenue									**1.7**
MW-8-2/7/2005	2/7/2005	Fox Avenue									
MW-8-12/15/2005	12/15/2005	Fox Avenue									
MW-8-8/7/2007	8/7/2007	Fox Avenue									
MW-8-24	1/28/2009	Fox Avenue									

Table 4.8b
Groundwater Analytical Results—Lower Water-Bearing Zone

		Analyte Class	Petroleum Hydrocarbons					Polychlorinated Biphenyls (PCBs)		Dioxins/ Furans	Other Semivolatile Organic Compounds
		Analyte	Gasoline-Range Organics, weathered (1)	Stoddard Solvent	Diesel-Range Organics, weathered (1)	Oil-Range Organics	Total DRO + ORO	Total PCB Aroclors	Total PCB congeners	Total dioxin/furan TEQ	Pentachlorophenol
		CAS No.	TPHG	TPHSS	TPHD	TPHO	TPHD+O	1336-36-3	PCBCON	DFTEQ	87-86-5
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pg/L	pg/L	µg/L
		PSL	30	500	500	500	500	0.000007	7	0.0051	0.002
Sample Name	**Sample Date**	**Site**									
MW-10											
MW-10-12/16/2005	12/16/2005	Fox Avenue									
MW-10-12/4/2006	12/4/2006	Fox Avenue									
MW-10-8/7/2007	8/7/2007	Fox Avenue									
MW-10-24	1/26/2009	Fox Avenue									
MW-10-24	10/20/2010	Fox Avenue	***50 U***	**1,800**	50 U	100 U	100 U (2)				
MW-10-051414	5/14/2014	Fox Avenue									
MW-10-102214	10/22/2014	Fox Avenue									
MW-10-010915	1/9/2015	Fox Avenue									
MW-10-051515	5/15/2015	Fox Avenue									
DUP-1-051515	5/15/2015	Fox Avenue									
DUP-1-093015	9/30/2015	Fox Avenue									
MW-10-093015	9/30/2015	Fox Avenue									
PTM-2L											
PTM-2L-12/9/2003	12/9/2003	Fox Avenue									
PTM-2L-1/28/2004	1/28/2004	Fox Avenue									
PTM-2L-2/26/2004	2/26/2004	Fox Avenue									
PTM-2L-3/27/2004	3/27/2004	Fox Avenue									
PTM-2L-4/26/2004	4/26/2004	Fox Avenue									
PTM-2L-5/28/2004	5/28/2004	Fox Avenue									
PTM-2L-2/16/2006	2/16/2006	Fox Avenue									
PTM-2L-12/4/2006	12/4/2006	Fox Avenue									
PTM-2L-8/9/2007	8/9/2007	Fox Avenue									
PTM-2L-36	1/26/2009	Fox Avenue									
PTM-2L-35	10/20/2010	Fox Avenue	***50 U***	500	50 U	100 U	100 U (2)				

Notes:
- Results have been rounded to two significant digits.
- Empty cells are intentional.
- **RED/BOLD** Detection exceeds PSL.
- ***BOLD/ITALIC*** Analyte not detected at reporting limit; reporting limit exceeds PSL.
- 1 GRO PSL was developed assuming weathered product from historic spills, based on Lower Duwamish Preliminary Cleanup Levels.
- 2 Chromatograms were not reviewed for this sum; both ORO and DRO are included.

Abbreviations:
- DRO Diesel-range organics
- µg/L Micrograms per liter
- NA Not applicable
- ORO Oil-range organics

Qualifiers:
- J Analyte was detected, concentration is considered an estimate.
- U Analyte was not detected, concentration given is the reporting limit.
- UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.8b
Groundwater Analytical Results—Lower Water-Bearing Zone

		Analyte Class	Volatile Organic Compounds														
		Analyte	Benzene	Chloroethane	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	Ethylbenzene	Methylene chloride	Tetrachloroethylene	Toluene	1,1,1-Trichloroethane	Trichloroethylene	Vinyl chloride	Total xylenes
		CAS No.	71-43-2	75-00-3	75-34-3	107-06-2	75-35-4	156-59-2	156-60-5	100-41-4	75-09-2	127-18-4	108-88-3	71-55-6	79-01-6	75-01-4	1330-20-7
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	1.6	19,000	7.7	4.2	7	16	100	31	5	2.9	130	200	0.7	0.18	330
Sample Name	Sample Date	Site															
B-19																	
B-19-8/18/2003	8/18/2003	Fox Avenue						32				26			50	0.50 U	
B-19-12/13/2005	12/13/2005	Fox Avenue						23				1.9			24	1.2	
B-19-8/3/2007	8/3/2007	Fox Avenue						34				0.54			10	25	
B-19-41.5	1/28/2009	Fox Avenue	20 U	20 U	20 U	20 U	20 U	87	20 U	20 U	20 U	20 U	20 U	20 U	20 U	36	20 U
DUP2-012110	1/21/2010	Fox Avenue	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	70	1.0 U	1.0 U	1.0 U	3.7	1.0 U	1.0 U	1.0 U	19	1.0 U
B-19-012110	1/21/2010	Fox Avenue	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	67	1.0 U	1.0 U	1.0 U	3.2	1.0 U	1.0 U	1.0 U	19	1.0 U
B-19-051514	5/15/2014	Fox Avenue	1.0 U		1.0 U	1.0 U	3.1	660	2.4	1.0 U		1.0 U	1.0 U	1.0 U	0.50 U	240	
DUP-03-052715	5/27/2015	Fox Avenue	1.0 U		1.0 U	1.0 U	1.0 U	98	1.9	1.0 U		1.0 U	1.0 U	1.0 U	0.50 U	44	
B-19-052715	5/27/2015	Fox Avenue	1.0 U		1.0 U	1.0 U	1.0 U	95	1.5	1.0 U		1.0 U	1.0 U	1.0 U	0.50 U	48	
B-21																	
B-21-8/19/2003	8/19/2003	Fox Avenue						830				1.0 U			1.5	7,100	
B-21-12/11/2003	12/11/2003	Fox Avenue						67				20 U			20 U	980	
B-21-1/28/2004	1/28/2004	Fox Avenue						52				50 U			50 U	3,200	
B-21-2/26/2004	2/26/2004	Fox Avenue						100 U				100 U			100 U	3,000	
B-21-3/29/2004	3/29/2004	Fox Avenue						40 U				40 U			40 U	1,500	
B-21-4/27/2004	4/27/2004	Fox Avenue						100 U				100 U			100 U	2,300	
B-21-5/28/2004	5/28/2004	Fox Avenue						24				2.2			1.0 U	120	
B-21-1/11/2005	1/11/2005	Fox Avenue						16				10 U			10 U	450	
B-21-2/10/2005	2/10/2005	Fox Avenue						100 U				100 U			100 U	400	
B-21-3/8/2005	3/8/2005	Fox Avenue						10 U				10 U			10 U	460	
B-21-8/6/2007	8/6/2007	Fox Avenue						260 J				1.6 UJ			0.51 J	67 J	
B-21-39.5	1/28/2009	Fox Avenue	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.20 U	1.0 U
B-21-44.5	1/28/2009	Fox Avenue	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 U	1.0 U
B-21-062014	6/20/2014	Fox Avenue	1.9		2.2	1.0 U	1.0 U	3.2	1.0 U	1.7		1.0 U	16	1.0 U	0.50 U	0.20 U	
B-21-051315	5/13/2015	Fox Avenue	3.1		3.4	1.0 U	1.0 U	4.1	1.0 U	3.2		1.0 U	6.7	1.0 U	0.50 U	290	
B-21-092915	9/29/2015	Fox Avenue	6.0		4.2	1.0 U	1.0 U	1.0 U	1.0 U	2.8		1.0 U	6.3	1.0 U	0.50 U	41	
B-35																	
B-35-8/18/2003	8/18/2003	Fox Avenue						150				37			100	5,800	
B-35-12/13/2005	12/13/2005	Fox Avenue						250				20 U			20 U	630	
B-35-12/6/2006	12/6/2006	Fox Avenue						40 J				4.0 UJ			4.0 UJ	380 J	
B-35-8/6/2007	8/6/2007	Fox Avenue						8.9 J				0.20 UJ			1.7 J	1,400 J	
B-35-012110	1/21/2010	Fox Avenue	10 U	10 U	23	10 U	10 U	1,200	13	10 U	10 U	10	10 U	10 U	10 U	5,000	10 U
Dup1-081712	8/17/2012	Fox Avenue	4.8		10	1.0 U	1.0 U	98	5.1	1.0 U		1.0 U	1.0 U	1.0 U	1.0 U	1,200	
B-35-081712	8/17/2012	Fox Avenue	4.8		10	1.0 U	1.0 U	96	6.3	1.0 U		1.0 U	1.0 U	1.0 U	1.0 U	1,100	
B-37																	
B-37-8/18/2003	8/18/2003	Fox Avenue						1.0 U				1.0 U			1.0 U	0.50 U	
B-37-8/9/2007	8/9/2007	Fox Avenue						0.20 U				0.20 U			0.20 U	0.20 U	

Table 4.8b
Groundwater Analytical Results—Lower Water-Bearing Zone

		Analyte Class	Volatile Organic Compounds														
		Analyte	Benzene	Chloroethane	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	Ethylbenzene	Methylene chloride	Tetrachloroethylene	Toluene	1,1,1-Trichloroethane	Trichloroethylene	Vinyl chloride	Total xylenes
		CAS No.	71-43-2	75-00-3	75-34-3	107-06-2	75-35-4	156-59-2	156-60-5	100-41-4	75-09-2	127-18-4	108-88-3	71-55-6	79-01-6	75-01-4	1330-20-7
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	1.6	19,000	7.7	4.2	7	16	100	31	5	2.9	130	200	0.7	0.18	330
Sample Name	Sample Date	Site															
B-45																	
B-45-8/20/2003	8/20/2003	Fox Avenue						6,600				25			2,100	500 U	
B-45-12/11/2003	12/11/2003	Fox Avenue						14,000				400 U			410	620	
B-45-1/29/2004	1/29/2004	Fox Avenue						4,700				100 U			280	150	
B-45-2/26/2004	2/26/2004	Fox Avenue						950				20 U			350	12	
B-45-3/29/2004	3/29/2004	Fox Avenue						1,300				50 U			340	25 U	
B-45-4/27/2004	4/27/2004	Fox Avenue						1,300				40 U			320	20 U	
B-45-5/28/2004	5/28/2004	Fox Avenue						1,500				2.2			510	9.4	
B-45-1/11/2005	1/11/2005	Fox Avenue						3,000				100 U			160	170	
B-45-2/9/2005	2/9/2005	Fox Avenue						2,300				40 U			390	57	
B-45-3/9/2005	3/9/2005	Fox Avenue						3,600				80 U			370	130	
B-45-2/16/2006	2/16/2006	Fox Avenue						2,800				20 U			370	280	
B-45-12/5/2006	12/5/2006	Fox Avenue						5,600				60			250	200	
B-45-8/6/2007	8/6/2007	Fox Avenue						14,000 J				29 J			710 J	250 J	
B-45-43.5	1/28/2009	Fox Avenue	200 U	200 U	200 U	200 U	200 U	4,400	200 U	200 U	200 U	200 U	200 U	200 U	190	460	200 U
B-45-38.5	1/28/2009	Fox Avenue	200 U	200 U	200 U	200 U	200 U	2,500	200 U	200 U	200 U	200 U	200 U	200 U	350	94	200 U
B-45-051414	5/14/2014	Fox Avenue	1.6		2.0	1.0 U	1.0 U	1000	17	1.0 U		1.0 U	1.0 U	1.0 U	0.83	1,000	
B-45-102214	10/22/2014	Fox Avenue	3.1		4.1	1.0 U	7.7	7,300	67	1.0 U		1.6	2.3	1.0 U	3.0	11,000	
B-45-010915	1/9/2015	Fox Avenue	1.6		2.0	1.0 U	2.7	1,900	40	1.0 U		1.0 U	3.6	1.0 U	2.3	3,200	
B-45-051315	5/13/2015	Fox Avenue	1.6		1.0 U	1.0 U	2.0	1,700	26	1.5		1.0 U	4.5	1.0 U	2.1	2,200	
B-45-093015	9/30/2015	Fox Avenue	2.0		1.0 U	1.0 U	1.0 U	49	2.7	1.7		1.4	4.2	1.0 U	0.53	160	
B-59																	
B-59-8/19/2003	8/19/2003	Fox Avenue						290				6.3			5.1	67	
B-59-12/14/2005	12/14/2005	Fox Avenue						460				40 U			40 U	860	
B-59-12/6/2006	12/6/2006	Fox Avenue						1,100				9.8			4.0 U	1,400	
B-59-8/9/2007	8/9/2007	Fox Avenue						230				0.84			1.9	180	
B-59-26.5	1/27/2009	Fox Avenue	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	48	1.0 U	1.0 U	1.0 U	23	1.0 U	1.0 U	6.5	2.5	1.0 U
B-59-042809	4/28/2009	Fox Avenue	4.1	1.0 U	1.0 U	1.0 U	1.3	150	7.7	1.0 U	1.0 U	18	1.0 U	1.0 U	22	200	1.0 U
B-59-102609	10/26/2009	Fox Avenue	1.0 U	1.0 U	1.0 U	3.2	1.0 U	3.8	1.1	1.0 U	1.0 U	14	1.0 U	1.0 U	1.7	7.8	1.0 U
B-59-012110	1/21/2010	Fox Avenue	1.0 U	1.6	1.0 U	1.6	1.0 U	2.8	1.0 U	1.0 U	1.0 U	45	1.0 U	1.0 U	2.4	1.7	1.0 U
B-59C-27	10/21/2010	Fox Avenue	1.0	0.89 J	1.0 U	2.8	0.76 J	27	0.55 J	1.0 U	1.0 U	1.1	1.0 U	1.0 U	0.60 J	7.9	1.0 U
B-59-27.5	10/21/2010	Fox Avenue	1.3	0.99 J	1.0 U	3.3	0.90 J	16	1.0 U	1.0 U	1.0 U	1.2	1.0 U	1.0 U	0.54 J	8.7	1.0 U
B-59-033011	3/30/2011	Fox Avenue	1.0 U	1.1 J	1.0 U	1.2	1.0 U	7.8	1.0 U	1.0 U	1.0 U	1.4	1.0 U	1.0 U	1.3	5.9	
B-59-112911	11/29/2011	Fox Avenue	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.5	1.0 U	1.0 U	1.0 U	1.0 U	6.0	1.0 U	1.0 U	2.1	
B-59-082012	8/20/2012	Fox Avenue	1.1		1.0 U	1.0 U	1.0 U	21	1.6	1.0 U		1.0 U	15	1.0 U	2.4	58	
B-59-052913	5/29/2013	Fox Avenue	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.6	1.0 U	1.0 U	1.0 U	1.0 U	5.7	1.0 U	1.0 U	12	
B-59-072413	7/24/2013	Fox Avenue	1.0 U		1.0 U	1.0 U	1.0 U	2.3	1.0 U	1.0 U		1.0 U	120	1.0 U	1.0 U	3.0	
B-59-051514	5/15/2014	Fox Avenue	1.8		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		1.0 U	11	1.0 U	0.50 U	3.3	
B-59-102214	10/22/2014	Fox Avenue	1.6		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		1.0 U	2.0	1.0 U	0.50 U	27	
B-59-010915	1/9/2015	Fox Avenue	1.7		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	0.50 U	8.0	
B-59-051315	5/13/2015	Fox Avenue	1.6		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	0.50 U	1.1	
B-59D-092915	9/29/2015	Fox Avenue	1.2		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	0.50 U	3.3	

Table 4.8b
Groundwater Analytical Results—Lower Water-Bearing Zone

		Analyte Class	Volatile Organic Compounds														
		Analyte	**Benzene**	**Chloroethane**	**1,1-Dichloroethane**	**1,2-Dichloroethane**	**1,1-Dichloroethylene**	**cis-1,2-Dichloroethylene**	**trans-1,2-Dichloroethylene**	**Ethylbenzene**	**Methylene chloride**	**Tetrachloroethylene**	**Toluene**	**1,1,1-Trichloroethane**	**Trichloroethylene**	**Vinyl chloride**	**Total xylenes**
		CAS No.	71-43-2	75-00-3	75-34-3	107-06-2	75-35-4	156-59-2	156-60-5	100-41-4	75-09-2	127-18-4	108-88-3	71-55-6	79-01-6	75-01-4	1330-20-7
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	1.6	19,000	7.7	4.2	7	16	100	31	5	2.9	130	200	0.7	0.18	330
Sample Name	**Sample Date**	**Site**															
B-61																	
B-61-8/19/2003	8/19/2003	Fox Avenue						15,000				1.0 U			940	1,600	
B-61-12/11/2003	12/11/2003	Fox Avenue						9,600				200 U			460	1,100	
B-61-1/27/2004	1/27/2004	Fox Avenue						12,000				400 U			970	1,400	
B-61-2/26/2004	2/26/2004	Fox Avenue						16,000				250 U			1,700	2,000	
B-61-3/27/2004	3/27/2004	Fox Avenue						9,300				200 U			1,100	540	
B-61-4/26/2004	4/26/2004	Fox Avenue						9,700				200 U			980	740	
B-61-5/28/2004	5/28/2004	Fox Avenue						1,300				1.8			460	8.1	
B-61-1/11/2005	1/11/2005	Fox Avenue						8,100				100 U			350	2,100	
B-61-2/10/2005	2/10/2005	Fox Avenue						8,700				200 U			410	1,500	
B-61-3/8/2005	3/8/2005	Fox Avenue						7,400				200 U			250	1,700	
B-61-12/13/2005	12/13/2005	Fox Avenue						5,800				200 U			200 U	800	
B-61-12/6/2006	12/6/2006	Fox Avenue						3,600				8.0 U			14	1,200	
B-61-8/9/2007	8/9/2007	Fox Avenue						3,200				8.4 JB			8.0 U	1,900	
B-61-40.5	1/27/2009	Fox Avenue	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	870	11	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	76	450	1.0 U
DUP1-042809	4/28/2009	Fox Avenue	1.5	1.2	2.4	1.0 U	3.6	1,600	28	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.1	1,800	1.2
B-61-042809	4/28/2009	Fox Avenue	1.7	1.5	2.0	1.0 U	4.1	1,700	36	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.4	1,200	1.3
B-61-062309	6/23/2009	Fox Avenue	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	100	1.0 U	1.0 U	1.0 U	5.7	1.0 U	1.0 U	13	5.2	1.0 U
B-61-072309	7/23/2009	Fox Avenue	2.7	1.0 U	10	1.0 U	3.1	1,700	38	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.1	1,600	1.2
B-61-102609	10/26/2009	Fox Avenue	10 U	10 U	10 U	10 U	10 U	1,100	14	10 U	10 U	10 U	10 U	10 U	10 U	1,200	10 U
B-61-011410	1/14/2010	Fox Avenue	10 U	10 U	10 U	10 U	10 U	2,300	29	10 U	10 U	10 U	10 U	10 U	10 U	3,900	10 U
B-61-021610	2/16/2010	Fox Avenue	5.0 U	5.0 U	5.0 U	5.0 U	5.1	2,600	24	5.0 U	5.0 U	14	5.0 U	5.0 U	16	2,100	5.0 U
B-61-041410	4/14/2010	Fox Avenue	20 U	20 U	20 U	20 U	20 U	1,300	16 J	20 U	20 U	20 U	20 U	20 U	20 U	950	20 U
B-61-41.5	10/21/2010	Fox Avenue	4.5	3.6	4.6	1.0 U	1.0	350	5.4	1.0 U	1.0 U	0.82 J	0.78 J	1.0 U	1.0 U	710	1.6
DUP1-033011	3/30/2011	Fox Avenue	1.7	1.5 J	1.0 U	1.0 U	1.9	860	30	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.4	630	
B-61-033011	3/30/2011	Fox Avenue	1.9	1.0 UJ	1.0 U	1.0 U	2.4	850	13	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.5	630	
B-61-112911	11/29/2011	Fox Avenue	1.7	1.0 U	1.0 U	1.0 U	1.7	1,300	12	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.6	1,200	
Dup2-082012	8/20/2012	Fox Avenue	1.9		1.0	1.0 U	1.0 U	2.7	1.0 U	1.1		1.0 U	1.2	1.0 U	1.0 U	11	
B-61-082012	8/20/2012	Fox Avenue	1.8		1.0 U	1.0 U	1.0 U	2.2	1.0 U	1.0		1.0 U	1.2	1.0 U	1.0 U	9.3	
B-61-052913	5/29/2013	Fox Avenue	1.7	1.0 U	1.0 U	1.0 U	1.0 U	20	1.0 U	1.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	170	
B-61-072213	7/22/2013	Fox Avenue	1.4		1.0 U	1.0 U	1.0 U	4.2	1.0 U	1.2		1.0 U	1.0 U	1.0 U	1.0 U	150	
B-61-051514	5/15/2014	Fox Avenue	2.3		1.7	1.0 U	1.0 U	16	1.0 U	1.1		1.0 U	1.0 U	1.0 U	0.50 U	17	
B-61-102214	10/22/2014	Fox Avenue	3.1		2.3	1.0 U	1.0 U	9.6	1.0 U	1.1		1.0 U	1.0 U	1.0 U	0.50 U	2.8	
B-61-010915	1/9/2015	Fox Avenue	4.2		4.9	1.0 U	1.0 U	6.9	1.0 U	2.0		1.0 U	1.0 U	1.0 U	0.50 U	1.7	
B-61-051315	5/13/2015	Fox Avenue	5.4		6.0	1.0 U	1.0 U	170	1.5	1.0 U		1.0 U	1.0 U	1.0 U	0.50 U	640	
B-61D-093015	9/30/2015	Fox Avenue	6.0		5.0	1.0 U	1.0	460	16	1.0 U		1.0 U	1.0 U	1.0 U	0.82	1,100	
B-63																	
B-63-8/18/2003	8/18/2003	Fox Avenue						210				1.0 U			1.6	720	
B-63-12/13/2005	12/13/2005	Fox Avenue						59				1.0 U			1.0 U	360	
B-63-12/6/2006	12/6/2006	Fox Avenue						24				0.20 U			0.49	370	
B-63-8/6/2007	8/6/2007	Fox Avenue						1,400 J				0.52 UJ			1.0 J	1,300 J	
B-63-012110	1/21/2010	Fox Avenue	14	10 U	10 U	10 U	27	10,000 J	150	10 U	10 U	10 U	80	10 U	10 U	10,000 J	10 U
B-63-40.5	10/21/2010	Fox Avenue	1.0 U	1.0 U	1.4	1.0 U	1.0 U	260	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	66	1.0 U
B-63-051514	5/15/2014	Fox Avenue	1.0 U		2.7	1.0 U	1.0 U	4.2	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	0.50 U	65	

Table 4.8b
Groundwater Analytical Results—Lower Water-Bearing Zone

		Analyte Class	Volatile Organic Compounds														
		Analyte	Benzene	Chloroethane	1,1-Dichloroethane	1,2-Dichloroethane	1,1-Dichloroethylene	cis-1,2-Dichloroethylene	trans-1,2-Dichloroethylene	Ethylbenzene	Methylene chloride	Tetrachloroethylene	Toluene	1,1,1-Trichloroethane	Trichloroethylene	Vinyl chloride	Total xylenes
		CAS No.	71-43-2	75-00-3	75-34-3	107-06-2	75-35-4	156-59-2	156-60-5	100-41-4	75-09-2	127-18-4	108-88-3	71-55-6	79-01-6	75-01-4	1330-20-7
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		PSL	1.6	19,000	7.7	4.2	7	16	100	31	5	2.9	130	200	0.7	0.18	330
Sample Name	Sample Date	Site															
B-65																	
B-65-8/18/2003	8/18/2003	Fox Avenue						33,000				1.0 U			1.0 U	8,200	
B-65-11/16/2004	11/16/2004	Fox Avenue						22,000 J				2.8			1.0 U	7,600 J	
B-65-3/7/2005	3/7/2005	Fox Avenue						17,000				100 U			100 U	6,300	
B-65-12/13/2005	12/13/2005	Fox Avenue						12,000				200 U			200 U	6,200	
B-65-12/6/2006	12/6/2006	Fox Avenue						18,000 J				400 UJ			400 UJ	8,300 J	
B-65-8/2/2007	8/2/2007	Fox Avenue						28,000				1.1			0.79	7,500	
B-65-31.5-PDB	1/26/2009	Fox Avenue	20 U	20 U	20 U	20 U	48	15,000	130	20 U	20 U	20 U	20 U	20 U	20 U	6,500	20 U
B-65-31.5	1/29/2009	Fox Avenue	200 U	200 U	200 U	200 U	200 U	23,000	150 J	200 U	200 U	200 U	200 U	200 U	200 U	9,800	200 U
B-65-042809	4/28/2009	Fox Avenue	1.0 U	1.0 U	1.0 U	1.0 U	1.1	510	1.6	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	260	1.0 U
B-65-102909	10/29/2009	Fox Avenue	100 U	100 U	100 U	100 U	100 U	1,500	100 U	100 U	100 U	100 U	100 U	100 U	100 U	1,800	100 U
B-65-011410	1/14/2010	Fox Avenue	100 U	100 U	100 U	100 U	100 U	5,400	100 U	100 U	100 U	100 U	100 U	100 U	100 U	5,800	100 U
DUP1-021610	2/16/2010	Fox Avenue	5.0 U	5.0 U	6.1	5.0 U	9.7	5,400	17	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	4.8 J	3,600	5.0 U
B-65-021610	2/16/2010	Fox Avenue	5.0 U	5.0 U	5.7	5.0 U	10	5,500	12	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	4.3 J	3,900	5.0 U
B-65-033011	3/30/2011	Fox Avenue	1.5	1.0 UJ	2.9	1.0 U	5.6	2,600	17	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,300	
B-65-112811	11/28/2011	Fox Avenue	2.0	1.5	3.6	1.0 U	2.8	2,500	11	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000	
B-65-081712	8/17/2012	Fox Avenue	11		26	1.0 U	1.0 U	220	6.0	1.0 U		1.0 U	1.0 U	1.0 U	1.0 U	520	
B-65-072213	7/22/2013	Fox Avenue	15		26	1.0 U	1.0 U	21	1.0 U	2.4		1.0 U	1.9	1.0 U	1.0 U	110	
B-65-052715	5/27/2015	Fox Avenue	1.2		3.5	1.0 U	1.0 U	68	1.0 U	1.0 U		1.0 U	1.0 U	1.0 U	0.50 U	350	
MW-04																	
MW-4-10/31/2003	10/31/2003	Fox Avenue						14,000				1.0 U			980	7,300	
MW-4-11/16/2004	11/16/2004	Fox Avenue						7,000 J				1.0 U			160 J	5,100 J	
MW-4-2/7/2005	2/7/2005	Fox Avenue						8,500				200 U			340	7,600	
MW-4-3/7/2005	3/7/2005	Fox Avenue						5,900				10 U			270	4,500	
MW-4-12/12/2005	12/12/2005	Fox Avenue						2,600				100 U			100 U	3,300	
MW-4-12/7/2006	12/7/2006	Fox Avenue						6,500 J				100 UJ			100 UJ	4,500 J	
MW-4-8/2/2007	8/2/2007	Fox Avenue						6,000				3.9			1.8	3,400	
MW-4-102809	10/28/2009	Fox Avenue	10 U	10 U	10 U	10 U	10 U	3,600	38	10 U	10 U	12	10 U	10 U	10 U	2,500	10 U
MW-4-011510	1/15/2010	Fox Avenue	10 U	10 U	7.7 J	10 U	13	3,900	24	10 U	10 U	7.0 J	10 U	10 U	15	3,900	10 U
MW-4-042210	4/23/2010	Fox Avenue	20 U	20 U	15	10 U	10	3,900	17	20 U	20 U	4.2 J	20 U	20 U	20 U	3,100	20 U
DUP1-042210	4/23/2010	Fox Avenue	20 U	20 U	10 U	10 U	9.8 J	4,000	18	20 U	20 U	4.4 J	20 U	20 U	20 U	3,200	20 U
Dup1-121312	12/13/2012	Fox Avenue	11	1.0 U	19	1.0 U	1.0 U	1.0 U	1.0 U	4.4	1.0 U	1.0 U	3.1	1.0 U	1.0 U	4.4	
MW-4-121312	12/13/2012	Fox Avenue	12	1.0 U	21	1.0 U	1.0 U	1.5	1.0 U	4.6	1.0 U	1.0 U	3.3	1.0 U	1.0 U	5.3	
MW-4-052715	5/27/2015	Fox Avenue	11		12	1.0 U	1.0 U	1.0 U	1.0 U	58		1.0 U	1.2	1.0 U	0.50 U	0.90	
MW-4-111615	11/16/2015	Fox Avenue	6.7		6.4	1.0 U	1.0 U	1.0 U	1.0 U	36		1.0 U	1.0 U	1.0 U	0.50 U	15	
MW-08																	
MW-8-12/12/2003	12/12/2003	Fox Avenue						65				670			550	30	
MW-8-2/7/2005	2/7/2005	Fox Avenue						23				460			190	10 U	
MW-8-12/15/2005	12/15/2005	Fox Avenue						32				250			270	3.9	
MW-8-8/7/2007	8/7/2007	Fox Avenue						330				17			96	380	
MW-8-24	1/28/2009	Fox Avenue	20 U	20 U	20 U	20 U	20 U	160	20 U	20 U	20 U	12 J	20 U	20 U	81	200	20 U

Table 4.8b
Groundwater Analytical Results—Lower Water-Bearing Zone

		Analyte Class	Volatile Organic Compounds														
		Analyte	**Benzene**	**Chloroethane**	**1,1-Dichloroethane**	**1,2-Dichloroethane**	**1,1-Dichloroethylene**	**cis-1,2-Dichloroethylene**	**trans-1,2-Dichloroethylene**	**Ethylbenzene**	**Methylene chloride**	**Tetrachloroethylene**	**Toluene**	**1,1,1-Trichloroethane**	**Trichloroethylene**	**Vinyl chloride**	**Total xylenes**
		CAS No.	**71-43-2**	**75-00-3**	**75-34-3**	**107-06-2**	**75-35-4**	**156-59-2**	**156-60-5**	**100-41-4**	**75-09-2**	**127-18-4**	**108-88-3**	**71-55-6**	**79-01-6**	**75-01-4**	**1330-20-7**
		Unit	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
		PSL	**1.6**	**19,000**	**7.7**	**4.2**	**7**	**16**	**100**	**31**	**5**	**2.9**	**130**	**200**	**0.7**	**0.18**	**330**
Sample Name	**Sample Date**	**Site**															
MW-10																	
MW-10-12/16/2005	12/16/2005	Fox Avenue						**170**				***20 U***			***20 U***	**670**	
MW-10-12/4/2006	12/4/2006	Fox Avenue						**10,000**				0.31			**1.3**	**12,000**	
MW-10-8/7/2007	8/7/2007	Fox Avenue						**47,000 J**				***4.2 UJ***			**5.6 JB**	**6,300 J**	
MW-10-24	1/26/2009	Fox Avenue	**61**	20 U	**120**	***20 U***	**37**	**17,000**	**170**	**1,000**	***20 U***	***20 U***	**2,200**	20 U	***20 U***	**13,000**	**820**
MW-10-24	10/20/2010	Fox Avenue	**4.8**	1.0 U	**18**	1.0 U	4.9	**1,800**	78	**120**	1.0 U	1.0 U	**170**	1.0 U	***1.0 U***	**1,700**	71
MW-10-051414	5/14/2014	Fox Avenue	**3.6**		1.0 U	1.0 U	1.0 U	**7,500**	45	**35**		1.0 U	69	1.0 U	0.50 U	**270**	
MW-10-102214	10/22/2014	Fox Avenue	**3.9**		1.0 U	1.0 U	4.0	**6,700**	13	**43**		**5.5**	**170**	1.0 U	**2.5**	**1,600**	
MW-10-010915	1/9/2015	Fox Avenue	**3.6**		1.0 U	1.0 U	2.6	**4,200**	17	**42**		**5.0**	82	1.0 U	**1.2**	**1,400**	
MW-10-051515	5/15/2015	Fox Avenue	**2.7**		1.0 U	1.0 U	1.1	**1,600**	1.2	17		2.9	34	1.0 U	0.50 U	**470**	
DUP-1-051515	5/15/2015	Fox Avenue	**3.0**		1.0 U	1.0 U	1.2	**1,700**	1.2	17		2.7	36	1.0 U	0.50 U	**530**	
DUP-1-093015	9/30/2015	Fox Avenue	**2.1**		1.0 U	1.0 U	1.0 U	**130**	1.0 U	5.4		1.3	9.9	1.0 U	0.50 U	**740**	
MW-10-093015	9/30/2015	Fox Avenue	**2.1**		1.0 U	1.0 U	1.0 U	**130**	1.0 U	5.0		1.6	10	1.0 U	0.50 U	**780**	
PTM-2L																	
PTM-2L-12/9/2003	12/9/2003	Fox Avenue						**3,500**				**90**			**740**	**1,500**	
PTM-2L-1/28/2004	1/28/2004	Fox Avenue						**3,800**				***100 U***			**500**	**740**	
PTM-2L-2/26/2004	2/26/2004	Fox Avenue						**2,700**				***50 U***			**290**	**670**	
PTM-2L-3/27/2004	3/27/2004	Fox Avenue						**3,300**				***100 U***			**450**	**690**	
PTM-2L-4/26/2004	4/26/2004	Fox Avenue						**4,100**				***100 U***			**980**	**390**	
PTM-2L-5/28/2004	5/28/2004	Fox Avenue						**9,100**				***500 U***			***500 U***	**14,000**	
PTM-2L-2/16/2006	2/16/2006	Fox Avenue						**970**				***10 U***			***10 U***	**460**	
PTM-2L-12/4/2006	12/4/2006	Fox Avenue						**220**				**4.0**			**5.6**	**130**	
PTM-2L-8/9/2007	8/9/2007	Fox Avenue						**880**				**99**			**15**	**460**	
PTM-2L-36	1/26/2009	Fox Avenue	***20 U***	20 U	***20 U***	***20 U***	***20 U***	**1,500**	20 U	20 U	***20 U***	***20 U***	20 U	20 U	***20 U***	**1,900**	20 U
PTM-2L-35	10/20/2010	Fox Avenue	**5.0**	3.3	**16**	1.0 U	**7.9**	**1,300**	34	1.0 U	1.0 U	1.0	0.49 J	1.0 U	**140**	**790**	1.2

Notes:

Results have been rounded to two significant digits.
Empty cells are intentional.
RED/BOLD Detection exceeds PSL.
BOLD/ITALIC Analyte not detected at reporting limit; reporting limit exceeds PSL.
1 GRO PSL was developed assuming weathered product from historic spills, based on Lower Duwamish Preliminary Cleanup Levels.
2 Chromatograms were not reviewed for this sum; both ORO and DRO are included.

Abbreviations:

DRO Diesel-range organics
µg/L Micrograms per liter
NA Not applicable
ORO Oil-range organics

Qualifiers:

J Analyte was detected, concentration is considered an estimate.
U Analyte was not detected, concentration given is the reporting limit.
UJ Analyte was not detected, concentration given is the reporting limit, which is considered an estimate.

Table 4.9
Summary Information for Detected Chemicals in Soil

				All Soil Samples									In-Situ Soil								
Analyte	CAS No.	Units	Most Stringent PSL	Number of Results	Number of Detected Results	Percent of Detected Results	Minimum Detected Value	Maximum Detected Value	Location of Maximum Detected Value	Field Sample ID	Depth of Maximum Detect	Date of Maximum Detected Value	Number of Results	Number of Detected Results	Percent of Detected Results	Minimum Detected Value	Maximum Detected Value	Location of Maximum Detected Value	Field Sample ID	Depth of Maximum Detect	Date of Maximum Detected Value
Petroleum Hydrocarbons																					
Gasoline-range organics	TPHG	mg/kg	30	28	5	18%	160	10,000	WT-B17	B17-07.5	7.5 ft	4/5/2014	22	5	23%	160	10,000	WT-B17	B17-07.5	7.5 ft	4/5/2014
Diesel-range organics	TPHD	mg/kg	2,000	69	11	16%	110	23,000	WT-B17	B17-07.5	7.5 ft	4/5/2014	54	9	17%	110	23,000	WT-B17	B17-07.5	7.5 ft	4/5/2014
Oil-range organics	TPHO	mg/kg	2,000	76	20	26%	80	23,000	WT-MW-110	SB-11-4-5	4–5 ft	12/7/2015	63	11	17%	80	3,000	WT-B17	B17-07.5	7.5 ft	4/5/2014
Stoddard solvent	TPHSS	mg/kg	2,000	68	14	21%	110	25,000	WT-B17	B17-07.5	7.5 ft	4/5/2014	60	10	17%	140	25,000	WT-B17	B17-07.5	7.5 ft	4/5/2014
Total DRO + ORO	TPHD+O	mg/kg	2,000	67	21	31%	80	23,000	WT-MW-110	SB-11-4-5	4–5 ft	12/7/2015	54	12	22%	80	3,000	WT-B17	B17-07.5	7.5 ft	4/5/2014
Metals																					
Arsenic	7440-38-2	mg/kg	7	21	21	100%	1.5	10	SS-06	WT-SS-06-0-6"	0–6 in	4/11/2017	8	8	100%	1.8	4.88	WT-GP-7	GP-7 (0-5)	0–5 ft	3/26/2013
Barium	7440-39-3	mg/kg	8.3	21	21	100%	12	140	SS-04	WT-SS-04-0-6"	0–6 in	4/11/2017	8	8	100%	12.8	57	WT-GP-11	GP-11 (0-5)	0–5 ft	3/26/2013
Cadmium	7440-43-9	mg/kg	0.77	21	7	33%	0.18	1.6	SS-01	WT-SS-01-0-6"	0–6 in	4/11/2017	--	--	--	--	--	--	--	--	--
Chromium, trivalent	7440-47-3	mg/kg	27	21	21	100%	9.3	260	SS-04	WT-SS-04-0-6"	0–6 in	4/11/2017	8	8	100%	9.31	17.8	WT-GP-8	GP-8 (0-5)	0–5 ft	3/26/2013
Lead	7439-92-1	mg/kg	56	21	21	100%	0.98	110	SS-01	WT-SS-01-0-6"	0–6 in	4/11/2017	8	8	100%	0.979	15.6	WT-GP-11	GP-11 (0-5)	0–5 ft	3/26/2013
Mercury, inorganic	7439-97-6	mg/kg	0.07	22	1	4.5%	0.16	0.16	SS-01	WT-SS-01-0-6"	0–6 in	4/11/2017	--	--	--	--	--	--	--	--	--
Selenium	7782-49-2	mg/kg	0.26	21	17	81%	0.21	1.4	WT-SB-01	SB-01-0-2	0–2 ft	12/7/2015	8	7	88%	0.818	1.25	WT-GP-4	GP-4 (0-10)	0–10 ft	3/26/2013
Silver	7440-22-4	mg/kg	0.016	21	5	24%	0.13	0.47	SS-01	WT-SS-01-0-6"	0–6 in	4/11/2017	--	--	--	--	--	--	--	--	--
Polychlorinated Biphneyls (PCBs)																					
Total PCB Aroclors	1336-36-3	mg/kg	2.2E-06	13	8	62%	0.051	0.25	SS-01	WT-SS-01-0-6"	0–6 in	4/11/2017	--	--	--	--	--	--	--	--	--
Dioxins/Furans																					
Total dioxin/furan TEQ	DFTEQ	mg/kg	0.000013	7	7	100%	8.34E-07	0.00893	WT-B17	B17-07.5	7.5 ft	4/5/2014	7	7	100%	8.34E-07	0.00893	WT-B17	B17-07.5	7.5 ft	4/5/2014
Semivolatile Organic Compounds/Polycyclic Aromatic Hydrocarbons																					
Benzo(a)anthracene	56-55-3	mg/kg	--	6	1	17%	0.46	0.46	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	205-99-2	mg/kg	--	6	1	17%	0.82	0.82	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	191-24-2	mg/kg	--	5	1	20%	0.30	0.30	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	50-32-8	mg/kg	--	6	1	17%	0.64	0.64	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	207-08-9	mg/kg	--	6	1	17%	0.30	0.30	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Chrysene	218-01-9	mg/kg	--	6	1	17%	0.42	0.42	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Fluoranthene	206-44-0	mg/kg	0.09	5	1	20%	0.97	0.97	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-c,d)pyrene	193-39-5	mg/kg	--	6	1	17%	0.43	0.43	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Phenanthrene	85-01-8	mg/kg	--	5	1	20%	0.38	0.38	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Pyrene	129-00-0	mg/kg	0.14	5	1	20%	0.83	0.83	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Total cPAH TEQ	CPAHTEQ	mg/kg	0.000016	5	1	20%	0.84	0.84	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Other Semivolatile Organic Compounds																					
Bis(2-ethylhexyl) phthalate	117-81-7	mg/kg	0.0051	5	2	40%	0.14	2.6	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	85-68-7	mg/kg	0.00018	5	1	20%	0.86	0.86	WT-MW-110	SB-11-0-2	0–2 ft	12/7/2015	--	--	--	--	--	--	--	--	--
Pentachlorophenol	87-86-5	mg/kg	1.8E-06	60	16	27%	0.079	340	WT-B17	B17-07.5	7.5 ft	4/5/2014	49	11	22%	0.079	340	WT-B17	B17-07.5	7.5 ft	4/5/2014
Volatile Organic Compounds																					
Ethylbenzene	100-41-4	mg/kg	0.010	18	2	11%	2.1	3.9	WT-B16	B16-10.0	10 ft	4/5/2014	18	2	11%	2.1	3.9	WT-B16	B16-10.0	10 ft	4/5/2014
Tetrachloroethylene	127-18-4	mg/kg	0.0016	21	6	29%	0.026	0.16	WT-GP-7	GP-7 (3)	3 ft	3/26/2013	15	5	33%	0.026	0.16	WT-GP-7	GP-7 (3)	3 ft	3/26/2013
Trichloroethylene	79-01-6	mg/kg	0.00027	21	1	4.8%	0.021	0.021	WT-MW-06	B13-10.0	10 ft	4/5/2014	15	1	7%	0.021	0.021	WT-MW-06	B13-10.0	10 ft	4/5/2014
Total xylenes	1330-20-7	mg/kg	0.055	17	5	29%	1.3	68	WT-B17	B17-07.5	7.5 ft	4/5/2014	17	5	29%	1.3	68	WT-B17	B17-07.5	7.5 ft	4/5/2014

Note:

-- Not available.

Abbreviations:

CAS Chemical Abstracts Service
DRO Diesel-range organics
ft Feet
in Inches
mg/kg Milligrams per kilogram
NA Not applicable
ORO Oil-range organics
PSL Preliminary Screening Level
RI Remedial Investigation
TEQ Toxic equivalent

Table 4.10
Summary Information for Non-Detect Chemicals in Soil

Analyte	CAS No.	Units	Most Stringent PSL	Number of Results (1)	Minimum Non-Detect Value	Maximum Non-Detect Value
Semivolatile Organic Compounds/Polycyclic Aromatic Hydrocarbons						
Acenaphthene	83-32-9	mg/kg	0.028	5	0.081	0.095
Acenaphthylene	208-96-8	mg/kg	--	5	0.081	0.095
Anthracene	120-12-7	mg/kg	0.051	5	0.081	0.095
Dibenz(a,h)anthracene	53-70-3	mg/kg	--	6	0.010	0.095
Dibenzofuran	132-64-9	mg/kg	0.029	5	0.10	0.12
Fluorene	86-73-7	mg/kg	0.029	5	0.081	0.095
1-Methylnaphthalene	90-12-0	mg/kg	0.0042	5	0.081	0.095
2-Methylnaphthalene	91-57-6	mg/kg	0.039	5	0.081	0.095
Naphthalene	91-20-3	mg/kg	0.0021	6	0.050	0.095
Other Semivolatile Organic Compounds						
Benzyl alcohol	100-51-6	mg/kg	0.017	5	0.10	0.12
Bis(2-chloroethoxy)methane	111-91-1	mg/kg	--	5	0.10	0.12
Bis(2-chloroethyl)ether	111-44-4	mg/kg	0.000014	5	0.20	0.24
4-Bromophenyl phenyl ether	101-55-3	mg/kg	--	5	0.10	0.12
Carbazole	86-74-8	mg/kg	--	5	0.51	0.59
4-Chloroaniline	106-47-8	mg/kg	0.000077	5	0.51	0.59
4-Chloro-3-methylphenol	59-50-7	mg/kg	0.028	5	0.51	0.59
2-Chloronaphthalene	91-58-7	mg/kg	0.28	5	0.10	0.12
2-Chlorophenol	95-57-8	mg/kg	0.011	5	0.10	0.12
4-Chlorophenyl phenyl ether	7005-72-3	mg/kg	--	5	0.10	0.12
Dibutyl phthalate	84-74-2	mg/kg	0.015	5	0.10	0.12
1,2-Dichlorobenzene	95-50-1	mg/kg	0.0031	6	0.050	0.12
1,4-Dichlorobenzene	106-46-7	mg/kg	0.0081	17	0.050	0.12
2,4-Dichlorophenol	120-83-2	mg/kg	0.0043	5	0.20	0.24
1,3-Dichlorobenzene	541-73-1	mg/kg	0.0013	6	0.050	0.12
Diethyl phthalate	84-66-2	mg/kg	0.034	5	0.10	0.12
Dimethyl phthalate	131-11-3	mg/kg	0.019	5	0.10	0.12
2,4-Dimethylphenol	105-67-9	mg/kg	0.0031	5	0.10	0.12
4,6-Dinitro-2-methylphenol	534-52-1	mg/kg	0.0073	5	0.20	0.24
2,4-Dinitrophenol	51-28-5	mg/kg	0.0092	5	0.20	0.24
2,4-Dinitrotoluene	121-14-2	mg/kg	0.00016	16	0.096	0.12
2,6-Dinitrotoluene	606-20-2	mg/kg	0.000051	5	0.10	0.12
Di-n-octyl phthalate	117-84-0	mg/kg	0.33	5	0.10	0.12
Hexachlorobenzene	118-74-1	mg/kg	0.0000004	16	0.096	0.12
Hexachlorobutadiene	87-68-3	mg/kg	0.00054	17	0.096	0.25
Hexachlorocyclopentadiene	77-47-4	mg/kg	0.2	5	0.10	0.12
Hexachloroethane	67-72-1	mg/kg	0.000041	16	0.096	0.12
Isophorone	78-59-1	mg/kg	0.015	5	0.10	0.12
2-Methylphenol	95-48-7	mg/kg	0.01	16	0.096	0.12
4-Methylphenol	106-44-5	mg/kg	0.062	16	0.096	0.12
2-Nitroaniline	88-74-4	mg/kg	0.064	5	0.51	0.59
Nitrobenzene	98-95-3	mg/kg	0.0065	16	0.19	0.24
2-Nitrophenol	88-75-5	mg/kg	--	5	0.20	0.24
4-Nitrophenol	100-02-7	mg/kg	--	5	0.51	0.59
n-Nitrosodi-n-propylamine	621-64-7	mg/kg	0.0000039	5	0.10	0.12
Phenol	108-95-2	mg/kg	0.12	5	0.20	0.24
Pyridine	110-86-1	mg/kg	0.0029	11	0.19	0.23
1,2,4-Trichlorobenzene	120-82-1	mg/kg	0.0019	6	0.10	0.25
2,4,5-Trichlorophenol	95-95-4	mg/kg	0.000070	16	0.19	0.24
2,4,6-Trichlorophenol	88-06-2	mg/kg	0.0027	16	0.19	0.24
Volatile Organic Compounds						
Acetone	67-64-1	mg/kg	2.1	1	0.50	0.50
Benzene	71-43-2	mg/kg	0.00056	29	0.020	1.0
Bromoform	75-25-2	mg/kg	0.005	1	0.050	0.050
Bromobenzene	108-86-1	mg/kg	0.033	1	0.050	0.050
Bromomethane	74-83-9	mg/kg	0.003	1	0.50	0.50
sec-Butylbenzene	135-98-8	mg/kg	1.3	1	0.050	0.050
tert-Butylbenzene	98-06-6	mg/kg	1.0	1	0.050	0.050
Carbon tetrachloride	56-23-5	mg/kg	0.00015	12	0.022	0.050
Chlorobenzene	108-90-7	mg/kg	0.051	12	0.022	0.050
Chloroethane	75-00-3	mg/kg	--	10	0.50	0.50
Chloroform	67-66-3	mg/kg	0.0048	12	0.022	0.050
Chloromethane	74-87-3	mg/kg	--	1	0.50	0.50
2-Chlorotoluene	95-49-8	mg/kg	0.11	1	0.050	0.050
4-Chlorotoluene	106-43-4	mg/kg	--	1	0.050	0.050
Dibromochloromethane	124-48-1	mg/kg	0.00077	1	0.050	0.050
1,2-Dibromo-3-chloropropane	96-12-8	mg/kg	0.000081	1	0.50	0.50
Dibromomethane	74-95-3	mg/kg	0.028	1	0.050	0.050
Dichlorobromomethane	75-27-4	mg/kg	0.00096	1	0.050	0.050
Dichlorodifluoromethane	75-71-8	mg/kg	0.53	1	0.50	0.50

Table 4.10
Summary Information for Non-Detect Chemicals in Soil

Analyte	CAS No.	Units	Most Stringent PSL	Number of Results (1)	Minimum Non-Detect Value	Maximum Non-Detect Value
Volatile Organic Compounds (cont.)						
1,1-Dichloroethane	75-34-3	mg/kg	0.0026	10	0.050	0.050
1,2-Dichloroethane	107-06-2	mg/kg	0.0016	21	0.034	0.050
1,1-Dichloroethylene	75-35-4	mg/kg	0.0025	21	0.050	0.072
cis-1,2-Dichloroethylene	156-59-2	mg/kg	0.0052	10	0.050	0.050
trans-1,2-Dichloroethylene	156-60-5	mg/kg	0.032	10	0.050	0.050
1,2-Dichloropropane	78-87-5	mg/kg	0.001	1	0.050	0.050
1,3-Dichloropropane	142-28-9	mg/kg	0.057	1	0.050	0.050
2,2-Dichloropropane	594-20-7	mg/kg	--	1	0.050	0.050
1,1-Dichloropropene	563-58-6	mg/kg	--	1	0.050	0.050
cis-1,3-Dichloropropene	10061-01-5	mg/kg	0.00014	1	0.050	0.050
trans-1,3-Dichloropropene	10061-02-6	mg/kg	0.00014	1	0.050	0.050
Ethylene dibromide	106-93-4	mg/kg	0.000018	1	0.050	0.050
2-Hexanone	591-78-6	mg/kg	0.012	1	0.50	0.50
Isopropylbenzene	98-82-8	mg/kg	0.79	1	0.050	0.050
4-Isopropyltoluene	99-87-6	mg/kg	--	1	0.050	0.050
Methyl ethyl ketone	78-93-3	mg/kg	1.4	12	0.070	0.50
Methyl isobutyl ketone	108-10-1	mg/kg	0.19	1	0.50	0.50
Methyl tert-butyl ether	1634-04-4	mg/kg	0.0072	1	0.050	0.050
Methylene chloride	75-09-2	mg/kg	0.0015	10	0.50	0.50
n-Propylbenzene	103-65-1	mg/kg	0.88	1	0.050	0.050
Styrene	100-42-5	mg/kg	0.12	1	0.050	0.050
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	0.00063	1	0.050	0.050
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	0.00008	1	0.050	0.050
Toluene	108-88-3	mg/kg	0.044	18	0.020	1.0
1,2,3-Trichlorobenzene	87-61-6	mg/kg	--	1	0.25	0.25
1,1,1-Trichloroethane	71-55-6	mg/kg	0.084	10	0.050	0.050
1,1,2-Trichloroethane	79-00-5	mg/kg	0.00033	1	0.050	0.050
Trichlorofluoromethane	75-69-4	mg/kg	0.79	1	0.50	0.50
1,2,3-Trichloropropane	96-18-4	mg/kg	0.00000015	1	0.050	0.050
1,2,4-Trimethylbenzene	95-63-6	mg/kg	0.072	1	0.050	0.050
1,3,5-Trimethylbenzene	108-67-8	mg/kg	0.071	1	0.050	0.050
Vinyl chloride	75-01-4	mg/kg	0.000055	21	0.0022	0.050
m,p-Xylene	179601-23-1	mg/kg	0.055	1	0.10	0.10
o-Xylene	95-47-6	mg/kg	0.055	1	0.050	0.050

Notes:
-- Not available.
1 Both in situ and samples removed during the Interim Action are included in the non-detect data set.

Abbreviations:
CAS Chemical Abstracts Service
mg/kg Milligrams per kilogram
NA Not applicable
PSL Preliminary Screening Level

Table 4.11
Summary Information for Detected and Non-Detect Chemicals in Groundwater

Analyte	CAS No.	Most Stringent PSL	Unit	Number of Results (1)	Number of Detected Results	Percent of Detected Results	Minimum Detected Value	Maximum Detected Value	Location of Maximum Detected Value	Date of Maximum Detected Value
Petroleum Hydrocarbons										
Gasoline-Range Organics	GRO	30	µg/L	20	6	30%	110	9,700	WT-MW-02	04/15/2014
Diesel-Range Organics	DRO	500	µg/L	39	19	49%	56	19,000	MW-07	01/02/2014
Oil-Range Organics	ORO	500	µg/L	39	10	26%	170	3,500	MW-07	01/02/2014
Total DRO + ORO	T_DRO&ORO (U=0)	500	µg/L	32	16	50%	56	4,300	WT-MW-02	01/03/2014
Stoddard Solvent	--	500	µg/L	39	22	56%	80	16,000	MW-07	01/02/2014
Polychlorinated Biphenyls (PCBs)										
Total PCB Aroclors	T_PCB (U=0)	0.000007	µg/L	3	--	--	--	--	--	--
Total PCB congeners	T_PCBCg (U=0)	7	pg/L	3	3	100%	66.7	4,450	WT-MW-110	03/27/2017
Dioxins/Furans										
Total dioxin/furan TEQ	DF_TEQ (U=1/2)	0.0051	pg/L	3	3	100%	1.32	91.3	WT-MW-01	01/07/2016
Other Semivolatile Organic Compounds										
Pentachlorophenol	87-86-5	0.002	µg/L	67	46	69%	0.24	12,000	B-38	08/09/2007
Volatile Organic Compounds										
Benzene	71-43-2	1.6	µg/L	160	80	50%	1.0	61	MW-10	01/26/2009
Chloroethane	75-00-3	19,000	µg/L	96	17	18%	0.99	18	B-60	10/21/2010
1,1-Dichloroethane	75-34-3	7.7	µg/L	160	49	31%	0.61	120	MW-10	01/26/2009
1,2-Dichloroethane	107-06-2	4.2	µg/L	160	5	3.1%	1.2	3.3	B-59	10/21/2010
1,1-Dichloroethylene	75-35-4	7	µg/L	160	52	33%	0.70	48	B-65	01/26/2009
cis-1,2-Dichloroethylene	156-59-2	16	µg/L	336	304	90%	1.5	55,000	B-44	11/18/2004
trans-1,2-Dichloroethylene	156-60-5	100	µg/L	160	87	54%	0.55	170	MW-10	01/26/2009
Ethylbenzene	100-41-4	31	µg/L	160	40	25%	1.0	1,000	MW-10	01/26/2009
Methylene chloride	75-09-2	5	µg/L	96	--	--	--	--	--	--
Tetrachloroethylene	127-18-4	2.9	µg/L	336	189	56%	0.27	65,000	B-49	03/29/2004
Toluene	108-88-3	130	µg/L	160	53	33%	0.49	2,200	MW-10	01/26/2009
1,1,1-Trichloroethane	71-55-6	200	µg/L	160	3	1.9%	27	100	MW-09	01/26/2009
Trichloroethylene	79-01-6	0.7	µg/L	336	226	67%	0.49	62,000	B-49	04/27/2004
Vinyl chloride	75-01-4	0.18	µg/L	336	280	83%	0.22	18,000	PTM-2U	12/04/2006
Total xylenes	1330-20-7	330	µg/L	78	14	18%	1.2	820	MW-10	01/26/2009

Notes:

Groundwater data collected between 2003 and 2015 were included in calculating this summary table, except for dioxin/furan and PCB data, which were collected in 2016 and 2017. Field Sample and Field Duplicate pairs were reduced to the maximum detected value, or if both were non-detect, the minimum reporting limit.

1 Frequency of detection statistics were calculated using all upper and lower water-bearing zone wells displayed on Figure 3.2.

Abbreviations:

CAS Chemical Abstracts Service
DRO Diesel-range organics
µg/L Micrograms per liter
ORO Oil-range organics
PSL Preliminary Screening Level
TEQ Toxic equivalent

Table 4.11
Summary Information for Detected and Non-Detect Chemicals in Groundwater

Analyte	CAS No.	Most Stringent PSL	Unit	Number of Non-Detect Results	Percent of Non-Detect Results	Minimum Non-Detect Value	Maximum Non-Detect Value
Petroleum Hydrocarbons							
Gasoline-Range Organics	GRO	30	µg/L	14	70%	50	500
Diesel-Range Organics	DRO	500	µg/L	20	51%	50	50
Oil-Range Organics	ORO	500	µg/L	29	74%	99	250
Total DRO + ORO	T_DRO&ORO (U=0)	500	µg/L	16	50%	100	100
Stoddard Solvent	--	500	µg/L	17	44%	50	50
Polychlorinated Biphenyls (PCBs)							
Total PCB Aroclors	T_PCB (U=0)	0.000007	µg/L	3	100%	0.010	0.010
Total PCB congeners	T_PCBCg (U=0)	7	pg/L	--	--	--	--
Dioxins/Furans							
Total dioxin/furan TEQ	DF_TEQ (U=1/2)	0.0051	pg/L	--	--	--	--
Other Semivolatile Organic Compounds							
Pentachlorophenol	87-86-5	0.002	µg/L	21	31%	0.10	0.50
Volatile Organic Compounds							
Benzene	71-43-2	1.6	µg/L	80	50%	1.0	200
Chloroethane	75-00-3	19,000	µg/L	79	82%	1.0	200
1,1-Dichloroethane	75-34-3	7.7	µg/L	111	69%	1.0	200
1,2-Dichloroethane	107-06-2	4.2	µg/L	155	97%	1.0	200
1,1-Dichloroethylene	75-35-4	7	µg/L	108	68%	1.0	200
cis-1,2-Dichloroethylene	156-59-2	16	µg/L	32	9.5%	0.20	200
trans-1,2-Dichloroethylene	156-60-5	100	µg/L	73	46%	1.0	200
Ethylbenzene	100-41-4	31	µg/L	120	75%	1.0	200
Methylene chloride	75-09-2	5	µg/L	96	100%	1.0	200
Tetrachloroethylene	127-18-4	2.9	µg/L	147	44%	0.20	500
Toluene	108-88-3	130	µg/L	107	67%	1.0	200
1,1,1-Trichloroethane	71-55-6	200	µg/L	157	98%	1.0	200
Trichloroethylene	79-01-6	0.7	µg/L	110	33%	0.20	500
Vinyl chloride	75-01-4	0.18	µg/L	56	17%	0.20	1,000
Total xylenes	1330-20-7	330	µg/L	64	82%	1.0	200

Notes:

Groundwater data collected between 2003 and 2015 were included in calculating this summary table, except for dioxin/furan and PCB data, which were collected in 2016 and 2017. Field Sample and Field Duplicate pairs were reduced to the maximum detected value, or if both were non-detect, the minimum reporting limit.

1 Frequency of detection statistics were calculated using all upper and lower water-bearing zone wells displayed on Figure 3.2.

Abbreviations:

CAS Chemical Abstracts Service
DRO Diesel-range organics
µg/L Micrograms per liter
ORO Oil-range organics
PSL Preliminary Screening Level
TEQ Toxic equivalent

Table 6.1
Data Gaps Summary Table

Data Gap	Chemicals of Interest	Media	Status	Data Gap ID(s)
Recognized Environmental Conditions (RECs) Identified by SoundEarth Strategies (SES) (1,2,3)				
Confirmed soil and/or groundwater contamination beneath and near the Property and north adjoining property related to the Fox Avenue Site.	Pentachlorphenol (penta) Chlorinated volatile organic compounds (cVOCs) Benzene	Soil and groundwater	**Investigation proposed**. Penta, cVOCs, and benzene are confirmed Fox Avenue Site contaminants of concern (COCs) that have been identified in soil or groundwater on the 730 S. Myrtle Street property (Property). Additional investigation of these COCs and potential plume overlap in shallow and deep water bearing zones on the Property is proposed in the Remedial Investigation Work Plan (RIWP). Additional review of more recent data for the Fox Avenue Site will also be completed as part of the remedial investigation (RI) to evaluate current conditions.	DG-1, DG-3
Former use of a lumber dip tank and associated underground storage tank (UST) used to store penta adjacent to the south of the property in the South Myrtle Street right-of-way (ROW).	Stoddard solvent Penta	Soil and groundwater	**Investigation proposed**. Penta and Stoddard solvent have been identified in soil and groundwater in the former penta UST and dip tank area in the ROW (the source area) and in the area just north of the source area on the Property. Stoddard solvent and penta contaminated soil was excavated as part of the Interim Action (IA) in 2017 and 923 tons of contaminated soil was removed from the Property. The source area in the ROW was not excavated as part of the interim action and additional soil and groundwater data collection is proposed in RIWP to better delineate the extent of impacts in the ROW.	DG-1
Historical operation of a sawmill/lumber manufacturing facility on the Property from 1918 to approximately 1989.	Not specifically identified in the Phase I, presume petroleum-based products used in heavy equipment	Soil and groundwater	**Investigation proposed**. Existing soil and groundwater data do not support that former sawmill operations impacted soil or groundwater. Additional data collection in the northern portion of the Property is proposed in the RIWP to confirm that former sawmilling operations were not a source of subsurface contamination.	DG-2
Confirmed concentrations of Stoddard solvent and oil-range petroleum hydrocarbons in soil above their respective Model Toxics Control Act (MTCA) Method A cleanup levels at two separate locations on the Property (boring WT-GP-2 at 12-13 feet bgs and boring WT-GP-10 at 0-5 feet bgs, respectively).	Stoddard solvent Heavy oil-range organics (ORO)	Soil	**Not a data gap**. Additional evaluation was performed by Floyd|Snider in 2015/2016 to delineate these areas. These two previous boring locations and surrounding areas were subsequently excavated as part of the IA in 2017; 923 tons of Stoddard solvent contaminated soil was removed, and 441 tons of heavy oil-range organics contaminated soil was removed. The sample collected from 12–13 feet bgs at WT-GP-2 was also erroneously identified by SES; this sample had a Stoddard solvent concentration that exceeded the MTCA Method A cleanup level but was not analyzed for heavy oil-range organics.	N/A
Former operations of auto and truck repair shops on the south-central portion of the Property during the 1940s through the 1960s.	Heavy oil-range organics	Soil	**Not a data gap.** The full extent of heavy oil-range organics from the historical auto repair facility source were delineated as part of investigation conducted by Floyd|Snider in 2015/2016 and removed as part of the IA in 2017.	N/A
Former storage tanks with unknown contents at the Property.	Unknown	N/A	**Not a data gap**. Subsequent historical research completed by Floyd|Snider has determined that the address (600 South Myrtle Street) and the associated former USTs referenced in the Phase I were located on the south side of South Myrtle Street and therefore not associated with operations at the 730 S. Myrtle Street Property.	N/A
General industrial use of the Property from approximately 1991 to present day, including truck and freight container storage.	Total petroleum hydrocarbons (TPH) Metals Polychlorinated biphenyls (PCBs)	Soil	**Investigation proposed**. Surface soil PCB and metals data were collected by Floyd|Snider in 2017 prior to the start of IA construction. The results of the surface sample collection, in addition to previous soil data collected from surface soils indicated that metals and PCBs were detected at concentrations less than the most stringent MTCA Method A or B cleanup levels (4). Detected PCB and metals concentrations were generally consistent across the Property, with minor variations consistent with the heterogeneity of the shallow fill soils at the Property. The detected PCB and metals (some metals) concentrations are greater than the current Preliminary Screening Levels (PSLs) and additional data collection is proposed in the RIWP (5).	DG-4

Table 6.1
Data Gaps Summary Table

Data Gap	Chemicals of Interest	Media	Status	Data Gap ID(s)
Recognized Environmental Conditions (RECs) Identified by SoundEarth Strategies (SES) [1,2,3] (cont.)				
Historical operation of a gasoline service station on the east adjoining property in an inferred upgradient position	TPH BTEX	Soil and groundwater	**Investigation proposed.** SES performed additional subsurface investigation in December 2013/January 2014 to evaluate identified RECs (after the Phase I) that included soil borings in the eastern portion of the Property. Soil samples did not contain TPH; benzene, toluene, ethylbenzene, and xylenes (BTEX); or other field indications of contamination and data does not indicate that there are subsurface impacts associated with the adjacent property. However additional soil and groundwater data collection is proposed in this area in the RIWP to confirm that the former gasoline station on the adjacent property is not a source of contamination at the Whitehead Tyee Site (Site).	DG-2
Other Data Gaps Identified by Ecology in Various Correspondences [6]				
Tetrachloroethylene (PCE) analysis should be added to sample location in the vicinity of WT-GP-5, WT-GP-7, and WT-GP-8. Additional sampling locations may be necessary to adequately delineate the horizontal and vertical extent of PCE in vadose-zone soil.	PCE	Soil	**Investigation proposed.** cVOCs are being addressed as part of the Fox Avenue Cleanup Site, with ongoing injections and monitoring required for the Fox Avenue Site. Although a source of PCE has not been identified on the Property, additional characterization of PCE in vadose zone soil at the Site is proposed in the RIWP.	DG-3, DG-4
Investigation of soil and groundwater in the vicinity of former steam dry kilns should be completed.	Penta	Soil and groundwater	**Investigation proposed.** Operation of the dry kilns is not expected to have been a source of subsurface contamination. Regardless, additional soil and groundwater data is proposed in this area in the RIWP to confirm that drying treated wood in the dry kilns was not a source of contamination on the Property.	DG-2
Investigation of the area in the vicinity of in the vicinity of the former gasoline station on the east-adjacent property (near former borings WT-B06, WT-B07, and WT-B08) should be completed.	TPH	Soil and groundwater	**Investigation proposed.** Additional soil and groundwater data collection is proposed in this area in the RIWP to confirm that the former gasoline station on the adjacent property is not a source of contamination at the Site.	DG-2
Additional delineation is needed for dioxins/furans in groundwater and additional soil sample analyses is needed for dioxins/furans where penta has been found.	Dioxins/furans	Soil and groundwater	**Investigation proposed.** Additional dioxins/furans data are proposed for soil and groundwater in the RIWP.	DG-1
Other Potential Data Gaps Identified by Floyd|Snider [5]				
It is estimated that a 6- to 10-foot-thick layer of fill soil is present on the Property. Although most of the fill soil is assumed to be hydraulically dredged material, the fill is heterogeneous, and its origins are unknown. Therefore, pre-existing contaminants in imported urban fill are also a possible historical source of contamination at the Site.	PCE TPH/BTEX Metals PCBs	Soil	**Investigation proposed.** Additional vadose zone soil data collection is proposed to further evaluate fill quality in the RIWP.	DG-4
Penta has been detected in groundwater to the northeast of the former penta dip tank and UST in the presumed upgradient direction but has not been directly correlated to a potential soil source.	Penta	Soil and groundwater	**Investigation proposed.** Additional soil and groundwater data collection is proposed in the RIWP to evaluate the nature and extent of penta in the subsurface and whether there is a secondary source of penta associated with former operations in this area.	DG-1

Table 6.1
Data Gaps Summary Table

Data Gap	Chemicals of Interest	Media	Status	Data Gap ID(s)
Other Potential Data Gaps Identified by Floyd|Snider [5] (cont.)				
In the S. Myrtle Street ROW, the lateral extents of Stoddard solvent and penta have been largely delineated to the west and southwest but are not well delineated to the east and south. The extents of dioxin/furan contamination in soil associated with penta also requires further evaluation. The potential presence of volatile organic compounds (VOCs) including cVOCs and benzene in ROW vadose zone soil also requires further evaluation, as these contaminants have been detected in groundwater.	Stoddard solvent Penta Dioxins/furans VOCs	Soil	**Investigation proposed.** Additional soil samples are proposed in the ROW in the RIWP to better delineate the nature and extent of Stoddard solvent, penta, and dioxins/furans and to confirm if there is a potential soil source of VOCs in soil.	DG-1
The chromatographic overlap between Stoddard solvent, other diesel-range organics, gasoline-range organics, and fractions of volatile and extractable petroleum hydrocarbons is not fully understood.	Stoddard solvent TPH	Soil	**Investigation proposed.** Further evaluation and data collection are proposed in the RIWP to provide clarification of this overlap.	DG-1
Former operations of an auto repair facility in the southeast portion of the Property during the late 1920s through the 1940s.	TPH/BTEX Metals PCBs cPAHs	Soil and groundwater	**Investigation proposed.** Soil in this area has not been fully assessed for potential impacts from former auto repair operations. Groundwater is not expected to be impacted, but soil sampling is proposed to extend to the saturated zone to evaluate potential impacts below the water table.	DG-2
The general quality of groundwater flowing south onto the Property from the upgradient direction has not been fully assessed. In addition, cVOCs and benzene in groundwater on the Property are presumed to originate exclusively from the Fox Avenue Site, given the known operational history and documented presence of a source area in saturated soils, however the easternmost extent of the Fox Avenue Site plume located on the Property is inferred and has not been delineated by recent results from wells in this area.	Penta Stoddard solvent VOCs (PCE and benzene)	Groundwater	**Investigation proposed.** One year of quarterly groundwater monitoring is proposed in the RIWP along the northern Property line with the Fox Avenue Site and in the central/east-central portion of the Property to evaluate groundwater quality and the potential source of benzene exceedances in groundwater onsite and south of the Property line.	DG-3, DG-5
Additional hydrogeologic data are needed to assess horizontal gradients and to refine groundwater flow direction.	NA	Groundwater	**Investigation proposed.** Hydrogeologic data will be collected to further evaluate flow patterns and hydraulic gradients at the Site.	DG-6
Several chemicals that have not been detected at the Site have been analyzed with Practical Quantitation Limits (PQLs) greater than their respective PSLs.	VOCs SVOCs PCBs	Soil and groundwater	**Investigation proposed.** Certain chemicals identified in Table 4.9 have non-detect results in soil from prior investigations (i.e., VOCs, SVOCs, and PCBs). The presence of these chemicals will also be characterized in groundwater by analyzing VOCs, SVOCs, and PCBs from selected on-Property wells.	DG-4, DG-5

Table 6.1
Data Gaps Summary Table

Data Gap	Chemicals of Interest	Media	Status	Data Gap ID(s)
Other Potential Data Gaps Identified by Floyd|Snider (5) (cont.)				
Post-IA soil and groundwater quality has not been assessed to evaluate the effectiveness of the IA soil removal.	ORO Penta Stoddard solvent	Soil and groundwater	**Investigation proposed.** Although extensive additional soil sampling in the vicinity of the IA is not feasible due to the stormwater infrastructure installed during the IA, soil samples will be collected from a proposed soil boring in the eastern IA removal area. Additionally, 1 year of post-IA quarterly groundwater sampling is proposed to determine the effectiveness of the IA. Groundwater samples will be collected in areas within or immediately adjacent to the IA excavation areas for the IA COCs.	DG-4, DG-5

Notes:
1 RECs identified in the SES Phase I Environmental Site Assessment (ESA), Prepared for The Whitehead Company and Reliable Transfer and Storage Company, December 2013.
2 Per Section 8.0 of the SES Phase I ESA, no data gaps were identified during their environmental review.
3 SES performed additional subsurface investigation activities in December 2013/January 2014 to evaluate identified RECs presented in the Phase I ESA.
4 Site cleanup levels have not yet been established, so comparison to the most stringent and available MTCA Method A/B criteria was appropriate for reference at the time of sample collection.
5 It is important to note that during the IA, the Property was found to be largely paved below the crushed gravel surfacing and the top approximately 2 feet of surface material (including the pavement) was removed during surface grading. Therefore, any contaminants in surface soils that may have resulted from trucking and empty container storage were removed during IA construction. The Property was subsequently paved.
6 There have been numerous correspondences from Ecology over the years that have identified data gaps; the data gaps that have not already been addressed are summarized.
Summary of Subsurface Investigation Activities (SES 2014a)
Phase 2 Current Situation Report comments (Ecology 2015)
Interim Action Work Plan comments and final Interim Action Work Plan (Ecology 2016b, Floyd|Snider 2017a)

Table 6.2
Remedial Field Investigation for Soil

<table>
<tr><th>Location ID</th><th>Purpose/Objectives</th><th>Sample Collection (1)</th><th>Laboratory Analysis (2,3,4,5,6)</th></tr>
<tr><td colspan="4">Tier 1 Locations</td></tr>
<tr><td rowspan="3">WT-MW-04R</td><td rowspan="3">• Reinstall monitoring well WT-MW-04 to a depth of 16 feet bgs.
• Evaluate potential impacts from former on-Property lumber mill operations (hog fuel bin and window sash manufacturing and frame shop). (DG-2)
• Evaluate extent of PCE in vadose soil. (DG-3, DG-4)
• Evaluate general fill quality for TPH and metals resulting from recent industrial operations. (DG-4)
• Evaluate general fill soil quality on the Property to determine if fill soils are a source of subsurface contamination. (DG-4)
• Evaluate whether VOCs, PCBs and SVOCs are present, using lower PQLs. (DG-4)</td><td>Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 3 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.</td><td>Uppermost Fill Soil:
• PCBs
• RCRA 8 metals
• TPH-Dx
• TPH-Gx
Lowermost Fill Soil:
• PCBs
• RCRA 8 metals
• SVOCs including penta
• TPH-Dx
• TPH-Gx
• VOCs including cVOCS and BTEX
Other Fill Soil
• Archive and analyze additional analytes as needed based on initial sample results.</td></tr>
<tr><td>Native Soil: Collect one soil sample for analysis from immediately below fill-native contact. Collect remaining archive samples to the observed water table.</td><td>Uppermost Native Vadose Soil:
• RCRA 8 metals
• SVOCs including penta
• TPH-Dx
• TPH-Gx
• VOCs including cVOCs and BTEX
Other Native Vadose Soil
• Archive and analyze additional analytes as needed based on initial fill sample results.</td></tr>
<tr><td>Saturated Native Soil: Collect and archive samples collected below the water table.</td><td>Saturated Native Soil:
• Archive and analyze additional analytes as needed based on initial native vadose soil sample results.</td></tr>
</table>

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection [1]	Laboratory Analysis [2,3,4,5,6]
Tier 1 Locations (cont.)			
WT-MW-110R	• Reinstall monitoring well WT-MW-110 to a depth of 16 feet bgs. • Evaluate source of penta in groundwater previously collected from well WT-MW-110. (DG-2) • Evaluate effectiveness of the IA soil removal. (DG-4) • Evaluate general fill soil quality on the Property to determine if fill soils are a source of subsurface contamination. (DG-4)	Fill Soil: n/a. All fill soil was excavated in this area during the interim action.	Upper and Lower Fill Soil: • n/a
		Native Vadose Soil: Collect samples from 6 feet bgs to the observed water table; submit one vadose soil sample for analysis.	Uppermost Native Vadose Soil: • Dioxins/furans • PCBs • RCRA 8 Metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Native Vadose Soil • Archive and analyze additional analytes as needed based on initial fill sample results.
		Saturated Native Soil: Collect and archive samples collected below the water table.	Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native vadose soil sample results.

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection [1]	Laboratory Analysis [2,3,4,5,6]
Tier 1 Locations (cont.)			
WT-SB-23	• Advance soil boring to approximately 2 feet below observed water table. • Evaluate potential impacts from former on-Property lumber mill operations, (planning and cutting mill). (DG-2) • Evaluate extent of PCE in vadose soil. (DG-3, DG-4) • Evaluate general fill quality for TPH and metals resulting from recent industrial operations. (DG-4) • Evaluate general fill soil quality on the Property to determine if fill soils are a source of subsurface contamination. (DG-4) • Evaluate whether VOCs are present, using lower PQLs. (DG-4)	Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 3 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.	Uppermost Fill Soil • RCRA 8 metals • TPH-Dx • TPH-Gx Lowermost Fill Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Fill Soil • Archive and analyze additional analytes as needed based on initial sample results.
		Native Vadose Soil: Collect one sample for analysis from fill-native contact. Collect remaining archive samples to the observed water table.	Uppermost Native Vadose Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Native Vadose Soil: • Archive and analyze additional analytes as needed based on initial fill sample results.
		Saturated Native Soil: Collect and archive one sample in the uppermost interval of saturated soil.	Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native vadose soil sample results.
Tier 1 Locations (cont.)			
WT-SB-24	• Advance soil boring to approximately 2 feet below observed water table. • Evaluate mobility of dioxins/furans in Site soils. (DG-1) • Evaluate potential impacts from former on-Property lumber mill operations (dry kilns). (DG-2) • Evaluate extent of PCE in vadose soil. (DG-3, DG-4) • Evaluate general fill soil quality on the Property to determine if fill soils are a source of subsurface contamination. (DG-4) • Evaluate whether VOCs, PCBs and SVOCs are present, using lower PQLs. (DG-4)	Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 3 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.	Uppermost Fill Soil: • PCBs • RCRA 8 metals Lowermost Fill Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TOC • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Fill Soil: • Archive and analyze additional analytes as needed based on initial sample results.

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection (1)	Laboratory Analysis (2,3,4,5,6)
		Native Vadose Soil: Collect one sample for analysis from fill-native contact. Collect remaining archive samples to the observed water table.	Uppermost Native Vadose Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TOC • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Native Vadose Soil: • Archive and analyze additional analytes as needed based on initial fill sample results.
		Saturated Native Soil: Collect and archive one sample in the uppermost interval of saturated soil.	Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native vadose soil sample results.
Tier 1 Locations (cont.)			
WT-MW-111	• Advance soil boring to 16 feet bgs, install well WT-MW-111. • Evaluate mobility of dioxins/furans in Site soils. (DG-1) • Evaluate potential impacts from former on-Property lumber mill operations (as wood platform, possibly included wood drying and storage). (DG-2) • Evaluate source of penta in groundwater previously collected from well WT-MW-110. (DG-2) • Evaluate extent of PCE in vadose soil. (DG-3, DG-4) • Evaluate general fill quality for TPH and metals resulting from recent industrial operations. (DG-4) • Evaluate general fill soil quality on the Property to determine if fill soils are a source of subsurface contamination. (DG-4)	Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 3 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.	Uppermost Fill Soil: • RCRA 8 metals • TPH-Dx • TPH-Gx Lowermost Fill Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TOC • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Fill Soil: • Archive and analyze additional analytes as needed based on initial sample results.
		Native Vadose Soil: Collect one sample for analysis from fill-native contact. Collect remaining archive samples to the observed water table.	Uppermost Native Vadose Soil: • Dioxins/furans (analyze only if penta is detected) • PCBs • RCRA 8 metals • SVOCs including penta • TOC • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Native Vadose Soil: • Archive and analyze additional analytes as needed based on initial fill sample results.

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection [1]	Laboratory Analysis [2,3,4,5,6]
		Saturated Native Soil: Collect and archive samples collected below the water table.	Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native vadose soil sample results.

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection (1)	Laboratory Analysis (2,3,4,5,6)
Tier 1 Locations (cont.)			
WT-MW-112	• Advance soil boring to 16 feet bgs, install well WT-MW-112. • Evaluate potential soil impacts from former on-Property lumber mill operations (storage shed). (DG-2) • Evaluate general fill soil quality on the Property to determine if fill soils are a source of subsurface contamination. (DG-4)	Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 3 feet bgs) to the native soil contact; submit one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.	Lowermost Fill Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Fill Soil: • Archive and analyze additional analytes as needed based on initial sample results.
		Native Vadose Soil: Collect samples from fill-native contact to the observed water table; archive native soil sample intervals.	Uppermost Native Vadose Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Native Vadose Soil: • Archive and analyze additional analytes as needed based on initial fill sample results.
		Saturated Native Soil: Collect and archive samples collected below the water table.	Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native vadose soil sample results.

Table 6.2
Remedial Field Investigation for Soil

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<tr><th>Location ID</th><th>Purpose/Objectives</th><th>Sample Collection [1]</th><th>Laboratory Analysis [2,3,4,5,6]</th></tr>
<tr><td colspan="4">Tier 1 Locations (cont.)</td></tr>
<tr><td rowspan="3">WT-SB-25</td><td rowspan="3">• Advance soil boring to approximately 2 feet below observed water table.
• Evaluate potential impacts from former operations, including the auto repair facility and service station. (DG-2)
• Evaluate whether VOCs, PCBs and SVOCs are present, using lower PQLs. (DG-4)
• Evaluate general fill quality for TPH and metals resulting from recent industrial operations. (DG-4)
• Evaluate general fill soil quality on the Property to determine if fill soils are a source of subsurface contamination. (DG-4)</td><td>Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 3 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.</td><td>Uppermost Fill Soil:
• RCRA 8 metals
• TPH-Dx
• TPH-Gx
Lowermost Fill Soil:
• PCBs
• RCRA 8 metals
• SVOCs including penta and cPAHs
• TPH-Dx
• TPH-Gx
• VOCs including cVOCs and BTEX
Other Fill Soil:
• Archive and analyze additional analytes as needed based on initial sample results.</td></tr>
<tr><td>Native Vadose Soil: Collect samples from fill-native contact to the observed water table; archive native soil sample intervals.</td><td>Uppermost Native Vadose Soil:
• PCBs
• RCRA 8 metals
• SVOCs including penta
• TPH-Dx
• TPH-Gx
• VOCs including cVOCs and BTEX
Other Native Vadose Soil:
• Archive and analyze additional analytes as needed based on initial fill sample results.</td></tr>
<tr><td>Saturated Native Soil: Collect and archive one sample in the uppermost interval of saturated soil.</td><td>Saturated Native Soil:
• Archive and analyze additional analytes as needed based on initial native vadose soil sample results.</td></tr>
</table>

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection (1)	Laboratory Analysis (2,3,4,5,6)
Tier 1 Locations (cont.)			
WT-SB-26	• Advance soil boring to approximately 2 feet below observed water table. • Evaluate potential impacts from former on-Property lumber mill operations (sawdust bin/boiler house area). (DG-2) • Evaluate general fill soil quality on the Property to determine if fill soils are a source of subsurface contamination. (DG-4) • Evaluate whether VOCs, PCBs and SVOCs are not present, using lower PQLs. (DG-4) • Evaluate extent of PCE in vadose soil. (DG-3, DG-4) • Evaluate source of penta in groundwater previously collected from well WT-MW-110. (DG-2)	Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 3 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.	Uppermost Fill Soil: • PCBs Lowermost Fill Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Fill Soil: • Archive and analyze additional analytes as needed based on initial sample results.
		Native Vadose Soil: Collect one sample for analysis from fill-native contact. Collect remaining archive samples to the observed water table.	Uppermost Native Vadose Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs Other Native Vadose Soil: • Archive and analyze additional analytes as needed based on initial fill sample results.
		Saturated Native Soil: Collect and archive one sample in the uppermost interval of saturated soil.	Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native vadose soil sample results.

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection (1)	Laboratory Analysis (2,3,4,5,6)
Tier 1 Locations (cont.)			
WT-SB-27	• Advance boring to a minimum of 15 feet bgs or until evidence of contamination is no longer observed. • Evaluate extent of PCE in vadose soil. (DG-3, DG-4) • Evaluate full vertical extent of Stoddard solvent and penta contamination in the former penta dip tank and UST source area. (DG-1) • Clarify the extent of chromatographic overlap between Stoddard solvent and GRO, DRO, and ORO. (DG-1) • Evaluate extractable and volatile hydrocarbon fractions in Stoddard solvent-contaminated soil. (DG-1) • Evaluate general fill soil quality in the S. Myrtle Street ROW to determine if fill soils are a source of native soil contamination. (DG-4)	Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 2 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.	Uppermost Fill Soil: • TPH-Dx Lowermost Fill Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Fill Soil: • Archive and analyze additional analytes as needed based on initial sample results.
		Native Vadose Soil: Collect one sample for analysis from fill-native contact. Collect remaining archive samples to the observed water table.	Uppermost Native Vadose Soil: • EPH/VPH • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Native Vadose Soil: • Archive and analyze additional analytes as needed based on initial fill sample results.
		Saturated Native Soil: Collect samples until evidence of contamination is no longer observed. Submit one sample from lowest interval and archive remaining intervals.	Lowermost Saturated Native Soil: • SVOCs including penta • TPH-Dx • TPH-Gx Other Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native vadose soil sample results.

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection [1]	Laboratory Analysis [2,3,4,5,6]
Tier 1 Locations (cont.)			
WT-SB-28	• Advance boring to a minimum of 15 feet bgs or until evidence of contamination is no longer observed. • Evaluate full lateral and vertical extent of off-Property Stoddard solvent and penta contamination in the S. Myrtle Street ROW. (DG-1) • Clarify the extent of chromatographic overlap between Stoddard solvent and GRO, DRO, and ORO. (DG-1) • Evaluate extractable and volatile hydrocarbon fractions in Stoddard solvent-contaminated soil. (DG-1) • Evaluate the presence of dioxins/furans in areas with penta contamination in soil. (DG-1) • Evaluate general fill soil quality in the S. Myrtle Street ROW to determine if fill soils are a source of native soil contamination. (DG-4) • Evaluate mercury in vadose zone and saturated soil, using lower PQLs. (DG-4)	Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 4 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.	Uppermost Fill Soil: • TPH-Dx Lowermost Fill Soil: • Dioxins/furans • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Fill Soil: • Archive and analyze additional analytes as needed based on initial sample results.
		Native Vadose Soil: Collect one sample for analysis from fill-native contact. Collect remaining archive samples to the observed water table.	Uppermost Native Vadose Soil: • Dioxins/furans • EPH/VPH • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Gx • TPH-Dx • VOCs including cVOCs and BTEX Other Native Vadose Soil: • Archive and analyze additional analytes as needed based on initial fill sample results.
		Saturated Native Soil: Collect samples until evidence of contamination is no longer observed. Submit one sample from lowest interval and archive remaining intervals.	Lowermost Saturated Native Soil: • Dioxins/furans • Mercury • SVOCs including penta • TPH-Dx • VOCs including cVOCs and BTEX Other Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native saturated soil sample results.

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection [1]	Laboratory Analysis [2,3,4,5,6]
Tier 1 Locations (cont.)			
WT-SB-29	• Advance boring to a minimum of 15 feet bgs or until evidence of contamination is no longer observed. • Evaluate full lateral and vertical extent of off-Property Stoddard solvent and penta contamination in the S. Myrtle Street ROW. (DG-1) • Evaluate general fill soil quality in the S. Myrtle Street ROW to determine if fill soils are a source of native soil contamination. (DG-4)	Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 4 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.	Uppermost Fill Soil: • TPH-Dx Lowermost Fill Soil: • PCBs • RCRA 8 metals • TPH-Dx • TPH-Gx • SVOCs including penta • VOCs including cVOCs and BTEX Other Fill Soil: • Archive and analyze additional analytes as needed based on initial sample results.
		Native Vadose Soil: Collect one sample for analysis from fill-native contact. Collect remaining archive samples to the observed water table.	Uppermost Native Vadose Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Native Vadose Soil: • Archive and analyze additional analytes as needed based on initial fill sample results.
		Saturated Native Soil: Collect samples until evidence of contamination is no longer observed. Submit one sample from lowest interval and archive remaining intervals.	Lowermost Saturated Native Soil: • SVOCs including penta • TPH-Dx Other Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native saturated soil sample results.

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection (1)	Laboratory Analysis (2,3,4,5,6)
Tier 1 Locations (cont.)			
WT-SB-30	• Advance boring to a minimum of 15 feet bgs or until evidence of contamination is no longer observed. • Evaluate full lateral and vertical extent of off-Property Stoddard solvent and penta contamination in the S. Myrtle Street ROW. (DG-1) • Evaluate the presence of dioxins/furans in areas with penta contamination in soil. (DG-1) • Evaluate extent of PCE in vadose soil. (DG-3, DG-4) • Evaluate whether VOCs are present, using lower PQLs. (DG-4) • Confirm that cVOCs other than PCE are not present in off-Property vadose soil, using lower PQLs. (DG-4) • Evaluate general fill soil quality in the S. Myrtle Street ROW to determine if fill soils are a source of native soil contamination. (DG-4) • Evaluate mercury in vadose zone and saturated soil, using lower PQLs. (DG-4)	Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 4 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.	Uppermost Fill Soil: • TPH-Dx Lowermost Fill Soil: • Dioxins/furans • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Fill Soil: • Archive and analyze additional analytes as needed based on initial sample results.
		Native Vadose Soil: Collect one sample for analysis from fill-native contact. Collect remaining archive samples to the observed water table.	Uppermost Native Vadose Soil: • Dioxins/furans • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Native Vadose Soil: • Archive and analyze additional analytes as needed based on initial fill sample results.
		Saturated Native Soil: Collect samples until evidence of contamination is no longer observed. Submit one sample from lowest interval and archive remaining intervals.	Lowermost Saturated Native Soil: • Dioxins/furans • RCRA 8 metals • SVOCs including penta • TPH-Dx • VOCs including cVOCs and BTEX Other Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native saturated soil sample results.

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection [1]	Laboratory Analysis [2,3,4,5,6]
Tier 1 Locations (cont.)			
WT-MW-113	• Advance soil boring to 16 feet bgs, install well WT-MW-113. • Evaluate full lateral extent of off-Property Stoddard solvent and penta contamination in the 7th Ave S. ROW. (DG-1) • Evaluate the presence of dioxins/furans in areas with penta contamination in soil. (DG-1) • Evaluate general fill soil quality in the 7th Ave S. ROW to determine if fill soils are a source of native soil contamination. (DG-4)	Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 4 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.	Uppermost Fill Soil: • TPH-Dx Lowermost Fill Soil: • Dioxins/furans • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Fill Soil: • Archive and analyze additional analytes as needed based on initial sample results.
		Native Vadose Soil: Collect one sample for analysis from fill-native contact. Collect remaining archive samples to the observed water table.	Uppermost Native Vadose Soil: • Dioxins/furans • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • VOCs including cVOCs and BTEX Other Native Vadose Soil: • Archive and analyze additional analytes as needed based on initial fill sample results.
		Saturated Native Soil: Collect samples until evidence of contamination is no longer observed. Submit one sample from lowest interval and archive remaining intervals.	Lowermost Saturated Native Soil: • Dioxins/furans • SVOCs including penta • TPH-Dx • VOCs including cVOCs and BTEX Other Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native saturated soil sample results.

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection (1)	Laboratory Analysis (2,3,4,5,6)
Tier 1 Locations (cont.)			
WT-MW-114	• Advance soil boring to 16 feet bgs, install well WT-MW-114. • Evaluate potential impacts from former on-Property lumber mill operations Property-wide. (DG-2) • Evaluate extent of PCE in vadose soil. (DG-3, DG-4) • Evaluate general fill quality for TPH and metals resulting from recent industrial operations. (DG-4)	Fill Soil: Collect samples beginning at fill surface below CSBC (at approximately 3 feet bgs) to the native soil contact; submit one sample from the uppermost fill interval and one sample from the lowermost fill interval for analyses; archive remaining fill soil intervals.	Uppermost Fill Soil: • RCRA 8 Metals • TPH-Dx • TPH-Gx Lowermost Fill Soil: • PCBs • RCRA 8 metals • SVOCs including penta • TPH-Dx • TPH-Gx • cVOCs Other Fill Soil: • Archive and analyze additional analytes as needed based on initial sample results.
		Native Vadose Soil: Collect samples from fill-native contact to the observed water table; archive native soil sample intervals.	Uppermost Native Vadose Soil: • PCBs • RCRA 8 metals • TPH-Dx • TPH-Gx • SVOCs including penta • cVOCs Other Native Vadose Soil: • Archive and analyze additional analytes as needed based on initial fill sample results.
		Saturated Native Soil: Collect samples to the bottom of the boring; archive saturated soil samples.	Saturated Native Soil: • Archive and analyze additional analytes as needed based on initial native vadose soil sample results.

Table 6.2
Remedial Field Investigation for Soil

Location ID	Purpose/Objectives	Sample Collection [1]	Laboratory Analysis [2,3,4,5,6]
Tier 2 Locations [7]			
Contingency boring locations	• Advance boring(s) to a minimum of 15 feet bgs or until evidence of contamination is no longer observed. • Evaluate full lateral extent of off-Property Stoddard solvent and penta contamination associated with the former penta dip tank and UST source area in the S. Myrtle Street ROW. (DG-1) • Evaluate extents of other identified soil hot spots from other operations at the Property. (DG-2, DG-4)	Advance as needed based on field indications of contamination in Tier 1 borings or after laboratory analyses indicate nature and extent is not sufficiently defined. Collect samples from 5 feet bgs to bottom of boring. Submit one sample with highest PID reading or from interval just above water table.	• Dioxins/furans • PCBs • SVOCs including penta • TPH-Dx • VOCs including cVOCs and Benzene • Other analyses as needed to delineate contamination

Notes:
1 Soil samples will be collected at 1-foot intervals whenever the recovered sample volume is sufficient for the required laboratory analyses specified in this table. Soil sample intervals may be adjusted in the field to thicknesses of up to 2 feet if necessary to obtain sufficient sample volume for analysis.
2 A stepped approach will be taken in the laboratory analyses program to provide sufficient data to evaluate the nature and extent of soil contamination. Archived samples will be analyzed based on the initial data, as needed. In general, if a constituent is detected in fill soil, then a sample will be analyzed from the native soil to determine its source and extent. Additional native intervals will be analyzed as needed to determine vertical extent.
3 Additional laboratory analyses may be performed based on field observations and/or field screening during soil boring activities.
4 TPH-Dx analysis includes the DRO products: Stoddard solvent, DRO, and ORO.
5 Sample locations targeting petroleum and volatiles may require adjustment of sample interval to align with field observations of contamination (e.g., PID readings, visible sheen, and/or petroleum or diesel odor).
6 Total PCB Aroclors will be analyzed in samples targeted for PCB analysis via EPA Method 8082A. Upon receipt of PCB Aroclor results, the two samples with the minimum and maximum concentrations will be re-analyzed for total PCB congeners via EPA Method 1668 for correlation with Aroclor results.
7 Tier 2 contingency locations will be determined in coordination with Ecology after review of Tier 1 data.

Abbreviations:
bgs Below ground surface
BTEX Benzene, toluene, ethylbenzene, and xylene
CSBC Crushed surfacing base course
cVOC Chlorinated volatile organic compound
DRO Diesel-range organics
Ecology Washington State Department of Ecology
EPH Extractable petroleum hydrocarbon
GRO Gasoline-range organics
n/a Not applicable
ORO Oil-range organics
PCB Polychlorinated biphenyl
PCE Tetrachloroethene
penta Pentachlorophenol
PID Photoionization detector
PQL Practical quantitation limit
Property 730 S. Myrtle Street property
RCRA Resource Conservation and Recovery Act
ROW Right-of-way
SVOC Semivolatile organic compound
TOC Total organic carbon
TPH Total petroleum hydrocarbon
UST Underground storage tank
VOC Volatile organic compound
VPH Volatile petroleum hydrocarbon

Table 6.3
Remedial Field Investigation for Groundwater

Well Location	Purpose/Objectives [1,2]	Well Screen Interval	Laboratory Analysis [3,4]
Whitehead Tyee Site Monitoring Wells			
WT-MW-01 (Existing)	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern on-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3) • Evaluate post-IA excavation groundwater quality in the vicinity of the Stoddard solvent excavation (DG-5) • Evaluate if VOCs are present in groundwater (DG-5)	5 to 20 feet bgs	• SVOCs including penta • TPH-Dx • VOCs including cVOCs and BTEX
WT-MW-02 (Existing)	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern on-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3) • Evaluate post-IA excavation groundwater quality in the vicinity of the Stoddard solvent excavation (DG-5) • Evaluate if VOCs are present in groundwater (DG-5)	5 to 20 feet bgs	• SVOCs including penta • TPH-Dx • VOCs including cVOCs and BTEX
WT-MW-03 (Existing)	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern on-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3) • Evaluate post-IA excavation groundwater quality in the vicinity of the Stoddard solvent excavation (DG-5) • Evaluate if VOCs are present in groundwater (DG-5)	5 to 20 feet bgs	• SVOCs including penta • TPH-Dx • VOCs including cVOCs and BTEX
WT-MW-04R (Proposed Replacement Well)	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Clarify the extent of chromatographic overlap between Stoddard solvent and GRO, DRO, and ORO (DG-1) • Evaluate extractable and volatile hydrocarbon fractions in Stoddard solvent-contaminated groundwater (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern on-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3) • Evaluate post-IA excavation groundwater quality in the vicinity of the Stoddard solvent excavation (DG-5) • Evaluate if VOCs are present in groundwater (DG-5)	Install 10-foot well screen to intercept water table (anticipated to be 6 to 16 feet bgs)	• SVOCs including penta • GRO • TPH-Dx • EPH/VPH • VOCs including cVOCs and BTEX
WT-MW-05 (Existing)	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern off-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3) • Evaluate if VOCs are present in groundwater (DG-5)	5 to 20 feet bgs	• SVOCs including penta • TPH-Dx • VOCs including cVOCs and BTEX

Table 6.3
Remedial Field Investigation for Groundwater

Well Location	Purpose/Objectives (1,2)	Well Screen Interval	Laboratory Analysis (3,4)
Whitehead Tyee Site Monitoring Wells (cont.)			
WT-MW-06 (Existing)	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Determine potential for dioxins/furans in areas where penta is present (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern off-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3) • Confirm that PCBs as Aroclors are not present in groundwater (DG-5) • Evaluate if cPAHs are present in groundwater (DG-5) • Evaluate if VOCs are present in groundwater (DG-5)	5 to 20 feet bgs	• PCBs • SVOCs including cPAHs and penta • TPH-Dx • VOCs including cVOCs and BTEX • Contingency: Dioxins/furans (if detected at B-38)
WT-MW-07 (Existing)	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Clarify the extent of chromatographic overlap between Stoddard solvent and GRO, DRO, and ORO (DG-1) • Evaluate extractable and volatile hydrocarbon fractions in Stoddard solvent-contaminated groundwater (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern off-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3) • Evaluate if VOCs are present in groundwater (DG-5)	5 to 20 feet bgs	• SVOCs including penta • GRO • TPH-Dx • EPH/VPH • VOCs including cVOCs and BTEX
WT-MW-108 (Existing)	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Confirm that PCBs as Aroclors are not present in groundwater (DG-5) • Evaluate post-IA excavation groundwater quality in the vicinity of the Stoddard solvent excavation (DG-5) • Evaluate if cPAHs are present in groundwater (DG-5)	6 to 16 feet bgs	• PCBs • SVOCs including cPAHs and penta • TPH-Dx
WT-MW-109 (Existing)	• Assess groundwater quality in the vicinity of former on-Property lumber mill operations (DG-2) • Determine extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern on-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3) • Evaluate groundwater quality along northern property line (DG-3) • Evaluate if VOCs are present in groundwater (DG-5)	6 to 16 feet bgs	• SVOCs including cPAHs and penta • TPH-Dx • VOCs including cVOCs and BTEX
WT-MW-110R (Proposed Replacement Well)	• Assess groundwater quality in the vicinity of former on-Property auto repair shop operations (DG-2) • Confirm previously detected penta concentrations in well WT-MW-110 (DG-2) • Determine extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern on-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3) • Confirm that PCBs as Aroclors are not present in groundwater (DG-5) • Evaluate if cPAHs are present in groundwater (DG-5) • Evaluate post-IA excavation groundwater quality in the vicinity of the heavy oil excavation (DG-5)	Install 10-foot well screen to intercept water table (anticipated to be 6 to 16 feet bgs)	• PCBs • SVOCs including cPAHs and penta • VOCs including cVOCs and BTEX • TPH-Dx including ORO

Table 6.3
Remedial Field Investigation for Groundwater

Well Location	Purpose/Objectives [1,2]	Well Screen Interval	Laboratory Analysis [3,4]
Whitehead Tyee Site Monitoring Wells (cont.)			
WT-MW-111 (Proposed)	• Assess groundwater quality in the vicinity of former on-Property lumber mill operations (DG-2) • Determine extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern on-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3) • Evaluate if VOCs are present in groundwater (DG-5) • Evaluate upgradient groundwater quality (DG-5)	Install 10-foot well screen to intercept water table (anticipated to be 6 to 16 feet bgs)	• SVOCs including penta • VOCs including cVOCs and BTEX
WT-MW-112 (Proposed)	• Assess groundwater quality in the vicinity of former on-Property lumber mill operations (DG-2) • Evaluate groundwater quality along northern property line (DG-3) • Determine extent of commingling with Fox Avenue Site penta plume (DG-3) • Evaluate upgradient groundwater quality (DG-5)	Install 10-foot well screen to intercept water table (anticipated to be 6 to 16 feet bgs)	• SVOCs including penta • VOCs including cVOCs and BTEX • RCRA 8 Metals • TPH-Dx
WT-MW-113 (Proposed)	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern on-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3) • Evaluate if VOCs are present in groundwater (DG-5) • Evaluate downgradient groundwater quality (DG-5)	Install 10-foot well screen to intercept water table (anticipated to be 6 to 16 feet bgs)	• VOCs including cVOCs and BTEX • SVOCs including penta • TPH-Dx
WT-MW-114 (Proposed)	• Evaluate groundwater quality along northern property line (DG-3) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Evaluate upgradient groundwater quality (DG-5)	Install 10-foot well screen to intercept water table (anticipated to be 6 to 16 feet bgs)	• VOCs including cVOCs and BTEX • SVOCs including penta
Contingency well(s)	• If nature and extent of Stoddard solvent and penta plume is not defined with proposed network, install additional wells to assess groundwater quality in consultation with the Washington State Department of Ecology	6 to 16 feet bgs (anticipated)	• SVOCs including penta • TPH-Dx • Other analyses as needed based on Tier 1 analytical data

Table 6.3
Remedial Field Investigation for Groundwater

Well Location	Purpose/Objectives [1,2]	Well Screen Interval	Laboratory Analysis [3,4]
Fox Avenue Site Monitoring Wells			
B-18	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern on-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3)	6 to 16 feet bgs	• SVOCs including penta • TPH-Dx • VOCs including cVOCs and BTEX
B-19	• Evaluate extent of commingling with Fox Avenue Site penta plume in lower water-bearing zone (DG-1, DG-3)	37.5 to 47.5 feet bgs	• SVOCs including penta
B-20A	• Determine extent of commingling with Fox Avenue Site penta plume (DG-3)	7 to 12 feet bgs	• SVOCs including penta
B-36	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Contingency: Determine potential for dioxins/furans in areas where penta is present (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern on-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3)	6 to 11 feet bgs	• VOCs including cVOCs and BTEX • SVOCs including penta • TPH-Dx • Contingency: Dioxins/furans (if detected at B-38)
B-37	• Evaluate extent of commingling with Fox Avenue Site penta plume in lower water-bearing zone (DG-1, DG-3)	23 to 28 feet bgs	• SVOCs including penta
B-38	• Clarify the extent of chromatographic overlap between Stoddard solvent and GRO, DRO, and ORO (DG-1) • Evaluate extractable and volatile hydrocarbon fractions in Stoddard solvent-contaminated groundwater (DG-1) • Determine potential for dioxins/furans in areas where penta is present (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3)	6 to 16 feet bgs	• SVOCs including penta • GRO • TPH-Dx • EPH/VPH • Dioxins/furans
B-49	• Determine extent of commingling with Fox Avenue Site penta plume (DG-3) • Evaluate groundwater quality along northern property line (DG-3)	9.5 to 15.5 feet bgs	• SVOCs including penta • TPH-Dx
B-60	• Determine extent of commingling with Fox Avenue Site penta plume (DG-3)	7 to 12 feet bgs	• SVOCs including penta
B-64	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Evaluate extent of commingling with Fox Avenue Site penta plume (DG-3) • Determine eastern and southern on-Property extents of Fox Avenue Site cVOC and benzene plume (DG-3)	7 to 12 feet bgs	• VOCs including cVOCs and BTEX • SVOCs including penta • TPH-Dx
MW-07	• Determine the full lateral extent of the Stoddard solvent and penta plume associated with the former penta dip tank and UST (DG-1) • Determine extent of commingling with Fox Avenue Site penta plume (DG-3)	6 to 16 feet bgs	• SVOCs including penta • TPH-Dx

Table 6.3
Remedial Field Investigation for Groundwater

Well Location	Purpose/Objectives (1,2)	Well Screen Interval	Laboratory Analysis (3,4)
Fox Avenue Site Monitoring Wells (cont.)			
MW-08	• Determine extent of commingling with Fox Avenue Site penta plume in lower water-bearing zone (DG-1, DG-3)	20 to 30 feet bgs	• SVOCs including penta
MW-09	• Determine extent of commingling with Fox Avenue Site penta plume (DG-3)	7 to 13 feet bgs	• SVOCs including penta
MW-10	• Determine extent of commingling with Fox Avenue Site penta plume in lower water-bearing zone (DG-1, DG-3)	20 to 30 feet bgs	• SVOCs including penta

Notes:
1 Four rounds of groundwater sampling will be performed as part of the remedial investigation, to occur quarterly for 1 year.
2 Groundwater sampling will include measurement of depth to water to evaluate horizontal groundwater gradients and flow direction, and collection of field water quality parameters (temperature, pH, conductivity, oxidation/reduction potential, dissolved oxygen, and turbidity) to obtain representative samples and evaluate overall aquifer characteristics. Depth to water will be measured at high and low tide at wells WT-MW-01 through WT-MW-04R, WT-MW-06, and WT-MW-108 to assess potential tidal influence at the southwest corner of the Property. Collection of water levels during quarterly sampling (manually and via pressure transducers) will generate data needed to fill DG-6.
3 For analysis of constituents with a strong tendency to adsorb to soil particles, including cPAHs, PCBs, and dioxins/furans, samples will be collected after field measured turbidity is less than 5 NTU. If turbidity less than 5 NTU cannot be attained, these samples will be centrifuged by the laboratory to remove excess turbidity prior to analysis.
4 NWTPH-Dx analysis includes the DRO products: Stoddard solvent, DRO, and ORO.

Abbreviations:
bgs Below ground surface
cPAH Carcinogenic polycyclic aromatic hydrocarbon
cVOC Chlorinated volatile organic compound
DRO Diesel-range organics
EPH Extractable petroleum hydrocarbon
GRO Gasoline-range organics
IA Interim action
NTU Nephelometric turbidity units
ORO Oil-range organics
PCB Polychlorinated biphenyl
penta Pentachlorophenol
PQL Practical Quantitation Limit
Property 730 S. Myrtle Street property
SVOC Semivolatile organic compound
UST Underground storage tank
VOC Volatile organic compound
VPH Volatile petroleum hydrocarbon

Whitehead Tyee Site

Remedial Investigation Work Plan

Figures

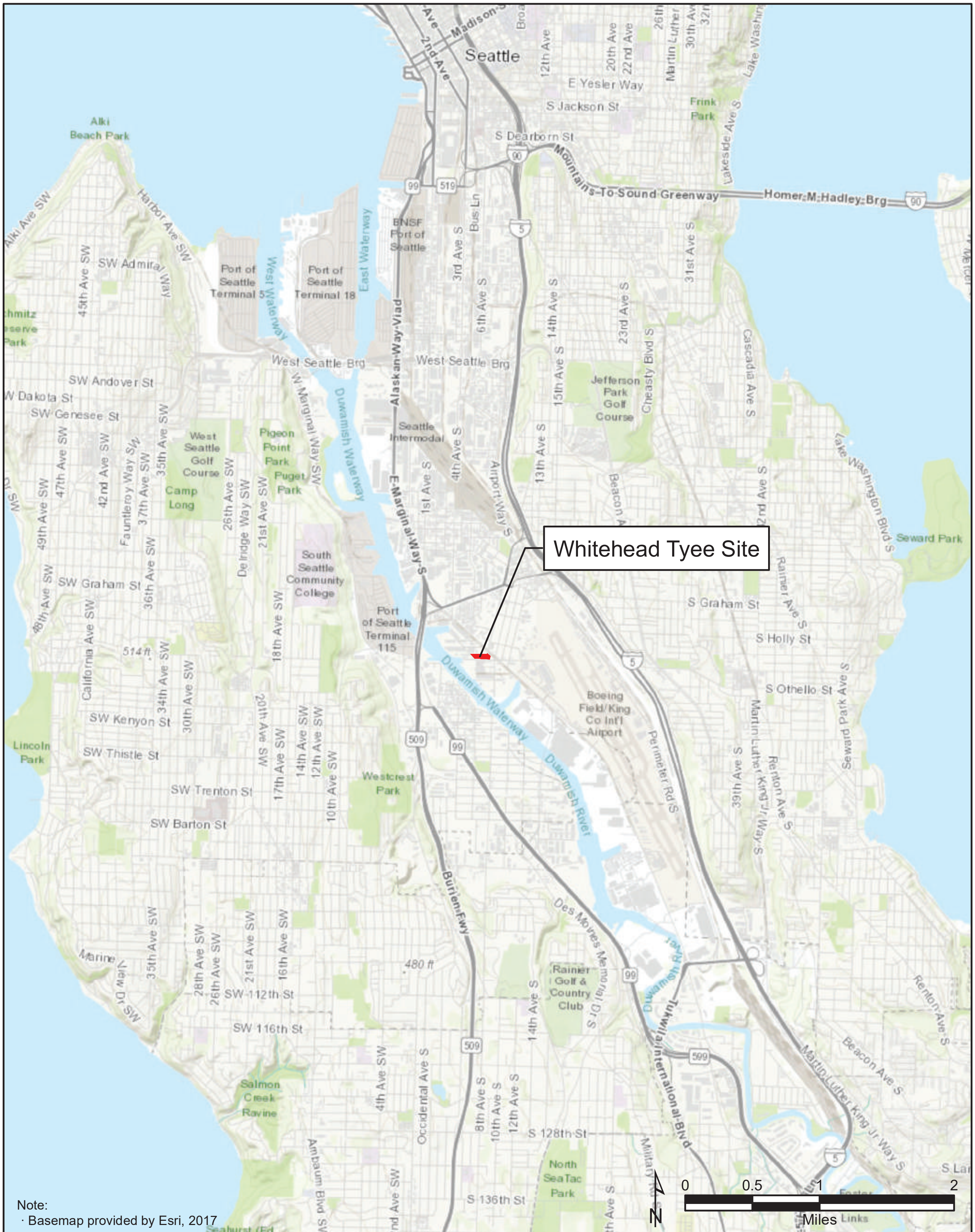

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Figure 1.1
Site Location Map

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan 2019\Figure 1.1 Site Location Map.mxd
11/13/2019

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Figure 1.2
Site Vicinity Map

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11/13/2019

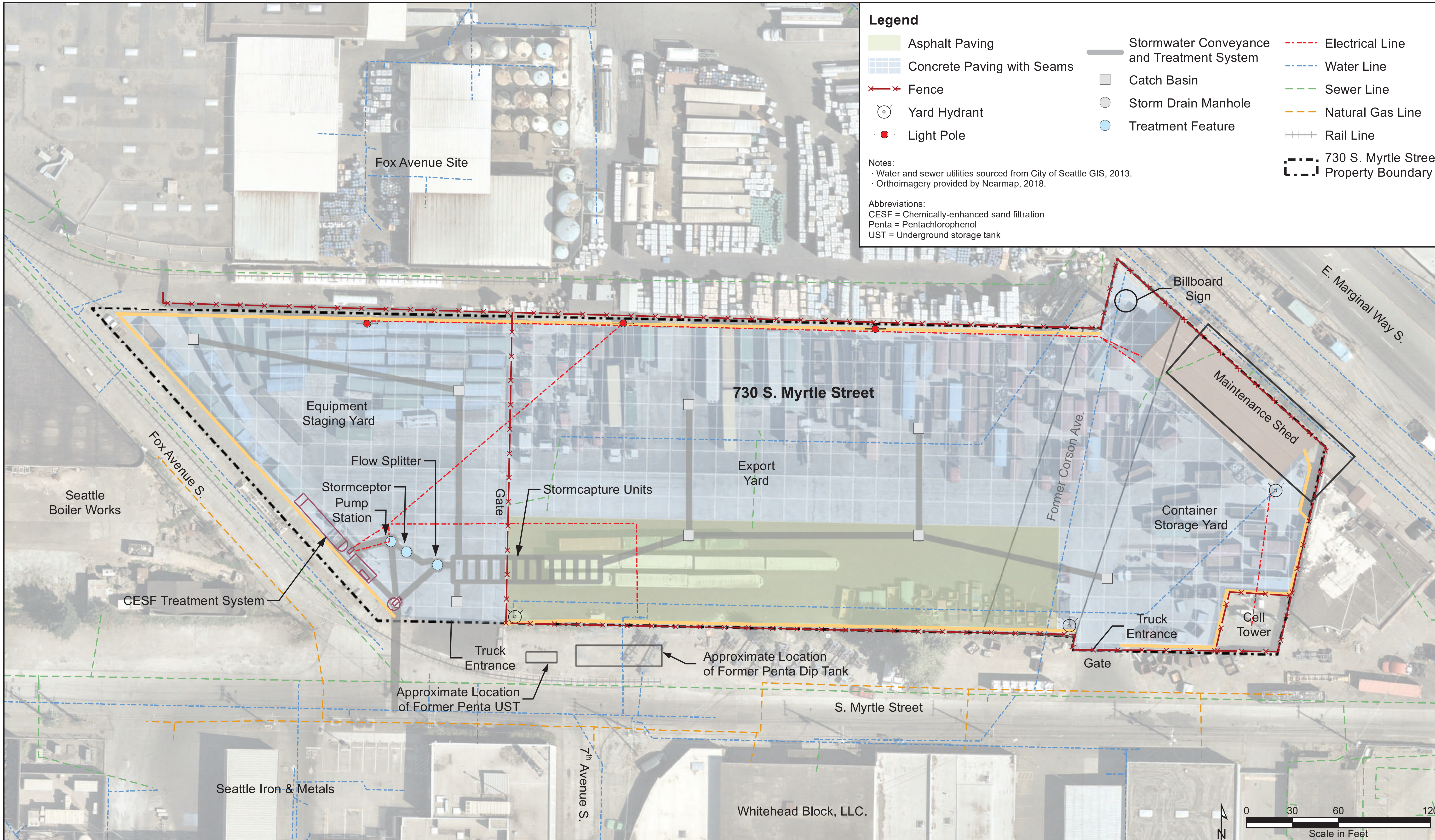

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Figure 2.1
Pertinent Site Features

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan 2022\Figure 2.1 Pertinent Site Features.mxd
1/20/2022

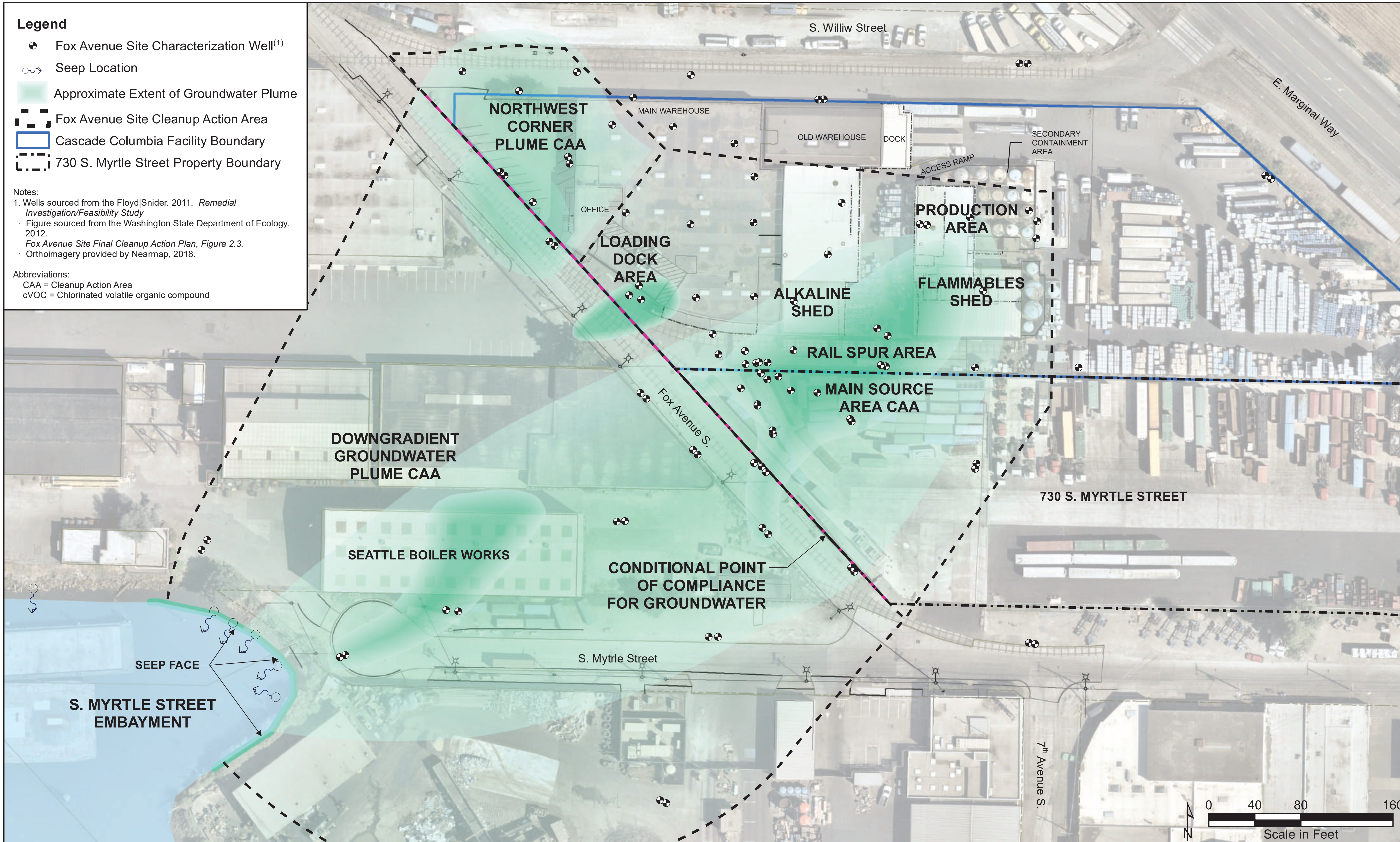

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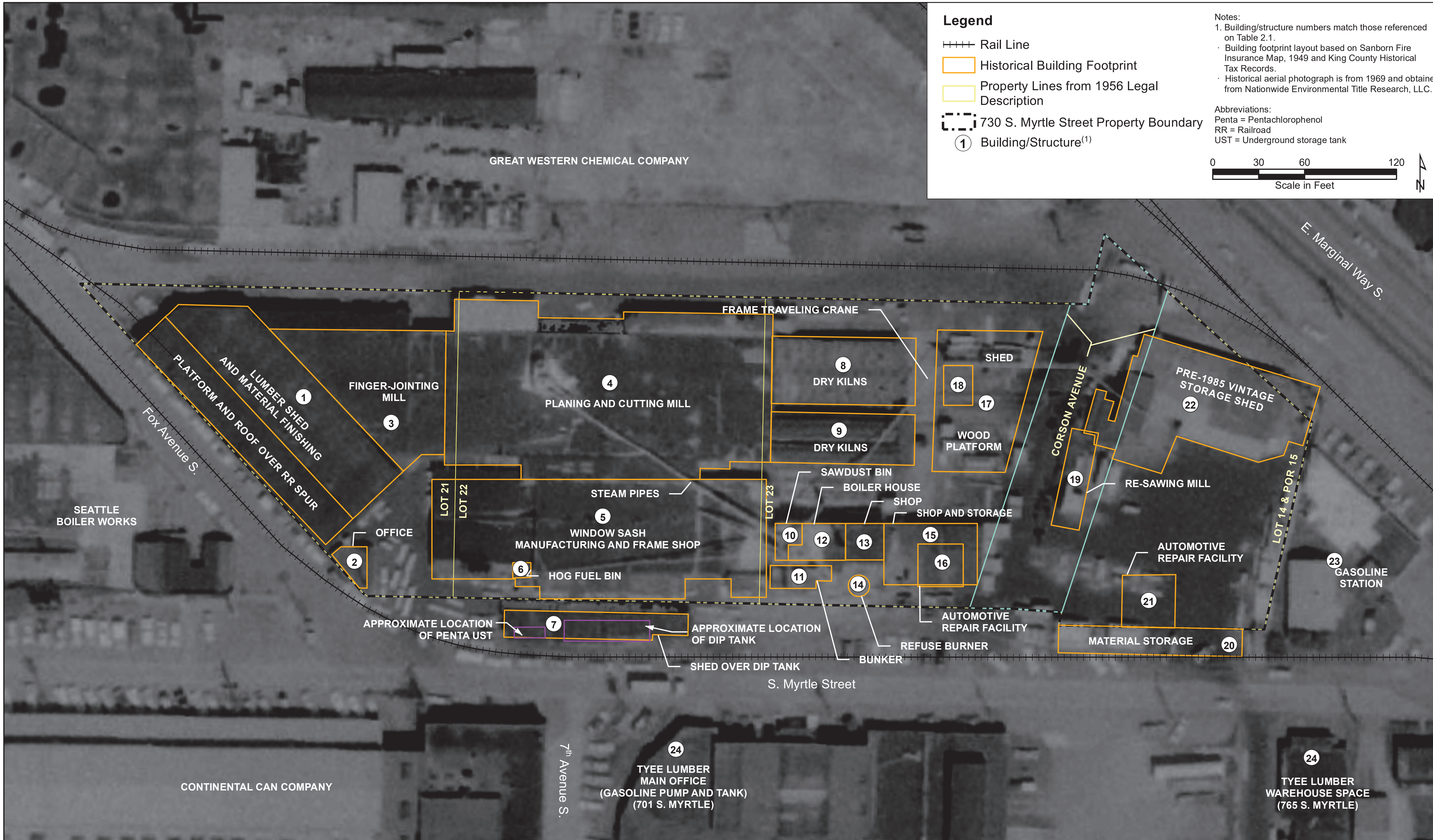
Figure 2.2
Fox Avenue Site Approximate cVOC Groundwater Plume Extent

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 2.2 Fox Avenue Site Approximate cVOC Groundwater Plume Extent.mxd
4/18/2023



Legend

- Rail Line
- Historical Building Footprint
- Property Lines from 1956 Legal Description
- 730 S. Myrtle Street Property Boundary
- (1) Building/Structure[(1)]

Notes:
1. Building/structure numbers match those referenced on Table 2.1.
- Building footprint layout based on Sanborn Fire Insurance Map, 1949 and King County Historical Tax Records.
- Historical aerial photograph is from 1969 and obtained from Nationwide Environmental Title Research, LLC.

Abbreviations:
Penta = Pentachlorophenol
RR = Railroad
UST = Underground storage tank

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Figure 2.3
Historical Mill Operations (prior to 1986)

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4/18/2023

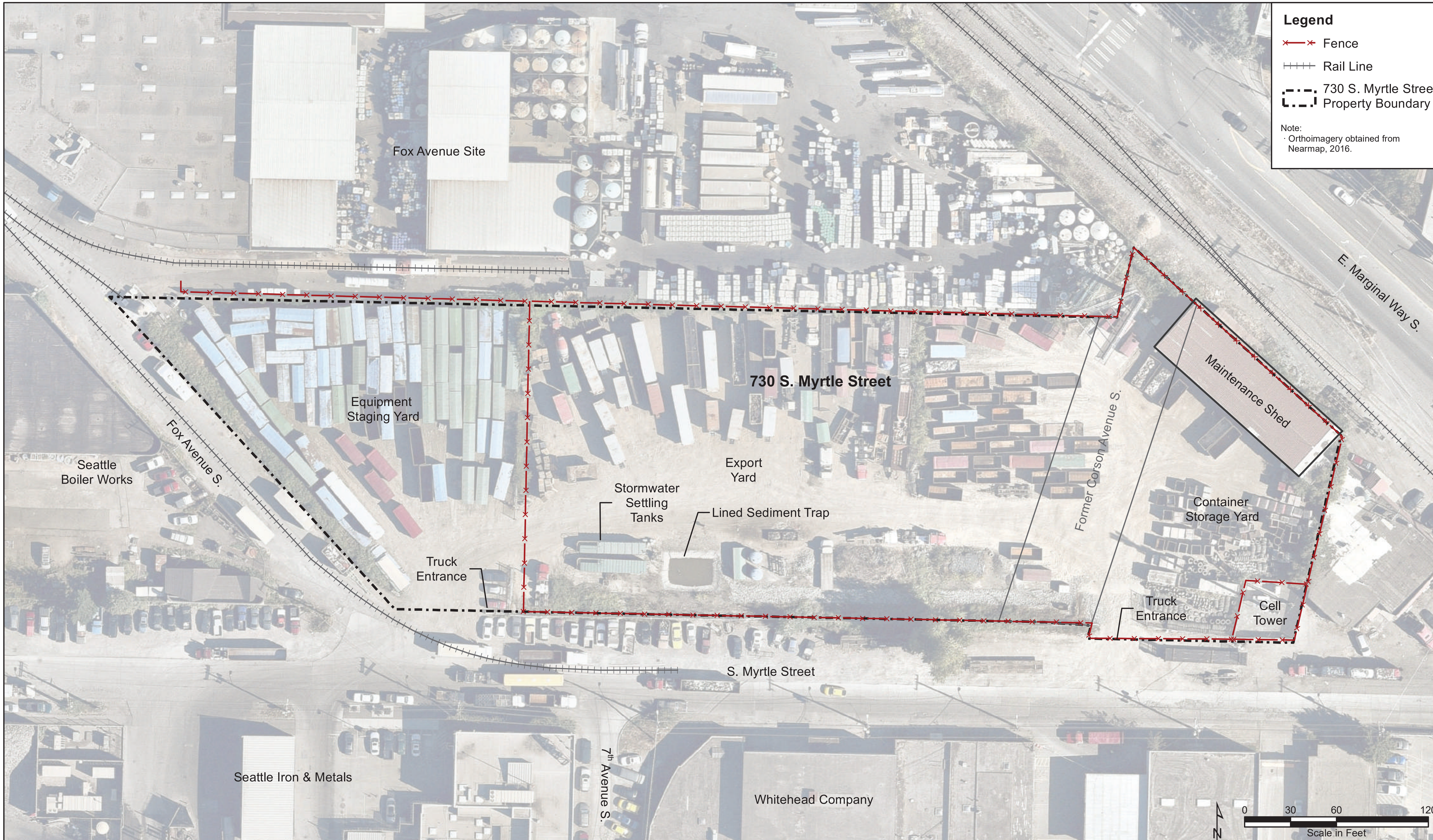

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Figure 2.4
Former SIM Site Operations (1999–2016)

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 2.4 Former SIM Site Operations (1999-2016).mxd
4/18/2023

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Figure 2.5
Terrestrial Ecological Evaluation Buffer

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 2.5 TEE Buffer.mxd
4/18/2023

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Figure 3.1
Soil Boring and Surface Soil Sample Locations

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan 2019\Figure 3.1 Soil Boring and Surface Soil Sample Locations.mxd
11/13/2019

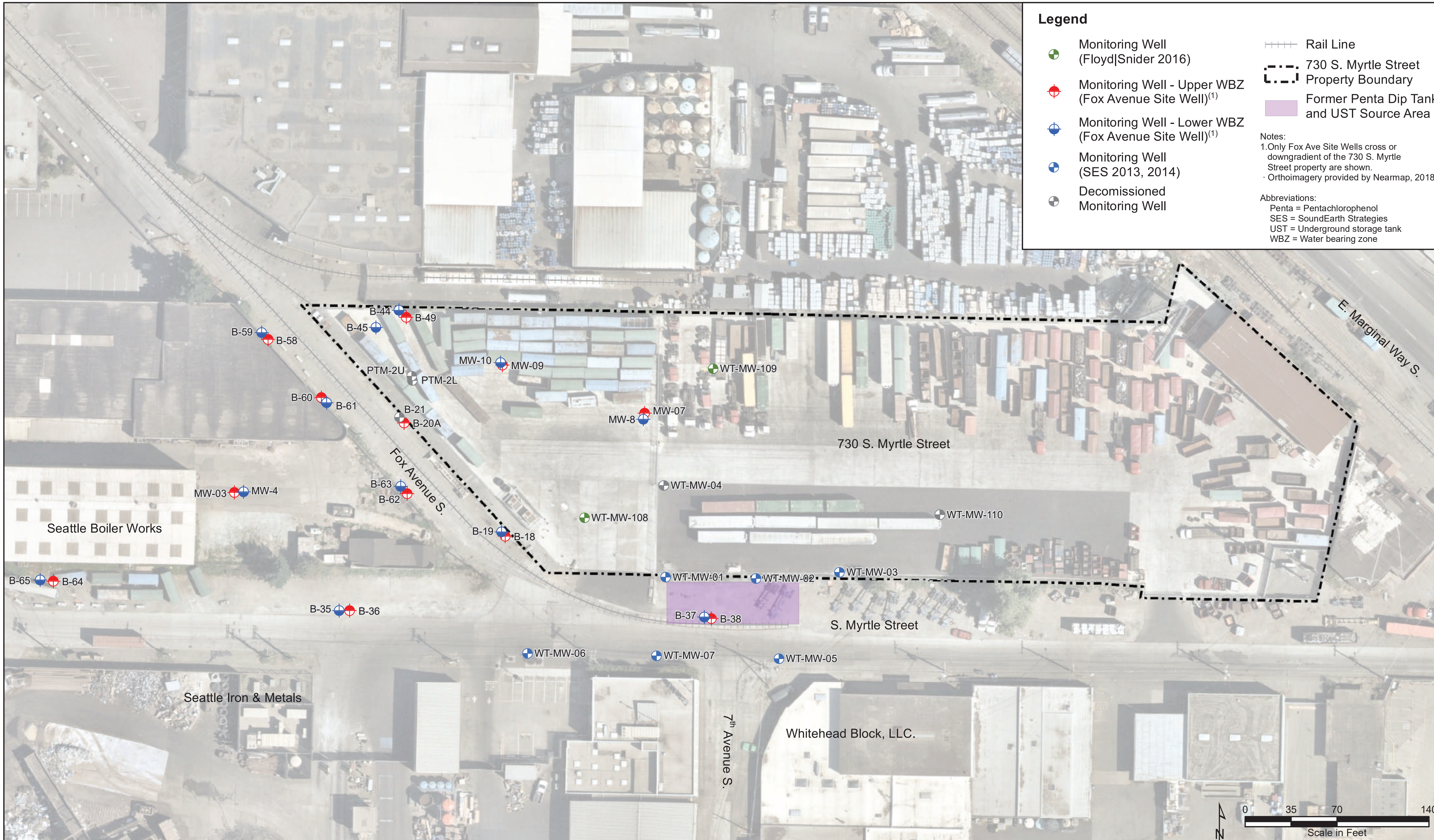

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Figure 3.2
Monitoring Well Locations

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 3.2 Monitoring Well Locations.mxd
4/6/2023

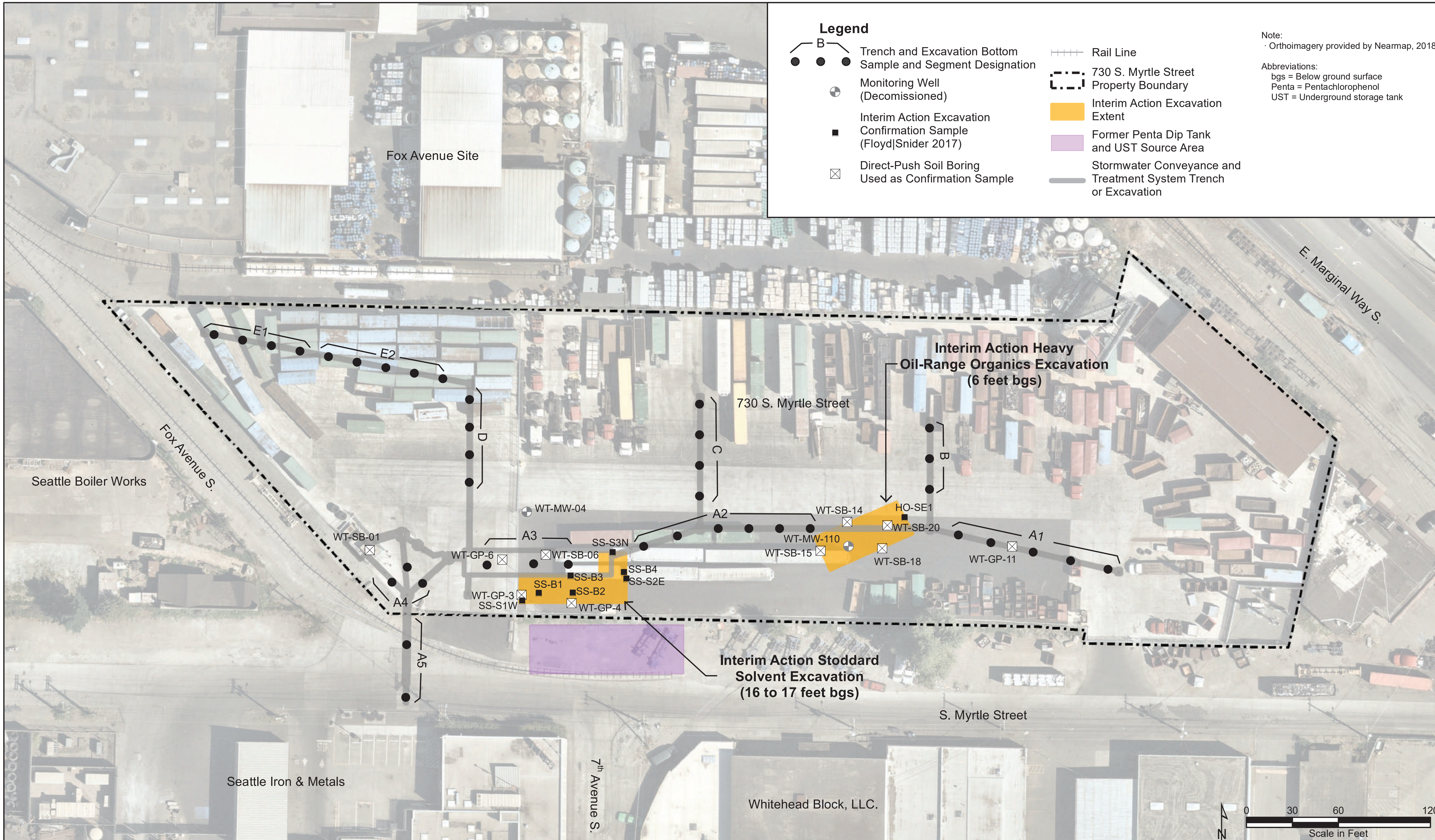

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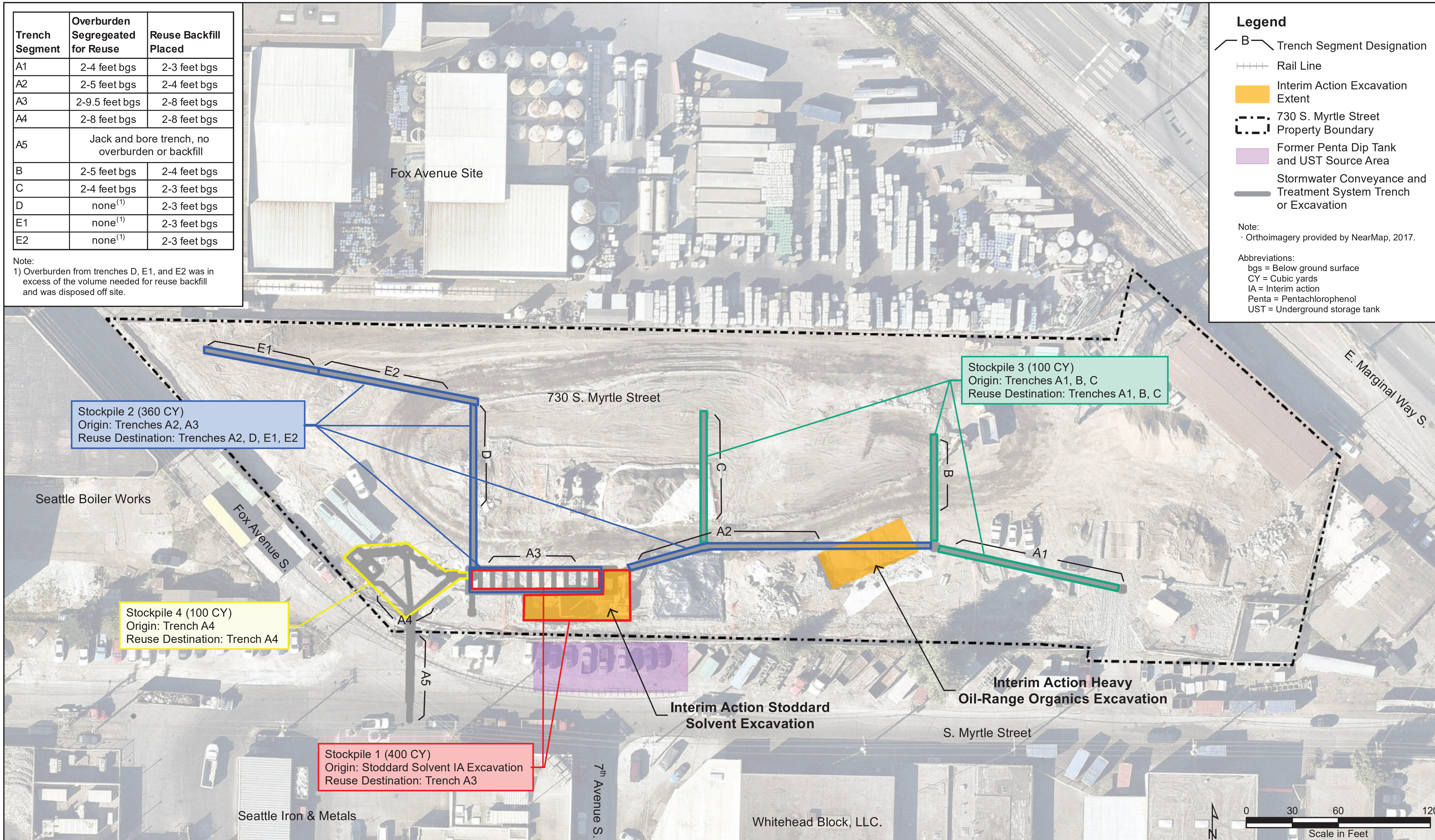
Figure 3.3
Interim Action Excavation and Confirmation Sample Locations

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 3.3 Interim Action Excavation and Confirmation Sample Locations.mxd
4/6/2023

Trench Segment	Overburden Segregated for Reuse	Reuse Backfill Placed
A1	2-4 feet bgs	2-3 feet bgs
A2	2-5 feet bgs	2-4 feet bgs
A3	2-9.5 feet bgs	2-8 feet bgs
A4	2-8 feet bgs	2-8 feet bgs
A5	Jack and bore trench, no overburden or backfill	
B	2-5 feet bgs	2-4 feet bgs
C	2-4 feet bgs	2-3 feet bgs
D	none(1)	2-3 feet bgs
E1	none(1)	2-3 feet bgs
E2	none(1)	2-3 feet bgs

Note:
1) Overburden from trenches D, E1, and E2 was in excess of the volume needed for reuse backfill and was disposed off site.



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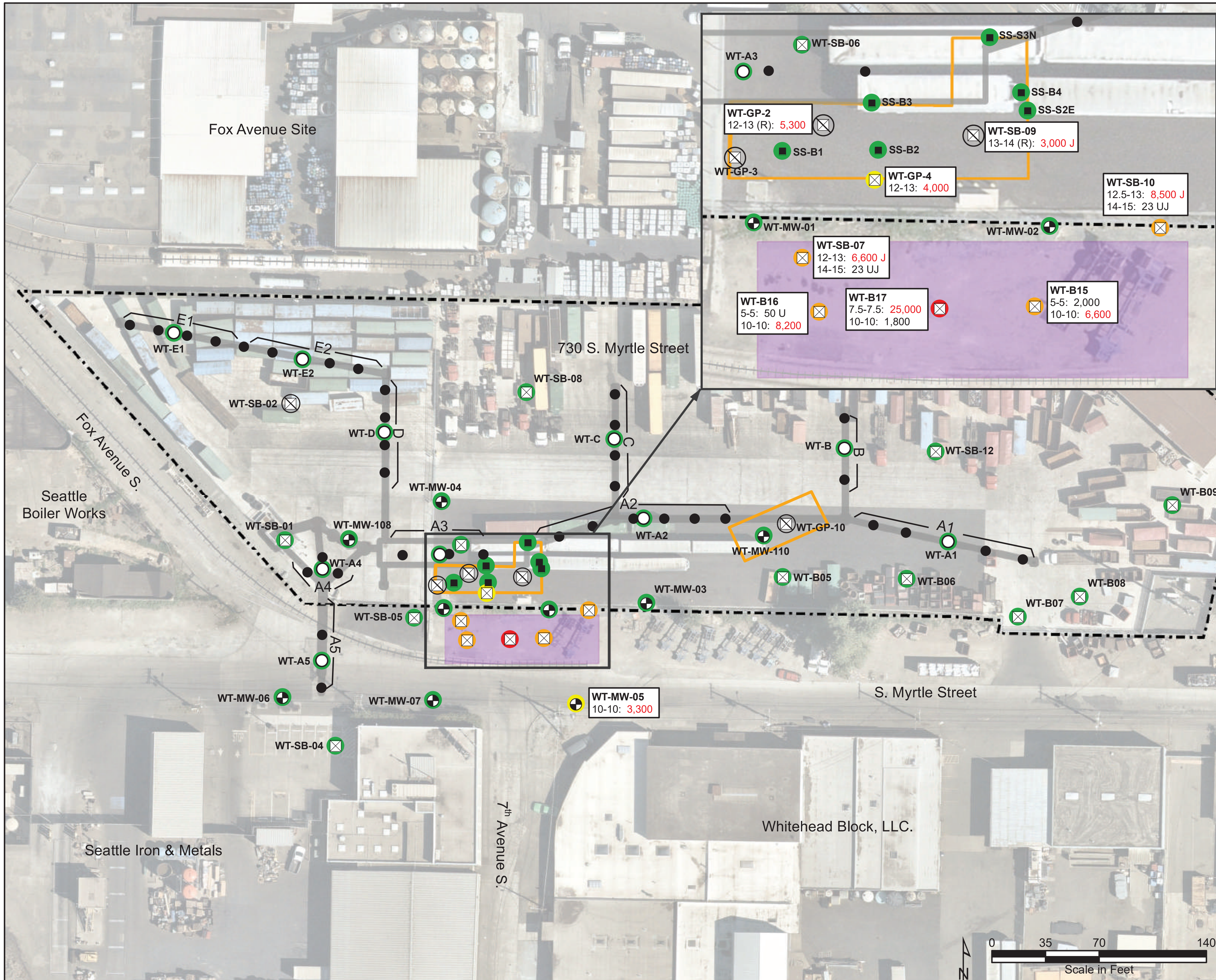
Seattle, Washington

Figure 3.4
Interim Action On-Site Soil Reuse

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 3.4 Interim Action On-Site Soil Reuse.mxd
4/18/2023



Legend

In Situ Soil Sample Results

- All Results Less Than Criteria
- One or More Non-Detect Results Greater Than Criteria
- One or More Results Greater Than Criteria by ≤ 2 times
- One or More Results Greater Than Criteria by > 2 to ≤ 5 times
- One or More Results Greater Than Criteria by > 5 times

Soil Sample Locations

- Interim Action Trench Segment and Excavation Bottom Samples(1)
- Monitoring Well
- Interim Action Excavation Confirmation Sample
- Soil Boring
- Removed During Interim Action

Other Features

- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area
- Stormwater Conveyance and Treatment System
- Rail Line

Label Key

Location → **WT-GP-2**
Depth (ft bgs) → 0-10 (R): 0.11 U ← Concentration and Qualifier

(R) indicates that the soil sample was removed as part of the interim action excavation in 2017 and is no longer representative of in situ conditions.

Preliminary Screening Level
Stoddard Solvent: 2,000 mg/kg

Notes:
1. Samples shown were composited into one composite sample per trench segment.
- All results presented are in units of milligrams per kilogram.
- Locations shown are all locations where samples were analyzed for the chemical.
- Chemical results are presented only at locations where a detected result exceeds the PSL.
- Results displayed in RED indicate an exceedance of the PSL.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
bgs = Below ground surface
ft = Feet
mg/kg = Milligrams per kilogram
Penta = Pentachlorophenol
PSL = Preliminary Screening Level
UST = Underground storage tank

Qualifiers:
J = Concentration is estimated but acceptable for most uses.
U = The result was not detected at the reporting limit.
UJ = The result was not detected at the associated reporting limit, which is an estimate.

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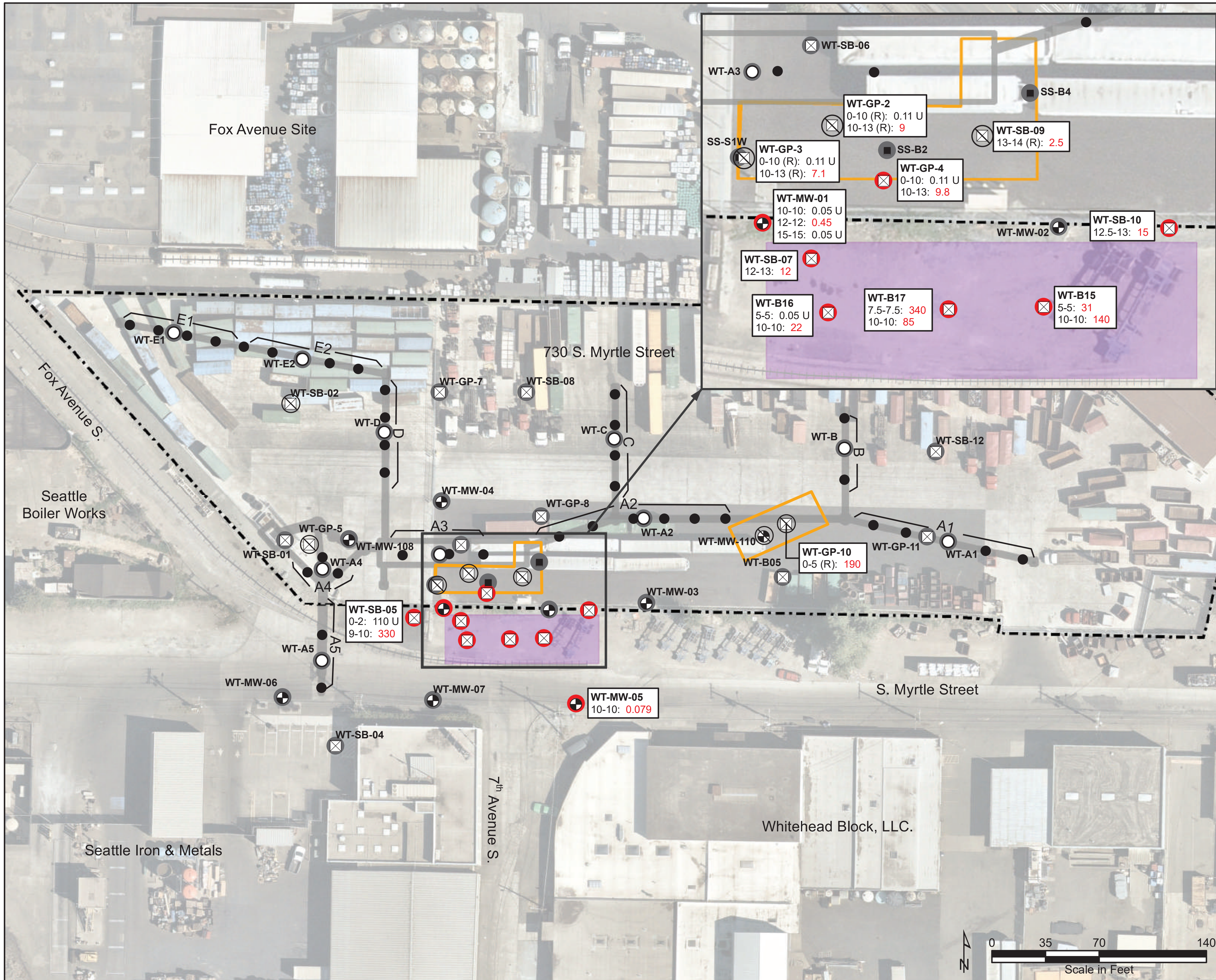
Figure 4.1
Soil Analytical Results for Stoddard Solvent

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 4.1 Soil Analytical Results for Stoddard Solvent.mxd
4/21/2023



Legend

In Situ Soil Sample Results

- All Results Less Than Criteria
- One or More Non-Detect Results Greater Than Criteria
- One or More Results Greater Than Criteria by ≤ 2 times
- One or More Results Greater Than Criteria by > 2 to ≤ 5 times
- One or More Results Greater Than Criteria by > 5 times

Soil Sample Locations

- Interim Action Trench Segment and Excavation Bottom Samples(1)
- Monitoring Well
- Interim Action Excavation Confirmation Sample
- Soil Boring
- Removed During Interim Action

Other Features

- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area
- Stormwater Conveyance and Treatment System
- Rail Line

Label Key

Location → WT-GP-2
Depth (ft bgs) → 0-10 (R): 0.11 U ← Concentration and Qualifier

(R) indicates that the soil sample was removed as part of the interim action excavation in 2017 and is no longer representative of in situ conditions.

Preliminary Screening Level
Penta: 0.0000018 mg/kg

Notes:
1. Samples shown were composited into one composite sample per trench segment.
· All results presented are in units of milligrams per kilogram.
· Locations shown are all locations where samples were analyzed for the chemical.
· Chemical results are presented only at locations where a detected result exceeds the PSL.
· Results displayed in RED indicate an exceedance of the PSL.
· Orthoimagery provided by Nearmap, 2018.

Abbreviations:
bgs = Below ground surface
ft = Feet
mg/kg = Milligrams per kilogram
Penta = Pentachlorophenol
PSL = Preliminary Screening Level
UST = Underground storage tank

Qualifier:
U = The result was not detected at the reporting limit.

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Figure 4.2
Soil Analytical Results for Pentachlorophenol

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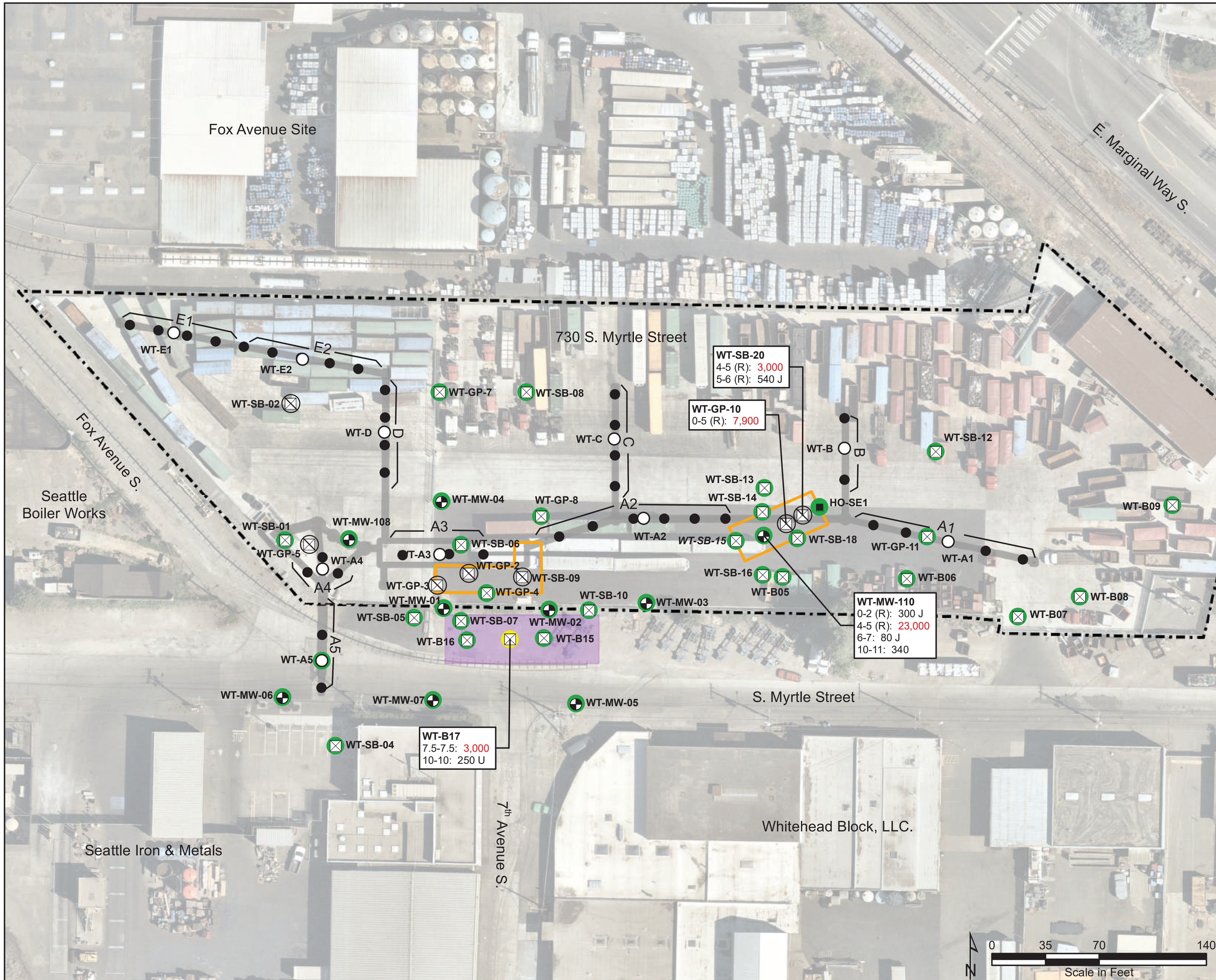
4/21/2023



Legend

In Situ Soil Sample Results

- All Results Less Than Criteria
- One or More Non-Detect Results Greater Than Criteria
- One or More Results Greater Than Criteria by ≤ 2 times
- One or More Results Greater Than Criteria by > 2 to ≤ 5 times
- One or More Results Greater Than Criteria by > 5 times

Soil Sample Locations

- Interim Action Trench Segment and Excavation Bottom Samples(1)
- Monitoring Well
- Interim Action Excavation Confirmation Sample
- Soil Boring
- Removed During Interim Action

Other Features

- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area
- Stormwater Conveyance and Treatment System
- Rail Line

Label Key

Location → **WT-GP-2**
Depth (ft bgs) → 0-10 (R): 0.11 U ← Concentration and Qualifier

(R) indicates that the soil sample was removed as part of the interim action excavation in 2017 and is no longer representative of in situ conditions.

Preliminary Screening Level
Total DRO and ORO: 2,000 mg/kg

Notes:
1. Samples shown were composited into one composite sample per trench segment.
- All results presented are in units of milligrams per kilogram.
- Locations shown are all locations where samples were analyzed for the chemical.
- Chemical results are presented only at locations where a detected result exceeds the PSL.
- Results displayed in RED indicate an exceedance of the PSL.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
bgs = Below ground surface
DRO = Diesel-range organics
ft = Feet
mg/kg = Milligrams per kilogram
ORO = Oil-range organics
Penta = Pentachlorophenol
PSL = Preliminary Screening Level
UST = Underground storage tank

Qualifiers:
J = Concentration is estimated but acceptable for most uses.
U = The result was not detected at the reporting limit.

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Whitehead Tyee Site
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Figure 4.3
Soil Analytical Results for Diesel- and Oil-Range Organics

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 4.3 Soil Analytical Results for DRO and ORO.mxd
4/21/2023

Legend

In Situ Soil Sample Results

- All Results Less Than Criteria
- One or More Non-Detect Results Greater Than Criteria
- One or More Results Greater Than Criteria by ≤ 2 times
- One or More Results Greater Than Criteria by > 2 to ≤ 5 times
- One or More Results Greater Than Criteria by > 5 times

Soil Sample Locations

- Interim Action Trench Segment and Excavation Bottom Samples(1)
- Interim Action Excavation Confirmation Sample
- Soil Boring

Other Features

- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area
- Stormwater Conveyance and Treatment System
- Rail Line

Label Key

Location → **WT-GP-2**
Depth (ft bgs) → 0-10 (R): 0.11 U ← Concentration and Qualifier

(R) indicates that the soil sample was removed as part of the interim action excavation in 2017 and is no longer representative of in situ conditions.

Preliminary Screening Level
Dioxin/Furan TEQ: 5.2 ng/kg

Notes:
1. Samples shown were composited into one composite sample per trench segment.
- All results presented are in units of nanograms per kilogram.
- Locations shown are all locations where samples were analyzed for the chemical.
- Chemical results are presented only at locations where a detected result exceeds the PSL.
- Results displayed in RED indicate an exceedance of the PSL.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
bgs = Below ground surface
ft = Feet
ng/kg = Nanograms per kilogram
Penta = Pentachlorophenol
PSL = Preliminary Screening Level
TEQ = Toxic equivalent
UST = Underground storage tank

Qualifiers:
J = Concentration is estimated but acceptable for most uses.

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Whitehead Tyee Site
Seattle, Washington

Figure 4.4
Soil Analytical Results for Dioxin/Furan TEQ

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 4.4 Soil Analytical Results for Dioxin_Furan TEQ.mxd
4/21/2023

Legend

In Situ Soil Sample Results

- All Results Less Than Criteria
- One or More Non-Detect Results Greater Than Criteria
- One or More Results Greater Than Criteria by ≤ 2 times
- One or More Results Greater Than Criteria by > 2 to ≤ 5 times
- One or More Results Greater Than Criteria by > 5 times

Soil Sample Locations

- Monitoring Well
- Interim Action Excavation Confirmation Sample
- Soil Boring
- Removed During Interim Action

Other Features

- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area
- Stormwater Conveyance and Treatment System
- Rail Line

Label Key

Location → **WT-GP-2**
Depth (ft bgs) → 0-10 (R): 0.11 U ← Concentration and Qualifier

(R) indicates that the soil sample was removed as part of the interim action excavation in 2017 and is no longer representative of in situ conditions.

Preliminary Screening Level
Tetrachloroethylene: 0.0016 mg/kg

Notes:
- All results presented are in units of milligrams per kilogram.
- Locations shown are all locations where samples were analyzed for the chemical.
- Chemical results are presented only at locations where a detected result exceeds the PSL.
- Results displayed in RED indicate an exceedance of the PSL.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
bgs = Below ground surface
ft = Feet
mg/kg = Milligrams per kilogram
Penta = Pentachlorophenol
PSL = Preliminary Screening Level
UST = Underground storage tank

Qualifier:
U = The result was not detected at the reporting limit.

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Figure 4.5
Soil Analytical Results for Tetrachloroethylene

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4/21/2023

Legend

In Situ Soil Sample Results

- All Results Less Than Criteria
- One or More Non-Detect Results Greater Than Criteria
- One or More Results Greater Than Criteria by ≤ 2 times
- One or More Results Greater Than Criteria by > 2 to ≤ 5 times
- One or More Results Greater Than Criteria by > 5 times

Soil Sample Locations

- Monitoring Well
- Interim Action Excavation Confirmation Sample
- Soil Boring
- Removed During Interim Action

Other Features

- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area
- Stormwater Conveyance and Treatment System
- Rail Line

Label Key

Location → WT-GP-2
Depth (ft bgs) → 0-10 (R): 0.11 U ← Concentration and Qualifier

(R) indicates that the soil sample was removed as part of the interim action excavation in 2017 and is no longer representative of in situ conditions.

Preliminary Screening Level
Benzene: 0.00056 mg/kg

Notes:
- All results presented are in units of milligrams per kilogram.
- Locations shown are all locations where samples were analyzed for the chemical.
- Chemical results are presented only at locations where a detected result exceeds the PSL.
- Results displayed in RED indicate an exceedance of the PSL.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
bgs = Below ground surface
ft = Feet
mg/kg = Milligrams per kilogram
Penta = Pentachlorophenol
PSL = Preliminary Screening Level
UST = Underground storage tank

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Whitehead Tyee Site
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Figure 4.6
Soil Analytical Results for Benzene

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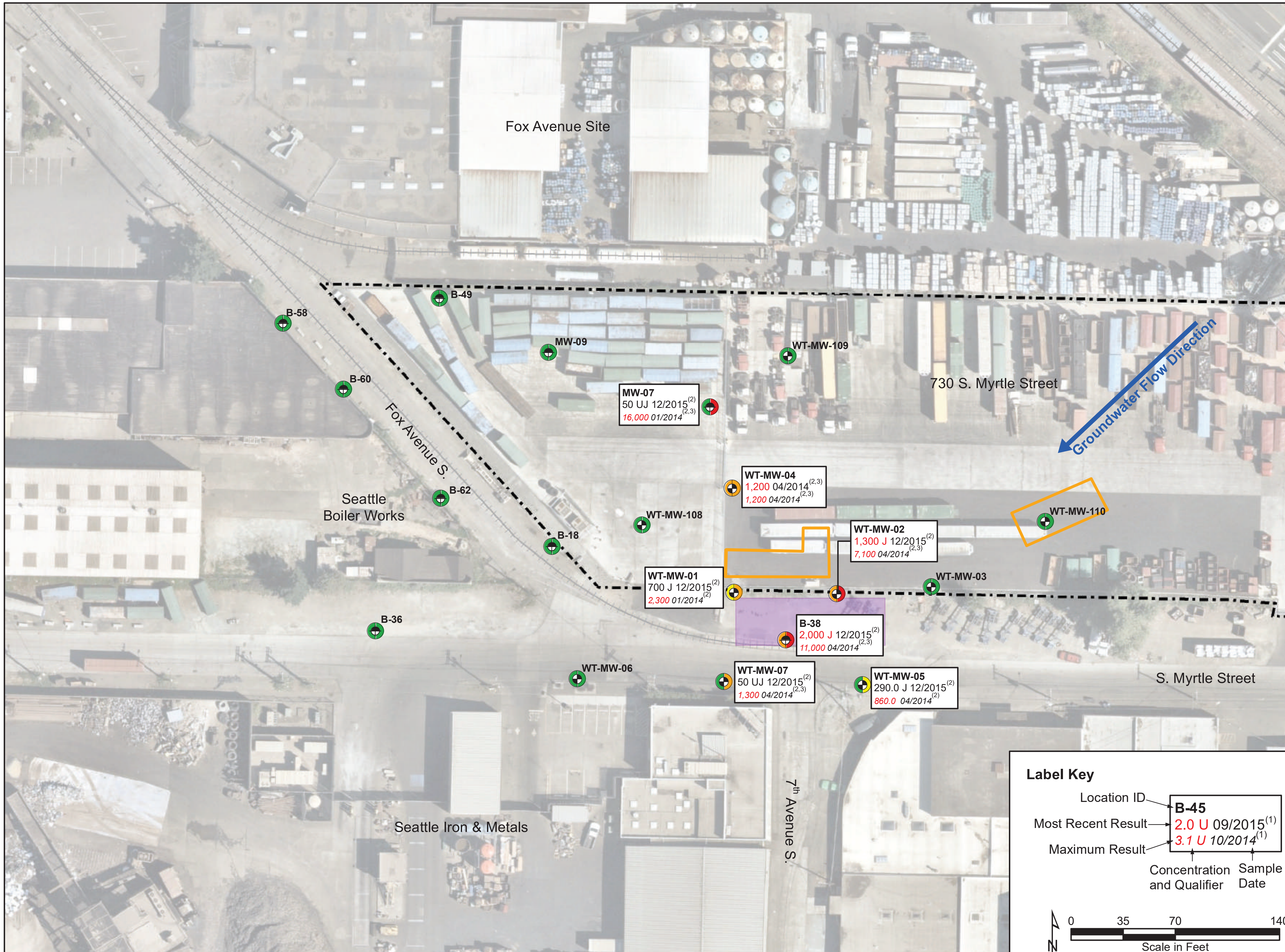
4/21/2023



Legend

Groundwater Sample Results

- Result Less Than Criteria
- Non-Detect Result Greater Than Criteria
- Result Greater Than Criteria by ≤ 2 times
- Result Greater Than Criteria by > 2 to ≤ 5 times
- Result Greater Than Criteria by > 5 times
- Most Recent Result / Maximum Result

Monitoring Well

- Monitoring Well - Upper WBZ (Whitehead Tyee Site)
- Monitoring Well - Upper WBZ (Fox Avenue Site Well)

Other Features

- Rail Line
- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area

Preliminary Screening Level
Stoddard Solvent: 500 µg/L

Notes:
1. Sample from Fox Avenue Site.
2. Sample from Whitehead Tyee Site.
3. The laboratory noted that the sample chromatographic pattern does not resemble the fuel standard used for quantitation.

- All results presented are in units of micrograms per liter.
- Locations shown are all locations where samples were analyzed for the chemical.
- Chemical results are presented only at locations where detected result exceeds the PSL.
- Results displayed in RED indicate an exceedance of the PSL.
- Data presented are through the most recent comprehensive Site investigation in 2015. Fox Avenue Site data are also included through this date. Only wells with data associated with this analyte are displayed.
- Monitoring wells screened in the Lower WBZ have been sampled exclusively for Fox Avenue Site monitoring events and are not presented on this figure.
- Refer to Appendix B for available Fox Avenue Site annual monitoring data from 2016 through 2022.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
µg/L = Micrograms per liter
Penta = Pentachlorophenol
PSL = Preliminary Screening Level
UST = Underground storage tank
WBZ = Water-bearing zone

Qualifiers:
J = Concentration is estimated but acceptable for most uses.
U = The result was not detected at the reporting limit.

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Whitehead Tyee Site
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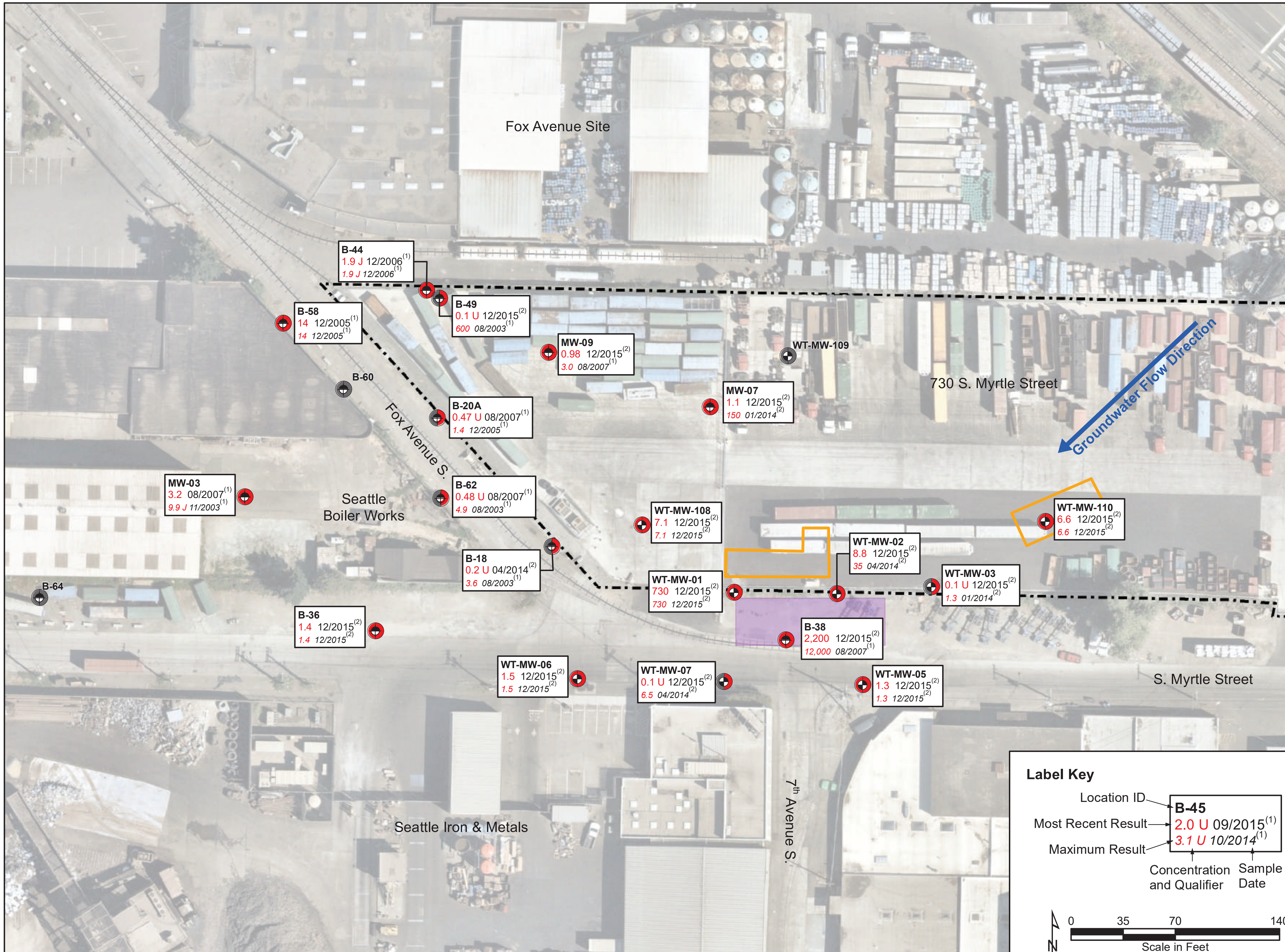
Figure 4.7
Groundwater Analytical Results for Stoddard Solvent (2010–2015)

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 4.7 Groundwater Analytical Results for Stoddard Solvent (2010-2015).mxd
4/21/2023



Legend

Groundwater Sample Results

- Result Less Than Criteria
- Non-Detect Result Greater Than Criteria
- Result Greater Than Criteria by ≤ 2 times
- Result Greater Than Criteria by > 2 to ≤ 5 times
- Result Greater Than Criteria by > 5 times

Most Recent Result → ← Maximum Result

Monitoring Well

- Monitoring Well - Upper WBZ (Whitehead Tyee Site)
- Monitoring Well - Upper WBZ (Fox Avenue Site Well)

Other Features

- Rail Line
- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area

Preliminary Screening Level
Pentachlorophenol: 0.002 µg/L

Notes:
1. Sample from Fox Avenue Site.
2. Sample from Whitehead Tyee Site.

- All results presented are in units of micrograms per liter.
- Locations shown are all locations where samples were analyzed for the chemical.
- Chemical results are presented only at locations where detected result exceeds the PSL.
- Results displayed in RED indicate an exceedance of the PSL.
- Data presented are through the most recent comprehensive Site investigation in 2015. Fox Avenue Site data are also included through this date. Only wells with data associated with this analyte are displayed.
- Monitoring wells screened in the Lower WBZ have been sampled exclusively for Fox Avenue Site monitoring events and are not presented on this figure.
- Refer to Appendix B for available Fox Avenue Site annual monitoring data from 2016 through 2022.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
µg/L = Micrograms per liter
Penta = Pentachlorophenol
PSL = Preliminary Screening Level
UST = Underground storage tank
WBZ = Water-bearing zone

Qualifiers:
J = Concentration is estimated but acceptable for most uses.
U = The result was not detected at the reporting limit.

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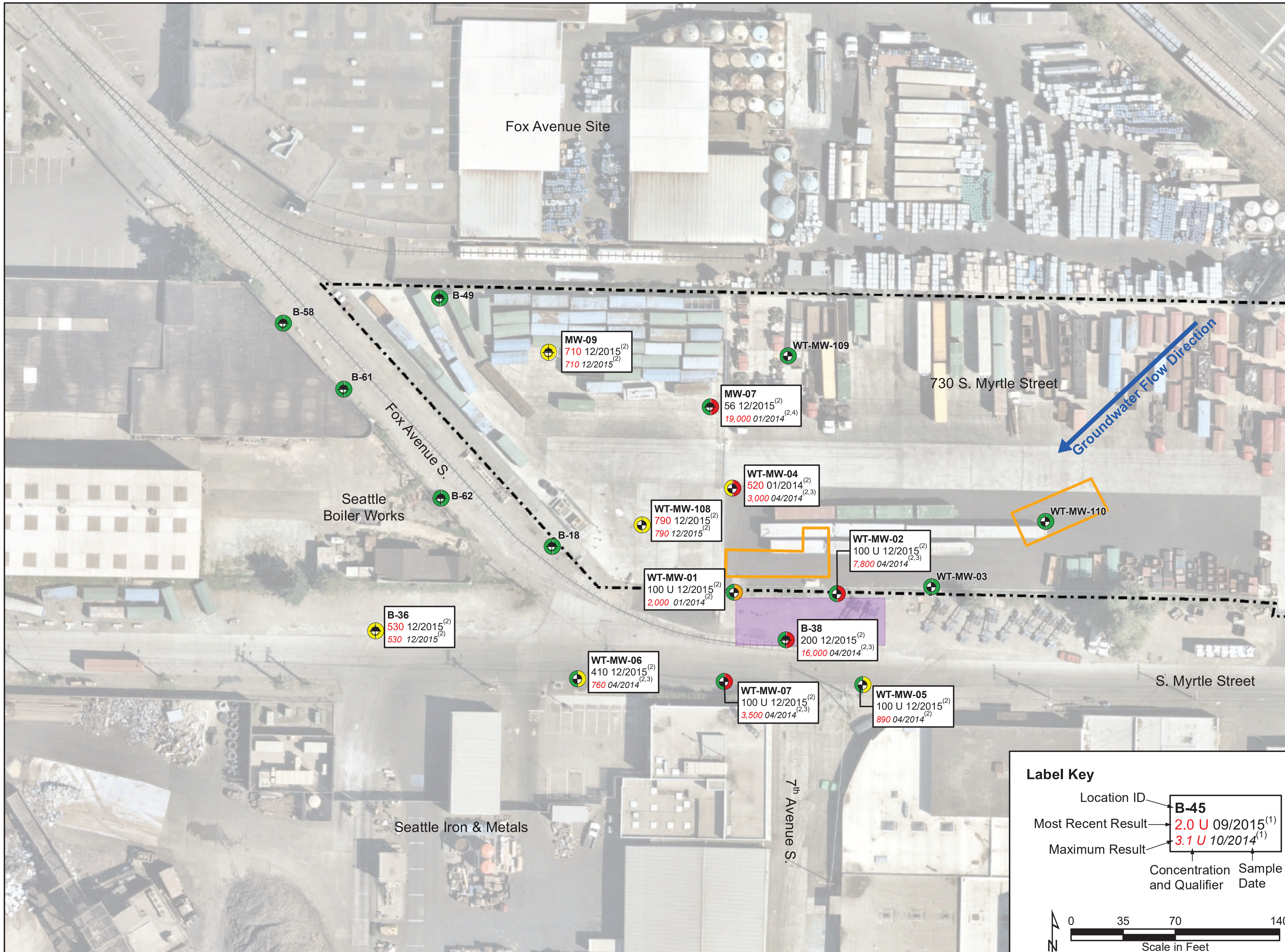
Whitehead Tyee Site
Seattle, Washington

Figure 4.8
Groundwater Analytical Results for Pentachlorophenol (2003–2015)

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 4.8 Groundwater Analytical Results for Pentachlorophenol (2003-2015).mxd
4/21/2023



Legend

Groundwater Sample Results

- Result Less Than Criteria
- Non-Detect Result Greater Than Criteria
- Result Greater Than Criteria by ≤ 2 times
- Result Greater Than Criteria by > 2 to ≤ 5 times
- Result Greater Than Criteria by > 5 times
- Most Recent Result / Maximum Result

Monitoring Well

- Monitoring Well - Upper WBZ (Whitehead Tyee Site)
- Monitoring Well - Upper WBZ (Fox Avenue Site Well)

Other Features

- Rail Line
- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area

Preliminary Screening Level
Total DRO and ORO: 500 µg/L

Notes:
1. Sample from Fox Avenue Site.
2. Sample from Whitehead Tyee Site.
3. A sum was not calculated for DRO and ORO due to a poor chromatographic match to the fuel standard for both analytes. The reported maximum result is for DRO, which was identified by the laboratory as a possible emulsifier.
4. Chromatograms were not reviewed for this sum, the maximum of DRO or ORO is presented.

- All results presented are in units of micrograms per liter.
- Locations shown are all locations where samples were analyzed for the chemical.
- Chemical results are presented only at locations where detected result exceeds the PSL.
- Results displayed in RED indicate an exceedance of the PSL.
- Data presented are through the most recent comprehensive Site investigation in 2015. Fox Avenue Site data are also included through this date. Only wells with data associated with this analyte are displayed.
- Refer to Appendix B for available Fox Avenue Site annual monitoring data from 2016 through 2022.
- Monitoring wells screened in the Lower WBZ have been sampled exclusively for Fox Avenue Site monitoring events and are not presented on this figure.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
DRO = Diesel-range organics
µg/L = Micrograms per liter
ORO = Oil-range organics
Penta = Pentachlorophenol
PSL = Preliminary Screening Level
UST = Underground storage tank
WBZ = Water-bearing zone

Qualifiers:
J = Concentration is estimated but acceptable for most uses.
U = The result was not detected at the reporting limit.

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Whitehead Tyee Site
Seattle, Washington

Figure 4.9
Groundwater Analytical Results for Diesel- and Oil-Range Organics (2010–2015)

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 4.9 Groundwater Analytical Results for DRO and ORO (2010-2015).mxd
4/21/2023

Legend

Groundwater Sample Results

- Result Less Than Criteria
- Non-Detect Result Greater Than Criteria
- Result Greater Than Criteria by ≤ 2 times
- Result Greater Than Criteria by > 2 to ≤ 5 times
- Result Greater Than Criteria by > 5 times
- Most Recent Result → ◐ ← Maximum Result

Monitoring Well

- Monitoring Well - Upper WBZ (Whitehead Tyee Site)
- Monitoring Well - Upper WBZ (Fox Avenue Site Well)

Other Features

- Rail Line
- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area

Preliminary Screening Level
Dioxin/Furan TEQ: 0.0051 pg/L

Notes:
1. Sample from Fox Avenue Site.
2. Sample from Whitehead Tyee Site.
- All results presented are in units of picograms per liter.
- Locations shown are all locations where samples were analyzed for the chemical.
- Results displayed in RED indicate an exceedance of the PSL.
- Data presented are associated with a 2016 Site groundwater monitoring event. These are the only dioxin/furan TEQ data available for the Site.
- Monitoring wells screened in the Lower WBZ have been sampled exclusively for Fox Avenue Site monitoring events and are not presented on this figure.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
Penta = Pentachlorophenol
pg/L = Picograms per liter
PSL = Preliminary Screening Level
TEQ = Toxic equivalent
UST = Underground storage tank
WBZ = Water-bearing zone

Qualifiers:
J = Concentration is estimated but accptable for most uses.
U = The result was not detected at the reporting limit.

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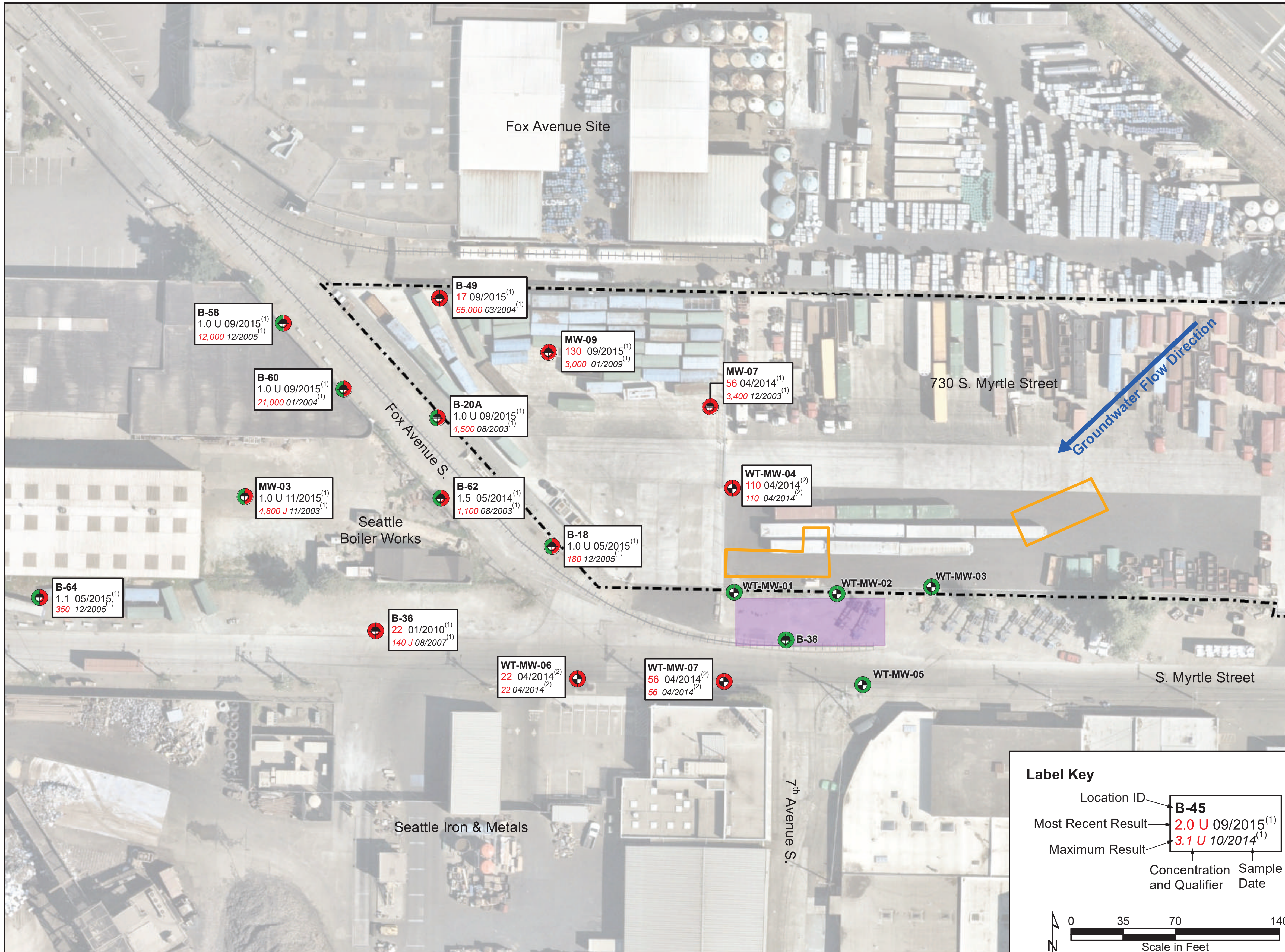
Whitehead Tyee Site
Seattle, Washington

Figure 4.10
Groundwater Analytical Results for Dioxin/Furan TEQ (2016)

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 4.10 Groundwater Analytical Results for Dioxins_Furans TEQ (2016).mxd
4/21/2023



Legend

Groundwater Sample Results

- Result Less Than Criteria
- Non-Detect Result Greater Than Criteria
- Result Greater Than Criteria by ≤ 2 times
- Result Greater Than Criteria by > 2 to ≤ 5 times
- Result Greater Than Criteria by > 5 times

Most Recent Result — Maximum Result

Monitoring Well

- Monitoring Well - Upper WBZ (Whitehead Tyee Site)
- Monitoring Well - Upper WBZ (Fox Avenue Site Well)

Other Features

- Rail Line
- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area

Preliminary Screening Level
Tetrachloroethylene: 2.9 µg/L

Notes:
1. Sample from Fox Avenue Site.
2. Sample from Whitehead Tyee Site.
- All results presented are in units of micrograms per liter.
- Locations shown are all locations where samples were analyzed for the chemical.
- Chemical results are presented only at locations where detected result exceeds the PSL.
- Results displayed in RED indicate an exceedance of the PSL.
- Data presented are through the most recent comprehensive Site investigation in 2015. Fox Avenue Site data are also included through this date. Only wells with data associated with this analyte are displayed.
- Monitoring wells screened in the Lower WBZ have been sampled exclusively for Fox Avenue Site monitoring events and are not presented on this figure.
- Refer to Appendix B for available Fox Avenue Site annual monitoring data from 2016 through 2022.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
µg/L = Micrograms per liter
Penta = Pentachlorophenol
PSL = Preliminary Screening Level
UST = Underground storage tank
WBZ = Water-bearing zone

Qualifiers:
J = Concentration is estimated but acceptable for most uses.
U = The result was not detected at the reporting limit.

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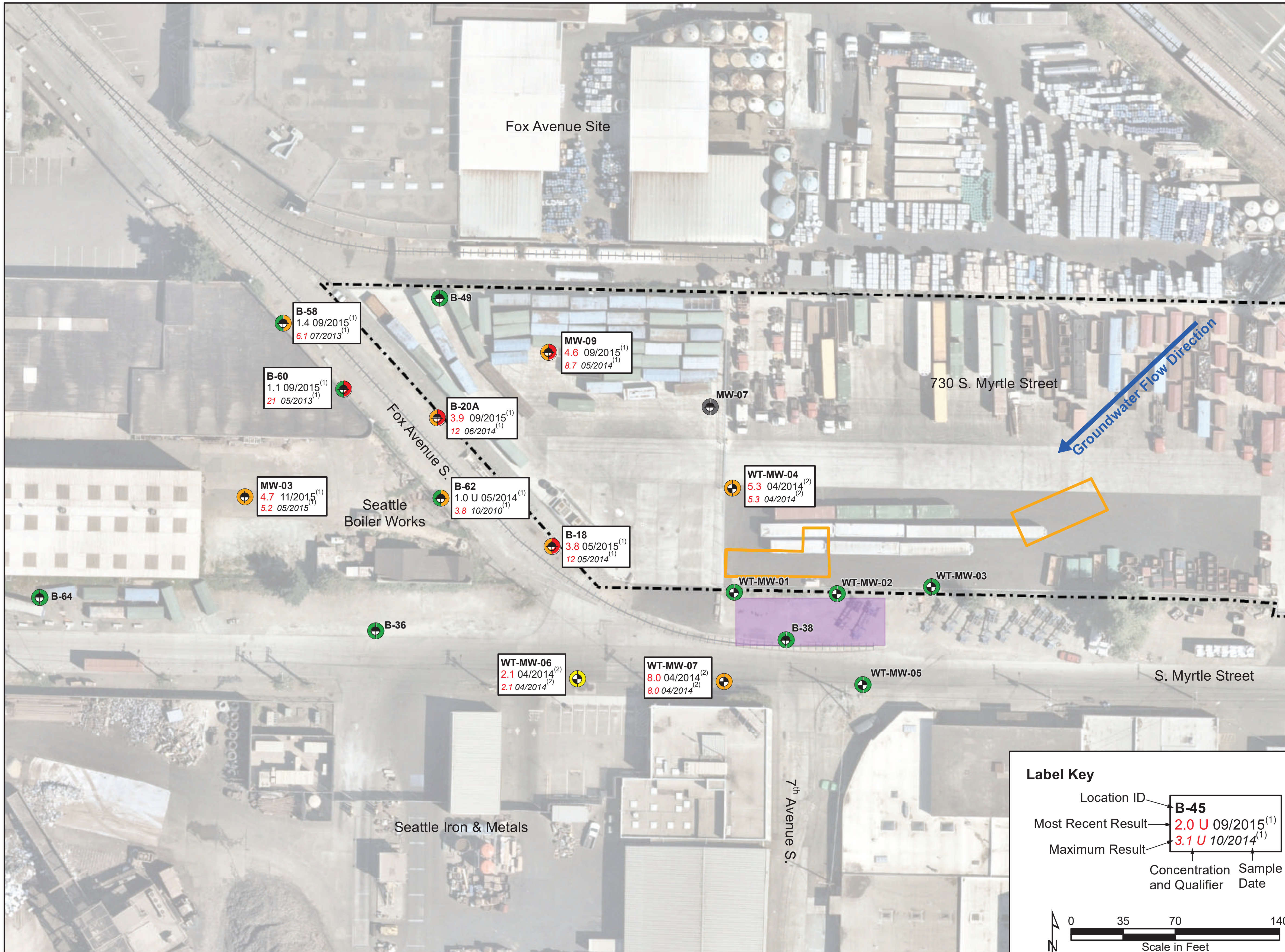
Seattle, Washington

Figure 4.11
Groundwater Analytical Results for Tetrachloroethylene (2003–2015)

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 4.11 Groundwater Analytical Results for PCE (2003-2015).mxd
4/21/2023



Legend

Groundwater Sample Results

- Result Less Than Criteria
- Non-Detect Result Greater Than Criteria
- Result Greater Than Criteria by ≤ 2 times
- Result Greater Than Criteria by > 2 to ≤ 5 times
- Result Greater Than Criteria by > 5 times

Most Recent Result → ← Maximum Result

Monitoring Well

- Monitoring Well - Upper WBZ (Whitehead Tyee Site)
- Monitoring Well - Upper WBZ (Fox Avenue Site Well)

Other Features

- Rail Line
- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area

Preliminary Screening Level
Benzene: 1.6 µg/L

Notes:
1. Sample from Fox Avenue Site.
2. Sample from Whitehead Tyee Site.
- All results presented are in units of micrograms per liter.
- Locations shown are all locations where samples were analyzed for the chemical.
- Chemical results are presented only at locations where detected result exceeds the PSL.
- Results displayed in RED indicate an exceedance of the PSL.
- Data presented are through the most recent comprehensive Site investigation in 2015. Fox Avenue Site data are also included through this date. Only wells with data associated with this analyte are displayed.
- Monitoring wells screened in the Lower WBZ have been sampled exclusively for Fox Avenue Site monitoring events and are not presented on this figure.
- Refer to Appendix B for available Fox Avenue Site annual monitoring data from 2016 through 2022.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
µg/L = Micrograms per liter
Penta = Pentachlorophenol
PSL = Preliminary Screening Level
UST = Underground storage tank
WBZ = Water-bearing zone

Qualifiers:
J = Concentration is estimated but acceptable for most uses.
U = The result was not detected at the reporting limit.

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Seattle, Washington

Figure 4.12
Groundwater Analytical Results for Benzene (2009–2015)

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 4.12 Groundwater Analytical Results for Benzene (2009-2015).mxd
4/21/2023

Legend

Groundwater Sample Results

- Result Less Than Criteria
- Non-Detect Result Greater Than Criteria
- Result Greater Than Criteria by ≤ 2 times
- Result Greater Than Criteria by > 2 to ≤ 5 times
- Result Greater Than Criteria by > 5 times
- Most Recent Result → ◑ ← Maximum Result

Monitoring Well

- Monitoring Well - Upper WBZ (Whitehead Tyee Site)
- Monitoring Well - Upper WBZ (Fox Avenue Site Well)

Other Features

- Rail Line
- Interim Action Excavation Extent
- 730 S. Myrtle Street Property Boundary
- Former Penta Dip Tank and UST Source Area

Preliminary Screening Level
Total PCBs: 7 pg/L

Notes:
1. Sample from Fox Avenue Site.
2. Sample from Whitehead Tyee Site.
- All results presented are in units of picograms per liter.
- Locations shown are all locations where samples were analyzed for the chemical.
- Results displayed in RED indicate an exceedance of the PSL.
- Data presented are associated with a 2017 sampling event conducted by Ecology to evaluate PCB occurrence in the vicinity of the Lower Duwamish Waterway Superfund Site. The samples presented were analyzed for total PCB congeners and total PCB Aroclors. To present results from samples analyzed by two methods, detected concentrations take highest precedence, followed by non-detect exceedances of the PSL.
- Monitoring wells screened in the Lower WBZ have been sampled exclusively for Fox Avenue Site monitoring events and are not presented on this figure.
- Orthoimagery provided by Nearmap, 2018.

Abbreviations:
Ecology = Washington State Department of Ecology
PCB = Polychlorinated biphenyl
Penta = Pentachlorophenol
pg/L = Picograms per liter
PSL = Preliminary Screening Level
UST = Underground storage tank
WBZ = Water-bearing zone

Qualifiers:
J = Concentration is estimated but acceptable for most uses.
U = The result was not detected at the reporting limit.

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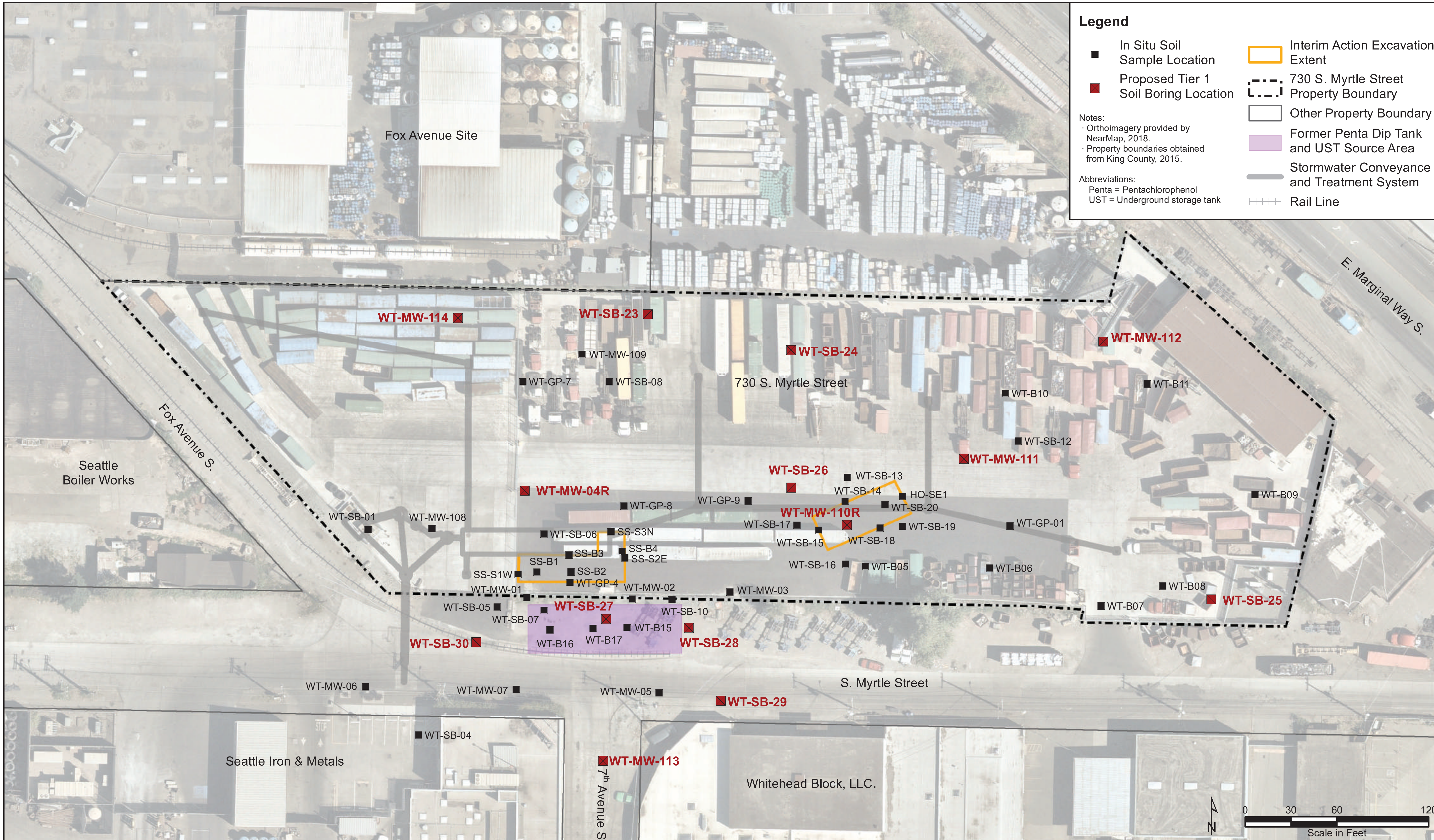
Figure 4.13
Groundwater Analytical Results for Total PCBs (2017)

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 4.13 Groundwater Analytical Results for Total PCBs (2017).mxd
4/21/2023



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Remedial Investigation Work Plan
Whitehead Tyee Site
Seattle, Washington

Figure 6.1
Proposed Soil Investigation Locations

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 6.1 Proposed Soil Investigation Locations.mxd
4/18/2023

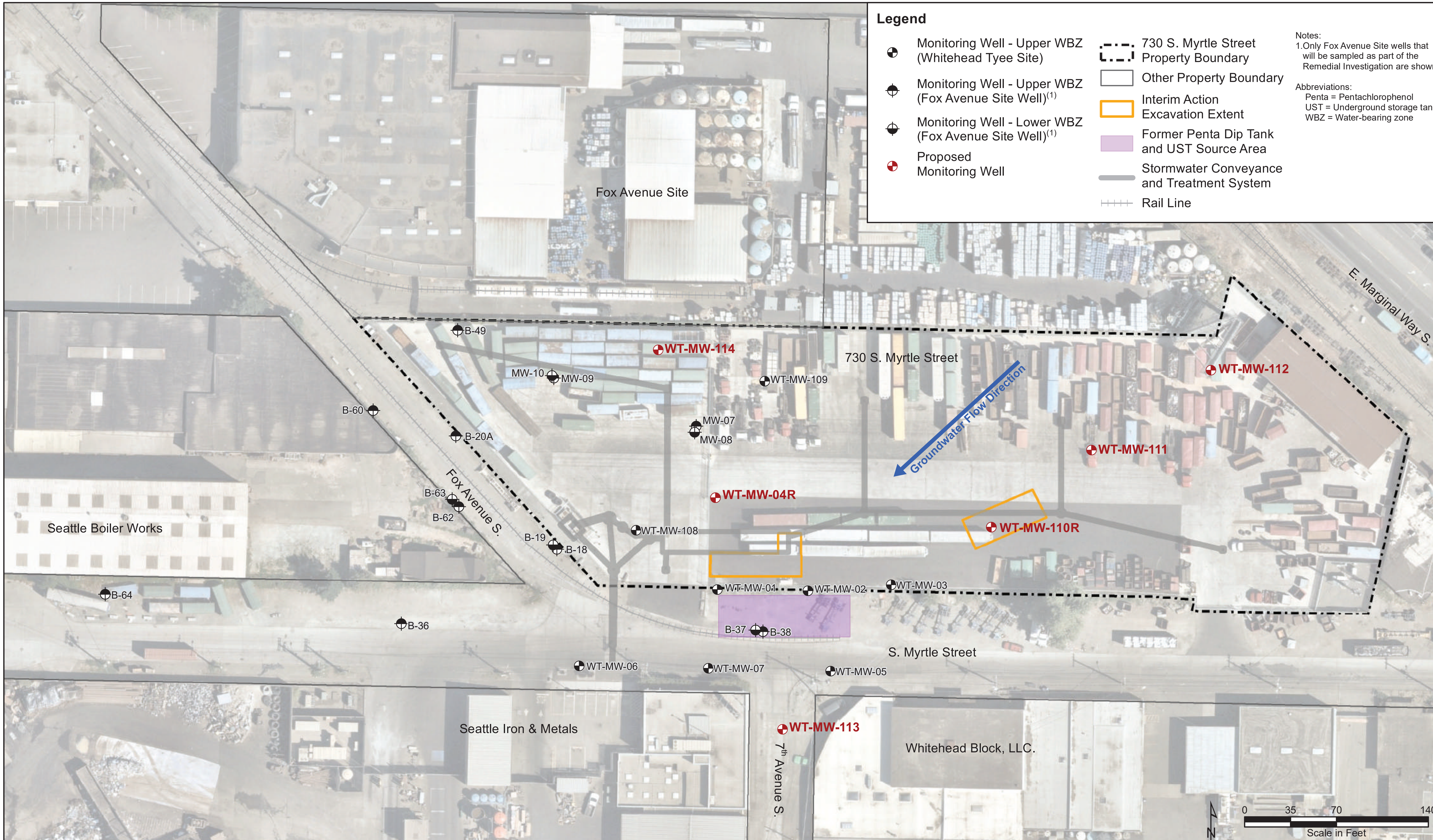

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Figure 6.2
Proposed Groundwater Investigation Locations

I:\GIS\Projects\SIM-730EDR\MXD\RI Work Plan\2023\Figure 6.2 Proposed Groundwater Investigation Locations.mxd
4/18/2023

Whitehead Tyee Site

Remedial Investigation Work Plan

Appendix A
Boring Logs

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Boring ID: GP-1

Coordinate system:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:

Drill Date: March 26, 2013
Logged By: Lynn Grochala
Drilled By: Don Harden/Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: 2"x5' Plastic Liner
Boring Diameter: 2 inches
Boring Depth (ft bgs): 7 feet bgs
Groundwater ATD (ft bgs):

Client: Seattle Iron and Metals
Project: SIM-730EDR
Task: 1001
Address: 730 Myrtle Street

Remarks: PID readings were collected from composites samples collected from 0 to 5 ft bgs.

PID (ppm)	SHEEN	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
0-5 ft 0.0 ppm		GP-1 (0-5')		0	GP	Sand and gravel.
					SM	Brown, compact, fine silty SAND.
				2	SP	Brown, fine SAND, intermittent layers of fine sandy silt.
		GP-1 (4')		4	ML	Brown, fine sandy SILT, soft, moist.
						No recovery.
				5	SP	Brownish-grey SAND, trace silt, dry.
				7		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Boring ID: GP-2

Drill Date: March 26, 2013
Logged By: Lynn Grochala
Drilled By: Don Harden/Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: 2"x5' Plastic Liner
Boring Diameter: 2 inches
Boring Depth (ft bgs): 13 feet bgs
Groundwater ATD (ft bgs): 10 feet bgs

Client: Seattle Iron and Metals
Project: SIM-730EDR
Task: 1001
Address: 730 Myrtle Street

Coordinate system:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:

Remarks: PID readings were collected from composites samples collected from various depth intervals.

PID (ppm)	SHEEN	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
			Recovered	0–0.6	GW	Gravel
0-5 ft 0.8 ppm		GP-2 (0-10')	Recovered	0.6–4	SW	Brown, fine to medium SAND, trace silt, compact, intermittent sandy silt red mottling.
			Not recovered	4–5		No recovery.
5-10 ft 0.5 ppm		GP-2 (7-8')	Recovered	5–9	SW-SP	Greyish-brown, fine to medium SAND, uniform.
			Not recovered	9–10		No recovery.
10-13 ft 1,393 ppm	Sheen test - yes sheen	GP-2 (10-13'); GP-2 (12-13')	Recovered	10–13		Grey, fine to medium SAND, some coarse, uniform, moist to wet, petroleum odor present.

Groundwater table at 10 ft bgs.

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Boring ID: GP-3

Coordinate system:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:

Drill Date: March 26, 2013
Logged By: Lynn Grochala
Drilled By: Don Harden/Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: 2"x5' Plastic Liner
Boring Diameter: 2 inches
Boring Depth (ft bgs): 13 feet bgs
Groundwater ATD (ft bgs): 10 feet bgs

Client: Seattle Iron and Metals
Project: SIM-730EDR
Task: 1001
Address: 730 Myrtle Street

Remarks: PID readings were collected from composites samples collected from various depth intervals.

PID (ppm)	SHEEN	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
0-5 ft 0.5 ppm		GP-3 (0-10')	Driven 0-5; recovered 0-4	0-0.6	GW	Sand and gravel.
				0.6-4	SM	Brownish-grey, fine to medium, silty SAND, with intermittent layers of red stained fine to medium SAND, moist zones.
				4-5		No recovery.
5-10 ft 12.9 ppm			Driven 5-10; recovered 5-8.5	5-8.2	SP	Greyish-brown, fine to medium SAND.
		GP-3 (8-9')		8.2-8.7	ML	SILT layer.
				8.7-10		No recovery.
10-13 ft 1,613 ppm	Sheen test - yes sheen	GP-3 (10-13') GP-3 (12-13')	Driven 10-13; recovered 10-13	10-13	SP	Dark grey, fine to medium SAND, moist to wet, petroleum odor.

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Boring ID: GP-4

Coordinate system:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:

Drill Date: March 26, 2013
Logged By: Lynn Grochala
Drilled By: Don Harden/Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: 2"x5' Plastic Liner
Boring Diameter: 2 inches
Boring Depth (ft bgs): 13 feet bgs
Groundwater ATD (ft bgs): 10 feet bgs

Client: Seattle Iron and Metals
Project: SIM-730EDR
Task: 1001
Address: 730 Myrtle Street

Remarks: PID readings were collected from composites samples collected from various depth intervals.

PID (ppm)	SHEEN	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				0–1	GW	Sand and gravel.
0-5 ft 1.3 ppm		GP-4 (0-10')		1–4	SP	Brown with grey/red mottles, fine to medium silty SAND.
		GP-4 (4.5')		4–5		No recovery.
5-10 ft 0.5 ppm				5–8.5	SP-SW	Greyish-brown, fine to medium SAND with intermittent silty sand layers.
				8.5–10		No recovery.
10-13 ft 1,250 ppm	Sheen test - yes sheen			10–13	SP	Dark grey, fine to medium SAND, moist to wet, petroleum odor.

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Boring ID: GP-5

Coordinate system:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:

Drill Date: March 26, 2013
Logged By: Lynn Grochala
Drilled By: Don Harden/Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: 2"x5' Plastic Liner
Boring Diameter: 2 inches
Boring Depth (ft bgs): 5 feet bgs
Groundwater ATD (ft bgs):

Client: Seattle Iron and Metals
Project: SIM-730EDR
Task: 1001
Address: 730 Myrtle Street

Remarks: PID readings were collected from composites samples collected from 0 to 5 ft bgs.

PID (ppm)	SHEEN	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				0	GP	Gravel
		GP-5 (0-5')		0.5–2	SM	Brown, compact, fine silty SAND.
0-5 ft 0.5 ppm		GP-5 (2')		2–4	SP	Brown, fine SAND, intermittent layers of fine sandy silt.
				4–5		No recovery.

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Boring ID: GP-6

Coordinate system:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:

Drill Date: March 26, 2013
Logged By: Lynn Grochala
Drilled By: Don Harden/Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: 2"x5' Plastic Liner
Boring Diameter: 2 inches
Boring Depth (ft bgs): 8 feet bgs
Groundwater ATD (ft bgs):

Client: Seattle Iron and Metals
Project: SIM-730EDR
Task: 1001
Address: 730 Myrtle Street

Remarks: PID readings were collected from composites samples collected from 0 to 5 ft bgs.

PID (ppm)	SHEEN	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				0–1	GW	Mixed gravel, sand, concrete.
0-4 ft 0.1 ppm		GP-6 (0-8'); GP-6 (4')		1–5	SP	Brown, fine to medium SAND, trace silt, intermittent layers of sandy silt.
5-8 ft 0.0 ppm				5–8		Fine to medium SAND, trace silt grading to fine to medium brownish-grey SAND.

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Boring ID: GP-8

Coordinate system:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:

Drill Date: March 26, 2013
Logged By: Lynn Grochala
Drilled By: Don Harden/Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: 2"x5' Plastic Liner
Boring Diameter: 2 inches
Boring Depth (ft bgs): 5 feet bgs
Groundwater ATD (ft bgs):

Client: Seattle Iron and Metals
Project: SIM-730EDR
Task: 1001
Address: 730 Myrtle Street

Remarks: PID readings were collected from composites samples collected from various depth intervals.

PID (ppm)	SHEEN	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				0	GW	Sand and gravel.
		GP-8 (0-5')		1	SM	Brownish-grey, fine to medium, silty SAND, with intermittent layers of red stained fine to medium SAND, moist zones.
0-5 ft 0.5 ppm				2		
				3		
		GP-8 (4-5')		4		No recovery.
				5		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Boring ID: GP-9

Coordinate system:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:

Drill Date: March 26, 2013
Logged By: Lynn Grochala
Drilled By: Don Harden/Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: 2"x5' Plastic Liner
Boring Diameter: 2 inches
Boring Depth (ft bgs): 5 feet bgs
Groundwater ATD (ft bgs):

Client: Seattle Iron and Metals
Project: SIM-730EDR
Task: 1001
Address: 730 Myrtle Street

Remarks: PID readings were collected from composites samples collected from various depth intervals.

PID (ppm)	SHEEN	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				0	GW	Sand and gravel.
		GP-9 (0-5')		1	SP	Brown-grey with red streaking, fine to medium silty SAND.
0-5 ft 0.6 ppm				2		
		GP-9 (3-4')		3		
				4		
				5		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Boring ID: GP-10

Drill Date: March 26, 2013
Logged By: Lynn Grochala
Drilled By: Don Harden/Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: 2"x5' Plastic Liner
Boring Diameter: 2 inches
Boring Depth (ft bgs): 5 feet bgs
Groundwater ATD (ft bgs):

Client: Seattle Iron and Metals
Project: SIM-730EDR
Task: 1001
Address: 730 Myrtle Street

Coordinate system:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:

Remarks: PID readings were collected from composites samples collected from various depth intervals.

PID (ppm)	SHEEN	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				0	GW	Sand and gravel, at 0.5' bgs pulverized concrete.
		GP-10 (0-5')		1		
0-5 ft 58.8 ppm				2	SP	Grey and brown, fine to medium SAND, trace silt, grading to finer sand.
				3		
		GP-10 (4-5')		4		
				5	ML	Grey, clayey SILT.

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Boring ID: GP-11

Coordinate system:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:

Drill Date: March 26, 2013
Logged By: Lynn Grochala
Drilled By: Don Harden/Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: 2"x5' Plastic Liner
Boring Diameter: 2 inches
Boring Depth (ft bgs): 5 feet bgs
Groundwater ATD (ft bgs):

Client: Seattle Iron and Metals
Project: SIM-730EDR
Task: 1001
Address: 730 Myrtle Street

Remarks: PID readings were collected from composites samples collected from various depth intervals.

PID (ppm)	SHEEN	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				0	GW	Sand and gravel.
		GP-11 (0-5')		1		
					SP	Dark brownish-black fine to medium SAND (fill?).
0-5 ft 0.7 ppm				2		Greyish-brown fine to medium SAND, few thing (1/4") stringers of brown silty sand.
				3		
		GP-11 (4-5')		4		
				5		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Boring ID: GP-12

Coordinate system:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:

Drill Date: March 26, 2013
Logged By: Lynn Grochala
Drilled By: Don Harden/Cascade Drilling
Drill Type: Direct Push Geoprobe
Sample Method: 2"x5' Plastic Liner
Boring Diameter: 2 inches
Boring Depth (ft bgs): 8 feet bgs
Groundwater ATD (ft bgs):

Client: Seattle Iron and Metals
Project: SIM-730EDR
Task: 1001
Address: 730 Myrtle Street

Remarks: PID readings were collected from composites samples collected from various depth intervals.

PID (ppm)	SHEEN	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				0	GW	Sand and gravel.
		GP-12 (0-8')		1	SP	Brown, fine silty SAND, compact.
0-5 ft 0.0 ppm				2–4		
					ML	Sandy SILT.
5-8 ft 0.0 ppm				5	SM	Brown, fine silty SAND, moist.
				6	SP	Greyish brown, fine to medium SAND.
		GP-12 (7-8')		7		
				8		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

SoundEarth Strategies

DRAFT

Project: Whitehead-Tyee Property
Project Number: 0973-001
Logged by: CGC
Date Started: 12/27/13
Surface Conditions: Soil
Well Location N/S: 8.5 feet North of top of yellow fire hydrant in South Myrtle Street ROW.
Well Location E/W: 125 feet West of top of yellow fire hydrant in South Myrtle Street ROW.
Reviewed by: CCC
Date Completed: 12/27/13

BORING LOG B01 MW01

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling: 10 feet bgs
Water Depth After Completion: 10.8 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
0						Fill (GM)		**Damp, medium dense, silty sandy GRAVEL. Brown. No hydrocarbon or solvent odor (20-30-50). Fill.**	
						Fill (SM)		**Damp, medium dense, silty fine SAND. Light brown. No hydrocarbon or solvent odor. Fill.**	
			70	0.0					
5				0.0	B01-05	Fill (SP)		**Damp, medium dense, SAND with trace silt. Brown. No hydrocarbon or solvent odor (5-95-0). Fill.**	
						Fill (SM-ML)		**Damp, medium dense, silty fine SAND. Brown. No hydrocarbon or solvent odor (40-60-0). Locally siltier at ~6 to 7 feet bgs (50-50-0).**	
				0.0					
			80						
10				0.0	B01-10	SP		**Moist, medium dense, SAND with trace silt. Dark brown. Moderate solvent odor at ~11.5 to 13 feet bgs (5-95-0). Becomes wet at ~10 feet bgs. Some tree roots at ~17.5 feet bgs.**	

Drilling Co./Driller: ESN Northwest/Don
Drilling Equipment: Combo Probe-Auger Rig
Sampler Type: Core Tube
Hammer Type/Weight: -- lbs
Total Boring Depth: 20 feet bgs
Total Well Depth: 20 feet bgs
State Well ID No.: BIE 956

Well/Auger Diameter: 2" / 7.25" O.D. inches
Well Screened Interval: 5 -20 ft bgs feet bgs
Screen Slot Size: 0.010 inches
Filter Pack Used: Sand
Surface Seal: Concrete
Annular Seal: Bentonite 1-3 ft bgs
Monument Type: Flush grade

Notes/Comments:
Moderate solvent odor at ~11.5 to 13 feet bgs.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/27/13
Surface Conditions:	Soil
Well Location N/S:	8.5 feet North of top of yellow fire hydrant in South Myrtle Street ROW.
Well Location E/W:	125 feet West of top of yellow fire hydrant in South Myrtle Street ROW.
Reviewed by:	CCC
Date Completed:	12/27/13

BORING LOG B01 MW01

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 10 feet bgs

Water Depth After Completion 10.8 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
				0.0		**SP**		**Moist, medium dense, SAND with trace silt. Dark brown. Moderate solvent odor at ~11.5 to 13 feet bgs (5-95-0). Becomes wet at ~10 feet bgs. Some tree roots at ~17.5 feet bgs.**	
					B01-12				
				124					
			90						
				0.0					
15									
			100						
					B01-20				
20									
								End of boring at 20.0 ft bgs. Boring overdrilled with hollow-stem auger and monitoring well MW01 installed to 20 feet bgs.	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	20	feet bgs
State Well ID No.:	BIE 956	

Well/Auger Diameter:	2" / 7.25" O.D.	inches
Well Screened Interval:	5 -20 ft bgs	feet bgs
Screen Slot Size:	0.010	inches
Filter Pack Used:	Sand	
Surface Seal:	Concrete	
Annular Seal:	Bentonite 1-3 ft bgs	
Monument Type:	Flush grade	

Notes/Comments:

Moderate solvent odor at ~11.5 to 13 feet bgs.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/27/13
Surface Conditions:	Soil
Well Location N/S:	10 feet North of top of yellow fire hydrant in South Myrtle Street ROW.
Well Location E/W:	52 feet West of top of yellow fire hydrant in South Myrtle Street ROW.
Reviewed by:	CCC
Date Completed:	12/27/13

BORING LOG B02 MW02

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling: 10 feet bgs

Water Depth After Completion: 10.3 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
0						Fill (SM)		**Moist, medium dense, silty SAND with gravel. Brown. No hydrocarbon or solvent odor (20-70-10). Fill.**	
						Fill (SP-SM)		**Moist, medium dense, fine SAND with trace silt. Brown. No hydrocarbon or solvent odor (5-95-0). Locally siltier at ~3.5 to 4 feet bgs (20-80-0). Fill.**	
			70	0.0					
					B02-05	Fill (ML)			
5				0.0				**Moist, stiff, clayey SILT. Gray. No hydrocarbon or solvent odor (100-0-0). Fill.**	
						Fill (SP)		**Moist, medium dense, SAND with silt. Brown. No hydrocarbon or solvent odor (5-95-0). Fill.**	
				0.0		Fill (ML)		**Moist, very stiff, clayey SILT with fine sand. Brown. No hydrocarbon or solvent odor (90-10-0). Fill.**	
			90	0.0					
						SP		**Moist, medium dense, SAND with trace silt. Gray. Strong solvent odor at ~8.5 to ~11 feet bgs, moderate solvent odor at ~11 feet to 13 feet bgs. Becomes wet-saturated at ~10 feet bgs. Fill.**	
				365					
				282	B02-10				
10									

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	20	feet bgs
State Well ID No.:	BIE 955	

Well/Auger Diameter:	2" / 7.25" O.D.	inches
Well Screened Interval:	5 -20 ft bgs	feet bgs
Screen Slot Size:	0.010	inches
Filter Pack Used:	Sand	
Surface Seal:	Concrete	
Annular Seal:	Bentonite 1-3 ft bgs	
Monument Type:	Flush grade	

Notes/Comments:

Moderate to strong solvent odor at ~8.5 to 14 feet bgs. Slight oily sheen on soil at ~11 to 13 feet bgs.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/27/13
Surface Conditions:	Soil
Well Location N/S:	10 feet North of top of yellow fire hydrant in South Myrtle Street ROW.
Well Location E/W:	52 feet West of top of yellow fire hydrant in South Myrtle Street ROW.
Reviewed by:	CCC
Date Completed:	12/27/13

BORING LOG B02 MW02

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 10 feet bgs

Water Depth After Completion 10.3 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
						SP		**Moist, medium dense, SAND with trace silt. Gray. Strong solvent odor at ~8.5 to ~11 feet bgs, moderate solvent odor at ~11 feet to 13 feet bgs. Becomes wet-saturated at ~10 feet bgs.**	
				175					
			85	0.0					
15				0.0	B02-15				
			100						
20				1.4	B02-20				
								End of boring at 20.0 ft bgs. Boring overdrilled with hollow-stem auger and monitoring well MW02 installed to 20 feet bgs.	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	20	feet bgs
State Well ID No.:	BIE 955	

Well/Auger Diameter:	2" / 7.25" O.D.	inches
Well Screened Interval:	5 -20 ft bgs	feet bgs
Screen Slot Size:	0.010	inches
Filter Pack Used:	Sand	
Surface Seal:	Concrete	
Annular Seal:	Bentonite 1-3 ft bgs	
Monument Type:	Flush grade	

Notes/Comments:

Moderate to strong solvent odor at ~8.5 to 14 feet bgs. Slight oily sheen on soil at ~11 to 13 feet bgs.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/27/13
Surface Conditions:	Soil
Well Location N/S:	14.5 feet North of top of yellow fire hydrant in South Myrtle Street ROW.
Well Location E/W:	10 feet East of top of yellow fire hydrant in South Myrtle Street ROW.
Reviewed by:	CCC
Date Completed:	12/27/13

BORING LOG B03 MW03

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling: 10 feet bgs

Water Depth After Completion: 10.3 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
0						Fill (GM)		Damp, medium dense, sandy GRAVEL. Brown. No hydrocarbon or solvent odor (20-30-50). Overlies 1-inch layer of asphalt at ~1 foot bgs. Fill.	
						Fill (SM)		Damp, medium dense, silty fine SAND with some wood chips. Brown. No hydrocarbon or solvent odor (30-60-10). Fill.	
						Fill (SP)		Damp to moist, medium dense, SAND with trace silt. Brown. No hydrocarbon or solvent odor (5-95-0). Fill.	
			90	0.0					
5				0.0	B03-05				
						Fill (SM-ML)		Moist, medium dense, silty fine SAND and sandy SILT. Gray and brown. No hydrocarbon or solvent odor (40-60-0)/(80-20-0). Fill.	
				0.0					
			80						
						SP		Moist, medium dense, SAND with trace silt. Dark brown. No hydrocarbon or solvent odor (5-95-0). Becomes wet to saturated at 10 feet bgs.	
10				0.0	B03-10				
						ML		Wet, stiff, sandy SILT. Brown. No hydrocarbon or solvent odor (80-20-0).	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	20	feet bgs
State Well ID No.:	BIE 954	

Well/Auger Diameter:	2" / 7.25" O.D.	inches
Well Screened Interval:	5 -20 ft bgs	feet bgs
Screen Slot Size:	0.010	inches
Filter Pack Used:	Sand	
Surface Seal:	Concrete	
Annular Seal:	Bentonite 1-3 ft bgs	
Monument Type:	Flush grade	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/27/13
Surface Conditions:	Soil
Well Location N/S:	14.5 feet North of top of yellow fire hydrant in South Myrtle Street ROW.
Well Location E/W:	10 feet East of top of yellow fire hydrant in South Myrtle Street ROW.
Reviewed by:	CCC
Date Completed:	12/27/13

BORING LOG B03 MW03

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling 10 feet bgs

Water Depth After Completion 10.3 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
						SP		**Wet to saturated, medium dense, SAND with trace silt. Dark brown. No hydrocarbon or solvent odor (5-95-0).**	
			75	0.0					
15				0.0	B03-15				
			100						
20				0.0	B03-20				
								End of boring at 20.0 ft bgs. Boring overdrilled with hollow-stem auger and monitoring well MW03 installed to 20 feet bgs.	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	20	feet bgs
State Well ID No.:	BIE 954	

Well/Auger Diameter:	2" / 7.25" O.D.	inches
Well Screened Interval:	5 -20 ft bgs	feet bgs
Screen Slot Size:	0.010	inches
Filter Pack Used:	Sand	
Surface Seal:	Concrete	
Annular Seal:	Bentonite 1-3 ft bgs	
Monument Type:	Flush grade	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/27/13
Surface Conditions:	Soil
Well Location N/S:	78 feet North of top of yellow fire hydrant in South Myrtle Street ROW.
Well Location E/W:	110 feet West of top of yellow fire hydrant in South Myrtle Street ROW.
Reviewed by:	CCC
Date Completed:	12/27/13

BORING LOG **B04** MW04

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling 10 feet bgs

Water Depth After Completion 11.5 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
0						**Fill (GM)**		**Damp, medium dense, silty sandy GRAVEL. Brown. No hydrocarbon or solvent odor (20-30-50). Fill.**	
			75	0.0					
						Fill (SM-SP)		**Damp to moist, medium dense, silty fine SAND and SAND with silt. Brown. No hydrocarbon or solvent odor (30-70-0)/(20-80-0). Fill.**	
5				0.0	B04-05				
				0.0		**Fill (GM)**		**Damp, medium dense, silty sandy GRAVEL. Brown. No hydrocarbon or solvent odor (20-30-50). Fill.**	
			75						
						Fill (PT-ML)		**Moist, stiff, wood chips, wood debris, and SILT. Fill.**	
						SP		**Moist, medium dense, SAND with trace silt. Dark brown. No hydrocarbon or solvent odor (5-95-0). Becomes wet to saturated at 10 feet bgs.**	
10				0.0	B04-10				

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	20	feet bgs
State Well ID No.:	BIE 957	

Well/Auger Diameter:	2" / 7.25" O.D.	inches
Well Screened Interval:	5 -20 ft bgs	feet bgs
Screen Slot Size:	0.010	inches
Filter Pack Used:	Sand	
Surface Seal:	Concrete	
Annular Seal:	Bentonite 1-3 ft bgs	
Monument Type:	Flush grade	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/27/13
Surface Conditions:	Soil
Well Location N/S:	78 feet North of top of yellow fire hydrant in South Myrtle Street ROW.
Well Location E/W:	110 feet West of top of yellow fire hydrant in South Myrtle Street ROW.
Reviewed by:	CCC
Date Completed:	12/27/13

BORING LOG **B04** MW04

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling: 10 feet bgs

Water Depth After Completion: 11.5 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
				0.0		**SP**		**Moist, medium dense, SAND with trace silt. Dark brown. No hydrocarbon or solvent odor (5-95-0). Becomes wet to saturated at 10 feet bgs.**	
			80	0.0					
15				0.0	B04-15				
				0.0					
			100						
20				0.0	B04-20				
								End of boring at 20.0 ft bgs. Boring overdrilled with hollow-stem auger and monitoring well MW04 installed to 20 feet bgs.	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	20	feet bgs
State Well ID No.:	BIE 957	

Well/Auger Diameter:	2" / 7.25" O.D.	inches
Well Screened Interval:	5 -20 ft bgs	feet bgs
Screen Slot Size:	0.010	inches
Filter Pack Used:	Sand	
Surface Seal:	Concrete	
Annular Seal:	Bentonite 1-3 ft bgs	
Monument Type:	Flush grade	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Gravel
Well Location N/S:	23 feet North of top of yellow fire hydrant in South Myrtle Street ROW.
Well Location E/W:	98 feet East of top of yellow fire hydrant in South Myrtle Street ROW.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG B05

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 11 feet bgs

Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
0						Fill (GM)		**Damp, medium dense, silty sandy GRAVEL. Brown. No hydrocarbon or solvent odor (20-30-50). Fill.**	
						Fill (SM)		**Damp, medium dense, silty SAND. Contains 1-inch-thick layer of wood chips, roots, and red brick pieces. Brown. No hydrocarbon or solvent odor. Fill.**	
			55	0.0					
						Fill		**Layer of broken asphalt. Fill.**	
5				0.0	B05-05	Fill (SM)		**Damp, medium dense, silty SAND with gravel. Brown. No hydrocarbon or solvent odor (30-60-10). Locally contains roots at ~7.5 to 8 feet bgs. Fill.**	
				0.0					
			65		B05-08				
						SP		**Damp to moist, medium dense, SAND with trace silt. Dark brown. No hydrocarbon or solvent odor (5-95-0). Becomes wet to saturated at 11 feet bgs.**	
10				0.0					
					B05-11				

Drilling Co./Driller:	ESN Northwest/Don		**Well/Auger Diameter:**	--	inches
Drilling Equipment:	Combo Probe-Auger Rig		**Well Screened Interval:**	--	feet bgs
Sampler Type:	Core Tube		**Screen Slot Size:**	--	inches
Hammer Type/Weight:	--	lbs	**Filter Pack Used:**	--	
Total Boring Depth:	20	feet bgs	**Surface Seal:**	--	
Total Well Depth:	--	feet bgs	**Annular Seal:**	--	
State Well ID No.:	--		**Monument Type:**	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Gravel
Well Location N/S:	23 feet North of top of yellow fire hydrant in South Myrtle Street ROW.
Well Location E/W:	98 feet East of top of yellow fire hydrant in South Myrtle Street ROW.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG B05

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 11 feet bgs
Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
			75	0.0		SP		**Saturated, medium dense, SAND with trace silt. Dark brown. No hydrocarbon or solvent odor (5-95-0).**	
15				0.0					
			100	0.0		ML		**Wet, stiff, clayey SILT. Gray. No hydrocarbon or solvent odor (100-0-0).**	
						SP		**Saturated, medium dense, SAND with trace silt. Dark brown. No hydrocarbon or solvent odor (5-95-0). ~0.5-inch-thick tree root at ~18 feet bgs.**	
20				0.0	B05-20				
								End of boring at 20.0 ft bgs. Temporary well screen set at 10 to 14 feet bgs. Boring abandoned with hydrated bentonite chips.	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Gravel
Well Location N/S:	45 feet North of gate post on west side of eastern most entry gate.
Well Location E/W:	35 feet West of gate post on west side of eastern most entry gate.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG B06

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 11.5 feet bgs

Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
0						**Fill (GM)**		**Damp, medium dense, silty sandy GRAVEL. Brown. No hydrocarbon or solvent odor (20-30-50). Fill.**	
						Fill (SM)		**Damp, medium dense, silty SAND with gravel. Tan and black. No hydrocarbon or solvent odor (25-60-15). Fill.**	
			70	0.0					
						Fill (SP-SM)		**Damp, medium dense, SAND with silt. Brown. No hydrocarbon or solvent odor (15-85-0). Fill.**	
5				0.0	B06-05				
				0.0					
			70			**Fill (ML)**		**Damp, stiff, sandy SILT. Brown. No hydrocarbon or solvent odor (90-10-0). Fill.**	
						SP		**Moist, medium dense, SAND with trace silt. Dark brown. No hydrocarbon or solvent odor (5-95-0). Becomes wet to saturated at 11.5 feet bgs.**	
10				0.0	B06-10				

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Gravel
Well Location N/S:	45 feet North of gate post on west side of eastern most entry gate.
Well Location E/W:	35 feet West of gate post on west side of eastern most entry gate.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG B06

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 11.5 feet bgs

Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
						SP		**Saturated, medium dense, SAND with silt. Dark brown. No hydrocarbon or solvent odor (5-95-0).**	
				0.0	B06-12				
			70						
15									
				0.0					
			100						
20				0.0	B06-20				
								End of boring at 20.0 ft bgs. Temporary well screen set at 10 to 14 feet bgs. Boring abandoned with hydrated bentonite chips.	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Quarry Spalls
Well Location N/S:	10 feet North of gate post on west side of eastern most entry gate.
Well Location E/W:	30 feet East of gate post on west side of eastern most entry gate.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG | B07

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 11.5 feet bgs

Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
0						**Fill (GM)**		**Damp, medium dense, silty fine SAND with gravel. Brown. No hydrocarbon or solvent odor (30-50-20). Fill.**	
						Fill (SM)		**Damp, medium dense, silty fine SAND with some gravel. Brown and gray. No hydrocarbon or solvent odor (30-60-10). Some wood chips at ~3 to 3.2 feet bgs. Fill.**	
			100	0.0					
						Fill (SP-SM)			
5				0.0	B07-05				
				0.0					
			50			**Fill (SP)**		**Damp, medium dense, SAND with silt and trace gravel. Brown. No hydrocarbon or solvent odor (5-90-5). Some wood chips at ~8.0 to 8.2 feet bgs. Fill.**	
						SP		**Damp, medium dense, SAND with silt. Dark brown. No hydrocarbon or solvent odor (5-95-0). Becomes wet at 11.5 feet bgs.**	
10				0.0	B07-10				

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Quarry Spalls
Well Location N/S:	10 feet North of gate post on west side of eastern most entry gate.
Well Location E/W:	30 feet East of gate post on west side of eastern most entry gate.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG **B07**

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 11.5 feet bgs

Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
						SP		**Wet, medium dense, SAND with silt. Dark brown. No hydrocarbon or solvent odor (5-95-0).**	
				0.0	B07-11.5				
			70						
15									
				0.0					
			100						
20				0.0	B07-20				
								End of boring at 20.0 ft bgs. Temporary well screen set at 10 to 14 feet bgs. Boring abandoned with hydrated bentonite chips.	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Gravel
Well Location N/S:	15 feet North of gate post on west side of eastern most entry gate.
Well Location E/W:	58 feet East of gate post on west side of eastern most entry gate.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG B08

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 11 feet bgs

Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
0						**Fill (GM)**		**Damp, medium dense, silty SAND with gravel. Brown and gray. No hydrocarbon or solvent odor (20-30-50). Contains wood chips. Fill.**	
						Fill (SM)		**Damp to moist, medium dense, silty fine SAND with some gravel. Gray. No hydrocarbon or solvent odor (40-50-10). Fill.**	
			90	0.0					
5				0.0	B08-05				
				0.0					
			75						
						SP		**Moist, medium dense, SAND with trace silt. Dark brown. No hydrocarbon or solvent odor (5-95-0). Becomes wet to saturated at 11 feet bgs.**	
10				0.0	B08-10				
					B08-11				

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property	**BORING LOG**	**B08**
Project Number:	0973-001	**Site Address:**	730 South Myrtle Street, Seattle, WA
Logged by:	CGC	**Water Depth At Time of Drilling**	11 feet bgs
Date Started:	12/26/13	**Water Depth After Completion**	-- feet bgs
Surface Conditions:	Gravel		
Well Location N/S:	15 feet North of gate post on west side of eastern most entry gate.		
Well Location E/W:	58 feet East of gate post on west side of eastern most entry gate.		
Reviewed by:	CCC		
Date Completed:	12/26/13		

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
				0.0		**SP**		**Wet, medium dense, SAND with silt. Dark brown. No hydrocarbon or solvent odor (5-95-0).**	
			80						
15									
				0.0					
			100						
				0.0	B08-20				
20									
								End of boring at 20.0 ft bgs. Temporary well screen set at 10 to 14 feet bgs. Boring abandoned with hydrated bentonite chips.	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Asphalt
Well Location N/S:	70 feet North of gate post on west side of eastern most entry gate.
Well Location E/W:	105 feet East of gate post on west side of eastern most entry gate.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG **B09**

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 13 feet bgs

Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
0						**Fill (GM)**		**2-inches asphalt surface. Damp, medium dense, silty fine SAND with gravel. Brown. No hydrocarbon or solvent odor (30-50-20). Fill.**	
						Fill (SM)		**Damp, medium dense, silty fine SAND with some gravel. Gray. No hydrocarbon or solvent odor (40-50-10). Locally contains wood chips at ~7.4 feet bgs. Fill.**	
			90	0.0					
5				0.0	B09-05				
				0.0					
			75			**SP**		**Damp to moist, medium dense, SAND with trace silt. Brown. No hydrocarbon or solvent odor (5-95-0). Becomes wet to saturated at 13 feet bgs.**	
10				0.0	B09-10				

Drilling Co./Driller:	ESN Northwest/Don		**Well/Auger Diameter:**	--	inches
Drilling Equipment:	Combo Probe-Auger Rig		**Well Screened Interval:**	--	feet bgs
Sampler Type:	Core Tube		**Screen Slot Size:**	--	inches
Hammer Type/Weight:	--	lbs	**Filter Pack Used:**	--	
Total Boring Depth:	20	feet bgs	**Surface Seal:**	--	
Total Well Depth:	--	feet bgs	**Annular Seal:**	--	
State Well ID No.:	--		**Monument Type:**	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Asphalt
Well Location N/S:	70 feet North of gate post on west side of eastern most entry gate.
Well Location E/W:	105 feet East of gate post on west side of eastern most entry gate.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG B09

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 13 feet bgs

Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
				0.0		**SP**		**Wet to saturated, medium dense, SAND with silt. Brown. No hydrocarbon or solvent odor (5-95-0).**	
			80		B09-13				
15									
			100	0.0					
20				0.0	B09-20				
								End of boring at 20.0 ft bgs. Temporary well screen set at 10 to 14 feet bgs. Boring abandoned with hydrated bentonite chips.	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Asphalt
Well Location N/S:	23 feet South of northwest corner of pre-1985 vintage storage building.
Well Location E/W:	100 feet West of northwest corner of pre-1985 vintage storage building.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG B10

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling 12.5 feet bgs

Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
0						Fill (GM)		**Damp, medium dense, silty sandy GRAVEL. Brown. No hydrocarbon or solvent odor (30-20-50). Fill.**	
			70	0.0		Fill (SM)		**Damp, medium dense, silty SAND with some gravel. Brown. No hydrocarbon or solvent odor (40-50-10). Locally contains brick pieces at ~2.5 to 2.8 feet bgs. Fill.**	
						Fill (SM-SP)		**Damp, medium dense, SAND with silt. Brown. No hydrocarbon or solvent odor (10-90-0).**	
5				0.0	B10-05				
				0.0		Fill (SM)		**Damp, medium dense, silty fine SAND. Brown. No hydrocarbon or solvent odor (40-60-0).**	
			80			SP		**Moist, medium dense, SAND with trace silt. Dark Brown. No hydrocarbon or solvent odor (5-95-0). Becomes wet to saturated at 12.5 feet bgs.**	
10				0.0	B10-10				

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Asphalt
Well Location N/S:	23 feet South of northwest corner of pre-1985 vintage storage building.
Well Location E/W:	100 feet West of northwest corner of pre-1985 vintage storage building.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG **B10**

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling 12.5 feet bgs

Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
						SP		**Wet to saturated, medium dense, SAND with trace silt. Dark Brown. No hydrocarbon or solvent odor (5-95-0).**	
					B10-12.5				
			85	0.0					
15				0.0					
				0.0					
			100						
20				0.0	B10-20				
								End of boring at 20.0 ft bgs. Temporary well screen set at 11 to 15 feet bgs. Boring abandoned with hydrated bentonite chips.	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

DRAFT

Project:	Whitehead-Tyee Property
Project Number:	0973-001
Logged by:	CGC
Date Started:	12/26/13
Surface Conditions:	Asphalt
Well Location N/S:	40 feet South of northwest corner of pre-1985 vintage storage building.
Well Location E/W:	5 feet East of northwest corner of pre-1985 vintage storage building.
Reviewed by:	CCC
Date Completed:	12/26/13

BORING LOG **B11** --

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling: 13 feet bgs

Water Depth After Completion: -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
0						Fill (GM)		**2-inches asphalt surface. Damp, medium dense, silty sandy GRAVEL. Gray. No hydrocarbon or solvent odor (20-30-50). Fill.**	
			80	0.0		Fill (SM)		**Damp, medium dense, silty fine SAND with some gravel. Gray and brown. No hydrocarbon or solvent odor (30-60-10). Locally contains wood chips at ~3.0 to 3.2 feet bgs and at ~6.5 to 7 feet bgs. Fill.**	
5				0.0	B11-05				
				0.0					
			80						
						SP		**Damp to moist, medium dense, SAND with trace silt. Dark brown. No hydrocarbon or solvent odor (5-95-0). Becomes saturated at 13 feet bgs.**	
10				0.0	B11-10				

Drilling Co./Driller:	ESN Northwest/Don		**Well/Auger Diameter:**	--	inches
Drilling Equipment:	Combo Probe-Auger Rig		**Well Screened Interval:**	--	feet bgs
Sampler Type:	Core Tube		**Screen Slot Size:**	--	inches
Hammer Type/Weight:	--	lbs	**Filter Pack Used:**	--	
Total Boring Depth:	20	feet bgs	**Surface Seal:**	--	
Total Well Depth:	--	feet bgs	**Annular Seal:**	--	
State Well ID No.:	--		**Monument Type:**	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

Project:	Whitehead-Tyee Property	
Project Number:	0973-001	
Logged by:	CGC	
Date Started:	12/26/13	
Surface Conditions:	Asphalt	
Well Location N/S:	40 feet South of northwest corner of pre-1985 vintage storage building.	
Well Location E/W:	5 feet East of northwest corner of pre-1985 vintage storage building.	
Reviewed by:	CCC	
Date Completed:	12/26/13	

SoundEarth Strategies

DRAFT

BORING LOG **B11** --

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling 13 feet bgs

Water Depth After Completion -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Construction Detail
						SP - SM			
			80	0.0	B11-13				
15									
			100	0.0					
				0.0	B11-20			**Saturated, medium dense, SAND with silt. Brown. No hydrocarbon or solvent odor (5-95-0). Localized layer of gray silty fine SAND at ~18.5 to 18.8 feet bgs.**	
20								**End of boring at 20.0 ft bgs. Temporary well screen set at 12 to 16 feet bgs. Boring abandoned with hydrated bentonite chips.**	

Drilling Co./Driller:	ESN Northwest/Don	
Drilling Equipment:	Combo Probe-Auger Rig	
Sampler Type:	Core Tube	
Hammer Type/Weight:	--	lbs
Total Boring Depth:	20	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

No obvious hydrocarbon or solvent odors noticed in recovered soil samples.

SoundEarth Strategies

Project:	Whitehead/Reliable Property
Project Number:	0973-001
Logged by:	CCC
Date Started:	4/5/14
Surface Conditions:	Concrete
Well Location N/S:	
Well Location E/W:	
Reviewed by:	JAC
Date Completed:	4/5/14

BORING LOG **B12** MW05

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling: 10 feet bgs
Water Depth After Completion: -- feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Detail/ Water Depth
0								**Concrete (9.5 inches thick) over gravel base course.**	
	X	7 7 6	80	0.7	B12-02.5	**SP**		**Moist, loose, fine SAND with gravel, trace silt, brown with black, no hydrocarbon odor (5-80-15).**	
5	X	3 4 5	100	1.5	B12-05.0	**SP-SM**		**Moist, very loose, fine SAND with silt, few gravel, silt-rich inclusions (70-30-0), brown (10-80-10).**	
	X	7 7 7	100	1.3	B12-07.5	**SP**		**Damp, loose, fine to medium SAND, trace silt, no hydrocarbon odor (3-97-0).**	
10	X	5 5 7	100	478.8	B12-10.0	**SP**		**Saturated, loose, fine to coarse SAND, trace silt, fuel/solvent odor, dark gray (5-95-0).**	▽
	X	2 1 2	90	277.5	B12-12.5	**SP** / **ML**		**Saturated, loose, medium to coarse SAND, trace silt, dark brown to black (5-95-0).** **Saturated, very soft SILT (100-0-0).**	
15	X	8 20 23	100	7.1	B12-15.0	**SM**		**Approximately 1-foot of heaving SAND** **Saturated, medium dense, silty fine SAND, dark gray to black (15-85-0) to (25-75-0).**	
20	X	7 10 16	100	18.8	--	**SM**		**Saturated, medium to fine silty SAND, dark gray to black (20-80-0).**	
25								**Boring B12 was terminated at 21.5 feet bgs and backfilled with silica sand to 20 feet bgs. Two-inch-diameter well MW05 was installed to a depth of 20 feet bgs, screened from 5 to 20 feet bgs, silica sand from 4 to 20 feet bgs, bentonite seal from 1 to 4 feet bgs, concrete from 0 to 1 feet bgs, and finished at surface grade with a flushmount monument.**	

Drilling Co./Driller:	Boretec/Bob	
Drilling Equipment:	HSA	
Sampler Type:	Cal. Sampler	
Hammer Type/Weight:	140	lbs
Total Boring Depth:	21.5	feet bgs
Total Well Depth:	20	feet bgs
State Well ID No.:	BXH333	

Well/Auger Diameter:	2"/7.25" O.D.	inches
Well Screened Interval:	5 -20 ft bgs	feet bgs
Screen Slot Size:	0.010	inches
Filter Pack Used:	Sand	
Surface Seal:	Concrete	
Annular Seal:	Bentonite	
Monument Type:	Flush grade	

Notes/Comments:
DRAFT

SoundEarth Strategies

Project: Whitehead/Reliable Property
Project Number: 0973-001
Logged by: CCC
Date Started: 4/5/14
Surface Conditions: Concrete
Well Location N/S:
Well Location E/W:
Reviewed by: JAC
Date Completed: 4/5/14

BORING LOG **B13** MW06

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling: 9 feet bgs
Water Depth After Completion: 7 feet bgs

Depth (feet bgs)	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Lithologic Description
0						**Concrete (11 inches thick) over gravel base course.**
	6 6 7	85	1.7	B13-02.5	SM SP-SM	**Moist, loose, silty SAND with gravel, brown (20-65-25).** **Moist, loose, SAND with silt and gravel, brown, no hydrocarbon odor (10-70-20).**
5	3 3 4	85	0.9	B13-05.0	SM	**Moist, very loose, silty SAND, dark brown, loose, no hydrocarbon odor (15-85-0).**
	6 7 8	100	1.3	B13-07.5	SP	**Moist to wet, loose, fine to coarse SAND, varigated brown, no hydrocarbon odor (5-95-0).**
10	2 7 10	100	4.3	B13-10.0	SP-SM	**Wet to saturated, loose, fine to medium SAND with silt, brown with black, no hydrocarbon odor (10-90-0).**
	3 6 9	100	5.3	B13-12.5	SP	**Wet, loose, fine to coarse SAND, trace silt, no hydrocarbon odor, dark gray to black (5-95-0).**
15	12 20 28	100	3.7	B13-15.0	SP	**Saturated, medium dense, fine to medium SAND, dark gray-black with brown grading, no hydrocarbon odor (5-95-0).**
20	7 12 18	--	1.1	--	SP-SM	**Saturated, medium dense, fine to medium SAND with silt, brown to black, no hydrocarbon odor (12-88-0).**
25						**Boring B13 was terminated at 21.5 feet bgs and backfilled with silica sand to 20 feet bgs. Two-inch-diameter well MW06 was installed to a depth of 20 feet bgs, screened from 5 to 20 feet bgs, silica sand from 4 to 20 feet bgs, bentonite seal from 1 to 4 feet bgs, concrete from 0 to 1 feet bgs, and finished at surface grade with a flushmount monument.**

Columns also include Interval, Graphic, and Well Detail/Water Depth.

Drilling Co./Driller: Boretec/Bob
Drilling Equipment: HSA
Sampler Type: Cal. Sampler
Hammer Type/Weight: 140 lbs
Total Boring Depth: 21.5 feet bgs
Total Well Depth: 20 feet bgs
State Well ID No.: --

Well/Auger Diameter: 2"/7.25" O.D. inches
Well Screened Interval: 5 -20 ft bgs feet bgs
Screen Slot Size: 0.010 inches
Filter Pack Used: Sand
Surface Seal: Concrete
Annular Seal: Bentonite
Monument Type: Flush grade

Notes/Comments:
DRAFT

SoundEarth Strategies

Project:	Whitehead/Reliable Property
Project Number:	0973-001
Logged by:	CCC
Date Started:	4/5/14
Surface Conditions:	Concrete
Well Location N/S:	
Well Location E/W:	
Reviewed by:	JAC
Date Completed:	4/5/14

BORING LOG B14 MW07

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling: -- feet bgs

Water Depth After Completion: 9.5 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Detail/ Water Depth
0								**Concrete (1-foot thick) over gravel base course.**	
		4 7 6	85	1.3	B14-02.5	SM-ML		**Moist, medium stiff, SILT, grading to fine sandy SILT or silty fine SAND at base, brown, no hydrocarbon odor (100-0-0) to (50-50-0).**	
5		3 4 6	80	1.2	B14-05.0	SP		**Moist, very loose, fine SAND, oxidized, gray-brown, no hydrocarbon oodr (5-95-0).**	
		6 7 6	90	1.2	B14-07.5	SP		**Moist to wet, loose, fine to medium SAND, trace silt, dark brown, no hydrocarbon odor (5-95-0).**	
10		3 4 6	90	1.6	B14-10.0	SP		**Saturated, loose, fine to coarse SAND, trace silt, dark gray to black, varigated, no hydrocarbon odor (5-95-0).**	
		3 4 6	95	1.6	B14-12.5	SP		**Same as above, very loose, no hydrocarbon odor (5-95-0).**	
15		7 10 15	100	1.2	B14-15.0	SP		**Same as above, loose, varigated black, no hydrocarbon odor (5-95-0).**	
20		7 13 22	100	1.5	--	SM		**Saturated, medium-dense, silty SAND, fine to coarse sand, black, no hycrocarbon odor (15-85-0).**	
25								**Boring B14 was terminated at 21.5 feet bgs and backfilled with silica sand to 20 feet bgs. Two-inch-diameter well MW07 was installed to a depth of 20 feet bgs, screened from 5 to 20 feet bgs, silica sand from 4 to 20 feet bgs, bentonite seal from 1 to 4 feet bgs, concrete from 0 to 1 feet bgs, and finished at surface grade with a flushmount monument.**	

Drilling Co./Driller:	Boretec/Bob	
Drilling Equipment:	HSA	
Sampler Type:	Cal. Sampler	
Hammer Type/Weight:	140	lbs
Total Boring Depth:	21.5	feet bgs
Total Well Depth:	20	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	2"/7.25" O.D.	inches
Well Screened Interval:	5 -20 ft bgs	feet bgs
Screen Slot Size:	0.010	inches
Filter Pack Used:	Sand	
Surface Seal:	Concrete	
Annular Seal:	Bentonite	
Monument Type:	Flush grade	

Notes/Comments:

DRAFT

SoundEarth Strategies

Project:	Whitehead/Reliable Property
Project Number:	0973-001
Logged by:	CCC
Date Started:	4/5/14
Surface Conditions:	Gravel
Well Location N/S:	16 feet south of fence corner
Well Location E/W:	80 feet east of fence corner
Reviewed by:	JAC
Date Completed:	4/5/14

BORING LOG **B15**

Site Address: 730 South Myrtle Street
Seattle, WA

Water Depth At Time of Drilling -- feet bgs

Water Depth After Completion 9.5 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Detail/ Water Depth
0								**Gravel**	
		9 9 6	80	5.6	B15-02.5	**SM-ML**		**Moist, loose, silty fine SAND, few gravel, silt-rich zone from 3.3' to 3.5' bgs, no hydrocarbon odor (20-70-10).**	
5		6 9 14	80	62.7	B15-05.0	**SP-SM**		**Moist, loose, fine to medium SAND with gravel, brown, no hydrocarbon odor, over silty SAND with coarse gravel and wood fragments, gray-black, solvent odor (FILL).**	
		4 3 3	45	317.8	B15-07.5	**SM**		**Moist, very loose, silty, fine to medium SAND with gravel, solvent odor, gray to gray-black (stained) with concrete fragments (20-60-20)(FILL).**	▼ (9.5)
10		2 4 6	80	1,074	B15-10.0	**SM-ML**		**Saturated, medium stiff, SILT with fine sand to very loose, silty, fine SAND, dark gray-black, hydrocarbon/solvent odor (80-20-0) grading to (15-35-0).**	
		12 16 24	70	707.8	B15-12.5	**SM**		**Saturated, medium dense, silty fine SAND, black, hydrocarbon/solvent odor.**	
15		12 10 11	100	75.0	B15-15.0	**SM**		**Saturated, loose, silty, fine to coarse SAND, some fine gravel, black/varigated, faint hydrocarbon/solvent odor.**	
								Boring B15 terminated at 16.5 ft bgs and backfilled with bentonite chips to surface grade.	
20									

Drilling Co./Driller:	Boretec/Bob	
Drilling Equipment:	HSA	
Sampler Type:	Cal. Sampler	
Hammer Type/Weight:	140	lbs
Total Boring Depth:	16.5	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:
DRAFT

BORING LOG B16

SoundEarth Strategies

Project:	Whitehead/Reliable Property
Project Number:	0973-001
Logged by:	CCC
Date Started:	4/5/14
Surface Conditions:	Gravel
Well Location N/S:	15 feet south of fence corner
Well Location E/W:	40 feet east of fence corner
Reviewed by:	JAC
Date Completed:	4/5/14

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling: -- feet bgs

Water Depth After Completion: 7.75 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Detail/ Water Depth
0						GP		**Gravel**	
	X	7 6 5	60	2.1	B16-02.5	ML		**Moist, medium stiff, SILT with fine sand, tan-gray-brown, no hydrocarbon/solvent odor (80-20-0).**	
5	X	4 6 5	70	2.0	B16-05.0	ML		**Same as above, tan-brown, no hydrocarbon/solvent odor (80-20-0).**	
						SP-SM		**Moist, very loose, fine SAND with silt, no hydrocarbon/solvent odor (10-90-0).**	
	X	5 5 4	70	20.7	B16-07.5	ML		**Saturated, medium stiff, fine sandy SILT, tan-gray, trace hydrocarbon/solvent odor (70-30-0).**	▼
						SP-SM		**Saturated, loose, fine SAND with silt, black/varigated, no hydrocarbon/solvent odor (10-90-0).**	
10	X	1 2 3	85	790.9	B16-10.0	SP-SM		**Saturated, very loose, fine to medium SAND, varies from some silt to silty, black, sheen, strong hydrocarbon/solvent odor (20-80-0) to (10-90-0).**	
	X	12 16 15	100	932.6	B16-12.5	SP		**Saturated, medium dense, fine to medium SAND, trace silt, black, sheen, strong hydrocarbon/solvent odor (5-95-0).**	
15	X	16 16 20		398.0	B16-15.0	SP-SM		**Saturated, medium dense, fine to medium SAND with silt, black/varigated, moderate hydrocarbon/solvent odor (10-90-0).**	
								Boring B16 terminated at 16.5 ft bgs and backfilled with bentonite chips to surface grade.	
20									

Drilling Co./Driller:	Boretec/Bob	
Drilling Equipment:	HSA	
Sampler Type:	Cal. Sampler	
Hammer Type/Weight:	140	lbs
Total Boring Depth:	16.5	feet bgs
Total Well Depth:	--	feet bgs
State Well ID No.:	--	

Well/Auger Diameter:	--	inches
Well Screened Interval:	--	feet bgs
Screen Slot Size:	--	inches
Filter Pack Used:	--	
Surface Seal:	--	
Annular Seal:	--	
Monument Type:	--	

Notes/Comments:

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SoundEarth Strategies

Project:	Whitehead/Reliable Property
Project Number:	0973-001
Logged by:	CCC
Date Started:	4/5/14
Surface Conditions:	Gravel
Well Location N/S:	16 feet south of fence corner
Well Location E/W:	58 feet east of fence corner
Reviewed by:	JAC
Date Completed:	4/5/14

BORING LOG **B17**

Site Address: 730 South Myrtle Street, Seattle, WA

Water Depth At Time of Drilling: -- feet bgs

Water Depth After Completion: 8.5 feet bgs

Depth (feet bgs)	Interval	Blow Count	% Recovery	PID (ppmv)	Sample ID	USCS Class	Graphic	Lithologic Description	Well Detail/ Water Depth
0						GP		**Gravel**	
	X	6 11 28	0	--				**Very rocky drilling (FILL)**	
5	X	6 5 5	90	166	B17-05.0	SM-ML		**Moist, medium stiff, fine sandy SILT to very loose, silty SAND, few gravel, wood fragments, brick, no hydrocarbon/solvent odor (40-40-10)(FILL).**	
	X	6 6 8	75	847.9	B17-07.5	SM		**Moist to wet, loose, silty fine SAND, few gravel, with organics, tan-brown, no hydrocarbon odor, black layer with wood and strong hydrocarbon odor at 8 to 8.5 feet bgs, strong hydrocarbon/solvent odor at 8.5 feet bgs (40-50-10) (FILL).**	▼
10	X	10 4 4	65	391.2	B17-10.0	SM		**Wet, very loose, silty SAND, few gravel, wood fragments, dark gray to black, strong hydrocarbon/solvent odor (30-60-10)(FILL).**	
	X	6 9 11	90	76.2	B17-12.5	SP-SM		**Saturated, loose, fine SAND with silt, black, faint to moderate hydrocarbon/solvent odor (8-92-0).**	
15	X	6 7 8		132.5	B17-15.0	SP-SM		**Same as above, black/varigated, very faint hydrocarbon/solvent odor (8-92-0).**	
								Boring B17 terminated at 16.5 ft bgs and backfilled with bentonite chips to surface grade.	
20									

Drilling Co./Driller:	Boretec/Bob		**Well/Auger Diameter:**	--	inches
Drilling Equipment:	HSA		**Well Screened Interval:**	--	feet bgs
Sampler Type:	Cal. Sampler		**Screen Slot Size:**	--	inches
Hammer Type/Weight:	140	lbs	**Filter Pack Used:**	--	
Total Boring Depth:	16.5	feet bgs	**Surface Seal:**	--	
Total Well Depth:	--	feet bgs	**Annular Seal:**	--	
State Well ID No.:	--		**Monument Type:**	--	

Notes/Comments:

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PROJECT: SIM-730 EDR	**LOCATION:** 730 S. Myrtle Property		**BORING ID:** **SB-01**
LOGGED BY: Kristin Anderson	**BORING LOCATION:** Dirt lot interior		
DRILLED BY: ESN	**NORTHING:**	**EASTING:**	
DRILLING EQUIPMENT: Geoprobe Combo Rig	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:**	
DRILLING METHOD: Direct-push rods	**TOTAL DEPTH (ft bgs):** 10	**DEPTH TO WATER (ft bgs):** NA	
SAMPLING METHOD/SAMPLER LENGTH: 2"x5' lined core	**BORING DIAMETER:** 2"	**DRILL DATE:** 12/7/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	# of Blows	PID (ppm)	Sample ID
0	GW	**GRAVEL** with sand, asphalt fragments and silt at ground surface.				
0.5					1.1	
1	SM	Moist, gray and brown silty fine **SAND**. No odor.				SB-01-0-2
3					1.7	
3.5	SP	Moist, gray and gray-brown fine **SAND**.				
6					1.8	
6.5		At 6.5 feet, becomes dark gray. No odor.				
8.5					1.8	
9.5		At 9.5 feet, gravel present and sand becomes more coarse.				SB-01-10
10		Bottom of boring = 10 feet bgs.				

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

FLOYD | SNIDER strategy ▪ science ▪ engineering	PROJECT: SIM-730 EDR	LOCATION: 730 S. Myrtle Property	BORING ID: **SB-02**
	LOGGED BY: Kristin Anderson	BORING LOCATION: Dirt lot interior	

DRILLED BY: ESN	**NORTHING:**	**EASTING:**
DRILLING EQUIPMENT: Geoprobe Combo Rig	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:**
DRILLING METHOD: Direct-push rods	**TOTAL DEPTH (ft bgs):** 5	**DEPTH TO WATER (ft bgs):** NA
SAMPLING METHOD/SAMPLER LENGTH: 2"x5' lined core	**BORING DIAMETER:** 2"	**DRILL DATE:** 12/7/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	# of Blows	PID (ppm)	Sample ID
0	SP-SM	Moist, gray-brown and dark brown poorly graded fine **SAND** with silt and gravel. Asphalt fragments present.				
1						SB-02-0-2
					2.7	
2	SM	Moist, poorly graded very fine silty **SAND**.				
3						
4					6.0	SB-02-4-5
5		Bottom of boring = 5 feet bgs.				
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

ABBREVIATIONS:
ft bgs = feet below ground surface USCS = Unified Soil Classification System
ppm = parts per million ▼ = denotes groundwater table

NOTES:

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PROJECT: SIM-730 EDR	**LOCATION:** 730 S. Myrtle Property
BORING ID: SB-04	**LOGGED BY:** Kristin Anderson
BORING LOCATION: SIM employee parking lot	**DRILLED BY:** ESN
NORTHING:	**EASTING:**
DRILLING EQUIPMENT: Geoprobe Combo Rig	**SURFACE ELEVATION:**
COORDINATE SYSTEM:	**DRILLING METHOD:** Direct-push rods
TOTAL DEPTH (ft bgs): 15	**DEPTH TO WATER (ft bgs):** 9.5
SAMPLING METHOD/SAMPLER LENGTH: 2"x5' lined core	**BORING DIAMETER:** 2"
DRILL DATE: 12/7/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	# of Blows	PID (ppm)	Sample ID
0	Concrete	Concrete ground surface (~10" thick).				
1	SP-SM	Moist, brown poorly graded fine **SAND** with silt.			2.1	
4					2.1	
5	SP	Moist, dark gray-brown poorly graded fine **SAND**. Red and white grains present. No odor.				
6.5					2.1	
8					2.2	
9–10						SB-04-9-10
9.5		At 9.5 feet, becomes wet.				
13		At 13 feet, becomes dark gray. No odor.				
14.5					2.1	
15		Bottom of boring = 15 feet bgs.				

ABBREVIATIONS:
ft bgs = feet below ground surface
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NOTES:
Moved ~5 feet due to potential utilities in parking lot.

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PROJECT: SIM-730 EDR	**LOCATION:** 730 S. Myrtle Property		**BORING ID:** SB-05
LOGGED BY: Kristin Anderson	**BORING LOCATION:** Dirt lot, south of property fence		
DRILLED BY: ESN	**NORTHING:**	**EASTING:**	
DRILLING EQUIPMENT: Geoprobe Combo Rig	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:**	
DRILLING METHOD: Direct-push rods	**TOTAL DEPTH (ft bgs):** 20	**DEPTH TO WATER (ft bgs):**	
SAMPLING METHOD/SAMPLER LENGTH: 2"x5' lined core	**BORING DIAMETER:** 2"	**DRILL DATE:** 12/7/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	# of Blows	PID (ppm)	Sample ID
0	GW	**GRAVEL** and asphalt fragments at ground surface (6").				
1	SP-SM	Moist, brown poorly graded fine **SAND** with silt.				SB-05-0-2
2		At 2 feet, becomes moist to wet.				
3						
4					1.8	SB-05-4-5
5		At 5 ft, alternating lenses of wet, brown poorly graded very fine sand with silt and and very moist, gray-brown poorly graded fine sand with red and white grains and trace to no silt. No odor.				
6					1.8	
7						
8						
9					1.2	SB-05-9-10
10 ▼		At 10 feet, becomes saturated. No odor.				
11					1.8	
12						
13					2.3	
14					2.0	
15	SP	Wet, dark gray-brown poorly graded fine **SAND**. Red and white grains present. No odor.				
16					2.4	
17					5.8	SB-05-17-18
18						
19					3.8	SB-05-19-20
20		Bottom of boring = 20 feet bgs.				

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: SIM-730 EDR	**LOCATION:** 730 S. Myrtle Property		**BORING ID:** SB-06
LOGGED BY: Kristin Anderson	**BORING LOCATION:** Dirt lot interior		
DRILLED BY: ESN	**NORTHING:**	**EASTING:**	
DRILLING EQUIPMENT: Geoprobe Combo Rig	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:**	
DRILLING METHOD: Direct-push rods	**TOTAL DEPTH (ft bgs):** 15	**DEPTH TO WATER (ft bgs):** 11	
SAMPLING METHOD/SAMPLER LENGTH: 2"x5' lined core	**BORING DIAMETER:** 2"	**DRILL DATE:** 12/7/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	# of Blows	PID (ppm)	Sample ID
0	SP-SM	Moist, gray-brown and dark brown poorly graded fine **SAND** with silt and gravel. Few asphalt fragments present.				
1.5					2.3	
3	SP	Moist, poorly graded very fine silty **SAND**. Few red and gray lenses present.				
4					1.9	
5.5					1.8	
6		Moist, gray poorly graded fine **SAND** with trace silt. No odor.				
8		At 8 feet, coarsens slightly and white grains present. No odor.				
8.5					1.8	
10.5					1.8	SB-06-10-11
11		At 11 feet, becomes wet. Some reddish brown lenses present. No odor.				
13.5					2.9	
15		Bottom of boring = 15 feet bgs.				

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
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NOTES:

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PROJECT: SIM-730 EDR	**LOCATION:** 730 S. Myrtle Property		**BORING ID:** **SB-07**
LOGGED BY: Kristin Anderson	**BORING LOCATION:** Dirt lot interoir		
DRILLED BY: ESN	**NORTHING:**	**EASTING:**	
DRILLING EQUIPMENT: Geoprobe Combo Rig	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:**	
DRILLING METHOD: Direct-push rods	**TOTAL DEPTH (ft bgs):** 20	**DEPTH TO WATER (ft bgs):**	
SAMPLING METHOD/SAMPLER LENGTH: 2"x5' lined core	**BORING DIAMETER:** 2"	**DRILL DATE:** 12/7/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	# of Blows	PID (ppm)	Sample ID
0	SP-SM	Moist, dark brown and black-brown poorly graded fine **SAND** with silt and gravel.				
1		At 1 foot, becomes brown and very fine and gravel disappears.				
3.5					1.7	
4		At 4 feet, becomes gray-brown.				
4.75		At 4.75 feet, alternating lenses of dark gray poorly graded fine sand with trace to no silt and brown poorly graded fine sand with silt.				
7	SP	Moist, dark gray poorly graded fine **SAND** with trace silt.			8.5	SB-07-7-8
9.5		At 9.5 feet, slight solvent odor present.			308.0	SB-07-9-10
10.5		At 10.5 feet, becomes wet with strong solvent odor.			408.0	
12.5					614.0	SB-07-12-13
14		At 14 feet, odor begins to dissipate.				SB-07-14-15
15		At 15 feet, sheen present on water at top of core.			16.3	
16.5					12.7	
17		At 17 feet, moderate solvent odor present.				
18					46.3	
19		At 19 feet, no solvent odor.			7.7	SB-07-19-20
20		Bottom of boring = 20 feet bgs.				

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
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NOTES:

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PROJECT: SIM-730 EDR	**LOCATION:** 730 S. Myrtle Property		**BORING ID:** **SB-09**
LOGGED BY: Kristin Anderson	**BORING LOCATION:** Dirt lot interior		
DRILLED BY: ESN	**NORTHING:**	**EASTING:**	
DRILLING EQUIPMENT: Geoprobe Combo Rig	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:**	
DRILLING METHOD: Direct-push rods	**TOTAL DEPTH (ft bgs):** 20	**DEPTH TO WATER (ft bgs):** 10	
SAMPLING METHOD/SAMPLER LENGTH: 2"x5' lined core	**BORING DIAMETER:** 2"	**DRILL DATE:** 12/7/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	# of Blows	PID (ppm)	Sample ID
0	SP-SM	Moist, gray-brown poorly graded fine **SAND** with silt and gravel. Some asphalt fragments present.				
1		At 1 foot, gravel disappears. No odor.			2.2	
4	SM	Moist, brown poorly graded very fine silty **SAND**. No odor.				
6.5					10.0	
7.5					50.0	SB-09-7-8
8	SP	Moist, brown poorly graded fine **SAND**. Slight hydrocarbon odor present.				SB-09-8-9
10 ▼		At 10 feet, becomes wet. Strong solvent odor and sheen present on core.				
12.5					591.0	
13.5						SB-09-13-14
14.5					41.0	
15.5					517.0	
16.5					5.6	
17		At 17 feet, odor disappears and soft brown silt lense present.				SB-09-17-18
18						SB-09-18-19
20		Bottom of boring = 20 feet bgs.				

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: SIM-730 EDR	**LOCATION:** 730 S. Myrtle Property	**BORING ID:** SB-10
LOGGED BY: Kristin Anderson	**BORING LOCATION:** Dirt lot, South of property fence	
DRILLED BY: ESN	**NORTHING:**	**EASTING:**
DRILLING EQUIPMENT: Geoprobe Combo Rig	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:**
DRILLING METHOD: Direct-push rods	**TOTAL DEPTH (ft bgs):** 15	**DEPTH TO WATER (ft bgs):** 10
SAMPLING METHOD/SAMPLER LENGTH: 2"x5' lined core	**BORING DIAMETER:** 2"	**DRILL DATE:** 12/7/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	# of Blows	PID (ppm)	Sample ID
0	SP-SM	Moist, gray-brown poorly graded fine **SAND** with silt and gravel. Some asphalt fragments present.			3.9	
1	SP	Moist, dark gray-brown poorly graded fine **SAND**.				
2	SM	Moist, brown poorly graded very fine silty **SAND**.				
3						
4	ML	Soft, gray **SILT**.			3.7	
5	SP	Moist, dark gray-brown poorly graded fine **SAND**.			31.0	SB-10-5-6
6						
7	ML	Soft, gray **SILT**. Strong solvent odor.			276.0	
8	SP	Moist, dark gray-brown poorly graded fine **SAND**.				
9					557.0	
10		At 10 feet, becomes wet.				
11						
12					695.0	
13		At 12.5 feet, silver staining and strong solvent odor present. At 13 feet, solvent odor begins to dissipate			97.0	SB-10-12.5-13
14		At 14 feet, becomes dark gray-brown with no staining.			4.2	SB-10-14-15
15		At 15 feet, slight to no odor present. Bottom of boring = 15 feet bgs.				
16						
17						
18						
19						
20						

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: SIM-730 EDR	**LOCATION:** 730 S. Myrtle Property		**BORING ID:** **SB-12**
LOGGED BY: Kristin Anderson	**BORING LOCATION:** Dirt lot interoir		
DRILLED BY: ESN	**NORTHING:**	**EASTING:**	
DRILLING EQUIPMENT: Geoprobe Combo Rig	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:**	
DRILLING METHOD: Direct-push rods	**TOTAL DEPTH (ft bgs):** 15	**DEPTH TO WATER (ft bgs):** 10	
SAMPLING METHOD/SAMPLER LENGTH: 2"x5' lined core	**BORING DIAMETER:** 2"	**DRILL DATE:** 12/7/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	# of Blows	PID (ppm)	Sample ID
0	SP-SM	Moist, dark gray-brown poorly graded fine **SAND** with silt and gravel.			2.1	
1						
2	SP	Moist, dark gray-brown poorly graded fine **SAND**. Red and white grains present. No odor.				
3						
4					2.1	
5						
6						
7		At 7 feet, 6-inch lense of very fine gray silty sand present.			2.2	
8						
9						
10 ▼						SB-12-10-11
11		At 11 feet, becomes wet.				
12						
13					2.1	
14						
15		Bottom of boring = 15 feet bgs.				
16						
17						
18						
19						
20						

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
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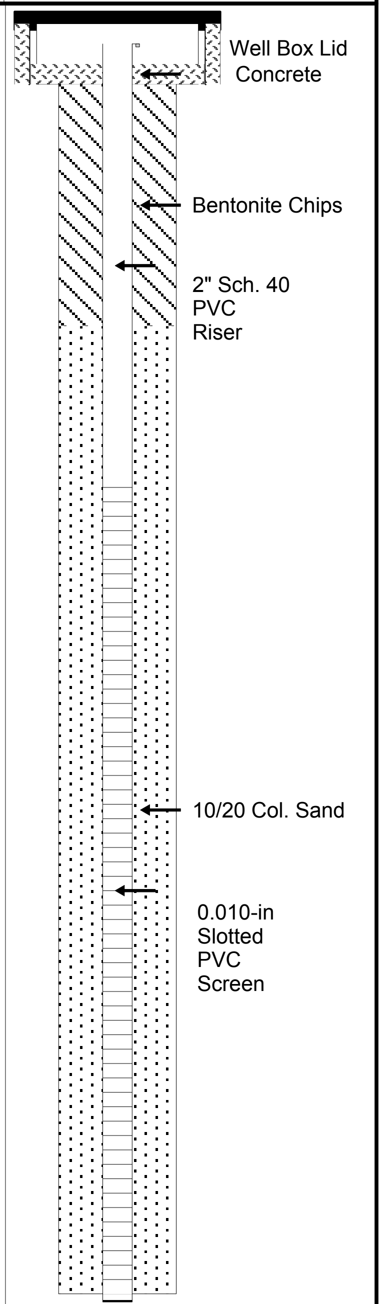
NOTES:

FLOYD | SNIDER strategy ▪ science ▪ engineering	PROJECT: **SIM 730 S. Myrtle Property**	LOCATION: **730 S. Myrtle Street, Seattle, WA**	WELL ID: **SB-03/MW-108**
	LOGGED BY: **Kristin Anderson**	COORDINATE SYSTEM: **WA SPCS NAD83 N FT**	ECOLOGY WELL ID: **BJW 742**
DRILLED BY: **ESN**		NORTHING:	EASTING:
DRILLING EQUIPMENT: **Geoprobe Combo Rig**		GROUND SURFACE ELEV.:	TOC ELEVATION:
DRILLING METHOD: **8" dia Hollow-Stem Auger**		TOTAL DEPTH (ft bgs): **15**	DEPTH TO WATER (ft bgs): **11**
SAMPLING METHOD: **5' x 2" lined core**		BORING DIAMETER: **8**	DRILL DATE: **12/7/2015**

Depth (feet)	USCS Symbol	Description	Drive/Recovery	# of Blows	PID (ppm)	Sample ID
0–2	SP-SM	Moist, dark gray-brown poorly graded fine **SAND** with silt and gravel.				
2–5	SM	Moist, brown fine silty **SAND**. No odor.				
5–10	SP	Moist,brown poorly graded very fine **SAND** with trace silt. No odor.				
8		At 8 feet, sand coarsens and becomes gray-brown.				
10–15	SP	At 10 feet, coarsens slightly and becomes dark gray with red and white grains. No odor.				SB-03-10-11
11 ▼		At 11 feet, becmoes wet.				
12		At 12 feet, 12-inch lense of ver fine brown silty sand present.				
13.5		At 13.5 feet, 6-inch lesne of very fine gray silty sand present. No odor.				
15		Bottom of boring = 15 feet bgs.				

Well Construction



ABBREVIATIONS:
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NOTES:

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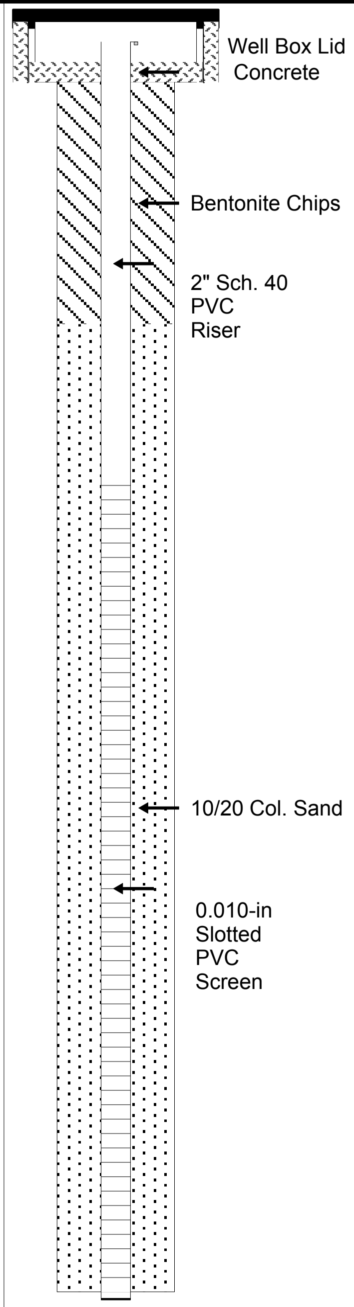
PROJECT: **SIM 730 S. Myrtle Property**	LOCATION: **730 S. Myrtle Street, Seattle, WA**	WELL ID: **SB-08/MW-109**	
LOGGED BY: **Kristin Anderson**	COORDINATE SYSTEM: **WA SPCS NAD83 N FT**	ECOLOGY WELL ID: **BJW 712**	
DRILLED BY: **ESN**	NORTHING:	EASTING:	
DRILLING EQUIPMENT: **Geoprobe Combo Rig**	GROUND SURFACE ELEV.:	TOC ELEVATION:	
DRILLING METHOD: **8" dia Hollow-Stem Auger**	TOTAL DEPTH (ft bgs): **15**	DEPTH TO WATER (ft bgs): **10**	
SAMPLING METHOD: **5' x 2" lined core**	BORING DIAMETER: **8**	DRILL DATE: **12/7/2015**	

Depth (feet)	USCS Symbol	Description	Drive/ Recovery	# of Blows	PID (ppm)	Sample ID
0	SP-SM	Moist, dark gray-brown poorly graded fine **SAND** with silt and gravel.				
1	SP	Moist, dark gray-brown poorly graded fine **SAND**. White grains present. No odor.				SB-08-0-2
2						
3						
4						SB-08-4-5
4.5		At 4.5 feet, becomes very fine and brown.				
5						
5.5		At 5.5 feet, becomes dark gray-brown.				
6						
7						
8		At 8 feet, 6-inch lense of brown silty sand present.				
9						
10		At 10 feet, becomes wet.				SB-08-10-11
11						
12						
13		At 13 feet, 12-inch lense of silty sand present.				
14						
15		Bottom of boring = 15 feet bgs.				
16						
17						

Well Construction



ABBREVIATIONS:
ft bgs = feet below ground surface
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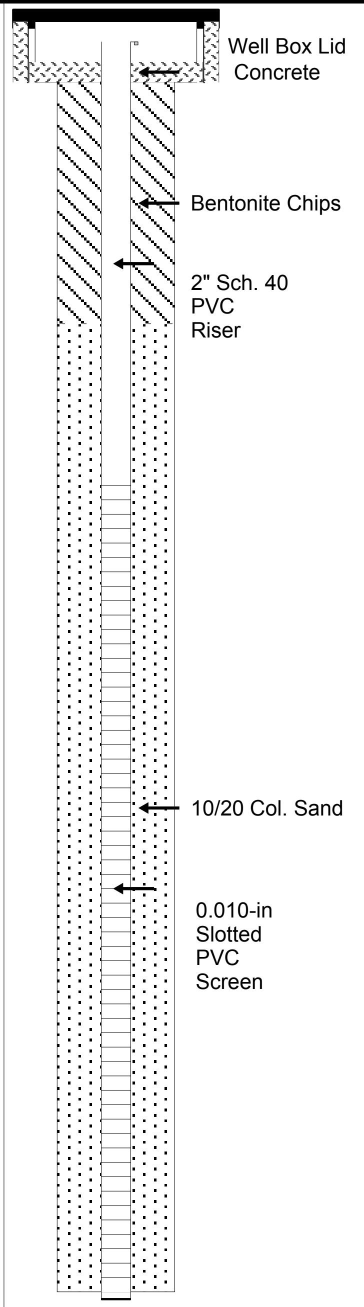
NOTES:

FLOYD | SNIDER strategy ▪ science ▪ engineering	PROJECT: **SIM 730 S. Myrtle Property**	LOCATION: **730 S. Myrtle Street, Seattle, WA**	WELL ID: **SB-11/MW-110**
	LOGGED BY: **Kristin Anderson**	COORDINATE SYSTEM: **WA SPCS NAD83 N FT**	ECOLOGY WELL ID: **BJW 743**
DRILLED BY: **ESN**		NORTHING:	EASTING:
DRILLING EQUIPMENT: **Geoprobe Combo Rig**		GROUND SURFACE ELEV.:	TOC ELEVATION:
DRILLING METHOD: **8" dia Hollow-Stem Auger**		TOTAL DEPTH (ft bgs): **15**	DEPTH TO WATER (ft bgs): **11**
SAMPLING METHOD: **5' x 2" lined core**		BORING DIAMETER: **8**	DRILL DATE: **12/7/2015**

Depth (feet)	USCS Symbol	Description	Drive/ Recovery	# of Blows	PID (ppm)	Sample ID
0	SP-SM	Moist, dark gray-brown poorly graded fine **SAND** with silt and gravel. Dry crushed gravel at 1 foot.				
1	SP	Moist, dark gray-brown poorly graded fine **SAND**.				SB-11-0-2
4		At 3.75 feet, 3-inch red-brown lense present. At 4 feet, becomes gray and very fine. Slight hydrocarbon odor present.				SB-11-4-5
5.5		At 5.5 feet, becomes dark gray and very fine with no odor.				
6						SB-11-6-7
10						SB-11-10-11
11 ▼		At 11 feet, becomes wet.				
15		Bottom of boring = 15 feet bgs.				
16						
17						

Well Construction



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NOTES:

Whitehead Tyee Site

Remedial Investigation Work Plan

Appendix B
Fox Avenue Site Compliance Monitoring Data 2016–2022

Fox Avenue Cleanup Levels from the Cleanup Action Plan

Table 3.1
Groundwater Cleanup Levels for Organic Compounds[1]

			Protection of Aquatic Species						Protection of Human Health										
			Federal Standards				Washington		Federal Standards		Washington								
			National Recommended Water Quality[2] Criteria CWA §304		National Toxics Rule[2] 40 CFR 131		Surface Water Quality Standards[2] WAC 173-201A		National Recommended Water Quality Criteria CWA §304	National Toxics Rule 40 CFR 131	MTCA Method B Surface Water WAC 173-340-730	Screening Criterion (Lowest Standard)	Maximum Detected in Groundwater Since Measurements Began			Maximum Detected Since 2007 (Post ChemOx Interim Measures)			Maximum Post-IM Concentration Exceeds Criterion?[5]
Chemical	CAS Number	Unit	Marine Chronic	Fresh Chronic	Marine Chronic	Fresh Chronic	Marine Chronic	Fresh Chronic	Marine (Organism Only)	Marine (Organism Only)	Fish Consumption		Value	Location	Date	Value	Location	Date	
Volatile Organic Compounds																			
Chlorinated Ethenes & Ethanes																			
Tetrachloroethene	127-18-4	µg/L	-	-	-	-	-	-	3.3	8.9	Use Standard	**3.3**	1,900,000	B-12	10/15/1990	64,000	B-46	1/28/2009	**YES**
Trichloroethene	79-01-6	µg/L	-	-	-	-	-	-	30	81	Use Standard	**30**	94,000	B-43	6/29/1993	44,000	GP-42	12/11/2008	**YES**
1,1-Dichloroethene	75-35-4	µg/L	-	-	-	-	-	-	7,100	3.2	Use Standard	**3.2**	810	B-43	6/29/1993	110	R1-IW2	7/23/2009	**YES**
cis-1,2-Dichloroethene	156-59-2	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	75,000	B-47	7/9/1993	50,000	GP-42	12/11/2008	**no**
trans-1,2-Dichloroethene	156-60-5	µg/L	-	-	-	-	-	-	10,000	No data	Use Standard	**10,000**	680	B-58	10/14/1999	240	GP-38	12/8/2008	**no**
Vinyl chloride	75-01-4	µg/L	-	-	-	-	-	-	2.4	530	Use Standard	**2.4**	25,000	B-33A	10/13/1999	15,600	PTM-2U	8/9/2007	**YES**
1,1,1-Trichloroethane	71-55-6	µg/L	-	-	-	-	-	-	-	-	930,000	**930,000**	18,000	B-31	9/15/1992	1,400	B-30	1/27/2009	**no**
1,1-Dichloroethane	75-34-3	µg/L	-	-	-	-	-	-	-	-		**No Tox Data**	2,500	B-08	9/28/1990	130	GP-38	12/8/2008	**no**
1,2-Dichloroethane	107-06-2	µg/L	-	-	-	-	-	-	37	99	Use Standard	**37**	300	B-10/10A	10/15/1990	29	GP-102	10/26/2010	**no**
Other Volatile Organic Compounds																			
1,2-Dichlorobenzene	95-50-1	µg/L	-	-	-	-	-	-	1,300	17,000	Use Standard	**1,300**	1,000	B-42	11/3/1998	400	B-47	1/29/2009	**no**
1,3-Dichlorobenzene	541-73-1	µg/L	-	-	-	-	-	-	960	2,600	Use Standard	**960**	91	B-29	5/6/1992	14	B-39	10/20/2010	**no**
1,4-Dichlorobenzene	106-46-7	µg/L	-	-	-	-	-	-	190	2,600	Use Standard	**190**	290	B-42	11/3/1998	58	B-39	10/20/2010	**no**
Acetone	67-64-1	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	30,000	B-30	9/17/1992	Not Measured			**no**
Chloroform	67-66-3	µg/L	-	-	-	-	-	-	470	470	Use Standard	**470**	13,000	B-07	10/8/1990	24	B-60	2/16/2010	**no**
Methyl ethyl ketone	78-93-3	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	170,000	B-15	4/29/1992	Not Measured			**no**
Methyl isobutyl ketone	108-10-1	µg/L	-	-	-	-	-	-	0	-	-	**No Tox Data**	12,000	B-30	9/17/1992	Not Measured			**no**
Methylene chloride	75-09-2	µg/L							590	1,600	Use Standard	**590**	43,000	B-08	9/28/1990	Non Detect			**no**
Total Petroleum Hydrocarbons, Benzene, Toluene, Ethylbenzene, Xylene & Alkylated Benzenes																			
Total Petroleum Hydrocarbons[2]																			
TPH-Mineral Spirits Range		µg/L	-	-	-	-	-	-	-	-	800	**800**	230,000	B-12	10/15/1990	6,400	B-30	1/29/2010	**YES**
TPH-Diesel Range		µg/L	-	-	-	-	-	-	-	-	500	**500**	5,000	B-30	9/17/1992	360	B-30	1/29/2010	**no**
TPH-Heavy Oil		µg/L	-	-	-	-	-	-	-	-	500	**500**	1,100	B-30	1/29/2010	1,100	B-30	1/29/2010	**YES, at 1 well**
Benzene, Toluene, Ethylbenzene, Xylene																			
Benzene	71-43-2	µg/L	-	-	-	-	-	-	51	71	Use Standard	**51**	53,000	B-49	10/25/1995	64	GP-26	12/1/2008	**YES**
Toluene	108-88-3	µg/L	-	-	-	-	-	-	15,000	200,000	Use Standard	**15,000**	1,500	B-30	9/17/1992	3,100	GP-38	12/8/2008	**no**
Ethylbenzene	100-41-4	µg/L	-	-	-	-	-	-	2,100	29,000	Use Standard	**2,100**	4,500	B-07	10/8/1990	1,000	MW-10	1/26/2009	**no**
Xylene (total)	1330-20-7	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	14,000	B-07	10/8/1990	920	GP-38	12/8/2008	**no**
Xylene (meta & para)		µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	5,300	B-47	6/22/1998	Not Measured			**no**
Xylene (ortho)	95-47-6	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	2,500	B-49	11/3/1998	Not Measured			**no**
Alkylated Benzenes																			
1,2,4-Trimethylbenzene	95-63-6	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	11,000	B-49	10/18/1999	Not Measured			**no**
1,3,5-Trimethylbenzene	108-67-8	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	9,600	B-49	10/18/1999	Not Measured			**no**
Styrene	100-42-5	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	1,800	B-49	11/3/1998	Not Measured			**no**
n-Propylbenzene	103-65-1	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	2,200	B-49	10/18/1999	Not Measured			**no**
iso-Propylbenzene	98-82-8	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	100	Multiple[3]	Multiple[3]	Not Measured			**no**
sec-Butylbenzene	135-98-8	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	2,300	B-49	10/18/1999	Not Measured			**no**
Semivolatile Organic Compounds																			
High Molecular Weight Polycyclic Aromatic Hydrocarbons																			
Benzofluoranthenes (total)	56832-73-6	µg/L										**No Tox Data**	2	B-12	12/19/1997	Not Measured			**no**
Pyrene	129-00-0	µg/L	-	-	-	-	-	-	4,000	11,000	Use Standard	**4,000**	23	B-12	6/29/1998	Not Measured			**no**
Low Molecular Weight Polycyclic Aromatic Hydrocarbons																			
2-Methylnaphthalene	91-57-6	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	130	B-10A	10/25/1995	Not Measured			**no**
Acenaphthene	83-32-9	µg/L	-	-	-	-	-	-	990	-	Use Standard	**990**	17	B-12	6/29/1998	Not Measured			**no**
Fluorene	86-73-7	µg/L	-	-	-	-	-	-	5,300	14,000	Use Standard	**5,300**	32	B-49	7/9/1993	Not Measured			**no**
Naphthalene	91-20-3	µg/L	-	-	-	-	-	-	-	-	4,900	**4,900**	6,700	B-44	6/22/1998	Non Detect			**no**
Phenanthrene	85-01-8	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	46	B-12	6/29/1998	Not Measured			**no**
Phthalates																			
bis(2-ethylhexyl)phthalate	117-81-7	µg/L	-	-	-	-	-	-	2.2	5.9	Use Standard	**2.2**	1,900	B-30	10/25/1995	Not Measured			**YES (old data)**
Butyl benzyl phthalate	85-68-7	µg/L	-	-	-	-	-	-	1,900	No data	Use Standard	**1,900**	400	B-27	9/3/1992	Not Measured			**no**
Diethylphthalate	84-66-2	µg/L	-	-	-	-	-	-	44,000	120,000	Use Standard	**44,000**	27	B-30	10/25/1995	Not Measured			**no**
Di-n-butyl phthalate	84-74-2	µg/L	-	-	-	-	-	-	4,500	12,000	Use Standard	**4,500**	880	B-30	9/17/1992	Not Measured			**no**
Chlorinated Phenols																			
Pentachlorophenol	87-86-5	µg/L	7.9	15.0	7.9	13.0	7.9	12.8	3.0	8.2	Use Standard	**3.0**	31,000	B-38	9/14/1992	116	B-49	8/6/2007	**YES**
2,4,5-Trichlorophenol	95-95-4	µg/L	-	-	-	-	-	-	3,600	-	Use Standard	**3,600**	5.1	B-20	10/21/1998	Not Measured			**no**
Tetrachlorophenols (total)	58-90-2	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	600	B-31	5/4/1992	Not Measured			**no**

Table 3.1
Groundwater Cleanup Levels for Organic Compounds[1]

Chemical	CAS Number	Unit	Protection of Aquatic Species – Federal Standards – National Recommended Water Quality[2] Criteria CWA §304: Marine Chronic	Fresh Chronic	National Toxics Rule[2] 40 CFR 131: Marine Chronic	Fresh Chronic	Washington – Surface Water Quality Standards[2] WAC 173-201A: Marine Chronic	Fresh Chronic	Protection of Human Health – Federal Standards – National Recommended Water Quality Criteria CWA §304: Marine (Organism Only)	National Toxics Rule 40 CFR 131: Marine (Organism Only)	Washington – MTCA Method B Surface Water WAC 173-340-730: Fish Consumption	Screening Criterion (Lowest Standard)	Maximum Detected in Groundwater Since Measurements Began: Value	Location	Date	Maximum Detected Since 2007 (Post ChemOx Interim Measures): Value	Location	Date	Maximum Post-IM Concentration Exceeds Criterion?[5]
Other Semivolatile Organic Compounds																			
2,4-Dimethylphenol	105-67-9	µg/L	-	-	-	-	-	-	850	No Data	Use Standard	**850**	500	B-29	5/6/1992	Not Measured			**no**
2-Methylphenol	95-48-7	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	750	B-29	5/6/1992	Not Measured			**no**
3-Methylphenol	108-37-4	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	130	B-12	12/19/1997	Not Measured			**no**
4-Methylphenol	106-44-5	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	650	B-39	10/25/1995	Not Measured			**no**
Benzoic acid	65-85-0	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	1,700	B-39	8/13/1993	Not Measured			**no**
Benzyl alcohol	100-51-6	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	260	B-12	9/17/1992	Not Measured			**no**
Carbazole	86-74-8	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	23	B-49	7/9/1993	Not Measured			**no**
Dibenzofuran	132-64-9	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	24	B-49	7/9/1993	Not Measured			**no**
Phenol	108-95-2	µg/L	-	-	-	-	-	-	1,700,000	4,600,000	Use Standard	**1,700,000**	140	B-27	7/9/1993	Not Measured			**no**
Glycols & Alcohols																			
Glycols																			
Ethylene glycol	107-21-1	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	22,000	B-15	4/29/1992	Not Measured			**no**
Diethylene glycol	111-46-6	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	8,100	B-33A	9/21/1992	Not Measured			**no**
Alcohol																			
Methanol	67-56-1	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	72,000	B-30	9/17/1992	Not Measured			**no**
Ethanol	64-17-5	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	30,000	B-11	9/15/1992	Not Measured			**no**
iso-Propanol	67-63-0	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	23,000	B-30	9/17/1992	Not Measured			**no**
1-Propanol	71-23-8	µg/L	-	-	-	-	-	-	-	-	-	**No Tox Data**	6,700	B-11	9/15/1992	Not Measured			**no**

Notes:

1 The 2007–2010 maximum concentration is compared to the lowest screening criteria or background.
2 Criteria Chronic Concentration used unless otherwise noted.
3 No surface water criteria are available for the TPH fractions; therefore MTCA Method A values for groundwater have been used as surrogates.
4 Well B-47 (6/22/1998), Wells B-18, WH-10, WH-11, WH-12, and WH-8 (8/11/10).

Abbreviations:

CFR Code of Federal Regulations
CWA Clean Water Act
IM Interim measure
MTCA Model Toxics Cleanup Act
TPH Total petroleum hydrocarbons
WAC Washington Administrative Code

Table 3.2
Groundwater Cleanup Levels for Metals

				Protection of Aquatic Species						Protection of Human Health										
				Federal Standards				Washington Standards		Federal Standards		Washington								
			Lower Duwamish Corridor Groundwater Metals Background	National Recommended Water Quality[1] Criteria CWA §304		National Toxics Rule[1] 40 CFR 131		Surface Water Quality Standards[1] WAC 173-201A		National Recommended Water Quality[1] Criteria CWA §304	National Toxics Rule[1] 40 CFR 131	MTCA Method B Surface Water[1] WAC 173-340-730	Screening Criterion (Lowest Standard Corrected for Background)	Maximum Detected in Groundwater Since Measurements Began			Maximum Detected Since 2007 (Post ChemOx Interim Measures)			Maximum Post-IM Concentration Exceeds Criterion?[4]
Chemical	CAS Number	Unit		Marine Chronic	Fresh Chronic	Marine Chronic	Fresh Chronic	Marine Chronic	Fresh Chronic	Fish Consumption	Fish Consumption	Fish Consumption		Value	Location	Date	Value	Location	Date	
Antimony	7440-36-0	µg/L		-	-	-	-	-	-	640	4,300	Use Standard	**640**	3.0	B-34	1/26/2009	3.0	B-34	1/26/2009	No
Arsenic	7440-38-2	µg/L	8.0	36	150	36	190	36	190	0.14	0.14	Use Standard	**8**	8.8	B-15	9/14/1992	5.0	B-59	1/27/2009	No
Barium	7440-39-3	µg/L		-	-	-	-	-	-	-	-	No tox data	**No data**	80	B-29	5/6/1992	Not Measured			-
Beryllium	7440-41-7	µg/L		-	-	-	-	-	-	-	-	270	**270**	7.0	B-33A	1/26/2009	7.0	B-33A	1/26/2009	No
Cadmium	7440-43-9	µg/L		8.8	0.25	9.3	1	9.3	0.37	-	-	20	**0.25**	0.50	B-19	5/5/1992	Not Detected at 0.4 µg/L			No
Chromium	7440-47-3	µg/L		-	-	-	-	-	-	-	-	No tox data	**No data**	41	B-34	1/26/2009	41	B-34	1/26/2009	No
Copper	7440-50-8	µg/L	8.0	3.1	9	2.4	11	3.1	3.5	-	-	2,700	**8.0**	55	B-34	1/26/2009	55	B-34	1/26/2009	**YES**
Molybdenum	7439-98-7	µg/L		-	-	-	-	-	-	-	-	No tox data	**No data**	98	B-34	1/26/2009	98	B-34	1/26/2009	No
Nickel	7440-02-0	µg/L		8.2	52	8.2	160	8.2	49	4,600	4,600	Use Standard	**8.2**	90	B-15	9/14/1992	21	B-34	1/26/2009	**YES**
Selenium	7782-49-2	µg/L		71	5	71	5	71	5	4,200	-	Use Standard	**5.0**	4.0	B-33A	1/26/2009	4.0	B-33A	1/26/2009	No
Silver	7440-22-4	µg/L		-	-	-	-	-	-	-	-	26,000	**26,000**	0.40	B-65,B-60	1/26–27/2009	0.40	B-65,B-60	1/26–27/2009	No
Zinc	7440-66-6	µg/L		81	120	81	100	81	32	26,000	No data	Use Standard	**32**	110	B-15	9/14/1992	23	B-65	1/26/2009	No

Notes:
1 Criteria Chronic Concentration used unless otherwise noted.
2 Wells B-18, WH-10, WH-11, WH-12, and WH-8.
3 Well B-47 (6/22/1998), Wells B-18, WH-10, WH-11, WH-12, and WH-8 (8/11/10).
4 The 2007–2010 maximum concentration is compared to the lowest screening criteria or background.

Abbreviations:
CFR Code of Federal Regulations
CWA Clean Water Act
IM Interim measure
MTCA Model Toxics Cleanup Act
WAC Washington Administrative Code

Fox Avenue Reporting Limits from the Cleanup Action Plan

Groundwater Remediation Level	Basis	Soil Remediation Level	Basis
250 µg/L Total CVOCs (as measured in the designated monitoring well network)	1. Expected residual average concentration in source area groundwater following source area remedy implementation. 2. Use of thermal treatment and ERD to achieve 250 µg/L total CVOCs, which is predicted to result in achieving cleanup levels at the seeps in reasonable restoration time frame. 3. Concentration will not present a vapor intrusion risk in downgradient properties. 4. Cleanup levels will be attained at the CPOC over an extended restoration time frame via natural attenuation.	10 mg/kg (average soil concentration following source area treatment)	1. Technologically achievable; represents 98 percent reduction from source area average concentration. 2. Achieves MTCA Method C direct contact levels. 3. Expected to eliminate source of current vapor intrusion into Cascade Columbia office. 4. Expected to result in 98 percent reduction in source area groundwater concentrations in 1st and 2nd WBZs.

Abbreviations:

CPOC	Conditional point of compliance
CVOC	Chlorinated volatile organic compound
ERD	Enhanced reductive dechlorination
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
MTCA	Model Toxics Control Act
WBZ	Water Bearing Zone

2016 Annual Report Key Tables and Figures

Table 3.1

Summary of Volatile Organic Compound Data in Groundwater[1]

				Non-Chlorinated Volatile Organic Compounds									Chlorinated Volatile Organic Compounds								
			Analyte	Acetone	Benzene	EB	MEK	Naphthalene	Toluene	1,2,4-TMBZ	Xylene	Xylene (ortho)	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	PCE	trans-1,2-DCE	TCE	VC	Total CVOCs
			Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	Sample ID	WBZ	Sample Date																		
Monitoring Wells																					
Fox Avenue																					
B-18	B-18-050616	1st	05/06/2016	5 U	2.35	1 U	5 U	1 U	2.19	1 U	1.09	1 U	1 U	1 U	1 U	2.84	1 U	1 U	0.5 U	19.4	22.2
	Dup03-050616	1st	05/06/2016	5 U	2.34	1 U	5 U	1 U	2.19	1 U	1.1	1 U	1 U	1 U	1 U	2.82	1 U	1 U	0.5 U	18.8	21.6
B-19	B-19-050616	2nd	05/06/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	38.5	1 U	1 U	0.5 U	22.4	60.9
B-20A	B-20a-050516	1st	05/05/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	93.5	1 U	3.27	0.5 U	71.5	168
	B-20a-121616	1st	12/12/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3.42	1 U	1 U	0.5 U	10.7	14.1
	Dup02-121616	1st	12/12/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	3.5	1 U	1 U	0.5 U	12	15.5
B-21	B-21-050516	2nd	05/05/2016	5 U	7.59	1 U	5 U	1 U	8.62	1 U	1.14	1.22	1.47	1 U	1 U	1 U	1 U	1 U	0.5 U	67.8	69.3
	B-21-121216	2nd	12/12/2016	23.7	1 U	1 U	12.8	1 U	4.59	1 U	1 U	1.3	1.81	1 U	1 U	1 U	1 U	1 U	0.5 U	38.4	40.2
B-58	B-58-050516	1st	05/05/2016	5.29	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	89.8	1 U	1 U	2.3	16.8	109
	B-58-120516	1st	12/05/2016	5 U	1.01	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	203	1 U	1.36	0.58	44	249
B-59	B-59-050516	2nd	05/05/2016	5 U	1 U	1 U	5 U	1 U	1.18	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	18.6	18.6
B-60	B-60-050516	1st	05/05/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	104	1 U	2.89	0.5 U	78.2	185
	B-60-120516	1st	12/05/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	7.8	7.8
B-61	B-61-050516	2nd	05/05/2016	5 U	3.16	1 U	5 U	1 U	1.69	1 U	1 U	1 U	1.53	1 U	1 U	21.1	1 U	1.29	0.5 U	84	108
	Dup02-050516	2nd	05/05/2016	5 U	3.58	1 U	5 U	1 U	1.8	1 U	1 U	1 U	1.71	1 U	1 U	28.6	1 U	1 U	0.5 U	169	199
	B-61-120516	2nd	12/05/2016	5 U	2.49	1 U	5 U	1 U	2.37	1 U	1 U	1 U	1.12	1 U	1 U	4.16	1 U	1 U	0.56	35.8	41.6
B-62	B-62-050616	1st	05/06/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
B-63	B-63-050616	2nd	05/06/2016	5 U	4.66	2.32	5 U	1 U	1.1	1 U	2.33	3.28	2.08	1 U	1 U	1 U	1 U	1 U	0.5 U	1.41	3.49
B-77	B-77-050416	1st	05/04/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.15	1 U	0.57	0.2 U	1.72
B-78	B-78-050416	2nd	05/04/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
Main Source Area																					
MW-15D	MW-15D-051016	2nd	05/10/2016	5 U	1 U	2.26	5 U	1 U	9.47	11.1	3.54	1.67	1 U	1 U	1 U	1.4	1 U	1 U	0.5 U	8.64	10
	MW-15D-121216	2nd	12/12/2016	5,880	1 U	1 U	5 U	1.01	50.1	13.5	3.77	2.01	1 U	1 U	1 U	18.2	1 U	1 U	0.5 U	0.02 U	18.2
MW-16D	MW-16D-051016	2nd	05/10/2016	5 U	1 U	27.5	5 U	4.3	3.14	26.2	9.56	2.02	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
	MW-16D-121316	2nd	12/13/2016	5 U	1 U	3.65	5 U	1.6	1.44	28.8	6.21	2.21	1 U	1 U	1 U	6.84	8.39	1 U	2.86	0.2 U	18.1
MW-17D	MW-17D-051116	2nd	05/11/2016	5 U	6.05	2.74	5 U	1 U	11.1	1 U	2.07	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	2.13	2.13
	MW-17D-121316	2nd	12/13/2016	5 U	4.81	2.63	5 U	1 U	6.78	1 U	2.16	1.01	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
MW-18S	MW-18S-051016	1st	05/10/2016	5 U	1.12	2.44	5 U	1 U	2.31	1 U	4.45	3.11	2.26	1 U	1 U	26.3	4.29	1 U	0.81	209	243
	MW-18S-121316	1st	12/13/2016	5 U	1 U	1 U	5 U	1 U	1.98	1 U	7.2	5.57	5.37	1 U	1 U	387	3.01	2.51	2.82	511	912
Myrtle Street																					
B-33A	B-33a-050916	2nd	05/09/2016	5 U	10.1	1 U	5 U	1 U	1 U	1 U	1 U	1 U	11.4	1 U	1 U	1 U	1 U	1 U	0.5 U	12.5	23.9
	B-33a-120516	2nd	12/05/2016	5 U	9.05	1 U	5 U	1 U	1 U	1 U	1 U	1 U	7.41	1 U	1 U	1 U	1 U	1 U	0.5 U	15.4	22.8
B-35	B-35-050916	2nd	05/09/2016	5 U	7.28	25	19.1	1 U	1 U	2.48	12	11.7	2.21	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	2.21
B-64	B-64-050916	1st	05/09/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	26.4	1 U	1 U	0.5 U	17.1	43.5
B-65	B-65-050916	2nd	05/09/2016	5 U	1.01	1 U	5 U	1 U	1 U	1 U	1 U	1 U	4.16	1 U	1 U	1 U	1 U	1 U	0.5 U	3.42	7.58

Table 3.1

Summary of Volatile Organic Compound Data in Groundwater[1]

				Non-Chlorinated Volatile Organic Compounds									Chlorinated Volatile Organic Compounds								
			Analyte	Acetone	Benzene	EB	MEK	Naphthalene	Toluene	1,2,4-TMBZ	Xylene	Xylene (ortho)	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	PCE	trans-1,2-DCE	TCE	VC	Total CVOCs
			Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	Sample ID	WBZ	Sample Date																		
Monitoring Wells (Cont.)																					
Northwest Corner																					
B-22	B-22-050416	1st	05/04/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	113	59.7	1.47	28.9	5.06	208
	Dup01-050416	1st	05/04/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	114	62.9	1.49	26.4	4.68	209
	B-22-120616	1st	12/06/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	108	47.1	1.82	33.9	19	210
NW 1-1	NW1-1-050416	1st	05/04/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	7.5	1 U	210	1 U	1.25	15.6	24.2	259
	NW1-1-120616	1st	12/06/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	116	1 U	1 U	0.5 U	27.2	143
Seattle Boiler Works																					
MW-03	MW-3-051016	1st	05/10/2016	5 U	2.2	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5.2	1 U	1 U	0.5 U	6.16	11.4
MW-04	MW-4-051016	2nd	05/10/2016	5 U	6.09	31.7	5 U	1 U	1 U	2.51	3.45	5.91	3.89	1 U	1 U	1 U	1 U	1 U	0.5 U	122	126
	MW-4-120516	2nd	12/05/2016	5 U	7.71	38.1	5 U	1 U	1 U	4.24	3.98	2.04	3.78	1 U	1 U	1 U	1 U	1 U	0.5 U	0.7	4.48
MW-05	MW-5-051016	1st	05/10/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2.44	6.78	1 U	1.1	0.2 U	10.3
MW-06	MW-6-051016	2nd	05/10/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.02	65.5	26.1	1.85	12.7	4.33	112
	MW-6-120516	2nd	12/05/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	90.7	18.8	1.44	9.6	1.87	122
Whitehead																					
B-45	B-45-051116	2nd	05/11/2016	5 U	1.34	1 U	5 U	1 U	2.28	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	5.92	5.92
	B-45-121216	2nd	12/12/2016	5 U	1 U	1 U	5 U	1 U	3.15	1 U	1 U	1.54	1 U	1 U	1 U	1.15	2.15	1 U	0.65	45.9	49.9
B-49	B-49-051116	1st	05/11/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	4	1 U	113	13.7	1.11	8.78	124	265
	B-49-121216	1st	12/12/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	24.3	121	1 U	26.6	0.2 U	172
MW-07	MW-7-051116	1st	05/11/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1	1 U	74.8	64	1.11	39.2	4.25	184
MW-08	MW-8-051116	2nd	05/11/2016	5 U	2.92	1 U	5 U	1 U	5.03	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	67	67
MW-09	MW-9-051116	1st	05/11/2016	5 U	1.5	1 U	5 U	1 U	1.5	1 U	1.05	1 U	1 U	8.1	1 U	313	55.5	5.81	48.5	818	1,250
	MW-9-1212116	1st	12/12/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1.03	5.2	1 U	467	42.5	34.5	56.5	418	1,020
MW-10	MW-10-051116	2nd	05/11/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	26.6	1.04	1 U	0.6	78.8	107
	DUP-1-051116	2nd	05/11/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	29	1.13	1 U	0.52	81.2	112
	MW-10-121216	2nd	12/12/2016	28.8	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U
	Dup-1-121216	2nd	12/12/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	8.74	1 U	1 U	0.73	30.1	39.6
Injection Wells																					
Fox Avenue																					
R1-IW17	R1-IW17-12-050616	1st	05/06/2016	5 U	2.37	59	5 U	6.95	1 U	27.2	35.6	17.8	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	1.25	1.25
	R1-IW17-55-050616	2nd	05/06/2016	5 U	2.44	49.4	5 U	6.83	1	23.7	32.4	17.1	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	1.14	1.14
R1-IW2	R1-IW2-050516	2nd	05/05/2016	5 U	1 U	1 U	5 U	1 U	2.74	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.44	0.44
R1-IW3A	R1-IW3a-050516	1st	05/05/2016	5 U	1 U	1 U	5 U	1 U	74.6	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.53	3.69	4.22
R1-IW4A	R1-IW4a-050516	1st	05/05/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	6.92	6.92
R1-IW4B	R1-IW4b-050516	2nd	05/05/2016	5 U	1 U	2.88	5 U	1 U	1,010	1 U	1	1 U	1 U	1 U	1 U	2.53	1 U	1 U	0.5 U	5.89	8.42
R1-IW5	R1-IW5-10-050516	1st	05/05/2016	5 U	1 U	1 U	5 U	1 U	23.1	1 U	1 U	1 U	1 U	1 U	1 U	4.72	1 U	1 U	0.5 U	25.2	29.9
	R1-IW5-60-050516	2nd	05/05/2016	5 U	1 U	1 U	5 U	1 U	26.4	1 U	1 U	1 U	1 U	1 U	1 U	4.81	1 U	1 U	0.5 U	29.1	33.9

Table 3.1

Summary of Volatile Organic Compound Data in Groundwater[1]

				Non-Chlorinated Volatile Organic Compounds									Chlorinated Volatile Organic Compounds									
			Analyte	Acetone	Benzene	EB	MEK	Naphthalene	Toluene	1,2,4-TMBZ	Xylene	Xylene (ortho)	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	PCE	trans-1,2-DCE	TCE	VC	Total CVOCs
			Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	Sample ID	WBZ	Sample Date																		
Injection Wells (Cont.)																						
Fox Avenue (Cont.)																						
R1-IW7	R1-IW7-17-050616	1st	05/06/2016	5 U	1 U	9.6	5 U	2.57	13.2	10.6	6.21	2.52	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	14.4	14.4
	R1-IW7-60-050616	2nd	05/06/2016	5 U	1.08	9.65	5 U	2.47	21.5	10.2	6.24	2.66	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	13.2	13.2
Loading Dock																						
R1-IW21	R1-IW21-050416	1st	05/04/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.07	3.21	1 U	1 U	0.5 U	8.91	13.2
Main Source Area																						
R0-IW2D	R0-IW02D-051016	2nd	05/10/2016	18	1 U	1 U	50.9	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	14.2	1 U	1 U	0.77	9.84	24.8
	R0-IW02D-121216	2nd	12/12/2016	1,930	1 U	1 U	91.9	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	32.1	1 U	1 U	1.38	9.65	43.1
R0-IW6D	R0-IW06D-051016	2nd	05/10/2016	311	1 U	1 U	85.1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	8.71	1 U	1 U	1.92	11	21.6
	R0-IW06D-121216	2nd	12/12/2016	5 U	1 U	1 U	101	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	16.7	1 U	1 U	3.49	19.5	39.7
R0-IW9S	R0-IW09S-051016	1st	05/10/2016	5 U	1 U	1 U	5 U	1 U	1.32	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
	R0-IW09S-121316	1st	12/13/2016	5 U	1 U	1 U	5 U	1 U	1.34	1 U	1 U	1 U	1 U	1 U	1 U	1.01	1 U	1 U	0.5 U	0.2 U	1.01
Myrtle Street																						
R2-IW3	R2-IW3-17-050916	1st	05/09/2016	23.1	7.56	31.1	513	1 U	4.7	1 U	7.16	6.6	3.6	1 U	1 U	2.04	1 U	1 U	0.5 U	11.8	17.4
	R2-IW3-30-050916	2nd	05/09/2016	19.3	6.82	23.7	437	1 U	4.42	1 U	5.81	5.51	3.68	1 U	1 U	2.07	1 U	1 U	0.5 U	8.01	13.8
R2-IW4	R2-IW4-45-050616	2nd	05/06/2016	101	2.56	3.18	1,470	1 U	45.3	1 U	1 U	1.54	1.15	1 U	1 U	2.18	1 U	1 U	0.5 U	0.58	3.91
R2-IW6	R2-IW6-30-050916	2nd	05/09/2016	122	5.57	2.94	5,440	1 U	15.3	1 U	1.62	1.02	1.97	1 U	1 U	1.48	1 U	1 U	0.5 U	2.77	6.22
Northwest Corner																						
R1-IW10	R1-IW10-050416	1st	05/04/2016	6.84	1 U	1 U	5 U	1 U	1.13	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	5.78	5.78
R1-IW12	R1-IW12-050416	1st	05/04/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1.2	1 U	1 U	23.5	1 U	1 U	0.5 U	10.7	35.4
R1-IW15	R1-IW15-050416	2nd	05/04/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	6.61	1 U	1 U	0.5 U	0.49	7.1
Seattle Boiler Works																						
R2-IW1	R2-IW1-17-050916	1st	05/09/2016	90.7	1.45	1 U	5,940	1 U	663	1 U	1 U	1 U	1 U	1 U	1 U	138	1 U	1 U	0.76	180	319
	R2-IW1-45-050916	2nd	05/09/2016	84.9	1.46	1 U	5,590	1 U	578	1 U	1 U	1 U	1 U	1 U	1 U	146	1 U	1 U	0.78	265	412
	Dup04-050916	2nd	05/09/2016	69.2	1.62	1 U	5,360	1 U	578	1 U	1 U	1 U	1 U	1 U	1 U	169	1 U	1 U	0.62	260	430
	R2-IW1-17-120516	1st	12/05/2016	5 U	1.2	1 U	946	1 U	494	1 U	1 U	1 U	1 U	1 U	1 U	23.4	1.02	1 U	1.02	55.2	80.6
	R2-IW1-45-120516	2nd	12/05/2016	5 U	1.18	1 U	625	1 U	470	1 U	1 U	1 U	1 U	1 U	1 U	24.3	1.05	1 U	1.08	64.2	90.6
	Dup01-120516	2nd	12/05/2016	5 U	1.19	1 U	883	1 U	457	1 U	1 U	1 U	1 U	1 U	1 U	24.2	1.04	1 U	1.07	60.2	86.5
R2-IW10	R2-IW10-12-051016	1st	05/10/2016	5 U	1 U	1 U	83.8	1 U	390	1 U	1 U	1 U	1 U	1 U	1 U	3.98	1 U	1 U	0.5 U	1.9	5.88
	Dup05-051016	1st	05/10/2016	5 U	1 U	1 U	84.2	1 U	360	1 U	1 U	1 U	1 U	1 U	1 U	3.28	1 U	1 U	0.5 U	1.48	4.76
R2-IW2	R2-IW2-17-050916	1st	05/09/2016	160	1.42	1 U	6,990	1 U	687	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.89	8.13	9.02
	R2-IW2-45-050916	2nd	05/09/2016	157	1.27	1 U	6,960	1 U	709	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.89	7.55	8.44
R2-IW8	R2-IW8-63-051016	2nd	05/10/2016	5 U	3.18	6.9	29.5	1 U	580	2.69	3.83	1.99	1.12	1 U	1 U	1.72	1 U	1 U	0.5 U	2.2	5.04
R2-IW9	R2-IW9-12-051016	1st	05/10/2016	5 U	1.61	1 U	5 U	1 U	1.44	1 U	1 U	1 U	1 U	1 U	1 U	11.9	1 U	1.01	0.5 U	41.9	54.8

Table 3.1
Summary of Volatile Organic Compound Data in Groundwater[1]

				Non-Chlorinated Volatile Organic Compounds									Chlorinated Volatile Organic Compounds								
			Analyte	Acetone	Benzene	EB	MEK	Naphthalene	Toluene	1,2,4-TMBZ	Xylene	Xylene (ortho)	1,1-DCA	1,1-DCE	1,2-DCA	cis-1,2-DCE	PCE	trans-1,2-DCE	TCE	VC	Total CVOCs
			Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	Sample ID	WBZ	Sample Date																		
Seep Data																					
S-2	SP-02-050916		05/09/2016	5 U	1 U	1 U	18	1 U	1 U	1 U	1 U	1 U	1.03	1 U	1 U	1.57	1 U	1 U	0.5 U	7.39	9.99
S-13 (Calibre S-3)	SP-03-050916		05/09/2016	5 U	7.89	1 U	5 U	1 U	1 U	1 U	1 U	1 U	4.64	1 U	1 U	8.03	1 U	1 U	0.67	27.1	40.4
S-3b	SP-03b-050916		05/09/2016	5 U	1.32	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1.48	1 U	2.53	104	1 U	11.7	0.5 U	46.4	166
S-16 (Calibre S-4)	SP-04-050916		05/09/2016	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U

Abbreviations:
- CVOC Chlorinated volatile organic compound
- DCA Dichloroethane
- DCE Dichloroethene
- EB Ethylbenzene
- MEK Methyl ethyl ketone
- µg/L Micrograms per liter
- PCE Tetrachloroethene
- TCE Trichloroethene
- TMBZ Trimethylbenzene
- VC Vinyl chloride
- WBZ Water bearing zone

Qualifier:
- U Analyte is not detected at the associated reporting limit.

TABLE 4.1
GROUNDWATER DATA SUMMARY
MAIN SOURCE AREA
CASCADE COLUMBIA/FOX AVENUE

Well	Date	Elapsed Time From Injection (days) (a)	Volatile Organic Compounds: Sum CVOCs (c) (µg/L)	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	Aquifer Redox Conditions: DO (mg/L)	ORP (mV)	Iron II (mg/L)	Iron (T) (mg/L)	Iron (D) (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	Donor Indicators: TOC (mg/L)	Acetone (µg/L)	MEK (µg/L)	pH	Other: Temp (deg C)	Comments	VOCs- micromoles/Liter(b): PCE	TCE	cDCE	VC	Ethene/ Ethane	Total Chloroethenes (c)	VOCs - Molar Fraction (d): PCE	TCE	cDCE	VC	Ethene/Ethane
RO-IW01D	2/25/2014	-146	952	<1.01	91.0	854	6.65						0.8			4.2			3.41				44.4		0.00	0.69	8.8	0.11		9.6	0.00	0.07	0.92	0.01	
RO-IW02D	2/25/2014	-146	2,808	649	1,000	1,090	68.7						2.0			38.9			6.45				25.6		3.9	7.6	11	1.1		24	0.16	0.32	0.47	0.05	
	5/14/2014	-68	12	<1	0.77	10.9	<0.2	<5	<5	ND	0.41	-76.5	2.2			38.7	<0.5	0.131	2.60	<5	<5	9.39	28.3	Clear, low, no odor/no sheen	0.00	0.01	0.11	0.00	0.00	0.12	0.00	0.05	0.95	0.00	0.00
	6/20/2014	-31	12	<1	0.664	9.63	1.25				0.59	-72.9								<5	<5	6.76	24.3	Clear, low, no odor/no sheen	0.00	0.01	0.10	0.02		0.12	0.00	0.04	0.80	0.16	
	10/22/2014	93	0.8	<1	<0.5	<1	0.75				3.34		7.5	953	890	699	<0.5		31.6	333	678	4.79	24.2	Cloudy, turbid, vomit-like smell, no sheen, well under very high pressure, water meter collected orange particulate and oil, effervescent	0.00	0.00	0.00	0.01		0.01	0.00	0.00	0.00	1.00	
	1/8/2015	171	21	<1	0.63	13.1	7.41	<5	<5	ND	6.64		5.6	566	542	178	<0.5	0.432	2,180	139	174	4.79	19.5	Light orange, low-med turbidity, vomit like odor, no sheen, efferevescent	0.00	0.00	0.14	0.12	0.00	0.26	0.00	0.02	0.52	0.46	0.00
	5/14/2015	297	129	<1	1.02	35.4	92.8				1.82	-96.0	5.0	642	650	162	2.40		2,500	188	285	9.77	15.1	Slightly turbid, colorless, no sheen, organic odor, slight effervescense	0.00	0.01	0.37	1.48		1.86	0.00	0.00	0.20	0.80	
	9/29/2015	435	135	<1	0.87	64.2	69.8	28.8	24.3	<5	0.61	-28.4	5.6	823	870	241	<0.5	2.33	2,720	147	265	4.50	15.3	Clear, colorless, no sheen, strong vomit-like odor, effervescent	0.00	0.01	0.66	1.12	1.97	1.79	0.00	0.00	0.18	0.30	0.52
	5/10/2016	659	25	<1	0.770	14.2	9.84	<5	<5	<5	0.40	-71.6	1.5	218	210	0.472	0.500	1.65	736	18.0	50.9	4.79	18.7	Colorless, slight turbidity, slight sulfur-like odor, no sheen	0.00	0.01	0.15	0.16	0.00	0.31	0.00	0.02	0.47	0.51	0.00
	12/12/2016	875	43	<1	1.38	32.1	9.65	<5	<5		0.71	-43.7	3.2	332	336	4.89			927	1,930	91.9	4.93	9.8	Very turbid, grayish color, injection fluid odor, slight sheen	0.00	0.01	0.33	0.15	0.00	0.50	0.00	0.02	0.67	0.31	0.00
RO-IW03D	2/25/2014	-146	369	109	171	84.3	4.88						2.4			14.3			3.16				21.7		0.66	1.3	0.87	0.08		2.9	0.23	0.45	0.30	0.03	
RO-IW04S	2/25/2014	-337	742	<1.00	2.25	734	5.84						1.6			6.0			19.7				57.2		0.00	0.02	7.6	0.09		7.7	0.00	0.00	0.99	0.01	
RO-IW04D	2/25/2014	-146	192	<1.00	<0.500	191	1.06						1.8			0.5			8.31				48.3		0.00	0.00	2.0	0.02		2.0	0.00	0.00	0.99	0.01	
RO-IW05S	2/25/2014	-337	385	<1.00	<0.500	381	3.51						0.4			<0.300			53.5				52.8		0.00	0.00	3.9	0.06		4.0	0.00	0.00	0.99	0.01	
RO-IW05D	2/25/2014	-146	50	<1.00	1.46	27.1	21.6						1.4			16.9			4.11				39.4		0.00	0.01	0.28	0.35		0.64	0.00	0.02	0.44	0.54	
RO-IW06S	3/3/2014	-331	856	<1.00	3.23	849	3.55						1.6			<0.300			27.0				52.2		0.00	0.02	8.8	0.06		8.8	0.00	0.00	0.99	0.01	
RO-IW06D	2/25/2014	-146	1,219	<1.00	<0.500	598	621						0.2			16.2			9.83				29.4		0.00	0.00	6.2	9.9		16	0.00	0.00	0.38	0.62	
	5/14/2014	-68	8.1	<1	<0.5	2.95	5.18	<5	<5	ND	0.05	-107.0	0.0			35.4	<0.5	0.380	3.81	<5	<5	6.92	33.1	Clear, low, no odor/no sheen, effervescent	0.00	0.00	0.03	0.08	0.00	0.11	0.00	0.00	0.27	0.73	0.00
	10/23/2014	94	8.7	<1	0.72	<1	8				1.74	-45.2	3.2	1,390	1,480	1,360	<0.5		26.7	1,130	647	4.76	27.6	Cloudy, light orange, moderate turbidity, vomit-like odor, NS, orange particulate on probe, well under pressure, effervescent	0.00	0.01	0.00	0.13		0.13	0.00	0.04	0.00	0.96	
	1/8/2015	171	27	<1	1.28	10.0	15.3	<5	<5	ND	1.91	-23.4	2.4	807	821	860	5.20	0.837	2,810	332	218	4.83	26.1	Orange, low-med turbidity, vomit like odor, no sheen, orange particles, effervescent	0.00	0.01	0.10	0.24	0.00	0.36	0.00	0.03	0.29	0.68	0.00
	5/14/2015	297	174	<50	32.5	96	45						0.8	849	1,030	974	16.8		5,070	558	<250			Orange, oily, organic, vomit-like odor, no sheen	0.00	0.25	0.99	0.72		1.96	0.00	0.13	0.51	0.37	
	9/28/2015																						21.6	Orange, oily, vomit-like odor, no sheen; oil content too high for lab to analyze as a water sample											
	5/10/2016	659	22	<1	1.92	8.71	11.0	<5	<5	<5	0.37	-80.0	2.0	501	488	75.9	0.700	0.616	1,250	311	85.1	4.7	19.0	Yellowish, high turbidity, sour odor, no sheen	0.00	0.01	0.09	0.18	0.00	0.28	0.00	0.05	0.32	0.63	0.00
	12/12/2016	875	40	<1	3.49	16.7	19.5	<5	<5		0.67	-159.2	3.6	557	580	49.6			1,030	<5	101	5.3	11.8	Clear with suspended particles, colorless, injection fluid odor, slight sheen	0.00	0.03	0.17	0.31	0.00	0.51	0.00	0.05	0.34	0.61	0.00
RO-IW07S	2/26/2014	-336	505	<1.00	3.83	499	1.88						0.8			<0.300			25.4				54.4		0.00	0.03	5.1	0.03		5.2	0.00	0.01	0.99	0.01	
RO-IW07D	2/26/2014	-145	359	147	116	74.3	21.3						2.0			4.12			4.93				20.6		0.89	0.88	0.77	0.34		2.9	0.31	0.31	0.27	0.12	
RO-IW08S	2/26/2014	-336	799	58.3	55.2	677	8.08						0.2			156			131				52.8		0.35	0.42	7.0	0.13		7.9	0.04	0.05	0.89	0.02	
RO-IW08D	2/26/2014	-145	1,466	<1.01	3.17	1,090	373						1.4			2.5			6.98				41.7		0.00	0.02	11	6.0		17	0.00	0.00	0.65	0.35	
RO-IW09S	2/26/2014	-336	800	56.9	34.0	704	5.57						0.2			29.0			30.5				48.9		0.34	0.26	7.3	0.09		8.0	0.04	0.03	0.91	0.01	
	5/14/2014	-259	835	105	66.6	657	6.35	<5	<5	ND	0.11	-130.2	0.2			31.9	<0.5	1.08	13.6	<5	<5	9.68	41.2	Slight amber color, low turb, no odor/no sheen, effervescent	0.63	0.51	6.8	0.10	0.00	8.02	0.08	0.06	0.85	0.01	0.00
	5/13/2015	105	106	<1	0.66	88.8	16.6				1.85	-76.9	3.8	1,120	1,270	1,550	24.8		23.3	31,100	4,030	5.45	21.8	Clear, grayish color, organic decaying odor, no sheen, very effervescent	0.00	0.01	0.9	0.27		1.19	0.00	0.00	0.77	0.22	
	9/28/2015	243	14	<1	<0.5	11	2.71	20.8	22.3	<5	0.10	-62.0	3.4	101	87.3	2.83	<0.5	2.09	75.6	11.5	<5	6.90	25.2	Turbid, vomit-like odor, no sheen, slightly effervescent	0.00	0.00	0.1	0.04	1.59	0.16	0.00	0.00	0.06	0.02	0.91
	5/10/2016	468	ND	<1	<0.5	<1	<0.2	<5	<5	<5	0.03	-140.0	1.4	97.8	89.4	0.355	<2.5	2.73	67.4	<5	<5	6.45	19.3	Clear, colorless, organic odor, no sheen, slight effervescence											
	12/13/2016	685	1.0	<1	<0.5	1.01	<0.2	<5	<5		0.52	-142.9	2.2	78.3	62.8	2.94			99.4	<5	<5	6.69	10.4	Slightly turbid with suspended particles, grayish tint, injection fluid odor, no sheen	0.00	0.00	0.0	0.00	0.00	0.01	0.00	0.00	1.00	0.00	0.00
RO-IW09D	2/26/2014	-145	2,593	<1.01	<0.500	363	2,230						1.8			2.9			33.9				27.8		0.00	0.00	3.7	36		39	0.00	0.00	0.09	0.91	
RO-IW10S	2/26/2014	-336	543	17.3	7.66	513	4.82						1.2			41.7			15.6				48.9		0.10	0.06	5.3	0.08		5.5	0.02	0.01	0.96	0.01	
RO-IW10D	2/26/2014	-145	1,929	<1.01	<0.500	169	1,760						1.6			1.2			7.43				31.1		0.00	0.00	1.7	28		30	0.00	0.00	0.06	0.94	
RO-IW11S	3/3/2014	-331	536	1.88	21.4	510	2.50						0.0			11.2			17.2				43.9		0.01	0.16	5.3	0.04		5.5	0.00	0.03	0.96	0.01	
RO-IW11D	2/26/2014	-145	593	<1.00	<0.500	7.80	585						2.0			0.4			4.93				32.2		0.00	0.00	0.08	9.36		9.4	0.00	0.00	0.01	0.99	
MW-9S	5/14/2014	-259	1,210	11.8	162	1,000	36.4	<5	<5	ND	0.19	-116.1	2.0			39.9	<0.5	1.32	49.8	<5	<5	8.76	44.6	Clear, low turb, no odor/no sheen, effervescent	0.07	1.2	10	0.58	0.00	12	0.01	0.10	0.85	0.05	0.00
	5/15/2015	107	1,127	114	35.1	566	412				0.09	-233.3	2.0	6.83	7.01	41.8	<0.5		43.1	<5	<5	6.65	30.3	Clear, colorless, no sheen, organic decay odor, effervescent	0.69	0.3	6	6.59		13	0.05	0.02	0.44	0.49	
	9/30/2015	245	1,230	130	84.1	856	160	34.7	25.4	<5	0.67	-15.9	4.0	9.03	7.35	23.6	<0.5	1.83	22.7	<5	<5	7.02	30.1	Clear, yellowish, no sheen, slight diesel-like odor	0.78	0.6	9	2.56	2.24	13	0.05	0.04	0.59	0.17	0.15
	1/4/2016	341	1,394	54.8	37.8	835	466	20.1	8.13	ND	0.26	-122.4	1.6	13.2	13.7	27.5	<0.500	2.05	16.9	<5.00	<5.00	6.86	24.4	Clear, slight yellow color, no sheen, slight petroleum-like odor	0.33	0.3	9	7.46	1.06	17	0.02	0.02	0.49	0.42	0.06
	5/11/2016	469	1,235	55.5	48.5	313	818	<5	<5	<5	0.12	-136.7	2.0	12	10.8	15.4	<0.5	3.18	18.4	<5	<5	6.53	21.8	Clear, colorless, no odor, no sheen	0.33	0.4	3	13.09	0.00	17	0.02	0.02	0.19	0.77	0.00
	12/12/2016	684	984	42.5	56.5	467	418				2.68	-40.9	2.6							<5	<5	5.48	14.9	Clear, colorless, no odor, no sheen	0.26	0.4	5	6.69	0.00	12	0.02	0.04	0.40	0.55	0.00

TABLE 4.1
GROUNDWATER DATA SUMMARY
MAIN SOURCE AREA
CASCADE COLUMBIA/FOX AVENUE

			Volatile Organic Compounds								Aquifer Redox Conditions								Donor Indicators				Other		VOCs- micromoles/Liter(b)						VOCs - Molar Fraction (d)				
Well	Date	Elapsed Time From Injection (days) (a)	**Sum CVOCs (c) (µg/L)**	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Iron II (mg/L)	Iron (T) (mg/L)	Iron (D) (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	TOC (mg/L)	Acetone (µg/L)	MEK (µg/L)	pH	Temp (deg C)	Comments	PCE	TCE	cDCE	VC	Ethene/ Ethane	Total Chloroethenes (c)	PCE	TCE	cDCE	VC	Ethene/Ethane
MW-10D (75 ft DG)	5/14/2014	-68	7,794	<1	<0.5	7,520	274	17.1	<5	ND	0.00	-86.2	1.8			<0.3	<0.5	2.17	45.8	9.27	<5	6.48	30.8	Slight amber color, low turb, no odor/no sheen, effervescent	0.00	0.00	78	4.4	0.66	82	0.00	0.00	0.94	0.05	0.01
	10/22/2014	93	8,308	5.5	2.46	6,670	1,630				0.32	-131.7	2.6	4.58	3.43	<1.50	<0.5		20.0	<5	<5	6.58	41.3	Clear, low turbidity, egg like odor, no sheen, effervescent	0.03	0.02	69	26		95	0.00	0.00	0.72	0.27	
	1/9/2015	172	5,636	5.03	1.21	4,190	1,440	37	<5	ND	0.43	-104.7	3.6	8.65	7.96	<1.50	<0.5	1.42	21.6	<5	<5	6.27	39.6	Slight sulfur like odor	0.03	0.01	43	23	1.4	66	0.00	0.00	0.64	0.34	0.02
	5/15/2015	298	2,032	2.89	<0.5	1,560	469				0.15	-188.4	4.2	10.8	10.7	<1.5	<0.5		21	<5	<5	6.41	37.1	Slightly turbid, colorless, no sheen, rotten egg-like odor	0.02	0.00	16	8		24	0.00	0.00	0.68	0.32	
	9/30/2015	436	915	1.57	<0.5	131	782	38.3	25.8	<5	0.12	-85.4	4.8	12.4	11.6	1.52	<0.5	2.03	9.48	<5	24	6.18	29.6	Clear, colorless, no sheen, slight diesel-like odor, slight effervescence	0.01	0.00	1	13	2.4	14	0.00	0.00	0.08	0.77	0.15
	1/4/2016	532	1,355	1.34	<0.500	34.0	1320	28.4	10.5	ND	0.13	-73.2	0.8	9.49	8.79	7.40	<0.500	3.32	7.56	<5.00	<5.00	6.07	21.6	Clear, colorless, no sheen, slight petroleum-like odor	0.01	0.00	0	21	1.5	21	0.00	0.00	0.02	0.92	0.06
	5/11/2016	660	107	1.04	0.600	26.6	78.8	<5	<5	<5	0.19	-121.9	1.8	6.61	6.5	44.4	<0.5	3.97	12.9	<5	<5	6.16	27.5	Clear, colorless, some black suspended solids, no sheen, slight efferevescence	0.01	0.00	0	1	0.0	2	0.00	0.00	0.18	0.82	0.00
	12/12/2016	875	ND	<1	<0.5	<1	<0.2				2.42	-179.8	2.0							28.8	<5	6.48	17.7	Clear with some suspended particles, colorless, no odor, no sheen											
MW-15D (between IW)	5/14/2014	-68	967	150	118	578	121	<5	<5	ND	0.03	-93.8	0.0			7.35	<0.5	1.63	12.8	<5	<5	7.12	30.7	Clear, low turb, no odor/no sheen, effervescent	0.90	0.90	6.0	1.9	0.00	9.7	0.09	0.09	0.61	0.20	0.00
	10/23/2014	94	927	1.28	<0.5	<1	926				0.28	-159.3	5.4	13.8	13	<3	<0.5		2.31	646	880	6.58	25.3	Clear, low turbidity, vomit odor, no sheen, effervescent	0.01	0.00	0.00	15		15	0.00	0.00	0.00	1.00	
	1/8/2015	171	6,514	1.24	<0.5	2.64	6,510	875	23.9	ND	2.41	-126.9	3.0	18.5	17.1	<3	0.800	2.60	359	779	647	6.63	20.3	Amber (initially) to gray, low, slight vomit odor, no sheen, effervescent	0.01	0.00	0.03	104	34	104	0.00	0.00	0.00	0.75	0.25
	5/14/2015	297	24	<1	<0.5	<1	23.8				1.68	-118.3	1.8	17.6	16.8	<60	6.8		222	616	235	9.16	18.3	Slightly turbid, yellow, no sheen, very effervescent, organic odor	0.00	0.00	0.00	0		0	0.00	0.00	0.00	1.00	
	9/29/2015	435	0.41	<1	<0.5	<1	0.405	56.8	66.7	<5	0.95	-169.3	2.6	15.1	16.4	1.05	<0.5	4.75	157	526	160	6.91	15.3	Lightly turbid, colorless at first then turned yellow and black (preservative dependent), no sheen, slight diesel-like odor, very effervescent	0.00	0.00	0.00	0	5	0	0.00	0.00	0.00	0.0014	1.00
	1/4/2016	532	3.6	<1.00	<0.500	<1.00	3.55	30.9	71.4	ND	0.45	-124.0	1.0	12.9	12.4	0.543	<1.00	5.93	85.6	60.6	30.9	7.03	14.0	Clear, green to yellow (depending on preservative), no sheen, organic odor, very effervescent	0.00	0.00	0.00	0	4	0	0.00	0.00	0.00	0.01	0.99
	5/10/2016	659	10	<1	<0.5	1.40	8.64	28.1	99.4	<5	0.91	-74.2	1.6	9.55	7.72	0.862	0.6	9.47	64.4	<5	<5	6.06	16.0	Clear, colorless, petroleum-like odor, foamy	0.00	0.00	0.01	0	5	0	0.00	0.00	0.00	0.03	0.97
	12/12/2016	875	18	<1	<0.5	18.2	<0.2	45.9	272		0.37	-263.1	1.8	28.6	21.9	163			101	5,880	<5	6.60	13.0	Clear with suspended particles, grayish/black color, injection fluid odor, no sheen, very effervescent	0.00	0.00	0.19	0	11	0	0.00	0.00	0.02	0.00	0.98
MW-16D (35 ft DG)	5/14/2014	-68	6,840	<1	<0.5	4,600	2,240	86.2	20.1	ND	0.17	-84.3	0.2			43	<0.5	1.760	7.4	<5	<5	9.85	35.9	Clear, low turb, no odor/no sheen, effervescent	0.00	0.00	47	36	4.03	83	0.00	0.00	0.54	0.41	0.05
	10/23/2014	94	2,750	1.42	8.11	1,660	1,080				0.66	-186.7	4.0	76	80.5	102	2.5		16	1,750	<5	5.96	30.2	Pumped out clear but turned gray over time, low-medium turbidity, egg odor, no sheen, effervescent	0.01	0.06	17	17		34	0.00	0.00	0.50	0.50	
	1/8/2015	171	6,681	1.99	8.51	2,460	4,210	71.6	<5	ND	2.17	-122.0		138	107	31	0.800	0.702	1,010	961	1,690	5.98	28.3	Clear, low, slight vomit odor, no sheen	0.01	0.06	25	67	2.8	93	0.00	0.00	0.27	0.70	0.03
	5/13/2015	296	78	<1	<0.5	2.57	75.8				0.12	-173.3	2.4	74.2	35.3	<60	<0.5		472	932	538	6.74	25.7	Clear, colorless, no sheen, decaying organic odor, very effervescent	0.00	0.00	0	1		1.2	0.00	0.00	0.02	0.98	
	9/28/2015	434	1.7	<1	<0.5	1.37	0.328	37.9	51.8	<5	0.09	-21.5	3.6	73.9	67.6	1.14	<0.5	2.72	37.3	209	185	6.7	23.6	Clear, colorless, no sheen, slight organic odor, no sheen, slightly effervescent	0.00	0.00	0	0	3.3	0.0	0.00	0.00	0.004	0.002	0.99
	1/4/2016	532	0.57	<1.00	<0.500	<1.00	0.570	<5	37.5	ND	0.15	-103.9	2.4	61.4	58.5	<0.600	<0.500	4.25	8.53	14.4	<5.00	6.18	17.2	Clear, colorless, slight petroleum-like odor, no sheen, effervescent	0.00	0.00	0	0	1.3	0.0	0.00	0.00	0.000	0.007	0.99
	5/10/2016	659	ND	<1	<0.5	<1	<0.2	<5	<5	<5	0.22	-87.9	2.0	40.9	37.8	0.285	<0.5	6.92	4.35	<5	<5	6.23	17.9	Clear, colorless, no sheen, slight rotten egg-like odor, slight effervescence											
	12/13/2016	876	18	8.39	2.86	6.84	<0.2	<5	15.2		1.08	-150.9	2.6	29.9	27.3	2.59			43.7	<5	<5	6.53	15.3	Clear, colorless, injection fluid odor, no sheen, slight effervescence	0.05	0.02	0	0	0.5	0.1	0.07	0.03	0.103	0.000	0.79
MW-17D (35 ft DG)	5/14/2014	-68	124	<1	0.738	69.3	53.5	6.11	<5	ND	0.19	-79.8	0.6			0.823	<0.5	3.29	40.9	<5	<5	9.79	42.5	Clear, low turb, no odor/no sheen, effervescent	0.00	0.01	0.71	0.86	0.23	1.6	0.00	0.00	0.39	0.47	0.13
	10/23/2014	94	21	<1	<0.5	3.99	17.4				0.29	-144.2	2.2	0.992	0.711	<1.50	<0.5		17.5	<5	<5	6.92	34.8	Clear to very slight yellow, low turbidity, slight egg odor, no sheen, effervescent	0.00	0.00	0.04	0.28		0.32	0.00	0.00	0.13	0.87	
	1/8/2015	171	25	<1	<0.5	2.75	21.8	<5	<5	ND	0.65	-170.2	4.2	1.15	1.02	<1.50	0.800	3.31	21.2	<5	<5	6.88	33.0	Clear, low, very slight sulfur odor, NS, effervescent	0.00	0.00	0.03	0.35	0.00	0.38	0.00	0.00	0.08	0.92	0.00
	5/15/2015	298	7.1	<1	<0.5	1.11	6.01				0.08	-229.1	2.4	1.86	2.19	<1.5	1.60		21	<5	<5	7.03	31.1	Slightly turbid, yellow, no sheen, effervescent, organic odor	0.00	0.00	0.01	0.10		0.11	0.00	0.00	0.11	0.89	
	9/29/2015	435	2.6	<1	<0.5	<1	2.56	<5	24.4	<5	0.28	-138.2	1.8	2.25	1.90	0.908	<0.5	3.72	10.9	<5	<5	6.97	29.3	Slightly turbid, colorless to yellow in air, no sheen, slight egg-like odor, slight effervescence	0.00	0.00	0.00	0.04	0.87	0.04	0.00	0.00	0.00	0.04	0.96
	1/5/2016	533	0.78	<1.00	<0.500	<1.00	0.780	<5	104	ND	0.07	-127.0	1.6	12.7	12.5	<0.600	<0.500	2.57	42.7	<5.00	<5.00	6.42	25.0	Clear, yellow, no sheen, organic odor, effervescent	0.00	0.00	0.00	0.01	3.71	0.01	0.00	0.00	0.00	0.00	1.00
	5/11/2016	660	2.1	<1	<0.5	<1	2.13	<5	45.1	<5	0.11	-107.5	3.4	19.1	18.7	<1.5	<0.5	4.39	49.7	<5	<5	6.5	26.7	Greenish yellow, clear, no sheen, organic odor, effervescent	0.00	0.00	0.00	0.03	1.61	0.03	0.00	0.00	0.00	0.02	0.98
	12/13/2016	876	ND	<1	<0.5	<1	<0.2	<5	38.1		0.47	-141.7	1.2	23	20.6	14.7			121	<5	<5	6.94	17.1	Clear, yellow tint, injection fluid odor, no sheen, foamy											
MW-18S (between IWs)	5/15/2014	-258	912	145	50.1	712	4.71	<5	<5	ND	0.00	47.3	0.0			239	<0.5	0.271	89.2	29.3	<5	7.05	47.0	Slightly cloudy, low turb, no odor/no sheen, effervescent	0.87	0.38	7.3	0.08	0.00	8.7	0.10	0.04	0.85	0.01	0.00
	10/22/2014	-98	1,952	17.7	23.2	1,870	41.4				0.20	-200.4								<5	<5	6.99	39.0	Slight amber color, low turbidity, slight egg odor, NS, effervescent	0.11	0.18	19	0.66		20	0.01	0.01	0.95	0.03	
	5/14/2015	106	208	1.4	0.74	82.8	123				0.16	-203.3	1.2	1.45	1.51	158	3.60		154	14.1	<5	5.96	28.7	Clear, slightly yellow, effervescent, organic odor, no sheen	0.01	0.01	1	1.97		3	0.00	0.00	0.30	0.69	
	9/28/2015	243	119	3.19	1.1	48.5	66	25.6	25.8	<5	0.07	-28.4	3.0	3.53	3.33	361	<0.5	2.51	125	5.36	<5	7.20	25.5	Clear, yellowish, slight diesel-like odor, no sheen, slightly effervescent	0.02	0.01	1	1.06	1.90	2	0.01	0.00	0.14	0.30	0.55
	1/4/2016	341	75	1.96	<0.500	25.3	47.7	<5	7.5	ND	0.32	-134.2	1.6	1.92	2.26	209	<0.500	2.37	82.8	<5.00	<5.00	7.28	19.8	Clear, yellow, slight petroleum-like odor, slight effervescence	0.01	0.00	0	0.76	0.27	1	0.01	0.00	0.20	0.59	0.21
	5/10/2016	468	240	4.29	0.810	26.3	209	<5	<5	<5	0.29	-96.3	1.6	4.87	4.53	152	<0.5	3.59	74.4	<5	<5	6.59	19.7	Clear, colorless, no sheen, slight organic odor, slight effervescence	0.03	0.01	0	3.34	0.00	4	0.01	0.00	0.07	0.92	0.00
	12/13/2016	685	904	3.01	2.82	387	511	<5	<5		0.34	-163.8	1.8	6.26	5.98	207			80.4	<5	<5	7.15	11.9	Clear with suspended particules, brown/yellow tint, rotten odor, no sheen	0.02	0.02	4	8.18	0.00	12	0.00	0.00	0.33	0.67	0.00
B-20AS	6/20/2014	-222	1,394	<1	11.5	1,280	102	21.6	<5	<5	0.13	-101.8	3.0			10.3	<0.5	4.39	36.1	5.69	<5	6.62	39.3	Clear, low turb, no odor, no sheen	0.00	0.09	13	1.6	0.83	15	0.00	0.01	0.84	0.10	0.05
	5/13/2015	105	1,477	<1	5.23	1,410	61.5				0.08	-208.7	2.8	7.51	6.94	25.9	<0.5		39.9	<5	<5	6.86	30.7	Clear, slightly yellow, no sheen, petroleum-like odor	0.00	0.04	15	1.0		16	0.00	0.00	0.93	0.06	
	9/29/2015	244	1,151	<1	<0.5	972	179				0.05	-56.8	3.0	8.21	7.81	21.3	<0.5		31.5	<5	<5	6.88	32.4	Clear, colorless, no sheen, slight diesel-like odor	0.00	0.00	10	2.9		13	0.00	0.00	0.78	0.22	
	1/5/2016	342 (e)	69	<1.00	<0.500	36.5	32.6				0.29	13.8	2.0	14.0	14.9	37.9	<0.500		5.73	<5.00	<5.00	6.05	19.7	Clear, colorless, no odor, no sheen, effervescent	0.00	0.00	0	0.5		1	0.00	0.00	0.42	0.58	
	5/5/2016	463	165	<1	<0.5	93.5	71.5	<5	<5	<5	0.31	-54	6.0	16.8	6.33	44.0	<0.5	1.03	8.08	<5	<5	5.99	23.2		0.00	0.00	1	1.1		2	0.00	0.00	0.46	0.54	
	12/16/2016	688	14	<1	<0.5	3.42	10.7				0.80	4				28.9				<5	<5	5.9	18.7		0.00	0.00	0	0.2		0	0.00	0.00	0.17	0.83	
B-21D	6/20/2014	-31	3.2	<1	<0.5	3.24	<0.2	<5	36.5	<5	0.21	-61.6	2.6			<1.50	<0.5	5.75	9.13	7.06	<5	6.42	33.4	Dark gray, moderately high, fermented sugar water odor, no sheen	0.00	0.00	0.03	0.00	1.3	0.03	0.00	0.00	0.03	0.00	0.97
	5/13/2015	296	290	<1	<0.5	4.06	286				0.53	-111.4	3.0	46	22.7	<1.5	4.8		21.3	<5	<5	6.49	30.9	Clear, turned dark gray, moderate turbifdity, pungent, unbearable smell, no sheen	0.00	0.00	0.04	4.58		4.62	0.00	0.00	0.01	0.99	
	9/29/2015	435	41	<1	<0.5	<1	41.4	77.5	77.1	<5	0.21	-117.4	3.4	30.1	21.8	20.1	<1	2.69	12.3	<5	<5	6.24	32.1	Clear, yellow to gray in oxygen, effervescent, black floating solids, no sheen, diesel-like odor	0.00	0.00	0.00	0.66	5.7	0.66	0.00	0.00	0.00	0.10	0.90
	1/5/2016	533 (e)	50	<1.00	<0.500	<1.00	50.0	36.1	18.9	ND	0.13	-136.5	2.7	19.9	14.4	26.2	<0.500	3.73	9.36	<5.00	<5.00	6.43	24.1	Slight turbidity, gray solids in sample, no sheen, petroleum-like odor	0.00	0.00	0.00	0.80	2.1	0.80	0.00	0.00	0.00	0.28	0.72
	5/5/2016	654	68	<1	<0.5	<1	67.8	128	22.7	<5	0.24	-60	0.5	81.8	11	<1.5	3.00	1.76	16.8	<5	<5	5.77	28.9		0.00	0.00	0.00	1.08	5.7	1.08	0.00	0.00	0.00	0.16	0.84
	12/16/2016	879	38	<1	<0.5	<1	38.4				1.35	27				2.29				27.3	12.8	5.12	18.6		0.00	0.00	0.00	0.61	0.0	0.61	0.00	0.00	0.00	1.00	0.00

TABLE 4.1
GROUNDWATER DATA SUMMARY
MAIN SOURCE AREA
CASCADE COLUMBIA/FOX AVENUE

			Volatile Organic Compounds								Aquifer Redox Conditions								Donor Indicators				Other		VOCs- micromoles/Liter(b)						VOCs - Molar Fraction (d)				
Well	Date	Elapsed Time From Injection (days) (a)	**Sum CVOCs (c) (µg/L)**	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Iron II (mg/L)	Iron (T) (mg/L)	Iron (D) (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	TOC (mg/L)	Acetone (µg/L)	MEK (µg/L)	pH	Temp (deg C)	Comments	PCE	TCE	cDCE	VC	Ethene/ Ethane	Total Chloroethenes (c)	PCE	TCE	cDCE	VC	Ethene/Ethane
B-45D (75 ft DG)	5/14/2014	-68	2,029	<1	0.830	998	1,030	35.6	10	ND	0.00	-80.9	1.8			26.1	<0.5	1.37	9.36	<5	<5	6.34	34.3	Clear, moderately low turb, no odor/no sheen, effervescent	0.00	0.01	10	16	1.7	27	0.00	0.00	0.36	0.58	0.06
	10/22/2014	93	17,975	1.55	3.03	7,270	10,700				0.32	-140.7	5.6	8.78	7.56	3.35	<0.5		6.1	<5	<5	6.56	31.5	Clear, low turbidity, egg odor, no sheen, effervescent	0.01	0.02	75	171		246	0.00	0.00	0.30	0.70	
	1/9/2015	172	5,092	<1	2.26	1,870	3,220	392	19.9	ND	0.42	-106.4	2.3	8.25	7.25	11.5	<0.5	1.21	7.73	<5	<5	6.57	30.5	Clear, low, slight sulfur odor, no sheen	0.00	0.02	19	52	16	71	0.00	0.00	0.22	0.59	0.18
	5/13/2015	296	3,882	<1	2.05	1,660	2,220				0.34	-142.4	2.4	12.7	11.4	2.21	<0.5		5.43	<5	<5	6.8	28.6	Clear, colorless, no sheen, petroluem-like odor	0.00	0.02	17	36		53	0.00	0.00	0.33	0.67	
	9/30/2015	436	215	1.38	0.53	49	164	75.2	137	<5	0.14	-118.5	3.6	23.9	21.6	2.97	<0.5	3.23	3.87	<5	<5	6.38	27.2	Clear, colorless, no sheen, very slight diesel-like odor, slight effervescence	0.01	0.00	1	3	8	3	0.00	0.00	0.05	0.24	0.71
	1/5/2016	533	68	1.53	<0.500	6.91	59.5	<5	86.2	ND	0.10	-107.0	1.6	38.0	32.9	1.04	<0.500	3.40	3.99	<5.00	<5.00	6.34	24.1	Clear, colorless, no sheen, slight petroleum-like odor, slight effervescence	0.01	0.00	0	1	3	1	0.00	0.00	0.02	0.23	0.75
	5/11/2016	469	5.9	<1	<0.5	<1	5.92	<5	40.3	<5	0.13	-100.4	2.0	49.1	44.3	1.28	<0.5	7.63	5.14	<5	<5	6.25	24.6	Clear, colorless, no odor, no sheen, slight effervescence	0.00	0.00	0	0	1	0	0.00	0.00	0.00	0.06	0.94
	12/12/2016	684	50	2.15	0.654	1.15	45.9				1.16	-121.8	3.8							<5	<5	6.38	19.2	Clear, colorless, no odor, no sheen, slight effervescence	0.01	0.00	0	1	0	1	0.02	0.01	0.02	0.96	0.00
B-49S (60 ft DG)	5/14/2014	-259	630	98.6	42.2	484	5.14	<5	<5	ND	0.21	-82.2	0.4			14.9	<0.5	0.532	11.4	7.89	<5	9.76	32.9	Clear, low turb, no odor/no sheen, effervescent	0.59	0.32	5.0	0.08	0.00	6.0	0.10	0.05	0.83	0.01	0.00
	10/23/2014	-97	1,226	13	26.1	1,170	17.2				0.26	-180.3								<5	<5	6.72	35.5	Clear, low turb, egg odor, no sheen, effervescent	0.08	0.20	12	0.28	0.00	13	0.01	0.02	0.96	0.02	0.00
	5/13/2015	105	855	11.7	8.32	375	460				1.39	-115.1	0.6	10.8	9.93	8.17	<0.5		7.23	<5	<5	6.7	22.5	Clear, low turbidity, fermented sugar water odor, no sheen	0.07	0.06	4	7.36		11	0.01	0.01	0.34	0.65	
	9/30/2015	245	202	17.4	17	132	35.2	24	23.9	<5	0.65	1.6	5.4	7.4	7.23	40.5	<0.5	0.852	12	20	<5	7.14	26.2	Clear, colorless, no sheen, diesel-like odor	0.10	0.13	1	0.56	1.77	2	0.03	0.03	0.35	0.14	0.45
	1/5/2016	342	152	59.2	35.7	55.2	2.38	<5	<5	ND	0.17	76.5	2.0	4.65	4.73	5.80	<0.500	0.498	2.45	<5.00	<5.00	6.70	14.5	Clear, colorless, no sheen, slight petroleum-like odor	0.36	0.27	1	0.04	0.00	1	0.29	0.22	0.46	0.03	0.00
	5/11/2016	469	259	13.7	8.78	113	124	<5	<5	<5	0.17	-70.7	2.0	8.74	8.15	13.8	<0.5	3.12	3.12	<5	<5	6.21	17.9	Colorless, clear, no odor, no sheen	0.08	0.07	1	1.98	0.00	3	0.03	0.02	0.35	0.60	0.00
	12/12/2016	684	172	121	26.6	24.3	<0.2				1.57	-46.2	1.8							<5	<5	5.94	11.6	Slight turbidity, colorless, no odor, no sheen	0.73	0.20	0	0.00	0.00	1	0.62	0.17	0.21	0.00	0.00
B-58S	5/15/2014	-258	458	5.43	3.04	305	145				2.17											6.07	26.0	Sampled by Calibre	0.03	0.02	3.1	2.3		5.5	0.01	0.00	0.57	0.42	
	5/13/2015	105	182	<1	<0.5	120	62				0.42	-182.1	2.4	16.3	17.1	24.5	<0.5		27.4	<5	<5	7.23	19.2	Clear, slighlty yellow, no odor, no sheen	0.00	0.00	1.2	1.0		2.2	0.00	0.00	0.56	0.44	
	9/29/2015	244	131	<1	1.77	78.8	50.2				0.10	-55.9	1.4	12.9	10.9	63.4	<0.5		18	<5	<5	6.80	23.2	Slightly turbid and yellow, no sheen, slight diesel-like odor	0.00	0.01	0.8	0.8		1.6	0.00	0.01	0.50	0.49	
	1/5/2016	342 (e)	261	<1.00	1.78	221	38.4				0.11	-134.6	2.2	9.99	9.92	35.9	<0.500		12.5	<5.00	<5.00	6.49	17.1	Clear, colorless, no sheen, slight petroleum-like odor	0.00	0.01	2.3	0.6		2.9	0.00	0.00	0.78	0.21	
	5/5/2016	463	109	<1	2.30	89.8	16.8				0.55	-94	5.5	21.7	0.232	93.4	<0.5		19.0	5.29	<5	6.50	19.2		0.00	0.02	0.9	0.3		1.2	0.00	0.01	0.76	0.22	
	12/5/2016	677	248	<1	0.577	203	44.0				3.18	-43				74.0				<5	<5	6.37	16.7		0.00	0.00	2.1	0.7		2.8	0.00	0.00	0.75	0.25	
B-59D	5/15/2014	-67	3.3	<1	<0.5	<1	3.29				1.57											5.79	25.1	Sampled by Calibre	0.00	0.00	0.00	0.05		0.05	0.00	0.00	0.00	1.00	
(150 ft DG)	10/22/2014	93	27	<1	<0.5	<1	26.8				0.93	-85.6	4.2	164	156	65.1	<0.5		12	<5	<5	5.78	23.1	Clear, low turbidity, slight egg odor, no sheen, effervescent	0.00	0.00	0.00	0.43		0.43	0.00	0.00	0.00	1.00	
	1/9/2015	172	8.0	<1	<0.5	<1	8.01				2.28	-37.3	2.8	120	110	53.9	<0.5		29.7	<5	<5	5.98	22.6	Slightly cloudy, low-moderate turbidity, slight sulfur odor, no sheen	0.00	0.00	0.00	0.13		0.13	0.00	0.00	0.00	1.00	
	5/13/2015	296	1.1	<1	<0.5	<1	1.06				1.54	-83.3	2.4	39.4	39.9	39.5	<0.5		15.9	<5	<5	6.17	21.1	Clear, colorless, rotten egg-like odor, no sheen, effervescent	0.00	0.00	0.00	0.02		0.02	0.00	0.00	0.00	1.00	
	9/29/2015	435	3.3	<1	<0.5	<1	3.29	20.1	27.6	<5	0.48	-91.2	3.6	183	174	97.3	<0.5	3.4	5.25	<5	<5	5.76	22.7	Clear, colorless, no sheen, slight diesel-like odor, slightly effervescent	0.00	0.00	0.00	0.05	1.76	0.05	0.00	0.00	0.00	0.03	0.97
	1/5/2016	533 (e)	3.6	<1.00	<0.500	<1.00	3.57	6.64	7.51	ND	0.30	-1.6	2.2	115	114	87.6	<0.500	4.65	8.49	<5.00	<5.00	6.58	20.0	Clear, colorless, no sheen, effervescent	0.00	0.00	0.00	0.06	0.52	0.06	0.00	0.00	0.00	0.10	0.90
	5/5/2016	654	19	<1	<0.5	<1	18.6	<5	<5	<5	4	-46	6.0	38.7	0.11	12.3	<0.5	4.90	3.24	<5	<5	5.81	21.2		0.00	0.00	0.00	0.30	0.00	0.30	0.00	0.00	0.00	1.00	0.00
B-60S	5/15/2014	-258	1,556	<1	3.51	1,500	52.0				1.09											6.13	33.6	Sampled by Calibre	0.00	0.03	15	0.83		16	0.00	0.00	0.95	0.05	
(145 ft DG)	6/20/2014	-222						<5	<5	<5	0.21	-87.3	2.4			24.0	<0.5	6.20	9.53			6.66	34.6	Slight amber color, low turb, smells bad, no sheen					0.00						
	5/13/2015	105	720	2.11	22.6	648	47.6				0.85	-91.3	1.8	8.8	9	19.5	<0.5		16.4	<5	<5	6.70	23.3	Clear, very slight yellow, petroleum-like odor, no sheen, effervescent	0.01	0.17	7	0.76		8	0.00	0.02	0.88	0.10	
	9/30/2015	245	610	<1	12.7	463	134				0.57	-12.3	2.0	12.1	10.4	16.1	<0.5		8.84	<5	<5	7.24	25.6	Clear, colorless, no sheen, strong diesel-like odor	0.00	0.10	5	2.14		7	0.00	0.01	0.68	0.31	
	1/5/2016	342 (e)	615	<1.00	1.51	367	246				0.10	-122.4	1.6	16.1	16.3	11.1	<0.500		16.6	<5.00	<5.00	6.42	19.1	Clear, colorless, slight effervescence, strong petroleum-like odor, no sheen	0.00	0.01	4	3.94		8	0.00	0.00	0.49	0.51	
	5/5/2016	463	182	<1	<0.5	104	78.2	<5	7.79	<5	0.31	-100	6.5	17.5	2.1	29.5	<0.5	1.72	17.3	<5	<5	6.10	19.3		0.00	0.00	1	1.25		2	0.00	0.00	0.46	0.54	
	12/5/2016	677	8	<1	<0.5	<1	7.8				3.45	-15				13.6				<5	<5	6.26	15.9		0.00	0.00	0	0.12		0	0.00	0.00	0.00	1.00	
B-61D	5/15/2014	-67	33	<1	<0.5	15.8	17.4				1.13											5.99	31.3	Sampled by Calibre	0.00	0.00	0.16	0.28		0.44	0.00	0.00	0.37	0.63	
(145 ft DG)	6/20/2014	-31						<5	26.3	<5	0.44	-57.5	2.0			<0.3	<0.5	11.6	4.05			6.36	27.0	Clear, low turb, no odor, no sheen, effervescent											
	10/22/2014	93	12	<1	<0.5	9.64	2.77				0.41	-96.0	4.5	40.7	38.3	<3	<0.5		9.07	7.29	<5	6.30	29.2	Clear, low turbidity, slight egg odor, no sheen, effervescent	0.00	0.00	0.10	0.04		0.14	0.00	0.00	0.69	0.31	
	1/9/2015	172	9	<1	<0.5	6.92	1.69				1.60	-77.9	2.4	37.7	40.3	<3	0.800		21.90	<5	<5	6.14	26.1	Slightly cloudy, low to moderate turbidity, slight vomit-like odor, no sheen	0.00	0.00	0.07	0.03		0.10	0.00	0.00	0.73	0.27	
	5/13/2015	296	802	<1	<0.5	165	637				0.13	-143.5	2.6	38.8	38.3	39.5	<0.5		13.4	<5	<5	6.39	27.6	Clear, low turbidity, vomit-like odor, no sheen	0.00	0.00	1.70	10.19		11.89	0.00	0.00	0.14	0.86	
	9/30/2015	436	1,564	<1	0.82	463	1,100	47.5	71.5	<5	0.23	-90.9	5.0	45.0	40.5	111	<0.5	3.24	6.45	<5	<5	6.09	26.2	Clear, colorless, very slight diesel-like odor, no sheen	0.00	0.01	4.78	17.60	4.37	22.38	0.00	0.00	0.18	0.66	0.16
	1/5/2016	533 (e)	3,875	<1.00	1.45	644	3230	53.7	129	ND	0.18	-95.2	1.4	27.1	27.5	63.0	<0.500	3.97	6.26	<5.00	<5.00	6.79	23.5	Clear, colorless, no sheen, slight petroleum-like odor	0.00	0.01	6.64	51.68	6.66	58.34	0.00	0.00	0.10	0.80	0.10
	5/5/2016	654	105	<1	<0.5	21.1	84.0	12.7	49.3	<5	0.21	-70	7.0	58.6	40.4	4.63	<0.5	2.61	6.44	<5	<5	5.88	24.6	Effervescent	0.00	0.00	0.22	1.34	2.25	1.56	0.00	0.00	0.06	0.35	0.59
	12/5/2016	868	41	<1	0.561	4.16	35.8				1.28	-20				7.75				<5	<5	6.11	19.4		0.00	0.00	0.04	0.57	0.00	0.62	0.00	0.01	0.07	0.92	0.00

PCE = Tetrachloroethene
TCE = Trichloroethene
cDCE = cis-1,2-Dichloroethene
VC = Vinyl Chloride
MEK = Methyl ethyl ketone

ORP = Oxidation Reduction Potential
TOC = Total Organic Carbon
DO = Dissolved Oxygen
Iron (T) = Total Iron
Iron (D) = Dissolved Iron

deg C = degrees Celcius
mV = millivolts
mg/L = milligrams per Liter
µg/L = micrograms per Liter

IW = Injection Well
S = Shallow
D = Deep
not analyzed or measured
predominant PCE or breakdown products molar fraction

(a) Elapsed time for shallow and deep wells is relative to the January 2015 WBZ#1 source area injection and the July 2014 WBZ#2 source area injection, respectively.
(b) Calculated by dividing the concentration in groundwater by the molecular weight of the compound. Reporting limits for non-detect results replaced with zero.
(c) Sum of PCE, TCE, cDCE, and VC.
(d) Indicates the fraction of total ethenes (PCE+TCE+cDCE+VC+ethene/ethane) due to each individual compound on a molar basis.
(e) Follows November 2015 injection of sugar substrate by Calibre to upgradient or adjacent Fox Avenue injection wells (R1-IW3a, R1-IW4a, R1-IW4b, R1-IW5, R1-IW6, R1-IW7).

Dates for Elapsed Time
7/21/2014 1st injection to WBZ#2
1/28/2015 1st injection to WBZ#1

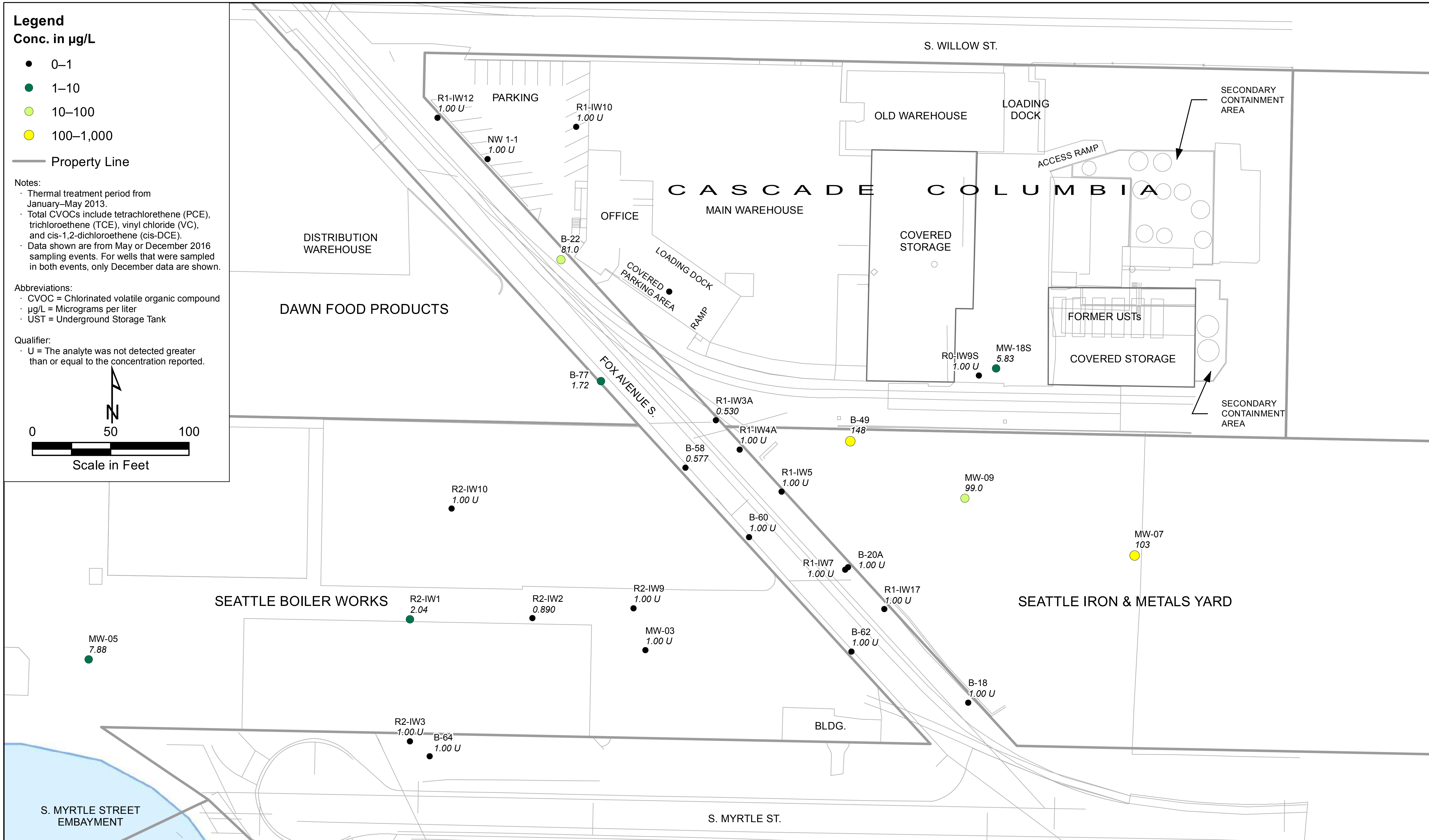

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Figure 4.1
PCE + TCE Concentrations in Groundwater
1st Water Bearing Zone

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Date: 2/17/2017

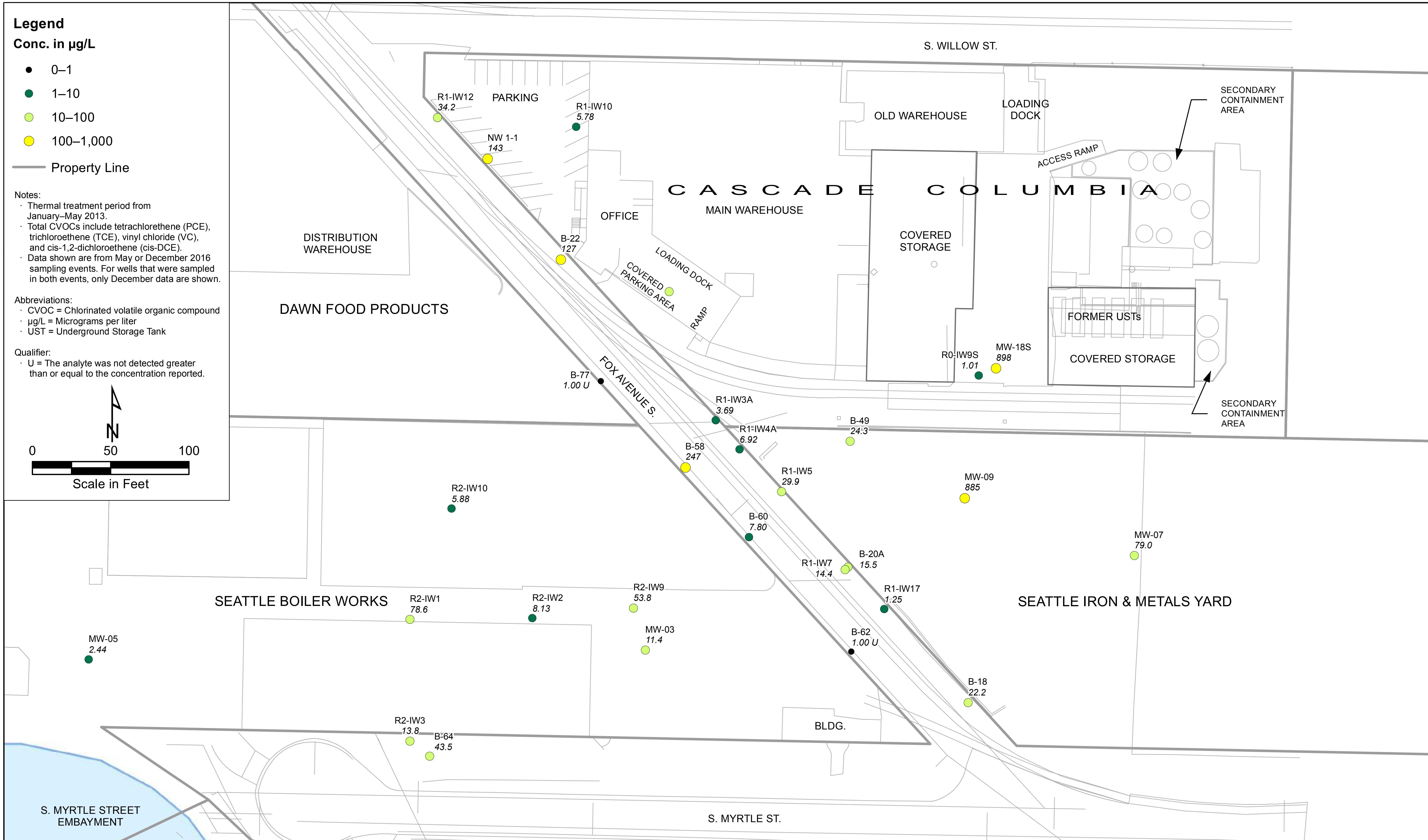

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Figure 4.3
cis-DCE + VC Concentrations in Groundwater
1st Water Bearing Zone

File: I:\GIS\Projects\FOXAVE-RA\MXD\2016 Annual Report\Figure 4.3 cis_VC WBZ1.mxd
Date: 2/17/2017

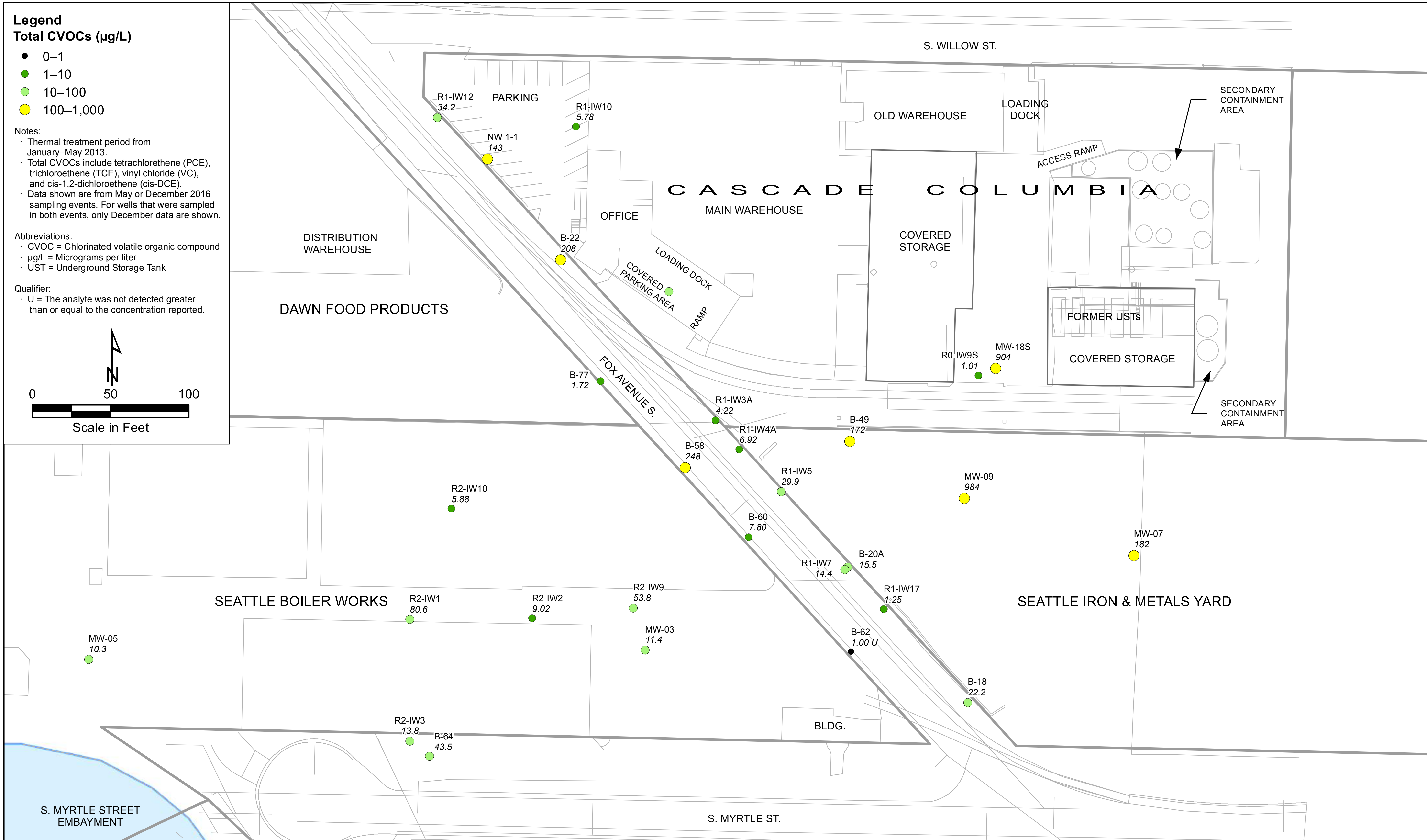

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Figure 4.5
Total CVOCs Concentrations in Groundwater
1st Water Bearing Zone

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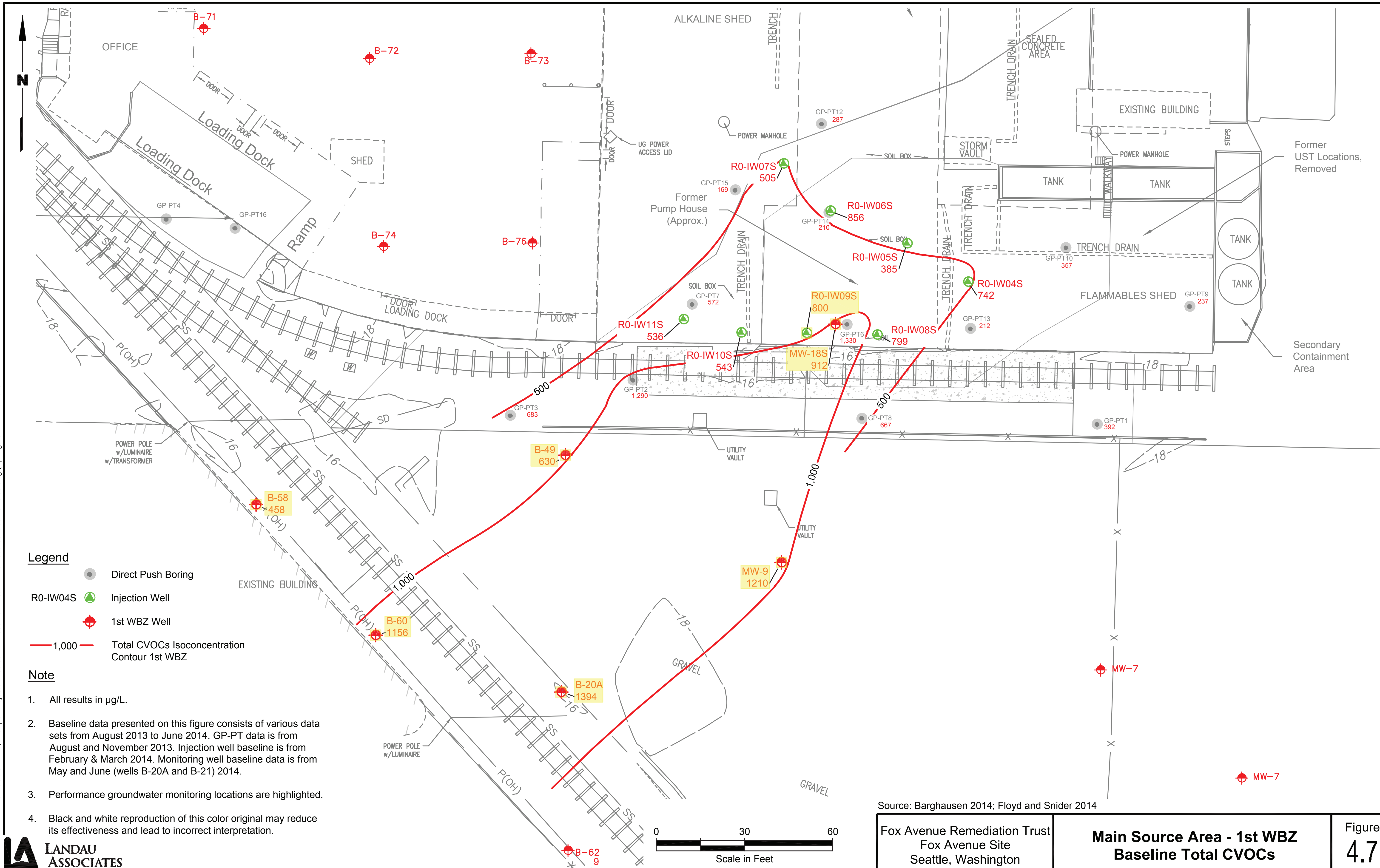
Date: 2/17/2017



Legend

- Direct Push Boring
- R0-IW04S — Injection Well
- 1st WBZ Well
- 1,000 — Total CVOCs Isoconcentration Contour 1st WBZ

Note

1. All results in µg/L.
2. Baseline data presented on this figure consists of various data sets from August 2013 to June 2014. GP-PT data is from August and November 2013. Injection well baseline is from February & March 2014. Monitoring well baseline data is from May and June (wells B-20A and B-21) 2014.
3. Performance groundwater monitoring locations are highlighted.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 30 60
Scale in Feet

Source: Barghausen 2014; Floyd and Snider 2014

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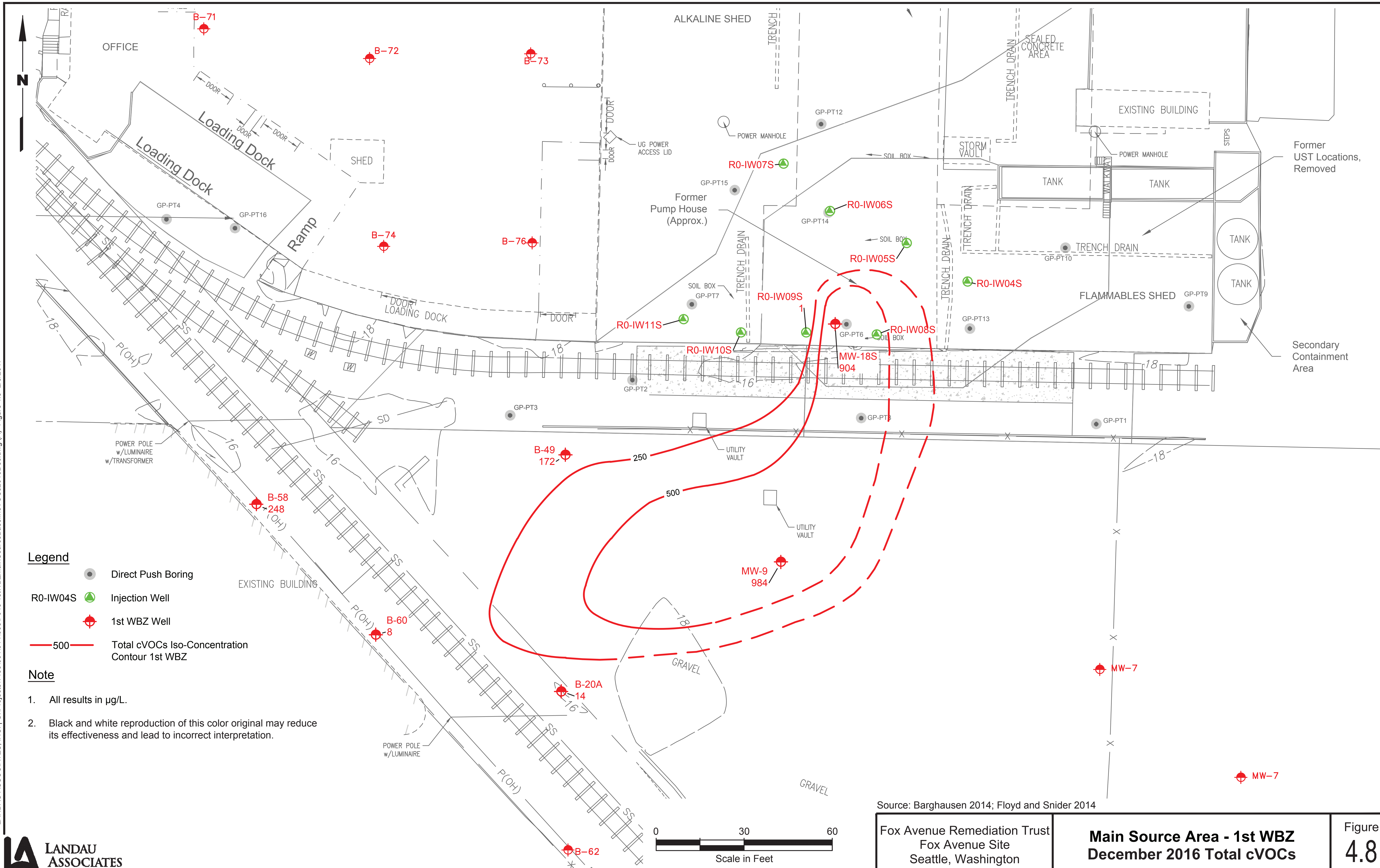
Fox Avenue Remediation Trust Fox Avenue Site Seattle, Washington	**Main Source Area - 1st WBZ Baseline Total CVOCs**	Figure 4.7



Fox Avenue Remediation Trust
Fox Avenue Site
Seattle, Washington

Main Source Area - 1st WBZ
December 2016 Total cVOCs

Figure 4.8

LANDAU ASSOCIATES

LANDAU ASSOCIATES, INC. | G:\Projects\1433\001\014\005\F048 1stWBZMainSourceBaselineVOCs2016Dec.dwg (A) "Figure 4.8" 2/3/2017

2017 Annual Report Key Tables and Figures

Table 3.1
Summary of Volatile Organic Compound Data in Groundwater

				Non-Chlorinated Volatile Organic Compounds									Chlorinated Volatile Organic Compounds						
			Analyte	Acetone	Benzene	EB	MEK	Naphthalene	Toluene	1,2,4-TMBZ	Xylene	Xylene (ortho)	1,1-DCA	cis-1,2-DCE	PCE	trans-1,2-DCE	TCE	VC	Total CVOCs[1]
			Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	Sample ID	WBZ	Sample Date																
Monitoring Wells																			
Fox Avenue																			
B-20A	B-20a-052617	1st WBZ	05/26/2017	6.97	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	30.5	1 U	1.39	0.5 U	11.7	43.59
B-21	B-21-052617	2nd WBZ	05/26/2017	5 U	6.1	1.08	5 U	1 U	8.21	1 U	1.12	1.01	1 U	1 U	1 U	1 U	0.5 U	0.2 U	
B-58	B-58-052517	1st WBZ	05/25/2017	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	114	1 U	1.87	0.5 U	52.2	168.07
B-58	Dup01-052517	1st WBZ	05/25/2017	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	127	1 U	1.73	0.5 U	58.9	187.63
B-60	B-60-052517	1st WBZ	05/25/2017	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	
B-61	B-61-052517	2nd WBZ	05/25/2017	5 U	1 U	1 U	5 U	1 U	1.01	1 U	1 U	1 U	1 U	2.98	1 U	1 U	0.5 U	25.5	28.48
Main Source Area																			
MW-15D	MW-15D-052517	2nd WBZ	05/25/2017	5 U	1 U	1.54	5 U	1 U	7.02	9.01	2.08	1.12	1 U	5.71	1 U	1.61	0.5 U	34.7	42.02
MW-16D	MW-16D-052417	2nd WBZ	05/24/2017	5 U	1 U	2.3	5 U	1 U	1 U	29.1	1.59	1.5	1 U	1 U	3.42	1 U	0.5 U	0.2 U	3.42
MW-17D	MW-17D-052517	2nd WBZ	05/25/2017	6.11	4.23	2.01	5 U	1 U	5.06	1 U	1.49	1 U	1 U	1 U	1 U	1 U	0.5 U	0.235	0.235
MW-18S	MW-18S-052517	1st WBZ	05/25/2017	5 U	1 U	1 U	77.7	1 U	1.6	1 U	4.08	3.91	5.12	261	15.6	1 U	4.95	179	465.67
Myrtle Street																			
B-33A	B-33a-052517	2nd WBZ	05/25/2017	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	3	1 U	1 U	1 U	0.5 U	2.09	5.09
B-64	B-64-052517	1st WBZ	05/25/2017	5 U	1 U	1 U	5 U	1 U	1.1	1 U	1 U	1 U	1 U	11.8	1 U	1 U	0.5 U	5.66	17.46
Northwest Corner																			
B-22	B-22-052517	1st WBZ	05/25/2017	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	74.4	51.5	1.89	38	9.66	175.45
NW 1-1	NW1-1-052517	1st WBZ	05/25/2017	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	235	1 U	1.07	0.5 U	34.9	272.88
Seattle Boiler Works																			
MW-06	MW-6-101217	2nd WBZ	10/12/2017	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	84.4	22.3	1.11	22.1	0.2 U	129.91
Whitehead																			
B-45	B-45-052417	2nd WBZ	05/24/2017	5 U	1 U	1 U	5 U	1 U	2.09	1 U	1 U	1.68	1 U	1 U	1 U	1 U	0.5 U	0.2 U	
B-49	B-49-052417	1st WBZ	05/24/2017	7.11	1 U	1 U	21.2	1 U	1 U	1 U	1 U	1 U	1 U	79.2	4.34	1 U	2.94	38.6	125.08
MW-07	MW-7-052417	1st WBZ	05/24/2017	33.7	1 U	1 U	66.9	1 U	1 U	1 U	1 U	1 U	1 U	115	15.5	1.49	34.7	4.13	170.82
MW-08	MW-8-052417	2nd WBZ	05/24/2017	25.9	1 U	1 U	33.6	1 U	2.29	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	
MW-09	MW-9-052417	1st WBZ	05/24/2017	6.88	1 U	1 U	36.8	1 U	1 U	1 U	1 U	1 U	1 U	160	17.6	7.24	6.47	437	628.31
MW-10	Dup-1-052417	2nd WBZ	05/24/2017	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	3.3	1 U	1 U	0.5 U	5.62	8.92
	MW-10-052417	2nd WBZ	05/24/2017	5.45	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	2.62	1 U	1 U	0.5 U	0.2 U	2.62
Injection Wells																			
Main Source Area																			
R0-IW2D	R0-IW02D-052517	2nd WBZ	05/25/2017	171	1 U	1 U	162	1 U	1 U	1 U	1 U	1 U	1 U	37.8	1 U	1.53	1.47	6.87	47.67
R0-IW6D	R0-IW06D-052517	2nd WBZ	05/25/2017	446	1 U	1 U	131	1 U	1 U	1 U	1 U	1 U	1 U	15.7	1 U	1 U	1.38	15.9	32.98
R0-IW9S	R0-IW09S-052517	1st WBZ	05/25/2017	7.06	1 U	1 U	5 U	1 U	1.07	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	
Myrtle Street																			
R2-IW3	R2-IW3-17-052517	2nd WBZ	05/25/2017	35.9	5.86	34.3	659	1.55	506	1.89	1 U	1.13	2.95	3.39	1 U	1 U	0.5 U	0.2 U	6.34
	R2-IW3-30-052517	2nd WBZ	05/25/2017	31.3	4.41	24.5	442	2.14	481	1.44	1 U	1.07	2.87	3.51	1 U	1 U	0.5 U	0.2 U	6.38
Seattle Boiler Works																			
R2-IW1	R2-IW1-17-101217	2nd WBZ	10/12/2017	83.3	1 U	1 U	1030	1 U	683	1 U	1 U	1 U	1 U	11.1	1 U	1 U	0.5 U	15	26.1
	R2-IW1-45-101217	2nd WBZ	10/12/2017	75.9	1 U	1 U	921	1 U	718	1 U	1 U	1 U	1 U	11.5	1 U	1 U	0.5 U	17.7	29.2
R2-IW10	R2-IW10-60-101217	1st WBZ	10/12/2017	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1.44	1 U	1 U	0.5 U	0.2 U	1.44

Table 3.1
Summary of Volatile Organic Compound Data in Groundwater

				Non-Chlorinated Volatile Organic Compounds									Chlorinated Volatile Organic Compounds						
			Analyte	Acetone	Benzene	EB	MEK	Naphthalene	Toluene	1,2,4-TMBZ	Xylene	Xylene (ortho)	1,1-DCA	cis-1,2-DCE	PCE	trans-1,2-DCE	TCE	VC	Total CVOCs[1]
			Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	**Sample ID**	**WBZ**	**Sample Date**																
Seep Data																			
S-2	SP-02-052617		05/26/2017	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	1.16	1.14	1 U	1 U	0.5 U	4.35	6.65
S-13 (Calibre S-3)	SP-03-052617		05/26/2017	5.4	6.01	2.6	5 U	3.16	1 U	1 U	1 U	1 U	2.11	10.6	1 U	1 U	0.5 U	13.3	26.01
S-3b	SP-03B-052617		05/26/2017	5 U	1 U	1 U	5 U	1.89	1 U	1 U	1 U	1 U	1 U	31.8	1 U	1.76	0.5 U	10.9	46.12

Notes:

1 Includes sum of all chlorinated compounds detected; total result may be slightly different than total CVOC concentrations shown on figures, which only include the sum of PCE, TCE, cis-1,2-DCE, and VC.

Abbreviations:

CVOC Chlorinated volatile organic compound
DCA Dichloroethane
DCE Dichloroethene
EB Ethylbenzene
µg/L Micrograms per liter
MEK Methyl ethyl ketone
PCE Tetrachloroethene
TCE Trichloroethene
TMBZ Trimethylbenzene
VC Vinyl chloride
WBZ Water bearing zone

Qualifier:

U Analyte is not detected at the associated reporting limit.

TABLE 4.1
GROUNDWATER DATA SUMMARY
MAIN SOURCE AREA
CASCADE COLUMBIA/FOX AVENUE

			Volatile Organic Compounds							Aquifer Redox Conditions								Donor Indicators				Other		VOCs- micromoles/Liter(b)						VOCs - Molar Fraction (d)						
Well	Date	Elapsed Time From Injection (days) (a)	Sum cVOCs (c) (µg/L)	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Iron II (mg/L)	Iron (T) (mg/L)	Iron (D) (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	TOC (mg/L)	Acetone (µg/L)	MEK (µg/L)	pH	Temp (deg C)	Comments	PCE	TCE	cDCE	VC	Ethene/ Ethane	Total Chloroethenes (d)	PCE	TCE	cDCE	VC	Ethene/ Ethane		Max
RO-IW01D	2/25/2014	-146	952	<1.01	91.0	854	6.65						0.8			4.2			3.41				44.4		0.00	0.69	8.8	0.11		9.6	0.00	0.07	0.92	0.01		1.00	0.92
RO-IW02D	2/25/2014	-146	2,808	649	1,000	1,090	68.7						2.0			38.9			6.45				25.6		3.9	7.6	11	1.1		24	0.16	0.32	0.47	0.05		1.00	0.47
	5/14/2014	-68	12	<1	0.77	10.9	<0.2	<5	<5	ND	0.41	-76.5	2.2			38.7	<0.5	0.131	2.60	<5	<5	9.39	28.3	Clear, low, no odor/no sheen	0.00	0.01	0.11	0.00	0.00	0.12	0.00	0.05	0.95	0.00	0.00	1.00	0.95
	6/20/2014	-31	12	<1	0.664	9.63	1.25				0.59	-72.9								<5	<5	6.76	24.3	Clear, low, no odor/no sheen	0.00	0.01	0.10	0.02		0.12	0.00	0.04	0.80	0.16		1.00	0.80
	10/22/2014	93	0.8	<1	<0.5	<1	0.75				3.34		7.5	953	890	699	<0.5		31.6	333	678	4.79	24.2	Cloudy, turbid, vomit-like smell, no sheen, well under very high pressure, water meter collected orange particulate and oil, effervescent	0.00	0.00	0.00	0.01		0.01	0.00	0.00	0.00	1.00		1.00	1.00
	1/8/2015	171	21	<1	0.63	13.1	7.41	<5	<5	ND	6.64		5.6	566	542	178	<0.5	0.432	2,180	139	174	4.79	19.5	Light orange, low-med turbidity, vomit like odor, no sheen, effervescent	0.00	0.00	0.14	0.12	0.00	0.26	0.00	0.02	0.52	0.46	0.00	1.00	0.52
	5/14/2015	297	129	<1	1.02	35.4	92.8				1.82	-96.0	5.0	642	650	162	2.40		2,500	188	285	9.77	15.1	Slightly turbid, colorless, no sheen, organic odor, slight effervescence	0.00	0.01	0.37	1.48		1.86	0.00	0.00	0.20	0.80		1.00	0.80
	9/29/2015	435	135	<1	0.87	64.2	69.8	28.8	24.3	<5	0.61	-28.4	5.6	823	870	241	<0.5	2.33	2,720	147	265	4.50	15.3	Clear, colorless, no sheen, strong vomit-like odor, effervescent	0.00	0.01	0.66	1.12	1.97	1.79	0.00	0.00	0.18	0.30	0.52	1.00	0.52
	5/10/2016	659	25	<1	0.770	14.2	9.84	<5	<5	<5	0.40	-71.6	1.5	218	210	0.472	0.500	1.65	736	18.0	50.9	4.79	18.7	Colorless, slight turbidity, slight sulfur-like odor, no sheen	0.00	0.01	0.15	0.16	0.00	0.31	0.00	0.02	0.47	0.51	0.00	1.00	0.51
	12/12/2016	875	43	<1	1.38	32.1	9.65	<5	<5		0.71	-43.7	3.2	332	336	4.89			927	1,930	91.9	4.93	9.8	Very turbid, grayish color, injection fluid odor, slight sheen	0.00	0.01	0.33	0.15	0.00	0.50	0.00	0.02	0.67	0.31	0.00	1.00	0.67
	5/25/2017	1039	46	<1	1.47	37.8	6.87	16.7	7.4	<5	4.90	37.6	3.0			<6.00	<0.500	6.82	1740	171	162	4.80	13.4	Clear, colorless, very rotten odor, no sheen	0.00	0.01	0.39	0.11	0.91	0.51	0.00	0.01	0.28	0.08	0.64	1.00	0.64
RO-IW03D	2/25/2014	-146	369	109	171	84.3	4.88						2.4			14.3			3.16				21.7		0.66	1.3	0.87	0.08		2.9	0.23	0.45	0.30	0.03		1.00	0.45
RO-IW04S	2/25/2014	-337	742	<1.00	2.25	734	5.84						1.6			6.0			19.7				57.2		0.00	0.02	7.6	0.09		7.7	0.00	0.00	0.99	0.01		1.00	0.99
RO-IW04D	2/25/2014	-146	192	<1.00	<0.500	191	1.06						1.8			0.5			8.31				48.3		0.00	0.00	2.0	0.02		2.0	0.00	0.00	0.99	0.01		1.00	0.99
RO-IW05S	2/25/2014	-337	385	<1.00	<0.500	381	3.51						0.4			<0.300			53.5				52.8		0.00	0.00	3.9	0.06		4.0	0.00	0.00	0.99	0.01		1.00	0.99
RO-IW05D	2/25/2014	-146	50	<1.00	1.46	27.1	21.6						1.4			16.9			4.11				39.4		0.00	0.01	0.28	0.35		0.64	0.00	0.02	0.44	0.54		1.00	0.54
RO-IW06S	3/3/2014	-331	856	<1.00	3.23	849	3.55						1.6			<0.300			27.0				52.2		0.00	0.02	8.8	0.06		8.8	0.00	0.00	0.99	0.01		1.00	0.99
RO-IW06D	2/25/2014	-146	1,219	<1.00	<0.500	598	621						0.2			16.2			9.83				29.4		0.00	0.00	6.2	9.9		16	0.00	0.00	0.38	0.62		1.00	0.62
	5/14/2014	-68	8.1	<1	<0.5	2.95	5.18	<5	<5	ND	0.05	-107.0	0.0			35.4	<0.5	0.380	3.81	<5	<5	6.92	33.1	Clear, low, no odor/no sheen, effervescent	0.00	0.00	0.03	0.08	0.00	0.11	0.00	0.00	0.27	0.73	0.00	1.00	0.73
	10/23/2014	94	8.7	<1	0.72	<1	8				1.74	-45.2	3.2	1,390	1,480	1,360	<0.5		26.7	1,130	647	4.76	27.6	Cloudy, light orange, moderate turbidity, vomit-like odor, NS, orange particulate on probe, well under pressure, effervescent	0.00	0.01	0.00	0.13		0.13	0.00	0.04	0.00	0.96		1.00	0.96
	1/8/2015	171	27	<1	1.28	10.0	15.3	<5	<5	ND	1.91	-23.4	2.4	807	821	860	5.20	0.837	2,810	332	218	4.83	26.1	Orange, low-med turbidity, vomit like odor, no sheen, orange particles, effervescent	0.00	0.01	0.10	0.24	0.00	0.36	0.00	0.03	0.29	0.68	0.00	1.00	0.68
	5/14/2015	297	174	<50	32.5	96	45						0.8	849	1,030	974	16.8		5,070	558	<250			Orange, oily, organic, vomit-like odor, no sheen	0.00	0.25	0.99	0.72		1.96	0.00	0.13	0.51	0.37		1.00	0.51
	9/28/2015																						21.6	Orange, oily, vomit-like odor, no sheen; oil content too high for lab to analyze as a water sample													
	5/10/2016	659	22	<1	1.92	8.71	11.0	<5	<5	<5	0.37	-80.0	2.0	501	488	75.9	0.700	0.616	1,250	311	85.1	4.7	19.0	Yellowish, high turbidity, sour odor, no sheen	0.00	0.01	0.09	0.18	0.00	0.28	0.00	0.05	0.32	0.63	0.00	1.00	0.63
	12/12/2016	875	40	<1	3.49	16.7	19.5	<5	<5		0.67	-159.2	3.6	557	580	49.6			1,030	<5	101	5.3	11.8	Clear with suspended particles, colorless, injection fluid odor, slight sheen	0.00	0.03	0.17	0.31	0.00	0.51	0.00	0.05	0.34	0.61	0.00	1.00	0.61
	5/25/2017	1039	33	<1	1.38	15.7	15.9	<5	<5	<5	4.30	-20.8	3.8			185	3.20	4.59	1,780	446	131	5.1	15.5	Clear with some suspended solids, colorless, rotten odor, no sheen	0.00	0.01	0.16	0.25	0.00	0.43	0.00	0.02	0.38	0.60	0.00	1.00	0.60
RO-IW07S	2/26/2014	-336	505	<1.00	3.83	499	1.88						0.8			<0.300			25.4				54.4		0.00	0.03	5.1	0.03		5.2	0.00	0.01	0.99	0.01		1.00	0.99
RO-IW07D	2/26/2014	-145	359	147	116	74.3	21.3						2.0			4.12			4.93				20.6		0.89	0.88	0.77	0.34		2.9	0.31	0.31	0.27	0.12		1.00	0.31
RO-IW08S	2/26/2014	-336	799	58.3	55.2	677	8.08						0.2			156			131				52.8		0.35	0.42	7.0	0.13		7.9	0.04	0.05	0.89	0.02		1.00	0.89
RO-IW08D	2/26/2014	-145	1,466	<1.01	3.17	1,090	373						1.4			2.5			6.98				41.7		0.00	0.02	11	6.0		17	0.00	0.00	0.65	0.35		1.00	0.65
RO-IW09S	2/26/2014	-336	800	56.9	34.0	704	5.57						0.2			29.0			30.5				48.9		0.34	0.26	7.3	0.09		8.0	0.04	0.03	0.91	0.01		1.00	0.91
	5/14/2014	-259	835	105	66.6	657	6.35	<5	<5	ND	0.11	-130.2	0.2			31.9	<0.5	1.08	13.6	<5	<5	9.68	41.2	Slight amber color, low turb, no odor/no sheen, effervescent	0.63	0.51	6.8	0.10	0.00	8.02	0.08	0.06	0.85	0.01	0.00	1.00	0.85
	5/13/2015	105	106	<1	0.66	88.8	16.6				1.85	-76.9	3.8	1,120	1,270	1,550	24.8		23.3	31,100	4,030	5.45	21.8	Clear, grayish color, organic decaying odor, no sheen, very effervescent	0.00	0.01	0.9	0.27		1.19	0.00	0.00	0.77	0.22		1.00	0.77
	9/28/2015	243	14	<1	<0.5	11	2.71	20.8	22.3	<5	0.10	-62.0	3.4	101	87.3	2.83	<0.5	2.09	75.6	11.5	<5	6.90	25.2	Turbid, vomit-like odor, no sheen, slightly effervescent	0.00	0.00	0.1	0.04	1.59	0.16	0.00	0.00	0.06	0.02	0.91	1.00	0.91
	5/10/2016	468	ND	<1	<0.5	<1	<0.2	<5	<5	<5	0.03	-140.0	1.4	97.8	89.4	0.355	<2.5	2.73	67.4	<5	<5	6.45	19.3	Clear, colorless, organic odor, no sheen, slight effervescence													
	12/13/2016	685	1.0	<1	<0.5	1.01	<0.2	<5	<5		0.52	-142.9	2.2	78.3	62.8	2.94			99.4	<5	<5	6.69	10.4	Slightly turbid with suspended particles, grayish tint, injection fluid odor, no sheen	0.00	0.00	0.0	0.00	0.00	0.01	0.00	0.00	1.00	0.00	0.00	1.00	1.00
	5/25/2017	848	ND	<1	<0.5	<1	<0.2	<5	<5	<5	2.00	-113.1	3.4			2.42	2.80	5.89	146	7.06	<5	6.30	19.7	Clear, colorless, rotten odor, no sheen (very effervescent)													
RO-IW09D	2/26/2014	-145	2,593	<1.01	<0.500	363	2,230						1.8			2.9			33.9				27.8		0.00	0.00	3.7	36		39	0.00	0.00	0.09	0.91		1.00	0.91
RO-IW10S	2/26/2014	-336	543	17.3	7.66	513	4.82						1.2			41.7			15.6				48.9		0.10	0.06	5.3	0.08		5.5	0.02	0.01	0.96	0.01		1.00	0.96
RO-IW10D	2/26/2014	-145	1,929	<1.01	<0.500	169	1,760						1.6			1.2			7.43				31.1		0.00	0.00	1.7	28		30	0.00	0.00	0.06	0.94		1.00	0.94
RO-IW11S	3/3/2014	-331	536	1.88	21.4	510	2.50						0.0			11.2			17.2				43.9		0.01	0.16	5.3	0.04		5.5	0.00	0.03	0.96	0.01		1.00	0.96

TABLE 4.1
GROUNDWATER DATA SUMMARY
MAIN SOURCE AREA
CASCADE COLUMBIA/FOX AVENUE

			Volatile Organic Compounds								Aquifer Redox Conditions								Donor Indicators				Other		VOCs- micromoles/Liter(b)						VOCs - Molar Fraction (d)						
Well	Date	Elapsed Time From Injection (days) (a)	Sum cVOCs (c) (µg/L)	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Iron II (mg/L)	Iron (T) (mg/L)	Iron (D) (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	TOC (mg/L)	Acetone (µg/L)	MEK (µg/L)	pH	Temp (deg C)	Comments	PCE	TCE	cDCE	VC	Ethene/ Ethane	Total Chloroethenes (d)	PCE	TCE	cDCE	VC	Ethene/ Ethane		Max
RO-IW11D	2/26/2014	-145	593	<1.00	<0.500	7.80	585						2.0			0.4			4.93				32.2		0.00	0.00	0.08	9.36		9.4	0.00	0.00	0.01	0.99		1.00	0.99
MW-9S	5/14/2014	-259	1,210	11.8	162	1,000	36.4	<5	<5	ND	0.19	-116.1	2.0			39.9	<0.5	1.32	49.8	<5	<5	8.76	44.6	Clear, low turb, no odor/no sheen, effervescent	0.07	1.2	10	0.58	0.00	12	0.01	0.10	0.85	0.05	0.00	1.00	0.85
	5/15/2015	107	1,127	114	35.1	566	412				0.09	-233.3	2.0	6.83	7.01	41.8	<0.5		43.1	<5	<5	6.65	30.3	Clear, colorless, no sheen, organic decay odor, effervescent	0.69	0.3	6	6.59		13	0.05	0.02	0.44	0.49		1.00	0.49
	9/30/2015	245	1,230	130	84.1	856	160	34.7	25.4	<5	0.67	-15.9	4.0	9.03	7.35	23.6	<0.5	1.83	22.7	<5	<5	7.02	30.1	Clear, yellowish, no sheen, slight diesel-like odor	0.78	0.6	9	2.56	2.24	13	0.05	0.04	0.59	0.17	0.15	1.00	0.59
	1/4/2016	341	1,394	54.8	37.8	835	466	20.1	8.13	ND	0.26	-122.4	1.6	13.2	13.7	27.5	<0.500	2.05	16.9	<5.00	<5.00	6.86	24.4	Clear, slight yellow color, no sheen, slight petroleum-like odor	0.33	0.3	9	7.46	1.06	17	0.02	0.02	0.49	0.42	0.06	1.00	0.49
	5/11/2016	469	1,235	55.5	48.5	313	818	<5	<5	<5	0.12	-136.7	2.0	12	10.8	15.4	<0.5	3.18	18.4	<5	<5	6.53	21.8	Clear, colorless, no odor, no sheen	0.33	0.4	3	13.09	0.00	17	0.02	0.02	0.19	0.77	0.00	1.00	0.77
	12/12/2016	684	984	42.5	56.5	467	418				2.68	-40.9	2.6							<5	<5	5.48	14.9	Clear, colorless, no odor, no sheen	0.26	0.4	5	6.69	0.00	12	0.02	0.04	0.40	0.55	0.00	1.00	0.55
	5/24/2017	847	621	17.6	6.47	160	437	27.8	17.1	<5	2.70	-58.6	1.6			1.67	1.2	1.82	101	6.88	36.8	6.00	16.5	Clear, colorless, rotten odor, no sheen	0.11	0.0	2	6.99	1.68	9	0.01	0.00	0.16	0.67	0.16	1.00	0.67
MW-10D (75 ft DG)	5/14/2014	-68	7,794	<1	<0.5	7,520	274	17.1	<5	ND	0.00	-86.2	1.8			<0.3	<0.5	2.17	45.8	9.27	<5	6.48	30.8	Slight amber color, low turb, no odor/no sheen, effervescent	0.00	0.00	78	4.4	0.66	82	0.00	0.00	0.94	0.05	0.01	1.00	0.94
	10/22/2014	93	8,308	5.5	2.46	6,670	1,630				0.32	-131.7	2.6	4.58	3.43	<1.50	<0.5		20.0	<5	<5	6.58	41.3	Clear, low turbidity, egg like odor, no sheen, effervescent	0.03	0.02	69	26		95	0.00	0.00	0.72	0.27		1.00	0.72
	1/9/2015	172	5,636	5.03	1.21	4,190	1,440	37	<5	ND	0.43	-104.7	3.6	8.65	7.96	<1.50	<0.5	1.42	21.6	<5	<5	6.27	39.6	Slight sulfur like odor	0.03	0.01	43	23	1.4	66	0.00	0.00	0.64	0.34	0.02	1.00	0.64
	5/15/2015	298	2,032	2.89	<0.5	1,560	469				0.15	-188.4	4.2	10.8	10.7	<1.5	<0.5		21	<5	<5	6.41	37.1	Slightly turbid, colorless, no sheen, rotten egg-like odor	0.02	0.00	16	8		24	0.00	0.00	0.68	0.32		1.00	0.68
	9/30/2015	436	915	1.57	<0.5	131	782	38.3	25.8	<5	0.12	-85.4	4.8	12.4	11.6	1.52	<0.5	2.03	9.48	<5	24	6.18	29.6	Clear, colorless, no sheen, slight diesel-like odor, slight effervescence	0.01	0.00	1	13	2.4	14	0.00	0.00	0.08	0.77	0.15	1.00	0.77
	1/4/2016	532	1,355	1.34	<0.500	34.0	1320	28.4	10.5	ND	0.13	-73.2	0.8	9.49	8.79	7.40	<0.500	3.32	7.56	<5.00	<5.00	6.07	21.6	Clear, colorless, no sheen, slight petroleum-like odor	0.01	0.00	0	21	1.5	21	0.00	0.00	0.02	0.92	0.06	1.00	0.92
	5/11/2016	660	107	1.04	0.600	26.6	78.8	<5	<5	<5	0.19	-121.9	1.8	6.61	6.5	44.4	<0.5	3.97	12.9	<5	<5	6.16	27.5	Clear, colorless, some black suspended solids, no sheen, slight effervescence	0.01	0.00	0	1	0.0	2	0.00	0.00	0.18	0.82	0.00	1.00	0.82
	12/12/2016	875	ND	<1	<0.5	<1	<0.2				2.42	-179.8	2.0							28.8	<5	6.48	17.7	Clear with some suspended particles, colorless, no odor, no sheen													
	5/24/2017	1038	3	<1	<0.5	2.62	<0.2	<5	31.5	<5	1.20	-67.1	1.4			69.1	<0.5	7.23	39.1	5.45	<5	6.52	18.8	Clear, colorless, no odor, no sheen	0.00	0.00	0	0	1.1	0	0.00	0.00	0.02	0.00	0.98	1.00	0.98
MW-15D (between IW)	5/14/2014	-68	967	150	118	578	121	<5	<5	ND	0.03	-93.8	0.0			7.35	<0.5	1.63	12.8	<5	<5	7.12	30.7	Clear, low turb, no odor/no sheen, effervescent	0.90	0.90	6.0	1.9	0.00	9.7	0.09	0.09	0.61	0.20	0.00	1.00	0.61
	10/23/2014	94	927	1.28	<0.5	<1	926				0.28	-159.3	5.4	13.8	13	<3	<0.5		2.31	646	880	6.58	25.3	Clear, low turbidity, vomit odor, no sheen, effervescent	0.01	0.00	0.00	15		15	0.00	0.00	0.00	1.00		1.00	1.00
	1/8/2015	171	6,514	1.24	<0.5	2.64	6,510	875	23.9	ND	2.41	-126.9	3.0	18.5	17.1	<3	0.800	2.60	359	779	647	6.63	20.3	Amber (initially) to gray, low, slight vomit odor, no sheen, effervescent	0.01	0.00	0.03	104	34	104	0.00	0.00	0.00	0.75	0.25	1.00	0.75
	5/14/2015	297	24	<1	<0.5	<1	23.8				1.68	-118.3	1.8	17.6	16.8	<60	6.8		222	616	235	9.16	18.3	Slightly turbid, yellow, no sheen, very effervescent, organic odor	0.00	0.00	0.00	0		0	0.00	0.00	0.00	1.00		1.00	1.00
	9/29/2015	435	0.41	<1	<0.5	<1	0.405	56.8	66.7	<5	0.95	-169.3	2.6	15.1	16.4	1.05	<0.5	4.75	157	526	160	6.91	15.3	Lightly turbid, colorless at first then turned yellow and black (preservative dependent), no sheen, slight diesel-like odor, very effervescent	0.00	0.00	0.00	0	5	0	0.00	0.00	0.00	0.0014	1.00	1.00	1.00
	1/4/2016	532	3.6	<1.00	<0.500	<1.00	3.55	30.9	71.4	ND	0.45	-124.0	1.0	12.9	12.4	0.543	<1.00	5.93	85.6	60.6	30.9	7.03	14.0	Clear, green to yellow (depending on preservative), no sheen, organic odor, very effervescent	0.00	0.00	0.00	0	4	0	0.00	0.00	0.00	0.01	0.99	1.00	0.99
	5/10/2016	659	10	<1	<0.5	1.40	8.64	28.1	99.4	<5	0.91	-74.2	1.6	9.55	7.72	0.862	0.6	9.47	64.4	<5	<5	6.06	16.0	Clear, colorless, petroleum-like odor, foamy	0.00	0.00	0.01	0	5	0	0.00	0.00	0.00	0.03	0.97	1.00	0.97
	12/12/2016	875	18	<1	<0.5	18.2	<0.2	45.9	272		0.37	-263.1	1.8	28.6	21.9	163			101	5,880	<5	6.60	13.0	Clear with suspended particles, grayish/black color, injection fluid odor, no sheen, very effervescent	0.00	0.00	0.19	0	11	0	0.00	0.00	0.02	0.00	0.98	1.00	0.98
	5/25/2017	1039	40	<1	<0.5	5.71	34.7	20.7	229	<5	2.40	-91.6	1.6			9.10	5	5.04	87.5	<5	<5	6.86	13.4	Clear with many suspended particles, colorless, slight injection odor, no sheen, slight effervescent	0.00	0.00	0.06	1	9	1	0.00	0.00	0.01	0.06	0.94	1.00	0.94
MW-16D	5/14/2014	-68	6,840	<1	<0.5	4,600	2,240	86.2	20.1	ND	0.17	-84.3	0.2			43	<0.5	1.760	7.4	<5	<5	9.85	35.9	Clear, low turb, no odor/no sheen, effervescent	0.00	0.00	47	36	4.03	83	0.00	0.00	0.54	0.41	0.05	1.00	0.54
(35 ft DG)	10/23/2014	94	2,750	1.42	8.11	1,660	1,080				0.66	-186.7	4.0	76	80.5	102	2.5		16	1,750	<5	5.96	30.2	Pumped out clear but turned gray over time, low-medium turbidity, egg odor, no sheen, effervescent	0.01	0.06	17	17		34	0.00	0.00	0.50	0.50		1.00	0.50
	1/8/2015	171	6,681	1.99	8.51	2,460	4,210	71.6	<5	ND	2.17	-122.0		138	107	31	0.800	0.702	1,010	961	1,690	5.98	28.3	Clear, low, slight vomit odor, no sheen	0.01	0.06	25	67	2.8	93	0.00	0.00	0.27	0.70	0.03	1.00	0.70
	5/13/2015	296	78	<1	<0.5	2.57	75.8				0.12	-173.3	2.4	74.2	35.3	<60	<0.5		472	932	538	6.74	25.7	Clear, colorless, no sheen, decaying organic odor, very effervescent	0.00	0.00	0	1		1.2	0.00	0.00	0.02	0.98		1.00	0.98
	9/28/2015	434	1.7	<1	<0.5	1.37	0.328	37.9	51.8	<5	0.09	-21.5	3.6	73.9	67.6	1.14	<0.5	2.72	37.3	209	185	6.7	23.6	Clear, colorless, no sheen, slight organic odor, no sheen, slightly effervescent	0.00	0.00	0	0	3.3	0.0	0.00	0.00	0.004	0.002	0.99	1.00	0.99
	1/4/2016	532	0.57	<1.00	<0.500	<1.00	0.570	<5	37.5	ND	0.15	-103.9	2.4	61.4	58.5	<0.600	<0.500	4.25	8.53	14.4	<5.00	6.18	17.2	Clear, colorless, slight petroleum-like odor, no sheen, effervescent	0.00	0.00	0	0	1.3	0.0	0.00	0.00	0.000	0.007	0.99	1.00	0.99
	5/10/2016	659	ND	<1	<0.5	<1	<0.2	<5	<5	<5	0.22	-87.9	2.0	40.9	37.8	0.285	<0.5	6.92	4.35	<5	<5	6.23	17.9	Clear, colorless, no sheen, slight rotten egg-like odor, slight effervescence													
	12/13/2016	876	18	8.39	2.86	6.84	<0.2	<5	15.2		1.08	-150.9	2.6	29.9	27.3	2.59			43.7	<5	<5	6.53	15.3	Clear, colorless, injection fluid odor, no sheen, slight effervescence	0.05	0.02	0	0	0.5	0.1	0.07	0.03	0.103	0.000	0.79	1.00	0.79
	5/24/2017	1038	3	3.42	<0.5	<1	<0.2	<5	105	<5	2.40	-44.9	2.2			<3	<0.5	13.0	54.2	<5	<5	6.27	16.3	Clear with some suspended particles, colorless, no odor, no sheen (effervescent)	0.02	0.00	0	0	3.7	0.0	0.01	0.00	0.000	0.000	0.99	1.00	0.99
MW-17D	5/14/2014	-68	124	<1	0.738	69.3	53.5	6.11	<5	ND	0.19	-79.8	0.6			0.823	<0.5	3.29	40.9	<5	<5	9.79	42.5	Clear, low turb, no odor/no sheen, effervescent	0.00	0.01	0.71	0.86	0.23	1.6	0.00	0.00	0.39	0.47	0.13	1.00	0.47
(35 ft DG)	10/23/2014	94	21	<1	<0.5	3.99	17.4				0.29	-144.2	2.2	0.992	0.711	<1.50	<0.5		17.5	<5	<5	6.92	34.8	Clear to very slight yellow, low turbidity, slight egg odor, no sheen, effervescent	0.00	0.00	0.04	0.28		0.32	0.00	0.00	0.13	0.87		1.00	0.87
	1/8/2015	171	25	<1	<0.5	2.75	21.8	<5	<5	ND	0.65	-170.2	4.2	1.15	1.02	<1.50	0.800	3.31	21.2	<5	<5	6.88	33.0	Clear, low, very slight sulfur odor, NS, effervescent	0.00	0.00	0.03	0.35	0.00	0.38	0.00	0.00	0.08	0.92	0.00	1.00	0.92
	5/15/2015	298	7.1	<1	<0.5	1.11	6.01				0.08	-229.1	2.4	1.86	2.19	<1.5	1.60		21	<5	<5	7.03	31.1	Slightly turbid, yellow, no sheen, effervescent, organic odor	0.00	0.00	0.01	0.10		0.11	0.00	0.00	0.11	0.89		1.00	0.89
	9/29/2015	435	2.6	<1	<0.5	<1	2.56	<5	24.4	<5	0.28	-138.2	1.8	2.25	1.90	0.908	<0.5	3.72	10.9	<5	<5	6.97	29.3	Slightly turbid, colorless to yellow in air, no sheen, slight egg-like odor, slight effervescence	0.00	0.00	0.00	0.04	0.87	0.04	0.00	0.00	0.00	0.04	0.96	1.00	0.96
	1/5/2016	533	0.78	<1.00	<0.500	<1.00	0.780	<5	104	ND	0.07	-127.0	1.6	12.7	12.5	<0.600	<0.500	2.57	42.7	<5.00	<5.00	6.42	25.0	Clear, yellow, no sheen, organic odor, effervescent	0.00	0.00	0.00	0.01	3.71	0.01	0.00	0.00	0.00	0.00	1.00	1.00	1.00
	5/11/2016	660	2.1	<1	<0.5	<1	2.13	<5	45.1	<5	0.11	-107.5	3.4	19.1	18.7	<1.5	<0.5	4.39	49.7	<5	<5	6.5	26.7	Greenish yellow, clear, no sheen, organic odor, effervescent	0.00	0.00	0.00	0.03	1.61	0.03	0.00	0.00	0.00	0.02	0.98	1.00	0.98
	12/13/2016	876	ND	<1	<0.5	<1	<0.2	<5	38.1		0.47	-141.7	1.2	23	20.6	14.7			121	<5	<5	6.94	17.1	Clear, yellow tint, injection fluid odor, no sheen, foamy													
	5/25/2017	1039	0.2	<1	<0.5	<1	0.235	<5	80.7	<5	2.30	-87.7	1.2			<6	0.800	15.1	153	6.11	<5	6.33	18.4	Clear, colorless, slight rotten odor, no sheen (very effervescent)	0.00	0.00	0.00	0.00	2.88	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00

TABLE 4.1
GROUNDWATER DATA SUMMARY
MAIN SOURCE AREA
CASCADE COLUMBIA/FOX AVENUE

			Volatile Organic Compounds								Aquifer Redox Conditions								Donor Indicators				Other		VOCs- micromoles/Liter(b)						VOCs - Molar Fraction (d)						
Well	Date	Elapsed Time From Injection (days) (a)	Sum cVOCs (c) (µg/L)	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	DO (mg/L)	ORP (mV)	Iron II (mg/L)	Iron (T) (mg/L)	Iron (D) (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)	TOC (mg/L)	Acetone (µg/L)	MEK (µg/L)	pH	Temp (deg C)	Comments	PCE	TCE	cDCE	VC	Ethene/ Ethane	Total Chloroethenes (d)	PCE	TCE	cDCE	VC	Ethene/ Ethane		Max
MW-18S	5/15/2014	-258	912	145	50.1	712	4.71	<5	<5	ND	0.00	47.3	0.0			239	<0.5	0.271	89.2	29.3	<5	7.05	47.0	Slightly cloudy, low turb, no odor/no sheen, effervescent	0.87	0.38	7.3	0.08	0.00	8.7	0.10	0.04	0.85	0.01	0.00	1.00	0.85
(between IWs)	10/22/2014	-98	1,952	17.7	23.2	1,870	41.4				0.20	-200.4								<5	<5	6.99	39.0	Slight amber color, low turbidity, slight egg odor, NS, effervescent	0.11	0.18	19	0.66		20	0.01	0.01	0.95	0.03		1.00	0.95
	5/14/2015	106	208	1.4	0.74	82.8	123				0.16	-203.3	1.2	1.45	1.51	158	3.60		154	14.1	<5	5.96	28.7	Clear, slightly yellow, effervescent, organic odor, no sheen	0.01	0.01	1	1.97		3	0.00	0.00	0.30	0.69		1.00	0.69
	9/28/2015	243	119	3.19	1.1	48.5	66	25.6	25.8	<5	0.07	-28.4	3.0	3.53	3.33	361	<0.5	2.51	125	5.36	<5	7.20	25.5	Clear, yellowish, slight diesel-like odor, no sheen, slightly effervescent	0.02	0.01	1	1.06	1.90	2	0.01	0.00	0.14	0.30	0.55	1.00	0.55
	1/4/2016	341	75	1.96	<0.500	25.3	47.7	<5	7.5	ND	0.32	-134.2	1.6	1.92	2.26	209	<0.500	2.37	82.8	<5.00	<5.00	7.28	19.8	Clear, yellow, slight petroleum-like odor, slight effervescence	0.01	0.00	0	0.76	0.27	1	0.01	0.00	0.20	0.59	0.21	1.00	0.59
	5/10/2016	468	240	4.29	0.810	26.3	209	<5	<5	<5	0.29	-96.3	1.6	4.87	4.53	152	<0.5	3.59	74.4	<5	<5	6.59	19.7	Clear, colorless, no sheen, slight organic odor, slight effervescence	0.03	0.01	0	3.34	0.00	4	0.01	0.00	0.07	0.92	0.00	1.00	0.92
	12/13/2016	685	904	3.01	2.82	387	511	<5	<5		0.34	-163.8	1.8	6.26	5.98	207			80.4	<5	<5	7.15	11.9	Clear with suspended particules, brown/yellow tint, rotten odor, no sheen	0.02	0.02	4	8.18	0.00	12	0.00	0.00	0.33	0.67	0.00	1.00	0.67
	5/25/2017	848	461	15.6	4.95	261	179	27.2	6.37	<5	2.16	-255.7	0.8			29	17.4	5.54	278	<5	77.7	6.74	14.4	Clear, slight yellow tint, rotten odor, no sheen	0.09	0.04	3	2.86	1.27	6	0.01	0.01	0.39	0.41	0.18	1.00	0.41
B-20AS	6/20/2014	-222	1,394	<1	11.5	1,280	102	21.6	<5	<5	0.13	-101.8	3.0			10.3	<0.5	4.39	36.1	5.69	<5	6.62	39.3	Clear, low turb, no odor, no sheen	0.00	0.09	13	1.6	0.83	15	0.00	0.01	0.84	0.10	0.05	1.00	0.84
	5/13/2015	105	1,477	<1	5.23	1,410	61.5				0.08	-208.7	2.8	7.51	6.94	25.9	<0.5		39.9	<5	<5	6.86	30.7	Clear, slightly yellow, no sheen, petroleum-like odor	0.00	0.04	15	1.0		16	0.00	0.00	0.93	0.06		1.00	0.93
	9/29/2015	244	1,151	<1	<0.5	972	179				0.05	-56.8	3.0	8.21	7.81	21.3	<0.5		31.5	<5	<5	6.88	32.4	Clear, colorless, no sheen, slight diesel-like odor	0.00	0.00	10	2.9		13	0.00	0.00	0.78	0.22		1.00	0.78
	1/5/2016	342 (e)	69	<1.00	<0.500	36.5	32.6				0.29	13.8	2.0	14.0	14.9	37.9	<0.500		5.73	<5.00	<5.00	6.05	19.7	Clear, colorless, no odor, no sheen, effervescent	0.00	0.00	0	0.5		1	0.00	0.00	0.42	0.58		1.00	0.58
	5/5/2016	463	165	<1	<0.5	93.5	71.5	<5	<5	<5	0.31	-54	6.0	16.8	6.33	44.0	<0.5	1.03	8.08	<5	<5	5.99	23.2		0.00	0.00	1	1.1		2	0.00	0.00	0.46	0.54		1.00	0.54
	12/16/2016	688	14	<1	<0.5	3.42	10.7				0.80	4				28.9				<5	<5	5.9	18.7		0.00	0.00	0	0.2		0	0.00	0.00	0.17	0.83		1.00	0.83
	5/26/2017	849	42	<1	<0.500	30.5	11.7				3.47	-102				21.8				6.97	<5	6.44	19.0	reducing odor, sediment in purge water initially	0.00	0.00	0	0.2		1	0.00	0.00	0.63	0.37		1.00	0.63
B-21D	6/20/2014	-31	3.2	<1	<0.5	3.24	<0.2	<5	36.5	<5	0.21	-61.6	2.6			<1.50	<0.5	5.75	9.13	7.06	<5	6.42	33.4	Dark gray, moderately high, fermented sugar water odor, no sheen	0.00	0.00	0.03	0.00	1.3	0.03	0.00	0.00	0.03	0.00	0.97	1.00	0.97
	5/13/2015	296	290	<1	<0.5	4.06	286				0.53	-111.4	3.0	46	22.7	<1.5	4.8		21.3	<5	<5	6.49	30.9	Clear, turned dark gray, moderate turbidity, pungent, unbearable smell, no sheen	0.00	0.00	0.04	4.58		4.62	0.00	0.00	0.01	0.99		1.00	0.99
	9/29/2015	435	41	<1	<0.5	<1	41.4	77.5	77.1	<5	0.21	-117.4	3.4	30.1	21.8	20.1	<1	2.69	12.3	<5	<5	6.24	32.1	Clear, yellow to gray in oxygen, effervescent, black floating solids, no sheen, diesel-like odor	0.00	0.00	0.00	0.66	5.7	0.66	0.00	0.00	0.00	0.10	0.90	1.00	0.90
	1/5/2016	533 (e)	50	<1.00	<0.500	<1.00	50.0	36.1	18.9	ND	0.13	-136.5	2.7	19.9	14.4	26.2	<0.500	3.73	9.36	<5.00	<5.00	6.43	24.1	Slight turbidity, gray solids in sample, no sheen, petroleum-like odor	0.00	0.00	0.00	0.80	2.1	0.80	0.00	0.00	0.00	0.28	0.72	1.00	0.72
	5/5/2016	654	68	<1	<0.5	<1	67.8	128	22.7	<5	0.24	-60	0.5	81.8	11	<1.5	3.00	1.76	16.8	<5	<5	5.77	28.9		0.00	0.00	0.00	1.08	5.7	1.08	0.00	0.00	0.00	0.16	0.84	1.00	0.84
	12/16/2016	879	38	<1	<0.5	<1	38.4				1.35	27				2.29				27.3	12.8	5.12	18.6		0.00	0.00	0.00	0.61	0.0	0.61	0.00	0.00	0.00	1.00	0.00	1.00	1.00
	5/26/2017	1040	ND	<1	<0.5	<1	<0.2				0.79	-102								<5	<5	6.07	26.2	reducing odor, sediment in purge water initially	0.00	0.00	0.00	0.00	0.0	0.00							
B-45D	5/14/2014	-68	2,029	<1	0.830	998	1,030	35.6	10	ND	0.00	-80.9	1.8			26.1	<0.5	1.37	9.36	<5	<5	6.34	34.3	Clear, moderately low turb, no odor/no sheen, effervescent	0.00	0.01	10	16	1.7	27	0.00	0.00	0.36	0.58	0.06	1.00	0.58
(75 ft DG)	10/22/2014	93	17,975	1.55	3.03	7,270	10,700				0.32	-140.7	5.6	8.78	7.56	3.35	<0.5		6.1	<5	<5	6.56	31.5	Clear, low turbidity, egg odor, no sheen, effervescent	0.01	0.02	75	171		246	0.00	0.00	0.30	0.70		1.00	0.70
	1/9/2015	172	5,092	<1	2.26	1,870	3,220	392	19.9	ND	0.42	-106.4	2.3	8.25	7.25	11.5	<0.5	1.21	7.73	<5	<5	6.57	30.5	Clear, low, slight sulfur odor, no sheen	0.00	0.02	19	52	16	71	0.00	0.00	0.22	0.59	0.18	1.00	0.59
	5/13/2015	296	3,882	<1	2.05	1,660	2,220				0.34	-142.4	2.4	12.7	11.4	2.21	<0.5		5.43	<5	<5	6.8	28.6	Clear, colorless, no sheen, petroleum-like odor	0.00	0.02	17	36		53	0.00	0.00	0.33	0.67		1.00	0.67
	9/30/2015	436	215	1.38	0.53	49	164	75.2	137	<5	0.14	-118.5	3.6	23.9	21.6	2.97	<0.5	3.23	3.87	<5	<5	6.38	27.2	Clear, colorless, no sheen, very slight diesel-like odor, slight effervescence	0.01	0.00	1	3	8	3	0.00	0.00	0.05	0.24	0.71	1.00	0.71
	1/5/2016	533	68	1.53	<0.500	6.91	59.5	<5	86.2	ND	0.10	-107.0	1.6	38.0	32.9	1.04	<0.500	3.40	3.99	<5.00	<5.00	6.34	24.1	Clear, colorless, no sheen, slight petroleum-like odor, slight effervescence	0.01	0.00	0	1	3	1	0.00	0.00	0.02	0.23	0.75	1.00	0.75
	5/11/2016	469	5.9	<1	<0.5	<1	5.92	<5	40.3	<5	0.13	-100.4	2.0	49.1	44.3	1.28	<0.5	7.63	5.14	<5	<5	6.25	24.6	Clear, colorless, no odor, no sheen, slight effervescence	0.00	0.00	0	0	1	0	0.00	0.00	0.00	0.06	0.94	1.00	0.94
	12/12/2016	684	50	2.15	0.654	1.15	45.9				1.16	-121.8	3.8							<5	<5	6.38	19.2	Clear, colorless, no odor, no sheen, slight effervescence	0.01	0.00	0	1	0	1	0.02	0.01	0.02	0.96	0.00	1.00	0.96
	5/24/2017	847	ND	<1	<0.5	<1	<0.2	<5	192	<5	3.65	-81.1	1.6			<6	<0.5	10.7	93.8	<5	<5	6.30	16.0	Clear with some suspended particles, colorless, no odor, no sheen (slight effervescent)	0.00	0.00	0	0	7	0	0.00	0.00	0.00	0.00	1.00	1.00	1.00
B-49S	5/14/2014	-259	630	98.6	42.2	484	5.14	<5	<5	ND	0.21	-82.2	0.4			14.9	<0.5	0.532	11.4	7.89	<5	9.76	32.9	Clear, low turb, no odor/no sheen, effervescent	0.59	0.32	5.0	0.08	0.00	6.0	0.10	0.05	0.83	0.01	0.00	1.00	0.83
(60 ft DG)	10/23/2014	-97	1,226	13	26.1	1,170	17.2				0.26	-180.3								<5	<5	6.72	35.5	Clear, low turb, egg odor, no sheen, effervescent	0.08	0.20	12	0.28	0.00	13	0.01	0.02	0.96	0.02	0.00	1.00	0.96
	5/13/2015	105	855	11.7	8.32	375	460				1.39	-115.1	0.6	10.8	9.93	8.17	<0.5		7.23	<5	<5	6.7	22.5	Clear, low turbidity, fermented sugar water odor, no sheen	0.07	0.06	4	7.36		11	0.01	0.01	0.34	0.65		1.00	0.65
	9/30/2015	245	202	17.4	17	132	35.2	24	23.9	<5	0.65	1.6	5.4	7.4	7.23	40.5	<0.5	0.852	12	20	<5	7.14	26.2	Clear, colorless, no sheen, diesel-like odor	0.10	0.13	1	0.56	1.77	2	0.03	0.03	0.35	0.14	0.45	1.00	0.45
	1/5/2016	342	152	59.2	35.7	55.2	2.38	<5	<5	ND	0.17	76.5	2.0	4.65	4.73	5.80	<0.500	0.498	2.45	<5.00	<5.00	6.70	14.5	Clear, colorless, no sheen, slight petroleum-like odor	0.36	0.27	1	0.04	0.00	1	0.29	0.22	0.46	0.03	0.00	1.00	0.46
	5/11/2016	469	259	13.7	8.78	113	124	<5	<5	<5	0.17	-70.7	2.0	8.74	8.15	13.8	<0.5	3.12	3.12	<5	<5	6.21	17.9	Colorless, clear, no odor, no sheen	0.08	0.07	1	1.98	0.00	3	0.03	0.02	0.35	0.60	0.00	1.00	0.60
	12/12/2016	684	172	121	26.6	24.3	<0.2				1.57	-46.2	1.8							<5	<5	5.94	11.6	Slight turbidity, colorless, no odor, no sheen	0.73	0.20	0	0.00	0.00	1	0.62	0.17	0.21	0.00	0.00	1.00	0.62
	5/24/2017	847	125	4.34	2.94	79.2	38.6	7.06	<5	<5	2.25	-45.3	1.2			5.22	0.6	0.801	61.2	7.11	21.2	5.98	12.4	Clear, colorless, rotten odor, no sheen	0.03	0.02	1	0.62	0.27	1	0.01	0.01	0.47	0.35	0.15	1.00	0.47
B-58S	5/15/2014	-258	458	5.43	3.04	305	145				2.17											6.07	26.0	Sampled by Calibre	0.03	0.02	3.1	2.3		5.5	0.01	0.00	0.57	0.42		1.00	0.57
	5/13/2015	105	182	<1	<0.5	120	62				0.42	-182.1	2.4	16.3	17.1	24.5	<0.5		27.4	<5	<5	7.23	19.2	Clear, slightly yellow, no odor, no sheen	0.00	0.00	1.2	1.0		2.2	0.00	0.00	0.56	0.44		1.00	0.56
	9/29/2015	244	131	<1	1.77	78.8	50.2				0.10	-55.9	1.4	12.9	10.9	63.4	<0.5		18	<5	<5	6.80	23.2	Slightly turbid and yellow, no sheen, slight diesel-like odor	0.00	0.01	0.8	0.8		1.6	0.00	0.01	0.50	0.49		1.00	0.50
	1/5/2016	342 (e)	261	<1.00	1.78	221	38.4				0.11	-134.6	2.2	9.99	9.92	35.9	<0.500		12.5	<5.00	<5.00	6.49	17.1	Clear, colorless, no sheen, slight petroleum-like odor	0.00	0.01	2.3	0.6		2.9	0.00	0.00	0.78	0.21		1.00	0.78
	5/5/2016	463	109	<1	2.30	89.8	16.8				0.55	-94	5.5	21.7	0.232	93.4	<0.5		19.0	5.29	<5	6.50	19.2		0.00	0.02	0.9	0.3		1.2	0.00	0.01	0.76	0.22		1.00	0.76
	12/5/2016	677	248	<1	0.577	203	44.0				3.18	-43				74.0				<5	<5	6.37	16.7		0.00	0.00	2.1	0.7		2.8	0.00	0.00	0.75	0.25		1.00	0.75
	5/25/2017	848	166	<1	<0.5	114	52.2				6.99	-104				46.3				<5	<5	6.65	13.3	Clear, No odor	0.00	0.00	1.2	0.8		2.0	0.00	0.00	0.58	0.42		1.00	0.58
B-59D	5/15/2014	-67	3.3	<1	<0.5	<1	3.29				1.57											5.79	25.1	Sampled by Calibre	0.00	0.00	0.00	0.05		0.05	0.00	0.00	0.00	1.00		1.00	1.00
(150 ft DG)	10/22/2014	93	27	<1	<0.5	<1	26.8				0.93	-85.6	4.2	164	156	65.1	<0.5		12	<5	<5	5.78	23.1	Clear, low turbidity, slight egg odor, no sheen, effervescent	0.00	0.00	0.00	0.43		0.43	0.00	0.00	0.00	1.00		1.00	1.00
	1/9/2015	172	8.0	<1	<0.5	<1	8.01				2.28	-37.3	2.8	120	110	53.9	<0.5		29.7	<5	<5	5.98	22.6	Slightly cloudy, low-moderate turbidity, slight sulfur odor, no sheen	0.00	0.00	0.00	0.13		0.13	0.00	0.00	0.00	1.00		1.00	1.00
	5/13/2015	296	1.1	<1	<0.5	<1	1.06				1.54	-83.3	2.4	39.4	39.9	39.5	<0.5		15.9	<5	<5	6.17	21.1	Clear, colorless, rotten egg-like odor, no sheen, effervescent	0.00	0.00	0.00	0.02		0.02	0.00	0.00	0.00	1.00		1.00	1.00
	9/29/2015	435	3.3	<1	<0.5	<1	3.29	20.1	27.6	<5	0.48	-91.2	3.6	183	174	97.3	<0.5	3.4	5.25	<5	<5	5.76	22.7	Clear, colorless, no sheen, slight diesel-like odor, slightly effervescence	0.00	0.00	0.00	0.05	1.76	0.05	0.00	0.00	0.00	0.03	0.97	1.00	0.97
	1/5/2016	533 (e)	3.6	<1.00	<0.500	<1.00	3.57	6.64	7.51	ND	0.30	-1.6	2.2	115	114	87.6	<0.500	4.65	8.49	<5.00	<5.00	6.58	20.0	Clear, colorless, no sheen, effervescent	0.00	0.00	0.00	0.06	0.52	0.06	0.00	0.00	0.00	0.10	0.90	1.00	0.90
	5/5/2016	654	19	<1	<0.5	<1	18.6	<5	<5	<5	4	-46	6.0	38.7	0.11	12.3	<0.5	4.90	3.24	<5	<5	5.81	21.2		0.00	0.00	0.00	0.30	0.00	0.30	0.00	0.00	0.00	1.00	0.00	1.00	1.00

TABLE 4.1
GROUNDWATER DATA SUMMARY
MAIN SOURCE AREA
CASCADE COLUMBIA/FOX AVENUE

Well	Date	Elapsed Time From Injection (days) (a)	Volatile Organic Compounds: Sum cVOCs (c) (µg/L)	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	Acetylene (µg/L)	Aquifer Redox Conditions: DO (mg/L)	ORP (mV)	Iron II (mg/L)	Iron (T) (mg/L)	Iron (D) (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	Methane (mg/L)
B-60S	5/15/2014	-258	1,556	<1	3.51	1,500	52.0				1.09							
(145 ft DG)	6/20/2014	-222						<5	<5	<5	0.21	-87.3	2.4			24.0	<0.5	6.20
	5/13/2015	105	720	2.11	22.6	648	47.6				0.85	-91.3	1.8	8.8	9	19.5	<0.5	
	9/30/2015	245	610	<1	12.7	463	134				0.57	-12.3	2.0	12.1	10.4	16.1	<0.5	
	1/5/2016	342 (e)	615	<1.00	1.51	367	246				0.10	-122.4	1.6	16.1	16.3	11.1	<0.500	
	5/5/2016	463	182	<1	<0.5	104	78.2	<5	7.79	<5	0.31	-100	6.5	17.5	2.1	29.5	<0.5	1.72
	12/5/2016	677	8	<1	<0.5	<1	7.8				3.45	-15				13.6		
	5/25/2017	848	ND	<1	<0.5	<1	<0.2				1.37	-94				21.2		
B-61D	5/15/2014	-67	33	<1	<0.5	15.8	17.4				1.13							
(145 ft DG)	6/20/2014	-31						<5	26.3	<5	0.44	-57.5	2.0			<0.3	<0.5	11.6
	10/22/2014	93	12	<1	<0.5	9.64	2.77				0.41	-96.0	4.5	40.7	38.3	<3	<0.5	
	1/9/2015	172	9	<1	<0.5	6.92	1.69				1.60	-77.9	2.4	37.7	40.3	<3	0.800	
	5/13/2015	296	802	<1	<0.5	165	637				0.13	-143.5	2.6	38.8	38.3	39.5	<0.5	
	9/30/2015	436	1,564	<1	0.82	463	1,100	47.5	71.5	<5	0.23	-90.9	5.0	45.0	40.5	111	<0.5	3.24
	1/5/2016	533 (e)	3,875	<1.00	1.45	644	3230	53.7	129	ND	0.18	-95.2	1.4	27.1	27.5	63.0	<0.500	3.97
	5/5/2016	654	105	<1	<0.5	21.1	84.0	12.7	49.3	<5	0.21	-70	7.0	58.6	40.4	4.63	<0.5	2.61
	12/5/2016	868	41	<1	0.561	4.16	35.8				1.28	-20				7.75		
	5/25/2017	1039	28	<1	<0.5	2.98	25.5				1.53	-90				6.76		
MW-7S	5/11/2016	469	182	64	39.2	74.8	4.25											
	5/24/2017	847	169	15.5	34.7	115	4.13	<5	<5	<5	2.50	-40.6	2.2			3.7	4.0	0.118
MW-8D	5/11/2016	660	67	<1	<0.5	<1	67											
	5/25/2017	1039	ND	<2	<0.6	<2	<0.3	12.6	<5	<5	2.80	-27.4	1.8			6.4	6.0	0.334

Well	Date	Donor Indicators: TOC (mg/L)	Acetone (µg/L)	MEK (µg/L)	pH	Other: Temp (deg C)	Comments	VOCs- micromoles/Liter(b): PCE	TCE	cDCE	VC	Ethene/ Ethane	Total Chloroethenes (d)	VOCs - Molar Fraction (d): PCE	TCE	cDCE	VC	Ethene/ Ethane		Max
B-60S	5/15/2014				6.13	33.6	Sampled by Calibre	0.00	0.03	15	0.83		16	0.00	0.00	0.95	0.05		1.00	0.95
(145 ft DG)	6/20/2014	9.53			6.66	34.6	Slight amber color, low turb, smells bad, no sheen					0.00								
	5/13/2015	16.4	<5	<5	6.70	23.3	Clear, very slight yellow, petroleum-like odor, no sheen, effervescent	0.01	0.17	7	0.76		8	0.00	0.02	0.88	0.10		1.00	0.88
	9/30/2015	8.84	<5	<5	7.24	25.6	Clear, colorless, no sheen, strong diesel-like odor	0.00	0.10	5	2.14		7	0.00	0.01	0.68	0.31		1.00	0.68
	1/5/2016	16.6	<5.00	<5.00	6.42	19.1	Clear, colorless, slight effervescence, strong petroleum-like odor, no sheen	0.00	0.01	4	3.94		8	0.00	0.00	0.49	0.51		1.00	0.51
	5/5/2016	17.3	<5	<5	6.10	19.3		0.00	0.00	1	1.25		2	0.00	0.00	0.46	0.54		1.00	0.54
	12/5/2016		<5	<5	6.26	15.9		0.00	0.00	0	0.12		0	0.00	0.00	0.00	1.00		1.00	1.00
	5/25/2017		<5	<5	6.38	14.3	Very slow recharge, reducing odor, clear	0.00	0.00	0	0.00		0							
B-61D	5/15/2014				5.99	31.3	Sampled by Calibre	0.00	0.00	0.16	0.28		0.44	0.00	0.00	0.37	0.63		1.00	0.63
(145 ft DG)	6/20/2014	4.05			6.36	27.0	Clear, low turb, no odor, no sheen, effervescent													
	10/22/2014	9.07	7.29	<5	6.30	29.2	Clear, low turbidity, slight egg odor, no sheen, effervescent	0.00	0.00	0.10	0.04		0.14	0.00	0.00	0.69	0.31		1.00	0.69
	1/9/2015	21.90	<5	<5	6.14	26.1	Slightly cloudy, low to moderate turbidity, slight vomit-like odor, no sheen	0.00	0.00	0.07	0.03		0.10	0.00	0.00	0.73	0.27		1.00	0.73
	5/13/2015	13.4	<5	<5	6.39	27.6	Clear, low turbidity, vomit-like odor, no sheen	0.00	0.00	1.70	10.19		11.89	0.00	0.00	0.14	0.86		1.00	0.86
	9/30/2015	6.45	<5	<5	6.09	26.2	Clear, colorless, very slight diesel-like odor, no sheen	0.00	0.01	4.78	17.60	4.37	22.38	0.00	0.00	0.18	0.66	0.16	1.00	0.66
	1/5/2016	6.26	<5.00	<5.00	6.79	23.5	Clear, colorless, no sheen, slight petroleum-like odor	0.00	0.01	6.64	51.68	6.66	58.34	0.00	0.00	0.10	0.80	0.10	1.00	0.80
	5/5/2016	6.44	<5	<5	5.88	24.6	Effervescent	0.00	0.00	0.22	1.34	2.25	1.56	0.00	0.00	0.06	0.35	0.59	1.00	0.59
	12/5/2016		<5	<5	6.11	19.4		0.00	0.00	0.04	0.57	0.00	0.62	0.00	0.01	0.07	0.92	0.00	1.00	0.92
	5/25/2017		<5	<5	6.10	20.4	Slight reducing odor, effervescent, clear	0.00	0.00	0.03	0.41	0.00	0.44	0.00	0.00	0.07	0.93	0.00	1.00	0.93
MW-7S	5/11/2016		<5	<5				0.39	0.30	0.77	0.07	0.00	1.52	0.25	0.20	0.51	0.04	0.00	1.00	0.51
	5/24/2017	350.0	33.7	66.9	5.60	14.3	Clear, colorless, slight rotten odor, no sheen	0.09	0.26	1.19	0.07	0.00	1.61	0.06	0.16	0.74	0.04	0.00	1.00	0.74
MW-8D	5/11/2016		<5	<5				0.00	0.00	0.00	1.07	0.00	1.07	0.00	0.00	0.00	1.00	0.00	1.00	1.00
	5/25/2017	160.0	25.9	33.6	5.50	14.1	Clear with some suspended particles, colorless, rotten milk odo	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00

PCE = Tetrachloroethene
TCE = Trichloroethene
cDCE = cis-1,2-Dichloroethene
VC = Vinyl Chloride
MEK = Methyl ethyl ketone

ORP = Oxidation Reduction Potential
TOC = Total Organic Carbon
DO = Dissolved Oxygen
Iron (T) = Total Iron
Iron (D) = Dissolved Iron

IW = Injection Well
S = Shallow
D = Deep
(shaded) not analyzed or measured

(a) Elapsed time for shallow and deep wells is relative to the January 2015 WBZ#1 source area injection and the July 2014 WBZ#2 source area injection, respectively.
(b) Calculated by dividing the concentration in groundwater by the molecular weight of the compound. Reporting limits for non-detect results replaced with zero.
(c) Sum of PCE, TCE, cDCE, and VC.
(d) Indicates the fraction of total ethenes (PCE+TCE+cDCE+VC+ethene/ethane) due to each individual compound on a molar basis.
(e) Follows November 2015 injection of sugar substrate by Calibre to upgradient or adjacent Fox Avenue injection wells (R1-IW3a, R1-IW4a, R1-IW4b, R1-IW5, R1-IW6, R1-IW7).
March 13, 2017 Calibre injected approx. 1,000 of 7.3% sugar solution to each of 5 wells (MW7, MW9, B49, R0-IW4S, RO-IW8S)

Dates for Elapsed Time
7/21/2014 1st injection to WBZ#2
1/28/2015 1st injection to WBZ#1

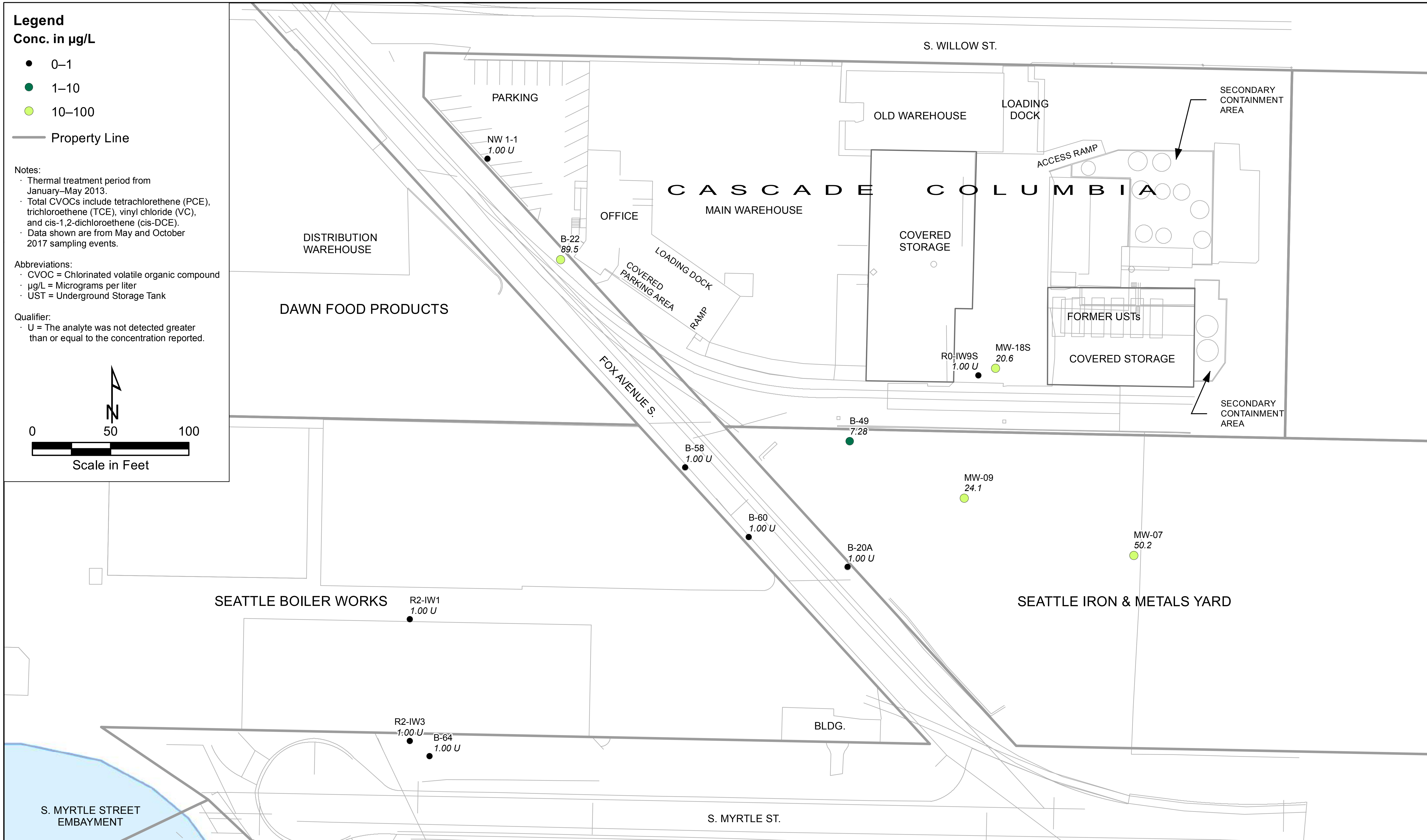


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Figure 4.1
PCE + TCE Concentrations in Groundwater
1st Water Bearing Zone

File: I:\GIS\Projects\FOXAVE-RA\MXD\2017 Annual Report\Figure 4.1 PCE_TCE WBZ1.mxd
Date: 3/5/2018

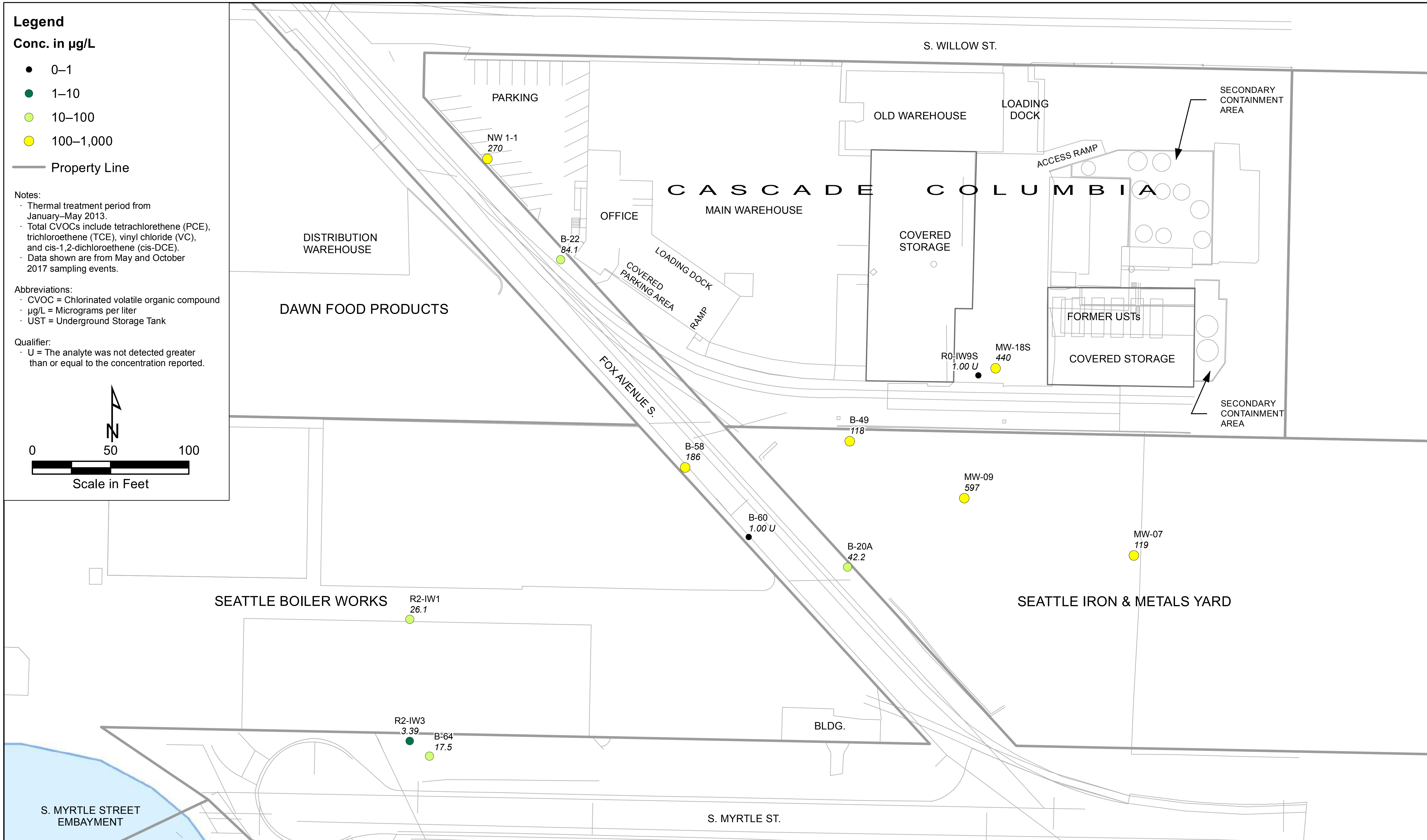

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Figure 4.3
cis-DCE + VC Concentrations in Groundwater
1st Water Bearing Zone

File: I:\GIS\Projects\FOXAVE-RA\MXD\2017 Annual Report\Figure 4.3 cis_VC WBZ1.mxd
Date: 3/5/2018

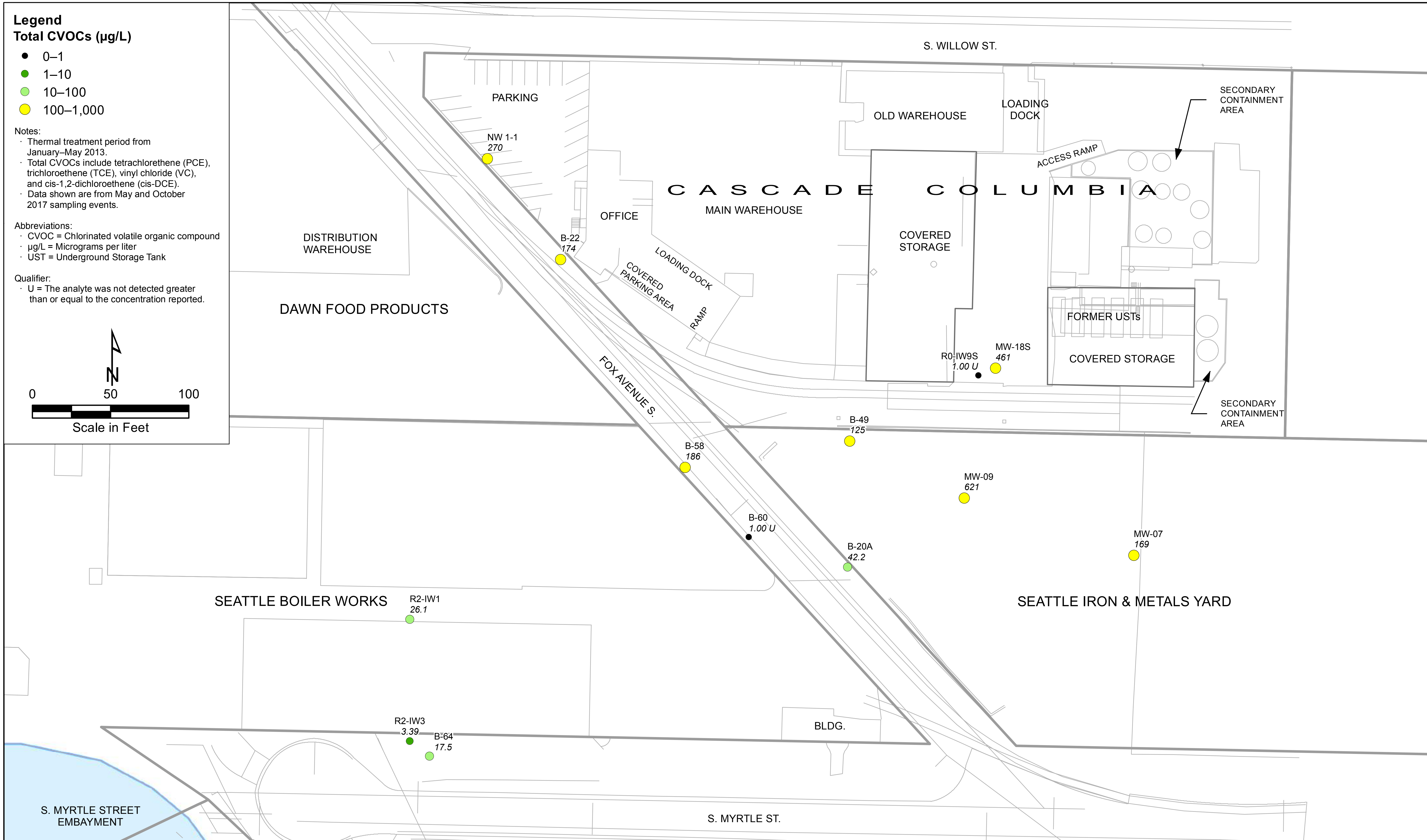

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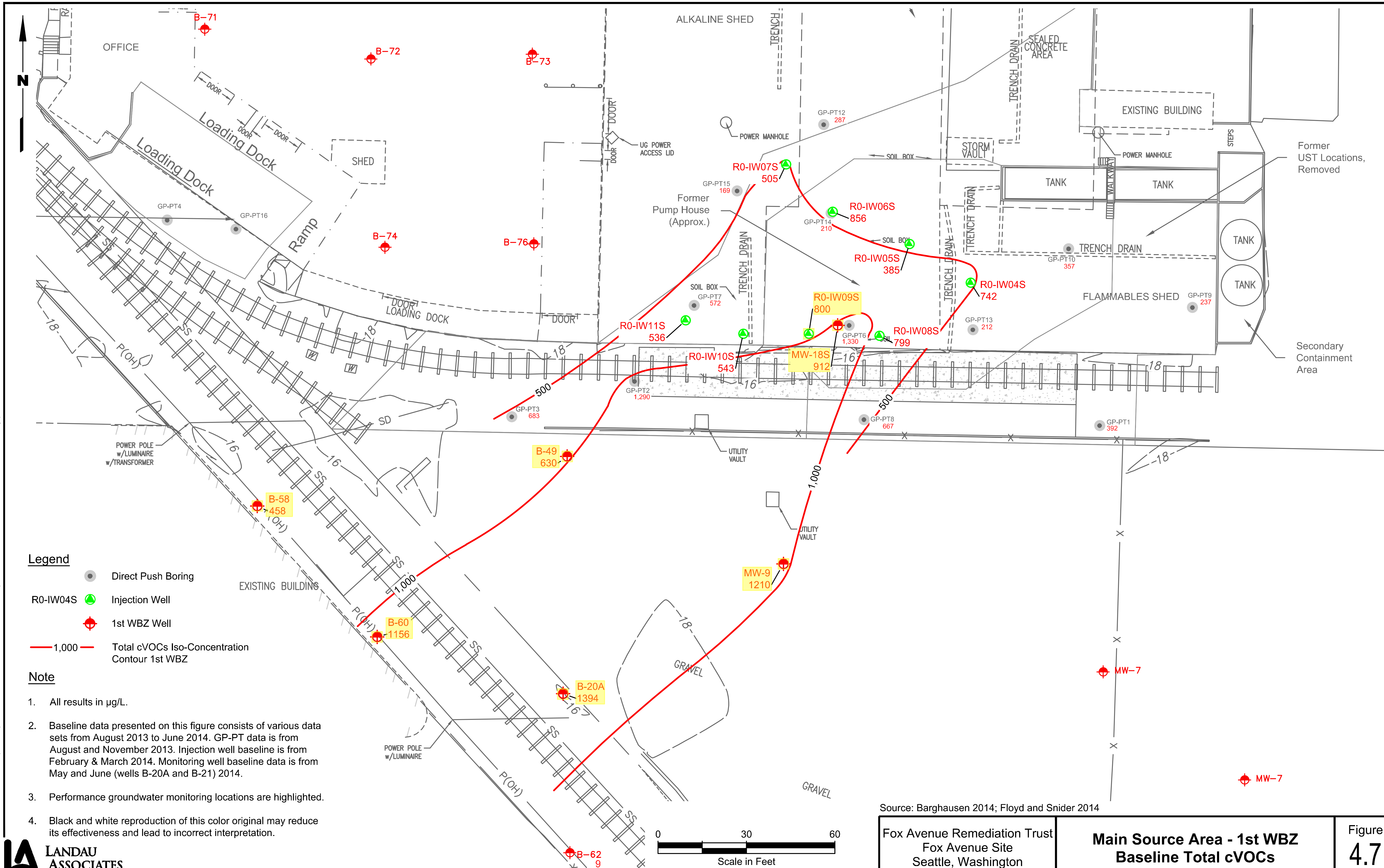
Figure 4.5
Total CVOCs Concentrations in Groundwater
1st Water Bearing Zone

File: I:\GIS\Projects\FOXAVE-RA\MXD\2017 Annual Report\Figure 4.5 Total CVOCs WBZ1.mxd
Date: 3/5/2018



Legend

- Direct Push Boring
- R0-IW04S — Injection Well
- 1st WBZ Well
- 1,000 — Total cVOCs Iso-Concentration Contour 1st WBZ

Note

1. All results in µg/L.
2. Baseline data presented on this figure consists of various data sets from August 2013 to June 2014. GP-PT data is from August and November 2013. Injection well baseline is from February & March 2014. Monitoring well baseline data is from May and June (wells B-20A and B-21) 2014.
3. Performance groundwater monitoring locations are highlighted.
4. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Source: Barghausen 2014; Floyd and Snider 2014

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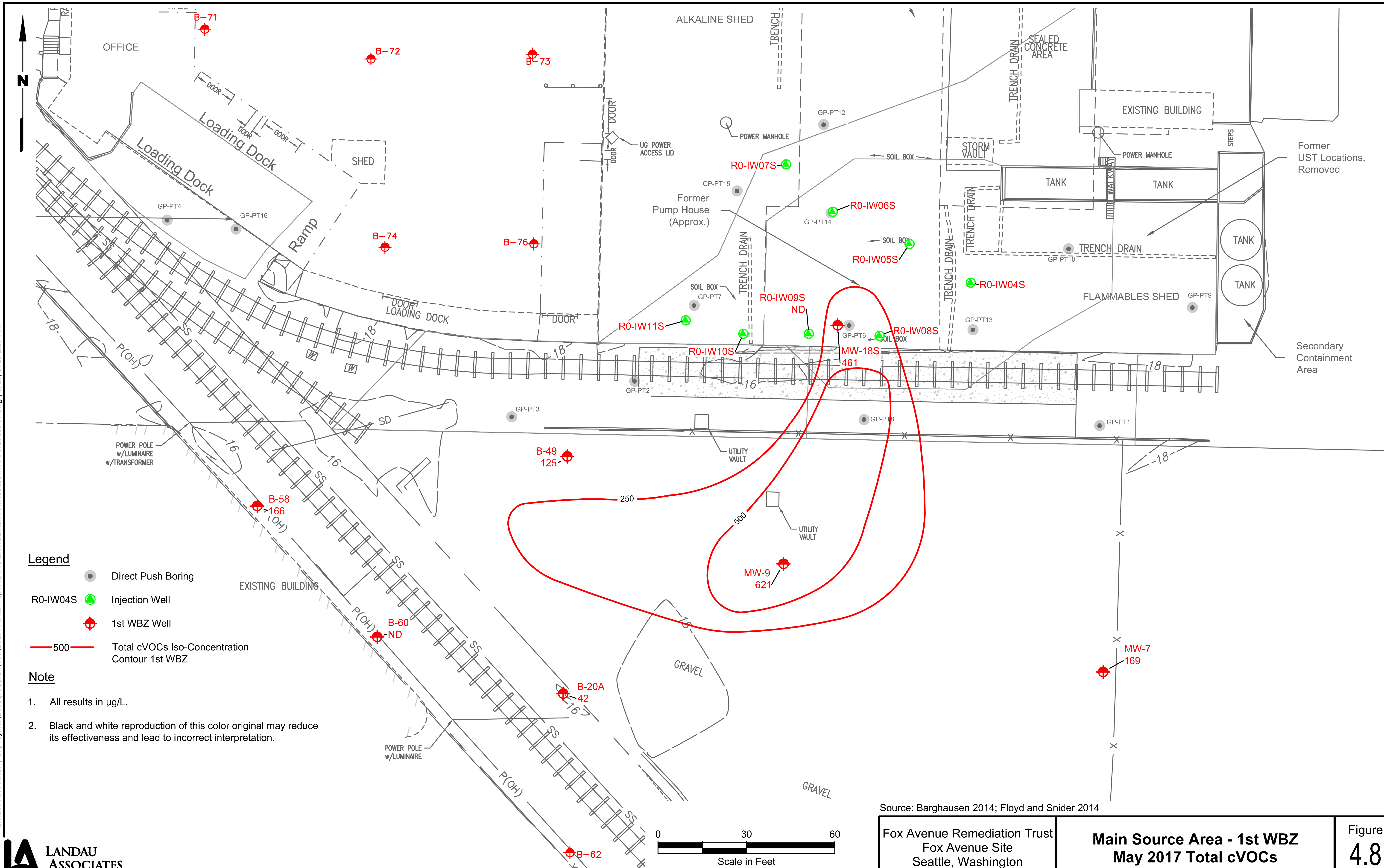
Fox Avenue Remediation Trust
Fox Avenue Site
Seattle, Washington

Main Source Area - 1st WBZ Baseline Total cVOCs

Figure 4.7



Legend

- Direct Push Boring
- R0-IW04S Injection Well
- 1st WBZ Well
- 500 Total cVOCs Iso-Concentration Contour 1st WBZ

Note

1. All results in µg/L.
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 30 60
Scale in Feet

Source: Barghausen 2014; Floyd and Snider 2014

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Fox Avenue Remediation Trust
Fox Avenue Site
Seattle, Washington

Main Source Area - 1st WBZ
May 2017 Total cVOCs

Figure 4.8

2018 Annual Report Key Tables and Figures

Table 3.1
Summary of Volatile Organic Compound Data in Groundwater

				Non-Chlorinated Volatile Organic Compounds								
			Analyte	Acetone	Benzene	EB	MEK	Naphthalene	Toluene	1,2,4-TMBZ	Xylene	Xylene (ortho)
			Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	**Sample ID**	**WBZ**	**Sample Date**									
Monitoring Wells												
Main Source Area												
MW-15D	MW-15D-052418	2nd	05/24/2018	72.1	1 U	1.33	63.5	1 U	2.04	9	1.71	1 U
MW-16D	MW-16D-052418	2nd	05/24/2018	5 U	1 U	1 U	5 U	1 U	1 U	19.6	1 U	1 U
MW-17D	MW-17D-052418	2nd	05/24/2018	5 U	5.87	2.01	5 U	1 U	6.4	1 U	1.71	1 U
MW-18S	MW-18S-052318	1st	05/23/2018	5 U	1 U	1 U	5 U	1 U	1.36	1.54	4.54	4.41
Whitehead												
B-45	B-45-052318	2nd	05/23/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
B-49	B-49-052318	1st	05/23/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
MW-07	MW-7-052318	1st	05/23/2018	5 U	1 U	1 U	57.7	1 U	1 U	1 U	1 U	1 U
MW-08	MW-8-052318	2nd	05/23/2018	5 U	1 U	1 U	5 U	1 U	1.38	1 U	1 U	1 U
MW-09	MW-9-052318	1st	05/23/2018	5 U	1 U	1 U	46.7	1 U	1 U	1 U	1 U	1 U
MW-10	MW-10-052318	2nd	05/23/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
	Dup-1-052318	2nd	05/23/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Fox Avenue												
B-18	B-18-051718	1st	05/17/2018	5 U	1.39	1 U	5 U	1 U	1 U	1 U	1 U	1 U
B-19	B-19-051718	2nd	05/17/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
B-20A	B-20a-051818	1st	05/18/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
B-58	B-58-051718	1st	05/17/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
B-59	B-59-051718	2nd	05/17/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
B-60	B-60-051718	1st	05/17/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
B-61	B-61-051718	2nd	05/17/2018	5 U	1.59	1 U	5 U	1 U	1 U	1 U	1 U	1 U
B-63	B-63-051718	2nd	05/17/2018	5 U	3.73	1 U	5 U	1 U	1 U	1 U	1 U	1 U
NW Corner												
B-22	B-22-051818	1st	05/18/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
	DUP02-051818	1st	05/18/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
NW 1-1	NW1-1-051718	1st	05/17/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Myrtle Street												
B-33A	B-33a-051718	2nd	05/17/2018	5 U	9.77	1 U	5 U	1 U	1 U	1 U	1 U	1 U
B-35	B-35-051818	2nd	05/18/2018	5 U	2.51	1.55	5 U	1 U	1 U	1 U	1 U	1 U
B-64	B-64-051718	1st	05/17/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
B-65	B-65-051718	2nd	05/17/2018	5 U	2.2	1 U	5 U	1 U	1 U	1 U	1 U	1.14
Seattle Boiler Works												
MW-05	MW-5-051718	1st	05/17/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
MW-06	MW-6-051718	2nd	05/17/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Injection Wells												
Fox Avenue												
R1-IW4A	R1-IW4a-11-051818	1st	05/18/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
R1-IW4B	R1-IW4b-50-051818	2nd	05/18/2018	5 U	1 U	1.98	5 U	1 U	1 U	1 U	1 U	1 U
R1-IW7	R1-IW7-41-051818	2nd	05/18/2018	5 U	1 U	1.63	5 U	1 U	1 U	1 U	1 U	1 U
R1-IW17	R1-IW17-12-051818	1st	05/18/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
	R1-IW17-55-051818	2nd	05/18/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
Main Source Area												
R0-IW2D	R0-IW02D-052418	2nd	05/24/2018	175	1 U	1 U	284	1 U	1 U	1 U	1 U	1 U
R0-IW6D	R0-IW06D-052418	2nd	05/24/2018	687	1 U	1 U	200	1 U	1 U	1 U	1 U	1 U
R0-IW9S	R0-IW09S-052418	1st	05/24/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
NW Corner												
R1-IW15	R1-IW15-55-051818	2nd	05/18/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U

Table 3.1
Summary of Volatile Organic Compound Data in Groundwater

				Non-Chlorinated Volatile Organic Compounds								
			Analyte	Acetone	Benzene	EB	MEK	Naphthalene	Toluene	1,2,4-TMBZ	Xylene	Xylene (ortho)
			Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	Sample ID	WBZ	Sample Date									
Seattle Boiler Works												
R2-IW1	R2-IW1-17-051718	1st	05/17/2018	5 U	1.29	1 U	591	1 U	184	1 U	1 U	1 U
	R2-IW1-45-051718	2nd	05/17/2018	5 U	1.43	1 U	599	1 U	190	1 U	1 U	1 U
	DUP01-051718	2nd	05/17/2018	5 U	1.49	1 U	638	1 U	197	1 U	1 U	1 U
R2-IW8	R2-IW8-63-051718	2nd	05/17/2018	5 U	1.17	4.47	5 U	1 U	1 U	1 U	1 U	1 U
Seep Data												
S-2	SP-02-051718		05/17/2018	5 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U
S-13 (Calibre S-3)	SP-03-051718		05/17/2018	5 U	7.34	3.66	5 U	4.88	1 U	1 U	1 U	1 U
S-3b	SP-03B-051718		05/17/2018	5 U	1.27	1 U	5 U	1 U	1 U	1 U	1 U	1 U

Note:

Blank cells indicate analyte was not analyzed for the sample.

Abbreviations:

CVOC Chlorinated volatile organic compound
DCA Dichloroethane
DCE Dichloroethene
EB Ethylbenzene
MEK Methyl ethyl ketone
µg/L Micrograms per liter
PCE Tetrachloroethene
TCE Trichloroethene
TMBZ Trimethylbenzene
VC Vinyl chloride
WBZ Water bearing zone

Qualifiers:

U Analyte is not detected at the associated reporting limit.

Table 3.1
Summary of Volatile Organic Compound Data in Groundwater

				Chlorinated Volatile Organic Compounds							
			Analyte	1,1-DCA	1,1-DCE	cis-1,2-DCE	PCE	trans-1,2-DCE	TCE	VC	Total CVOCs
			Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	Sample ID	WBZ	Sample Date								
Monitoring Wells											
Main Source Area											
MW-15D	MW-15D-052418	2nd	05/24/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
MW-16D	MW-16D-052418	2nd	05/24/2018	1 U	1 U	6.7	3.76	1 U	0.796	11.2	22.5
MW-17D	MW-17D-052418	2nd	05/24/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
MW-18S	MW-18S-052318	1st	05/23/2018	5.74	1 U	347	37.4	3.3	16.9	373	783
Whitehead											
B-45	B-45-052318	2nd	05/23/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
B-49	B-49-052318	1st	05/23/2018	1 U	1 U	32.3	1.36	1 U	1.83	48.9	84.4
MW-07	MW-7-052318	1st	05/23/2018	1 U	1 U	55.5	1 U	1 U	5.05	0.2 U	60.6
MW-08	MW-8-052318	2nd	05/23/2018	1 U	1 U	15.6	1 U	1.32	0.5 U	0.2 U	16.9
MW-09	MW-9-052318	1st	05/23/2018	1 U	1 U	436	1 U	4.18	0.5 U	180	620
MW-10	MW-10-052318	2nd	05/23/2018	1 U	1 U	1.6	1 U	1 U	0.5 U	0.2 U	1.6
	Dup-1-052318	2nd	05/23/2018	1 U	1 U	1.6	1 U	1 U	0.5 U	0.2 U	1.6
Fox Avenue											
B-18	B-18-051718	1st	05/17/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	4.27	4.27
B-19	B-19-051718	2nd	05/17/2018	1 U	1 U	18.9	1 U	1 U	0.5 U	10.3	29.2
B-20A	B-20a-051818	1st	05/18/2018	1 U	1 U	13.4	1 U	1 U	0.5 U	14.1	27.5
B-58	B-58-051718	1st	05/17/2018	1 U	1 U	30.6	1 U	1 U	0.5 U	57.8	88.4
B-59	B-59-051718	2nd	05/17/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	9.04	9.04
B-60	B-60-051718	1st	05/17/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	9.46	9.46
B-61	B-61-051718	2nd	05/17/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
B-63	B-63-051718	2nd	05/17/2018	1.97	1 U	1 U	1 U	1 U	0.5 U	1.54	3.51
NW Corner											
B-22	B-22-051818	1st	05/18/2018	1 U	1 U	60.2	99.7	1.16	29.5	3.66	194
	DUP02-051818	1st	05/18/2018	1 U	1 U	88.9	56.6	1.11	28.6	3.52	179
NW 1-1	NW1-1-051718	1st	05/17/2018	1 U	1 U	324	1 U	1 U	0.5 U	63.1	387
Myrtle Street											
B-33A	B-33a-051718	2nd	05/17/2018	4.24	1 U	1 U	1 U	1 U	0.5 U	5.13	9.37
B-35	B-35-051818	2nd	05/18/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	2.6	2.6
B-64	B-64-051718	1st	05/17/2018	1 U	1 U	6.5	1 U	1 U	0.5 U	4.82	11.3
B-65	B-65-051718	2nd	05/17/2018	3.68	1 U	1 U	1 U	1 U	0.5 U	0.2 U	3.68
Seattle Boiler Works											
MW-05	MW-5-051718	1st	05/17/2018	1 U	1 U	1 U	3.3	1 U	0.583	0.2 U	3.88
MW-06	MW-6-051718	2nd	05/17/2018	1 U	1 U	36.9	25.9	1 U	15.8	0.2 U	78.6
Injection Wells											
Fox Avenue											
R1-IW4A	R1-IW4a-11-051818	1st	05/18/2018	1 U	1 U	2.03	1 U	1 U	1.73	8.45	12.2
R1-IW4B	R1-IW4b-50-051818	2nd	05/18/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
R1-IW7	R1-IW7-41-051818	2nd	05/18/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
R1-IW17	R1-IW17-12-051818	1st	05/18/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
	R1-IW17-55-051818	2nd	05/18/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
Main Source Area											
R0-IW2D	R0-IW02D-052418	2nd	05/24/2018	1 U	1 U	47.9	1 U	1 U	2.18	0.2 U	50.1
R0-IW6D	R0-IW06D-052418	2nd	05/24/2018	1 U	1 U	27.7	1 U	1 U	2.81	0.2 U	30.5
R0-IW9S	R0-IW09S-052418	1st	05/24/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
NW Corner											
R1-IW15	R1-IW15-55-051818	2nd	05/18/2018	1 U	1 U	1.12	1 U	1 U	0.5 U	0.2 U	1.12

Table 3.1
Summary of Volatile Organic Compound Data in Groundwater

				Chlorinated Volatile Organic Compounds							
			Analyte	1,1-DCA	1,1-DCE	cis-1,2-DCE	PCE	trans-1,2-DCE	TCE	VC	Total CVOCs
			Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	Sample ID	WBZ	Sample Date								
Seattle Boiler Works											
R2-IW1	R2-IW1-17-051718	1st	05/17/2018	1 U	1 U	87.6	1 U	1 U	0.5 U	149	237
	R2-IW1-45-051718	2nd	05/17/2018	1 U	1 U	102	1 U	1 U	0.5 U	233	335
	DUP01-051718	2nd	05/17/2018	1 U	1 U	105	1 U	1 U	0.5 U	244	349
R2-IW8	R2-IW8-63-051718	2nd	05/17/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
Seep Data											
S-2	SP-02-051718		05/17/2018	1 U	1 U	1 U	1 U	1 U	0.5 U	0.2 U	1 U
S-13 (Calibre S-3)	SP-03-051718		05/17/2018	2.14	1 U	9.62	1 U	1 U	0.717	11.7	24.2
S-3b	SP-03B-051718		05/17/2018	1 U	1 U	69.5	1 U	1.46	1.1	39.8	112

Note:

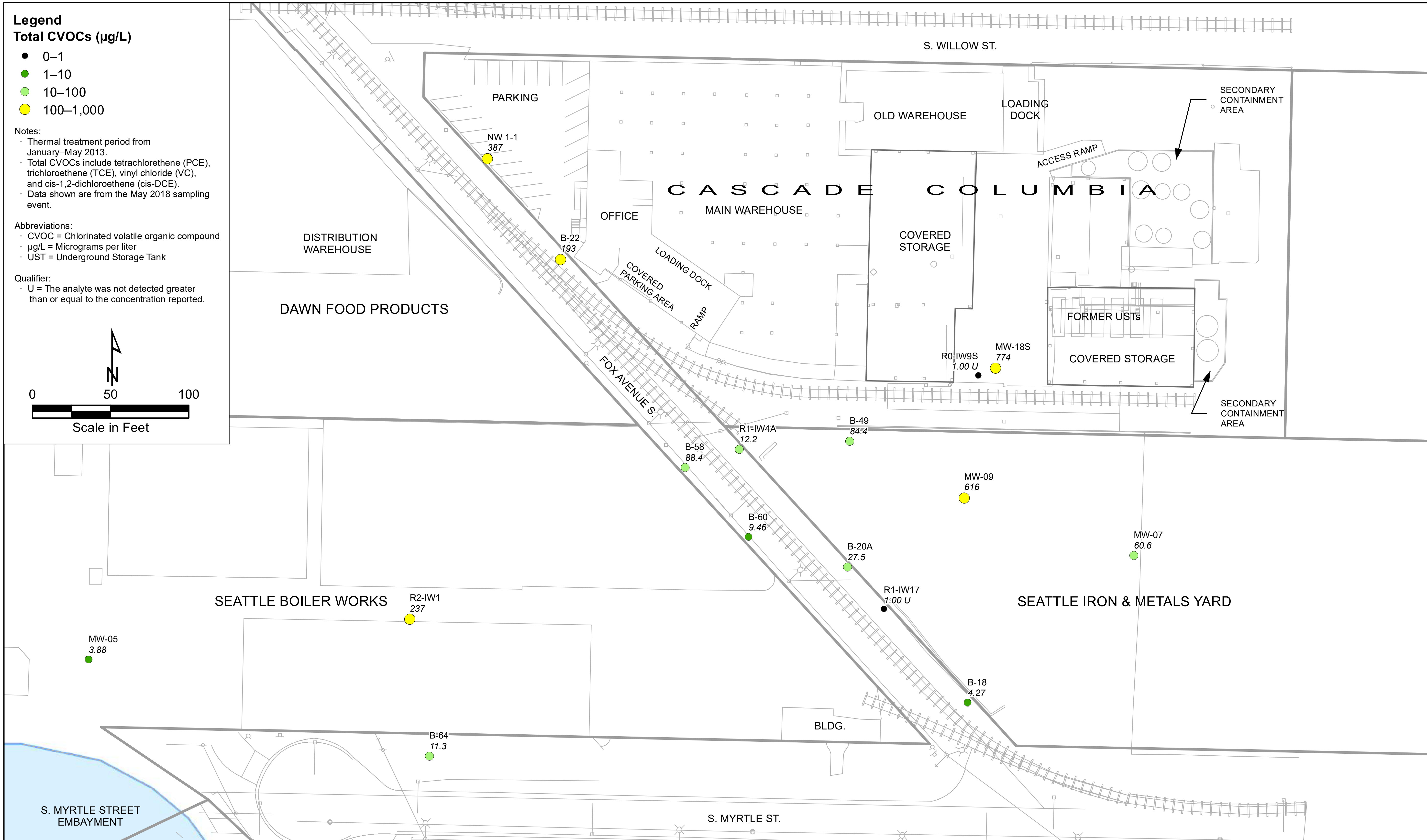
Blank cells indicate analyte was not analyzed for the sample.

Abbreviations:

CVOC Chlorinated volatile organic compound
DCA Dichloroethane
DCE Dichloroethene
EB Ethylbenzene
MEK Methyl ethyl ketone
µg/L Micrograms per liter
PCE Tetrachloroethene
TCE Trichloroethene
TMBZ Trimethylbenzene
VC Vinyl chloride
WBZ Water bearing zone

Qualifiers:

U Analyte is not detected at the associated reporting limit.



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2018 Annual Report
Fox Avenue Site
Seattle, Washington

Figure 4.1
Total CVOCs Concentrations in Groundwater
1st Water Bearing Zone
May 2018

File: I:\GIS\Projects\FOXAVE-RA\MXD\2018 Annual Report\Figure 4.1 Total CVOCs WBZ1.mxd
Date: 2/26/2019

2019–2020 Annual Report Key Tables and Figures

Table 3.1 - 2019 Summary of Volatile Organic Compound Data in Groundwater

Location	WBZ	Analyte	PCE		TCE		cis-1,2-DCE		Vinyl Chloride		Total CVOCs	TOC	
		Sample Date	µg/L		µg/L		µg/L		µg/L		µg/L	mg/L	
Main Source Area													
R0-IW03D	2nd	6/5/2019	2.46		10		150	D	203	D	365	3,480	D
MW-18S	1st	6/5/2019	<1	U	<0.5	U	8.28		17.6		25.9	--	
DUP02 (MW18S)	1st	6/5/2019	<1	U	<0.5	U	6.82		16.2		23.0	--	
Whitehead													
MW-9	1st	6/4/2019	<1	U	<0.5	U	1.15		<0.2	U	1.15	22.1	D
MW-7	1st	6/4/2019	<1	U	<0.5	U	29.5		20.3		49.8	--	
B-49	1st	6/4/2019	<1	U	<0.5	U	4.93		7.43		12.4	--	
Northwest Corner													
NW1-1	1st	6/5/2019	<1	U	<0.5	U	41.2	D	22		63.2	--	
B-22	1st	6/5/2019	7.44		8.07		116	D	12.5		144	--	
Fox Avenue													
R1-IW4a	1st	6/4/2019	<1	U	1.93		7.12		8.45		17.5	7.2	D
B-20a	1st	6/4/2019	<1	U	<0.5	U	2.46		4.97		7.43	--	
B-19	2nd	6/4/2019	<1	U	<0.5	U	46.5	D	10.9		57.4	--	
B-58	1st	6/5/2019	12.5		2.66		5.88		5.03		26.1	--	
Seattle Boiler Works													
R2-IW1	1st	6/4/2019	<1	U	<0.5	U	<1	U	<0.2	U	ND	2,030	D
R2-IW1	2nd	6/4/2019	<1	U	<0.5	U	<1	U	<0.2	U	ND	2,120	D
DUP01(R2IW1@45)	2nd	6/4/2019	<1	U	<0.5	U	<1	U	<0.2	U	ND	--	
MW-6	2nd	6/4/2019	17		11.5		48	D	<0.2	U	76.5	--	
Myrtle Street													
B-35	2nd	6/4/2019	<1	U	<0.5	U	<1	U	0.501		0.501	--	
B-64	1st	6/4/2019	<1	U	<0.5	U	4.55		4.56		9.11	--	
B-33a	2nd	6/4/2019	<1	U	<0.5	U	<1	U	<0.2	U	ND	--	
Embayment Seeps													
SP-03	--	6/4/2019	<1	U	<0.5	U	2.46		2.88		5.34	--	
SP-03b	--	6/4/2019	<1	U	<0.5	U	5.96		3.89		9.85	--	

Abbreviations:

WBZ	Water bearing zone
CVOC	Chlorinated volatile organic compound
PCE	Tetrachloroethene
TCE	Trichloroethene
DCE	Dichloroethene
TOC	Total organic carbon
µg/L	Micrograms per liter
mg/L	Milligrams per liter
ND	non-detect
--	Not analyzed

Qualifiers:

U	Analyte was not detected, concentration given is the reporting limit.
D	Dilution was required

Table 3.2 - 2020 Summary of Volatile Organic Compound Data in Groundwater

Location	WBZ	Analyte / Sample Date	PCE µg/L		TCE µg/L		cis-1,2-DCE µg/L		Vinyl chloride µg/L		Total CVOCs µg/L	TOC mg/L		DHC cells/mL	
Main Source Area															
R0-IW03D	2nd	6/23/2020	3.69		14.1		262	D	342	D	622	3,690	D	--	
R0-IW4D	2nd	7/21/2020	<1	U	<0.5	U	38		<0.2	U	38.0	127		--	
R0-IW4S	1st	7/21/2020	<1	U	<0.5	U	<1	U	<0.2	U	ND	59		--	
R0-IW7D	2nd	7/21/2020	<10	U	44.6	D	599	D	1,030	D	1,674	5,120	D	0.10	J
MW-18S	1st	6/23/2020	<1	U	<0.5	U	5.22		6.13		11.4	--		--	
Whitehead															
MW-9	1st	6/23/2020	<1	U	<0.5	U	21.6		43	D	64.6	15.3		--	
MW-7	1st	6/23/2020	<1	U	<0.5	U	39.7	D	28.1		67.8	--		--	
B-49	1st	6/23/2020	<1	U	0.672		1.65		0.758		3.08	--		--	
Northwest Corner															
NW1-1	1st	6/23/2020	<1	U	<0.5	U	55.7	D	47.1		103	--		--	
B-22	1st	6/23/2020 and 7/21/20	26.3		101	D	914	D	45.4	D	1,087	--		1,500	
Fox Avenue															
R1-IW4a	1st	6/23/2020	1.36		3.55		13.1		7.06		25.1	7.89		--	
B-20a	1st	6/23/2020	<1	U	<0.5	U	11.4		4.74		16.1	--		--	
B-19	2nd	6/23/2020	<1	U	<0.5	U	24.2		8.38		32.6	--		--	
DUP-01(B-19)	2nd	6/23/2020	<1	U	<0.5	U	23		8.18		31.2	--		--	
B-58	1st	6/23/2020	35.9		10.1		15.4		1.36		62.8	--		--	
Seattle Boiler Works															
R2-IW1	1st	6/23/2020	<1	U	<0.5	U	4.06		9.71		13.8	9.32		--	
R2-IW1	2nd	6/23/2020	<1	U	<0.5	U	<1	U	1.81		1.81	8.71		--	
MW-6	2nd	6/23/2020	36.6		35.8	D	102	D	<0.2	U	174	--		--	
Myrtle Street															
B-35	2nd	6/23/2020	<1	U	<0.5	U	<1	U	0.225		0.225	--		--	
B-64	1st	6/23/2020	<1	U	<0.5	U	2.68		1.69		4.37	--		--	
B-33a	2nd	6/23/2020	<1	U	<0.5	U	<1	U	1.92		1.92	--		--	
Embayment Seeps															
SP-03	--	6/23/2020	<1	U	<0.5	U	1.65		**1.30**		2.95	--		--	
SP-03b	--	6/23/2020	<1	U	0.81		10.4		**2.30**		13.5	--		--	

Abbreviations:

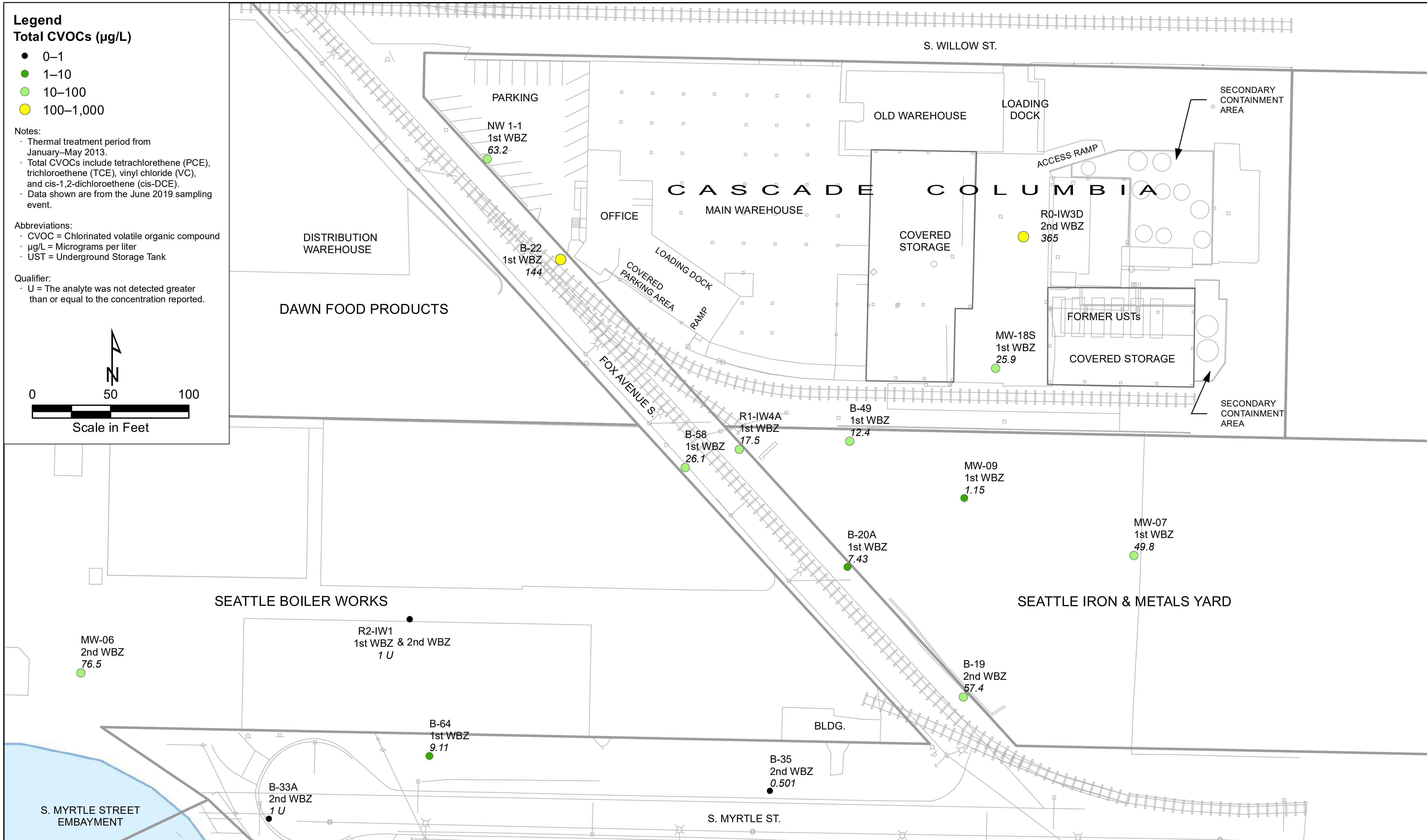
WBZ	Water bearing zone
CVOC	Chlorinated volatile organic compound
PCE	Tetrachloroethene
TCE	Trichloroethene
DCE	Dichloroethene
TOC	Total organic carbon
DHC	Dehalococcoides
µg/L	Micrograms per liter
mg/L	Milligrams per liter
ND	non-detect
--	Not analyzed

Qualifiers:

U	Analyte was not detected, concentration given is the reporting limit.
D	Dilution was required

Notes:

DHC samples collected in July 2020 from R0-IW7D and B-22



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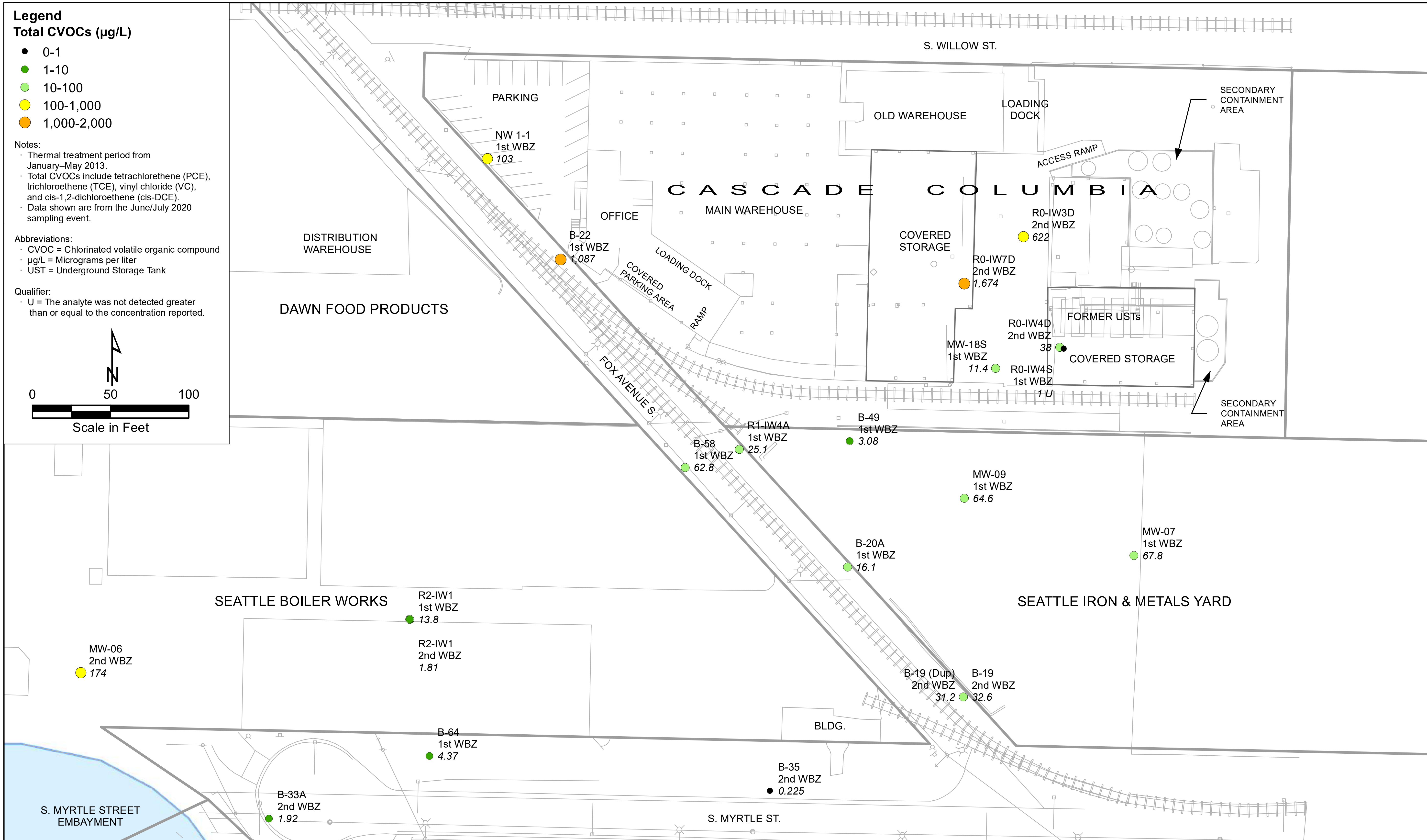
2019 Monitoring Summary
Fox Avenue Site
Seattle, Washington

Figure 4.1
Total CVOCs Concentrations in Groundwater
1st and 2nd Water Bearing Zones
June 2019



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2020 Monitoring Summary
Fox Avenue Site
Seattle, Washington

Figure 4.2
Total CVOCs Concentrations in Groundwater
1st and 2nd Water Bearing Zones
June and July 2020

2021 Annual Report Key Tables and Figures

Table 3.1 - 2021 Summary of Volatile Organic Compound Data in Groundwater

Location	WBZ	Sample Depth ft bgs	Analyte Sample Date	PCE µg/L		TCE µg/L		cis-1,2-DCE µg/L		trans-1,2-DCE µg/L		Vinyl chloride µg/L		Total CVOCs µg/L	TOC mg/L	
Source Area																
R0-IW02D	2nd	62	7/21/2021	<0.4	U	<0.5	U	13.7		<0.5	U	<0.2	U	**13.7**	3,280	D
R0-IW3D	2nd	63	7/21/2021	3.37		7.49		203	D	0.975		285	D	**500**	--	
R0-IW7D	2nd	63	7/21/2021	3.40		11.9		96.3	D	1.63		87.8	D	**201**	1,020	D
MW-18S	1st	18	7/21/2021	1.67		<0.5	U	13.6		<0.5	U	8.55		**23.8**	--	
Whitehead																
MW-9	1st	11	6/29/2021	<0.4	U	<0.5	U	2.26		0.836		11.9		**15.0**	12.5	
MW-7	1st	12	6/29/2021	<0.4	U	<0.5	U	<0.5	U	<0.5	U	0.492		**0.492**	--	
B-49	1st	13.5	6/29/2021	2.85		0.706		<0.5	U	<0.5	U	0.254		**3.81**	--	
Northwest Corner																
NW1-1	1st	11	6/29/2021	<0.4	U	<0.5	U	80.3	D	<0.5	U	77.6	D	**158**	--	
B-22	1st	10	6/29/2021	19.9		9.33		65.6	D	0.586		7.79		**103**	--	
DUP (B-22)	1st	10	6/29/2021	20.9		9.38		66.1	D	0.615		8.38		**105**	--	
B-57	1st	13	6/29/2021	7.67		0.643		0.565		<0.5	U	<0.2	U	**8.88**	--	
R1-IW9	1st	11	6/29/2021	480	D	212	D	57.8	D	0.663		20.7		**771**	--	
Fox Avenue Row 1 Injection Transect																
R1-IW4a	1st	11	6/29/2021	<0.4	U	4.34		8.66		<0.5	U	5.28		**18.3**	8.95	
B-20a	1st	14	6/29/2021	<0.4	U	<0.5	U	26.6		1.34		8.76		**36.7**	--	
B-19	2nd	45	6/29/2021	<0.4	U	<0.5	U	11.5		<0.5	U	17.4		**28.9**	--	
Fox Avenue Row 1 Monitoring Transect																
B-58	1st	11	6/29/2021	55.4	D	26.6		82.1	D	<0.5	U	11.2		**175**	--	
Seattle Boiler Works																
R2-IW1	1st	17	7/21/2021	<0.4	U	<0.5	U	1.32		<0.5	U	<0.2	U	**1.32**	8.79	
R2-IW1	2nd	45	7/21/2021	<0.4	U	<0.5	U	1.47		<0.5	U	<0.2	U	**1.47**	8.69	
MW-6	2nd	40	7/21/2021	11.7		14.1		70.9	D	0.835		1.74		**99.3**	--	
DUP (MW-6)	2nd	40	7/21/2021	11.7		14.0		70.5	D	0.871		1.83		**98.9**	--	
Myrtle St																
B-35	2nd	27	6/29/2021	<0.4	U	<0.5	U	<0.5	U	<0.5	U	<0.2	U	**ND**	--	
B-64	1st	10	6/29/2021	<0.4	U	<0.5	U	1.97		<0.5	U	1.49		**3.46**	--	
B-33a	2nd	30	6/29/2021	<0.4	U	<0.5	U	0.67		<0.5	U	1.59		**2.26**	--	
Embayment Seeps																
SP-03	--	--	7/21/2021	<0.4	U	<0.5	U	2.01		<0.5	U	0.42		**2.43**	--	
SP-03b	--	--	7/21/2021	<0.4	U	<0.5	U	<0.5	U	<0.5	U	<0.2	U	**ND**	--	

Abbreviations:

--	Not analyzed
DCE	Dichloroethene
PCE	Tetrachloroethene
TCE	Trichloroethene
TOC	Total Organic Carbon
µg/L	Micrograms per liter
ND	non-detect
ft bgs	feet below ground surface
WBZ	water bearing zone

Qualifiers:

D	Sample was diluted
U	Non-detect

Table 3.2 - Summary of Recent Benzene Data in Groundwater

Location	WBZ	Sample Depth ft bgs	2018 Benzene µg/L		2019 Benzene µg/L		2020 Benzene µg/L		2021 Benzene µg/L	
Source Area										
R0-IW02D	2nd	62	<1.00	U	<1.00	U	<1.00	U	<0.44	U
R0-IW3D	2nd	63	--		--		--		<0.44	U
R0-IW4D	2nd	63	--		--		1.86		--	
R0-IW4S	1st	17	--		--		<1.00	U	--	
R0-IW6D	2nd	63	<1.00	U	--		--		--	
R0-IW7D	2nd	63	--		--		<10.0	U	<0.44	U
R0-IW9S	1st	18	<1.00	U	--		--		--	
MW-15D	2nd	63	<1.00	U	--		--		--	
MW-16D	2nd	63	<1.00	U	--		--		--	
MW-17D	2nd	63	5.87		--		--		--	
MW-18S	1st	18	<1.00	U	<1.00	U	<1.00	U	0.81	
Whitehead										
MW-9	1st	11	<1.00	U	<1.00	U	<1.00	U	<0.44	U
MW-10	2nd	28	<1.00	U	--		--		--	
MW-7	1st	12	<1.00	U	<1.00	U	<1.00	U	<0.44	U
MW-8	2nd	28	<1.00	U	--		--		--	
B-49	1st	13.5	<1.00	U	<1.00	U	<1.00	U	<0.44	U
B-45	2nd	45	<1.00	U	--		--		--	
Fox Avenue Downgradient from Whitehead										
R1-IW7	2nd	41	<1.00	U	--		--		--	
B-20a	1st	14	<1.00	U	<1.00	U	9.22		<0.44	U
B-18	1st	14	1.39		--		--		--	
B-19	2nd	45	<1.00	U	<1.00	U	<1.00	U	<0.44	U
B-60	1st	11	<1.00	U	--		--		--	
B-61	2nd	42	1.59		--		--		--	
B-63	2nd	42	3.73		--		--		--	
R1-IW17	1st	12	<1.00	U	--		--		--	
R1-IW17	2nd	55	<1.00	U	--		--		--	
Northwest Corner										
NW1-1	1st	11	<1.00	U	<1.00	U	<1.00	U	<0.44	U
B-22	1st	10	<1.00	U	<1.00	U	<1.00	U	<0.44	U
B-57	1st	13	--		--		--		<0.44	U
R1-IW9	1st	11	--		--		--		<0.44	U
Fox Avenue Downgradient from Cascade										
R1-IW4a	1st	11	<1.00	U	<1.00	U	<1.00	U	<0.44	U
R1-IW4b	2nd	50	<1.00	U	--		--		--	
B-58	1st	11	<1.00	U	<1.00	U	<1.00	U	<0.44	U
B-59	2nd	27	<1.00	U	--		--		--	
R1-IW15	2nd	55	<1.00	U	--		--		--	

Table 3.2 - Summary of Recent Benzene Data in Groundwater

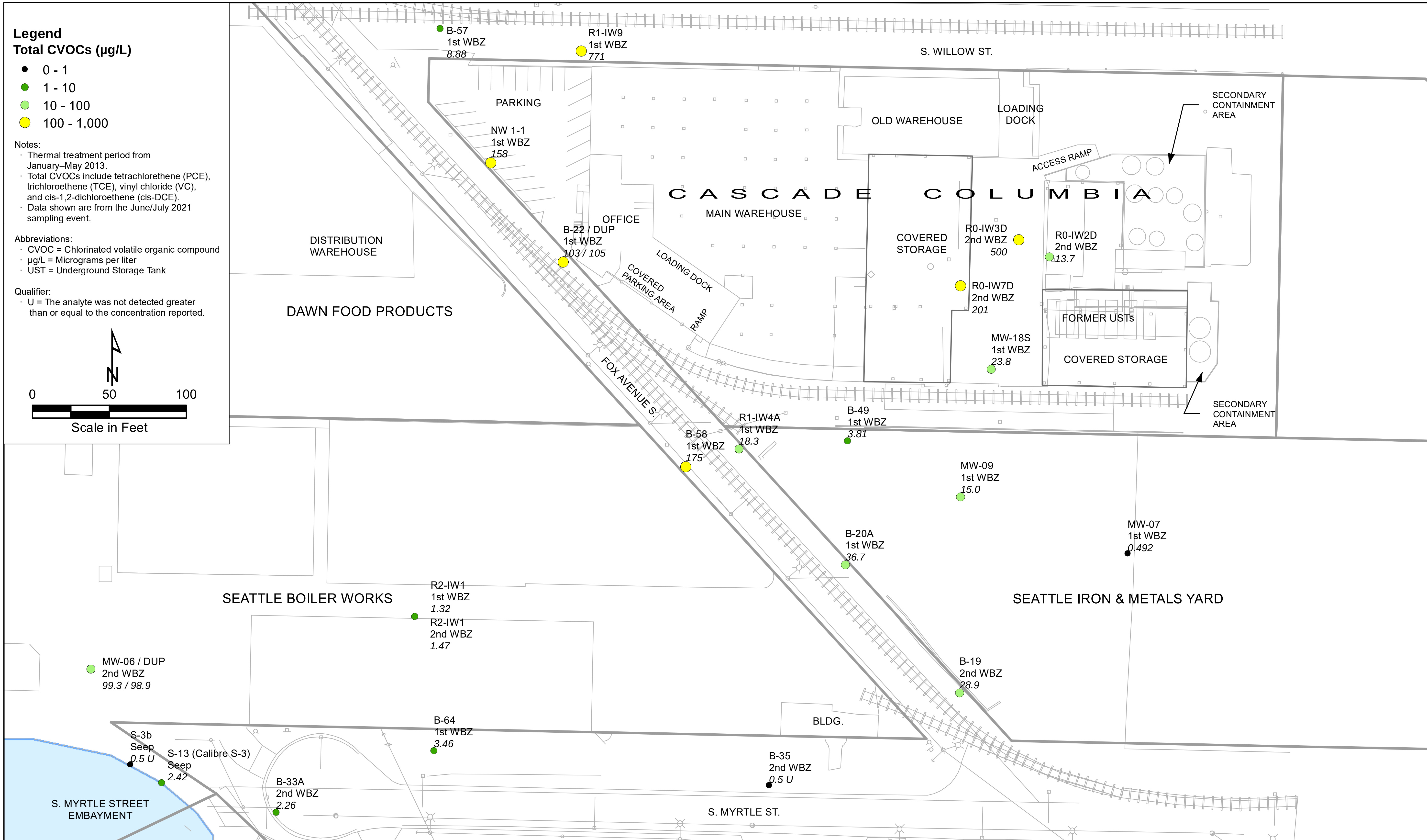
In SBW											
R2-IW1	1st	17		1.29		<1.00	U	<1.00	U	0.55	
R2-IW1	2nd	45		1.43		<1.00	U	4.67		0.65	
R2-IW8	2nd	63		1.17		--		--		--	
MW-5	1st	10		<1.00	U	--		--		--	
MW-6	2nd	40		<1.00	U	<1.00	U	<1.00	U	<0.44	U
Myrtle St											
B-35	2nd	27		2.51		1.84		<1.00	U	0.45	
B-64	1st	10		<1.00	U	<1.00	U	<1.00	U	<0.44	U
B-65	2nd	30		2.20		<1.00	U	<1.00	U	<0.44	U
B-33a	2nd	30		9.77		7.09		4.89		3.78	
Embayment Seeps											
SP-02	--	--		<1.00	U	--		--		--	
SP-03	--	--		7.34		3.96		2.94		2.34	
SP-03b	--	--		1.27		<1.00	U	<1.00	U	0.68	

Abbreviations:

--	Not analyzed
µg/L	Micrograms per liter
ft bgs	feet below ground surface
WBZ	water bearing zone

Qualifiers:

U	Non-detect



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2021 Monitoring Summary
Fox Avenue Site
Seattle, Washington

Figure 4.1
Total CVOCs Concentrations in Groundwater
1st and 2nd Water Bearing Zones
June and July 2021

2022 Annual Report Key Tables and Figures

Table 3.1 - 2022 Summary of Volatile Organic Compound Data in Groundwater

	WBZ	Sample Depth	Analyte	PCE		TCE		cis-1,2-DCE		trans-1,2-DCE		Vinyl chloride		Total CVOCs	TOC
Current CUL				***3.3***		***30***		**--**		**--**		***2.4***			
AWQC from WAC 173-201a-240				***7.1***		***0.86***		**--**		**--**		***0.26***			
Location		**ft bgs**	**Sample Date**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**	**mg/L**
Source Area															
R0-IW02D	2nd	62	7/19/2022	<0.4	U	<0.5	U	18.8		<0.5	U	<0.2	U	**18.8**	--
R0-IW3D	2nd	63	7/19/2022	7.11		<0.5	U	277		2.47		279		**566**	3,940
R0-IW7D	2nd	63	7/19/2022	5.78		11.4		98.2		1.72		42.8		**160**	1,250
MW-18S	1st	18	7/19/2022	3.20		0.873		41.6		1.06		52.8		**99.5**	--
MW-16D	2nd	63	8/22/2022	0.41		<0.5	U	0.76		<0.5	U	<0.2	U	**1.16**	--
Whitehead															
MW-10	2nd	28	7/19/2022	<0.4	U	<0.5	U	<0.5	U	<0.5	U	<0.2	U	**0**	--
MW-9	1st	11	7/19/2022	<0.4	U	<0.5	U	19.0		1.10		45.8		**65.9**	8.45
MW-9 (DUP)	1st	11	7/19/2022	<0.4	U	<0.5	U	19.2		1.58		57	E	**77.8**	--
MW-7	1st	12	7/19/2022	<0.4	U	<0.5	U	0.523		<0.5	U	<0.2	U	**0.52**	--
B-49	1st	13.5	7/19/2022	5.28		1.34		0.881		<0.5	U	2.23		**9.73**	--
Northwest Corner															
NW1-1	1st	11	7/18/2022	<0.4	U	<0.5	U	47.3		<0.5	U	77.1		**124**	--
B-22	1st	10	7/18/2022	86.2		19.1		79.9		0.663		4.94		**191**	--
B-22 (DUP)	1st	10	7/18/2022	91.3		18.2		83.1		<5	U	<2	U	**193**	--
R1-IW9	1st	11	7/18/2022	11.4		4.82		778		6.78		26.4		**827**	445
R1-IW12	1st	11	7/19/2022	<0.4	U	<0.5	U	66.2		<0.5	U	72		**138**	26.6
B-54	1st	12	8/22/2022	617	E	22		13.5		<0.5	U	<0.2	U	**653**	--
B-54 (dupe)	1st	12	8/22/2022	602		21.8		14		<0.5	U	<0.2	U	**638**	--
B-66	1st	14	8/22/2022	374	E	35		7.39		<0.5	U	<0.2	U	**416**	--
Fox Avenue Row 1 Injection Transect															
R1-IW3a	1st	10	8/22/2022	0.62		<0.5	U	50.7	D	<0.5	U	14.6		**65.9**	--
R1-IW4a	1st	11	7/18/2022	<0.4	U	<0.5	U	2.98		<0.5	U	2.66		**5.64**	16.0
B-20a	1st	14	7/18/2022	<0.4	U	<0.5	U	35.0		1.54		4.83		**41.4**	--
B-19	2nd	45	7/18/2022	<0.4	U	<0.5	U	8.96		<0.5	U	9.64		**18.6**	--
B-18	1st	14	8/22/2022	0.54		<0.5	U	32		<0.5	U	73.8	D	**106**	--
Fox Avenue Row 1 Monitoring Transect															
B-58	1st	11	7/18/2022	59	E	11.8		30.4		<0.5	U	7.62		**109**	--
B-60	1st	11	8/22/2022	0.86		1.35		17.7		<0.5	U	0.48		**20.4**	--
B-61	2nd	42	8/22/2022	<0.4	U	<0.5	U	<0.5	U	<0.5	U	<0.2	U	**0**	--
B-62	1st	11	8/22/2022	1.11		<0.5	U	<0.5	U	<0.5	U	<0.2	U	**1.11**	--
B-63	2nd	42	8/22/2022	<0.4	U	<0.5	U	<0.5	U	<0.5	U	<0.2	U	**0**	--
Seattle Boiler Works															
R2-IW1	1st	17	7/13/2022	<0.4	U	<0.5	U	2.61		<0.5	U	0.811		**3.42**	350
R2-IW1	2nd	45	7/13/2022	<0.4	U	<0.5	U	2.65		<0.5	U	0.864		**3.51**	389
R2-IW2	1st	17	7/18/2022	<0.4	U	<0.5	U	<0.5	U	<0.5	U	<0.2	U	**0**	--
R2-IW2	2nd	45	7/18/2022	<0.4	U	<0.5	U	3.22		<0.5	U	<0.2	U	**3.22**	--
R2-IW9	1st	12	7/18/2022	<0.4	U	0.567		1.72		<0.5	U	<0.2	U	**2.29**	--
R2-IW10	2nd	37	8/22/2022	<0.4	U	<0.5	U	1.66		<0.5	U	0.51		**2.17**	--
MW-3	1st	10	7/18/2022	1.77		1.31		1.31		<0.5	U	<0.2	U	**4.39**	--
MW-4	2nd	40	7/18/2022	<0.4	U	<0.5	U	<0.5	U	<0.5	U	<0.2	U	**0**	--
MW-5	1st	13	8/22/2022	0.41		<0.5	U	<0.5	U	<0.5	U	<0.2	U	**0.41**	--
MW-6	2nd	40	7/13/2022	9.23		8.0		57.6		0.596		0.943		**76.4**	--
DUP (MW-6)	2nd	40	7/13/2022	10.1		8.2		62	E	0.791		1.09		**82.1**	--
Myrtle St															
R2-IW6	2nd	45	7/18/2022	<0.4	U	<0.5	U	<0.5	U	<0.5	U	<0.2	U	**0**	--
B-35	2nd	27	7/18/2022	<0.4	U	<0.5	U	<0.5	U	<0.5	U	<0.2	U	**0**	--
B-64	1st	10	7/18/2022	<0.4	U	<0.5	U	1.15		<0.5	U	<0.2	U	**1.15**	--
B-33a	2nd	30	7/18/2022	<0.4	U	<0.5	U	<0.5	U	<0.5	U	<0.2	U	**0**	--

Table 3.1 - 2022 Summary of Volatile Organic Compound Data in Groundwater

	WBZ	Sample Depth	Analyte	PCE		TCE		cis-1,2-DCE		trans-1,2-DCE		Vinyl chloride		Total CVOCs	TOC	
Current CUL				***3.3***		***30***		***--***		***--***		***2.4***				
AWQC from WAC 173-201a-240				***7.1***		***0.86***		***--***		***--***		***0.26***				
Location		**ft bgs**	**Sample Date**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**	**mg/L**	
Embayment Seeps																
SP-02	--	--	7/13/2022	<0.4	U	<0.5	U	0.581		<0.5	U	<0.2	U	**0.58**	--	
SP-03	--	--	7/13/2022	<0.4	U	<0.5	U	2.27		<0.5	U	<0.2	U	**2.27**	--	
SP-03b	--	--	7/13/2022	<0.4	U	<0.5	U	0.542		<0.5	U	<0.2	U	**0.54**	--	

Abbreviations:

--	Not analyzed or not established
DCE	Dichloroethene
PCE	Tetrachloroethene
TCE	Trichloroethene
TOC	Total Organic Carbon
µg/L	Micrograms per liter
ft bgs	feet below ground surface
WBZ	water bearing zone
CUL	Cleanup Level
AWQC	Ambient Water Quality Criteria

Qualifiers:

D	Sample was diluted
U	Non-detect
E	Value above quantitation range

Table 3.2 - Summary of Recent Benzene Data in Groundwater

	WBZ	Sample Depth	2018 Benzene		2019 Benzene		2020 Benzene		2021 Benzene		2022 Benzene	
Location		**ft bgs**	**µg/L**		**µg/L**		**µg/L**		**µg/L**		**µg/L**	
Source Area												
R0-IW02D	2nd	62	<1.00	U	<1.00	U	<1.00	U	<0.44	U	<0.44	U
R0-IW3D	2nd	63	--		--		--		<0.44	U	<0.44	U
R0-IW4D	2nd	63	--		--		1.86		--		--	
R0-IW4S	1st	17	--		--		<1.00	U	--		--	
R0-IW6D	2nd	63	<1.00	U	--		--		--		--	
R0-IW7D	2nd	63	--		--		<10.0	U	<0.44	U	<0.44	U
R0-IW9S	1st	18	<1.00	U	--		--		--		--	
MW-15D	2nd	63	<1.00	U	--		--		--		--	
MW-16D	2nd	63	<1.00	U	--		--		--		<0.44	U
MW-17D	2nd	63	5.87		--		--		--		--	
MW-18S	1st	18	<1.00	U	<1.00	U	<1.00	U	0.81		<0.44	U
Whitehead												
MW-9	1st	11	<1.00	U	<1.00	U	<1.00	U	<0.44	U	<0.44	U
MW-10	2nd	28	<1.00	U	--		--		--		<0.44	U
MW-7	1st	12	<1.00	U	<1.00	U	<1.00	U	<0.44	U	<0.44	U
MW-8	2nd	28	<1.00	U	--		--		--		--	
B-49	1st	13.5	<1.00	U	<1.00	U	<1.00	U	<0.44	U	<0.44	U
B-45	2nd	45	<1.00	U	--		--		--		--	
Northwest Corner												
B-54	1st	12	--		--		--		--		<0.44	U
B-66	1st	14	--		--		--		--		<0.44	U
NW1-1	1st	11	<1.00	U	<1.00	U	<1.00	U	<0.44	U	<0.44	U
B-22	1st	10	<1.00	U	<1.00	U	<1.00	U	<0.44	U	<0.44	U
B-57	1st	13	--		--		--		<0.44	U	--	
R1-IW9	1st	11	--		--		--		<0.44	U	<0.44	U
R1-IW12	1st	11	--		--		--		--		<0.44	U
Fox Avenue Row 1 Injection Transect												
R1-IW3a	1st	10									<0.44	U
R1-IW4a	1st	11	<1.00	U	<1.00	U	<1.00	U	<0.44	U	<0.44	U
R1-IW4b	2nd	50	<1.00	U	--		--		--		--	
R1-IW7	2nd	41	<1.00	U	--		--		--		--	
B-20a	1st	14	<1.00	U	<1.00	U	9.22		<0.44	U	<0.44	U
B-18	1st	14	1.39		--		--		--		1.51	
B-19	2nd	45	<1.00	U	<1.00	U	<1.00	U	<0.44	U	<0.44	U
R1-IW15	2nd	55	<1.00	U	--		--		--		--	
R1-IW17	1st	12	<1.00	U	--		--		--		--	
R1-IW17	2nd	55	<1.00	U	--		--		--		--	

Table 3.2 - Summary of Recent Benzene Data in Groundwater

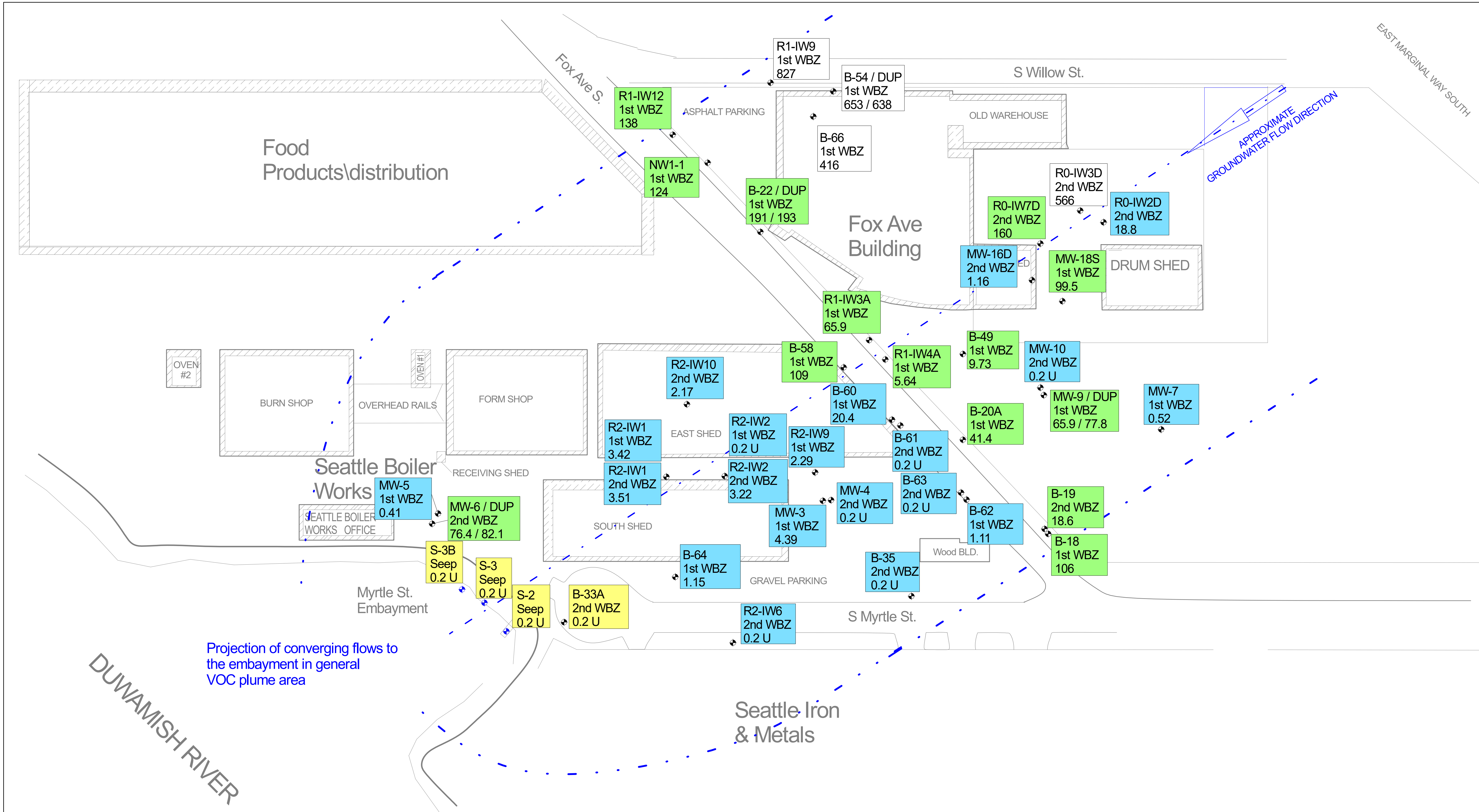
Location	WBZ	Sample Depth	2018 Benzene		2019 Benzene		2020 Benzene		2021 Benzene		2022 Benzene	
		ft bgs	µg/L		µg/L		µg/L		µg/L		µg/L	
Fox Avenue Row 1 Monitoring Transect												
B-58	1st	11	<1.00	U	<1.00	U	<1.00	U	<0.44	U	<0.44	U
B-59	2nd	27	<1.00	U	--		--		--		--	
B-60	1st	11	<1.00	U	--		--		--		<0.44	U
B-61	2nd	42	1.59		--		--		--		0.58	
B-62	1st	11	--		--		--		--		<0.44	U
B-63	2nd	42	3.73		--		--		--		0.60	
In SBW												
R2-IW1	1st	17	1.29		<1.00	U	<1.00	U	0.55		0.52	
R2-IW1	2nd	45	1.43		<1.00	U	4.67		0.65		0.56	
R2-IW2	1st	17	--		--		--		--		<0.44	U
R2-IW2	2nd	45	--		--		--		--		<0.44	U
R2-IW8	2nd	63	1.17		--		--		--			
R2-IW9	1st	12	--		--		--		--		<0.44	U
R2-IW10	2nd	37	--		--		--		--		<0.44	U
MW-3	1st	10	--		--		--		--		<0.44	U
MW-4	2nd	40	--		--		--		--		<0.44	U
MW-5	1st	10	<1.00	U	--		--		--		<0.44	U
MW-6	2nd	40	<1.00	U	<1.00	U	<1.00	U	<0.44	U	<0.44	U
Myrtle St												
B-35	2nd	27	2.51		1.84		<1.00	U	0.45		<0.44	U
R2-IW6	2nd	45	--		--		--		--		1.24	
B-64	1st	10	<1.00	U	<1.00	U	<1.00	U	<0.44	U	<0.44	U
B-65	2nd	30	2.20		<1.00	U	<1.00	U	<0.44	U	--	
B-33a	2nd	30	9.77		7.09		4.89		3.78		4.4	
Embayment Seeps												
SP-02	--	--	<1.00	U	--		--		--		<0.44	U
SP-03	--	--	7.34		3.96		2.94		2.34		1.35	
SP-03b	--	--	1.27		<1.00	U	<1.00	U	0.68		0.59	

Abbreviations:

--	Not analyzed
µg/L	Micrograms per liter
ft bgs	feet below ground surface
WBZ	water bearing zone

Qualifiers:

U	Non-detect



CALIBRE

Legend

- Text in green box represents CVOCs below Remediation Level of 250 ug/L.
- Text in blue box represents CVOCs below Remediation Level and Cleanup Levels.
- Text in yellow box represents VC below Cleanup Levels, data in boxes are 7/22 VC concentrations.

Notes:
- Thermal treatment period from Jan-May 2013
- Total CVOCs include tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride (VC), and cis-1,2-dichloroethene (cis-DCE).

Data presented are from the July 2022 sampling event.

- All data in ug/L.

0 30' 60' 120'
SCALE IN FEET

N

Figure 4.1
2022 Total CVOC Concentrations in Groundwater
1st and 2nd Water Bearing Zones
July/August 2022

Whitehead Tyee Site

Remedial Investigation Work Plan

Appendix C
Sampling and Analysis Plan/
Quality Assurance Project Plan

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List of Attachments

List of Abbreviations

Abbreviation	Definition
bgs	Below ground surface
CAS	Chemical Abstracts Service
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
DAHP	Washington State Department of Archaeology and Historic Preservation
DL	Detection limit
Ecology	Washington State Department of Ecology
EPH	Extractable petroleum hydrocarbons
F&B	Friedman & Bruya, Inc.
Fox Avenue Site	Fox Avenue MTCA Cleanup Site
HPAH	High molecular weight polycyclic aromatic hydrocarbon
HRA	Historical Research Associates, Inc.
HSA	Hollow-stem auger
IA	Interim action
LCS	Laboratory control sample
LNAPL	Light non-aqueous phase liquid
LPAH	Low molecular weight polycyclic aromatic hydrocarbon
MDL	Method detection limit
MS	Matrix spike

Abbreviation	Definition
MSD	Matrix spike duplicate
NAD 83 (2011)	North American Datum of 1983, 2011 National Adjustment
NAVD 88	North American Vertical Datum of 1988
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PID	Photoionization detector
Property	730 S. Myrtle Street property
PSL	Preliminary Screening Level
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RI/FS	Remedial Investigation/Feasibility Study
RL	Reporting limit
ROW	Right-of-Way
RPD	Relative percent difference
SAP	Sampling and Analysis Plan
Site	Whitehead Tyee Site
SVOC	Semivolatile organic compound
TCDD	2,3,7,8-Tetrachlorodibenzo-*p*-dioxin
TEF	Toxic equivalent factor
TEQ	Toxic equivalent
TPH	Total petroleum hydrocarbons
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound
VPH	Volatile petroleum hydrocarbons

1.0 Introduction

This Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) presents the proposed soil and groundwater sample collection to fulfill data gaps at the Whitehead Tyee Site (Site) for the purposes of preparing a Remedial Investigation/Feasibility Study (RI/FS), and is provided as an appendix to the RI Work Plan. The SAP/QAPP specifies field sample collection and laboratory analysis protocols, field and laboratory quality assurance (QA) objectives, and data management procedures. For clarity in this SAP/QAPP and consistent with the RI Work Plan main text, “Site” will be used when referring to the area of known contamination, which extends off-Property, and “Property” will be used when referring to the 730 S. Myrtle Street property only.

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2.0 Sampling and Analysis Plan

The investigation will involve collecting subsurface soil and groundwater samples for laboratory analyses at the locations shown on Figures 6.1 and 6.2 of the RI Work Plan, with sampling procedures described in the following section, including field methodology, sample nomenclature, and sample handling and custody documentation.

To minimize analytical costs to the extent practical, a tiered soil sample analytical approach will be conducted. These sampling and analytical programs are summarized in the following sections. Additionally, Table C.1 presents the analytical methods, preservation requirements, bottle types, and holding times for the sampling program. Table C.2 presents the detection limits (DLs) and reporting limits (RLs) for the analyses.

2.1 SOIL SAMPLE COLLECTION AND ANALYSIS

As described in Section 6.2 of the RI Work Plan, samples will be collected from soil borings to resolve soil data gaps. Floyd|Snider's standard guidelines for soil sample collection and soil logging (included in Attachment C.1) provide general details regarding field procedures, sample collection and processing, decontamination, and field documentation. Specific details regarding sample collection that are not described in the standard guidelines in Attachment C.1 are included in this section.

The proposed Tier 1 soil boring locations are shown on Figure 6.1 of the RI Work Plan.

2.1.1 Field Methods

Soil samples will be collected using direct-push and/or hollow-stem auger (HSA) drilling methods. Soil borings will be advanced to the target depths presented in Table 6.2, or until field indications of contamination are no longer present for at least 2 feet, using direct-push drilling. When using direct-push technology, soil cores will be collected continuously using a 4- or 5-foot-long lined sampler.

Soil borings for monitoring well installation will be advanced using HSA to a minimum depth of 16 feet below ground surface (bgs). The final depth will be decided based on field indicators in soil and will not exceed 20 feet bgs. Soil samples from the HSA will be collected for classification and laboratory analysis using an 18-inch-long split spoon. Alternatively, soil samples may be collected using direct-push methodology to determine well depth and collect samples for laboratory analysis, and wells installed by HSA at the same location without further collection of split spoon samples.

All soil borings will be observed by a field geologist, logged, classified according to the Unified Soil Classification System, and photographed according to Floyd|Snider's standard guideline for soil logging (Attachment C.1). Soil logging/monitoring well construction and sampling field forms are included in Attachment C.1.

After soil boring and monitoring well installation, each location will be field located by taking field measurements from permanent features on the Property or in the vicinity, accompanied with use of a global positioning system unit. All locations will be surveyed for horizontal positioning and elevation by a licensed surveyor.

2.1.2 Soil Inspection and Photoionization Detector Screening

Soils will be inspected for visual (e.g., light non-aqueous phase liquid [LNAPL], staining, or sheen) and/or olfactory indicators of contamination. Sheen tests will be conducted to accompany preliminary visual observations. Soil headspace will be screened for volatile organic compounds (VOCs) such as petroleum (i.e., Stoddard solvent) using a photoionization detector (PID). Soil from approximately 2-foot or smaller representative intervals will be collected in a sealed and labeled bag or jar for field measurement of VOCs. After soil vapor has had time to equilibrate with headspace gas, soil headspace will be screened with the PID and results will be noted on the field log. Other field observations, such as staining or odor, will also be noted on the field log.

2.1.3 Soil Sampling

Soil samples will be collected from each direct-push boring and/or hollow-stem augur boring for immediate analysis or archival at the laboratory (for future Tier 2 analysis) at 1-foot intervals wherever the recovered sample volume is sufficient for the required laboratory analyses specified in Table 6.2. Soil sample intervals may be adjusted in the field to thicknesses of up to 2 feet to obtain sufficient sample volume for laboratory analysis. In all cases, field staff will ensure that the soils in the interval sampled have consistent composition and field indications of contamination (e.g., odors, sheen, staining, LNAPL, elevated PID readings). Therefore, sample intervals may be adjusted to target field indications of contamination and may result in intervals less than 1 foot thick.

Samples for VOC and Stoddard solvent analysis will be transferred directly to the appropriate laboratory-provided jars without homogenization to minimize the potential loss of volatile constituents in accordance with Washington State Department of Ecology (Ecology) guidance (Ecology 2004a). Samples for non-volatile analysis will be transferred to a decontaminated stainless-steel bowl and homogenized until uniform in color and texture before being placed into laboratory-provided sample containers. Table C.1 summarizes the container type, preservation method, and holding times for soil sample analyses.

Sample collection and analysis will be tiered, as described below and in Table 6.2 of the RI Work Plan.

Tier 1: The first tier of samples analyzed will be those collected from the Tier 1 borings as shown on Figure 6.1 of the RI Work Plan, at the depth intervals specified in Table 6.2 of the RI Work Plan.

Tier 2: The second tier of samples analyzed may include archived sample intervals from the Tier 1 soil boring locations and/or samples collected from Tier 2 contingency soil borings, if necessary, to delineate the extents of contamination exceeding the Preliminary Screening Levels (PSLs) or otherwise fill data gaps.

2.1.4 Soil Sample Nomenclature

The sample naming format that will be used for the soil samples is: “WT-Boring Location number-sample depth interval in feet bgs.” For example, a soil sample collected from WT-SB-21 in the 3- to 6-foot bgs interval would be labeled WT-SB21-3-6. QA/quality control (QC) samples, such as field duplicates, will be named according to the boring location where they were collected.

2.2 GROUNDWATER SAMPLE COLLECTION AND ANALYSIS

As described in Section 6.2 of the RI Work Plan, groundwater samples will be collected from the Site monitoring well network including existing (WT-MW-06, WT-MW-07, WT-MW-108, and WT-MW-109), proposed (WT-MW-111, WT-MW-112 and WT-MW-113), and replacement (WT-MW-04R and WT-MW-110R) wells. Samples will also be collected from Fox Avenue MTCA Cleanup Site (Fox Avenue Site) wells on or surrounding the Property, including B-18, B-20A, B-36, B-37, B-38, B-49, B-60, B-64, MW-07, MW-08, MW-09, and MW-10. New monitoring wells within the Site monitoring well network will be developed prior to sampling and the existing wells will be evaluated for possible redevelopment. Four rounds of groundwater sampling will be performed as part of the RI, to occur quarterly for 1 year. Additional groundwater samples may be collected from new Tier 2 contingent wells or additional Tier 2 Fox Avenue Site wells if needed to delineate extents of contamination or otherwise fill data gaps. Groundwater sampling locations are shown on Figure 6.2 of the main text.

2.2.1 Monitoring Well Installation and Development

Monitoring well construction and development will be performed in accordance with Floyd|Snider’s monitoring well construction and development standard guidelines (Attachment C.1). A 2-inch-diameter polyvinyl chloride (PVC) well with a 10-foot screen will be installed using HSA drilling methods unless the field geologist indicates otherwise based on the material encountered in the subsurface. The screened interval will be approximately 6 to 16 feet bgs, designed to intercept the water table, which is typically between 8 and 11 feet bgs. Wells will be completed with flush-mounted monuments.

Following installation, monitoring wells will be developed to remove fine-grained material by purging with a submersible pump and surging with the pump or a surge block to move water through the sand pack and surrounding soil formation. Wells will be developed until the purge water achieves visual clarity. Existing Site wells and Fox Avenue Site wells that have not been accessed for sample collection within the past 3 years will also be redeveloped prior to sample collection. Purge water will be collected in 55-gallon drums and may require off-site disposal depending on groundwater analytical data.

2.2.2 Groundwater Sampling Methodology

Groundwater sampling will be completed a minimum of 1 week following the development of the new (and existing) monitoring wells. All wells will be purged and sampled using low-flow procedures in accordance with the Floyd|Snider low-flow groundwater sample collection standard guideline (Attachment C.1). Table C.1 summarizes the container type used during sample collection, preservation method, and holding time for each analyte. All water samples will be analyzed without centrifugation. If turbidity of 5 nephelometric turbidity units cannot be achieved during low-flow sampling, samples that will be analyzed for total polychlorinated biphenyls (PCBs) and dioxins/furans may also be run with centrifugation at the laboratory to remove suspended solid matter prior to analysis, in coordination with Ecology.

2.2.3 Transducer Study

Automatic data logging vented, or non-vented, pressure transducers will be deployed in selected monitoring wells as specified in the RI Work Plan (Section 6.3.2.6). Non-vented transducers, if used, will be deployed simultaneously at the Site with a barometer to record atmospheric pressure. At each well, the depth to water will be measured prior to placement, and the transducer will be hung on a cable long enough to reach at least 2 feet below the water table. The depth to water and cable length will be recorded by the field staff. The transducers and barometer (if needed) will be set to log data at 10-minute intervals for a period of one week following each groundwater sampling event.

At the end of each study, depth to water will be measured immediately prior to transducer removal from each well and the transducers and barometer will be removed from the Site. The data logged during the study period will be downloaded and corrected for barometric pressure changes, if non-vented transducers are used.

2.2.4 Groundwater Sample Analysis

Tier 1 groundwater samples will be analyzed using the approach presented in Table 6.3 of the RI Work Plan. If additional Tier 2 contingency groundwater sample locations are determined to be necessary, these wells will be installed and/or sampled according to the procedures outlined above and in Attachment C.1.

2.2.5 Groundwater Sample Nomenclature

The sample naming format that will be used for the groundwater samples is: "Groundwater well location number-month/day/year of collection." For example, a groundwater sample collected from WT-MW-07 on November 20, 2022, would be labeled WT-MW07-112022. QA/QC samples, such as field duplicates, will be named according to the monitoring well location where they were collected.

2.3 SAMPLE HANDLING AND CUSTODY DOCUMENTATION

Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analysis, to the time sample results are reported. A sample log form or field logbook entry will be completed for each soil boring well and monitoring well location and each sample collected.

To control the integrity of the samples during transit to the laboratory and during holding prior to analysis, established preservation and storage measures will be taken. The field lead will check all container labels, custody form entries, and logbook entries for completeness and accuracy at the end of each sampling day. Sample containers will be labeled at the time of sampling, clearly identifying the project name, project number, location name, sample number, sampler's initials, date and time of collection, analysis to be performed, and preservative.

Technical field staff will be responsible for all sample tracking and custody procedures in the field, and chain-of-custody procedures will be strictly followed. The field lead will be responsible for final sample inventory and will maintain sample custody documentation. Prior to transport, sample containers will be wrapped and securely packed inside the cooler with ice packs or crushed ice by the field technician. Samples will be delivered to the laboratory under chain-of-custody protocol following completion of sampling activities on the day of sample collection or the following day depending on the field sampling duration.

At the end of each day, and prior to transfer, Chain-of-Custody Form entries will be made for all samples. All Chain-of-Custody Forms will be completed in indelible ink. All sample information (i.e., sample names, sampling date/time, sample matrix, number of containers, etc.), including all required analyses, will be logged onto a Chain-of-Custody Form prior to formal transfer of sample containers to the analytical laboratory. The sampler will place the original form in a clear plastic bag inside the sample cooler with the samples.

The samples will be considered to be in custody if one of the following is maintained:

- The samples are in someone's physical possession.
- The samples are in someone's view.
- The samples are locked up, secured in a locked container or vehicle, or otherwise sealed so that any tampering would be evident.
- The samples are kept in a secured area, restricted to authorized personnel only.

Any time possession of the samples is transferred, the individuals relinquishing and receiving the samples will respectively sign, date, and note the time of transfer on the Chain-of-Custody Form. This form also documents the transfer of custody of samples from the sampler to the laboratory. Each delivery of sample coolers will be accompanied by Chain-of-Custody Forms. Copies of all forms will be retained as appropriate.

The designated sample receiver at the laboratory will accept custody of the samples and verify that the Chain-of-Custody Forms match the samples received. The laboratory sample receiver will ensure that the Chain-of-Custody Forms are properly signed upon receipt of the samples and will note questions or observations concerning sample integrity on the Chain-of-Custody Forms. Upon receipt, the laboratory will contact the Floyd|Snider Project Manager immediately if discrepancies are discovered between the Chain-of-Custody Forms and the sample shipment. The laboratory program manager, or designee, will specifically note any coolers that are not sufficiently cold upon receipt.

3.0 Quality Assurance Project Plan

This section describes the analytical program to be conducted for each sample selected for chemical analysis, and well as the laboratory QA objectives and QC procedures required to be met to achieve technically sound and useable data.

3.1 DATA QUALITY OBJECTIVES

The data collection described in the RI Work Plan is intended to ensure that a comprehensive Site RI/FS can be prepared that documents the nature and extent of Site contamination and recommends a remedial alternative that is protective of human health and the environment. These objectives have been used to define the following data quality objectives:

- The data must be representative of the media and relevant to the objective listed; this data quality objective is addressed by the design of the RI Work Plan.
- The data must be sufficiently complete so as not to introduce unacceptable uncertainty. This was addressed by multiple prior rounds of sampling and design of the sampling program to fulfill remaining data gaps.
- The data analysis must be both sensitive and selective. Standard U.S. Environmental Protection Agency (USEPA) and Ecology methods are used for the analysis of soil and groundwater samples. These methods have been selected to ensure that RLs are sufficiently low to compare the resulting data to the appropriate screening levels. They have been used previously at the Site to effectively quantify concentrations of contaminants and have been found to be without measurable analytical interference at the Site. The analytical methods for Stoddard solvent and oil-range organics analysis were adjusted to use the appropriate standards for quantitation.
- The analytical methods used to make the measurements must be selected to allow the data to be used in meeting the objectives. This data quality objective is addressed by using standardized USEPA methods.
- The analytical methods used to make measurements must be sufficiently sensitive to allow the objectives to be met. Specifically, the RLs of the selected methods are sufficiently low to allow the results to be distinguished from decision criteria.
- Data validation will be completed, and data will be reviewed to determine if the data are acceptable for their intended use based on project-specific decision criteria.

3.2 LABORATORY ANALYSES

Samples will be transported to Friedman & Bruya, Inc. (F&B), an accredited laboratory located in Seattle, Washington, for chemical analysis. F&B will subcontract select sample aliquots to Frontier Analytical in El Dorado Hills, California; Fremont Analytical in Seattle, Washington; and OnSite Environmental, Inc., in Redmond, Washington. The samples collected will be analyzed for the following chemicals as indicated on Table C.2, by the methods for soil and groundwater indicated below:

- Total petroleum hydrocarbons (TPH) as gasoline-range organics by NWTPH-Gx
- TPH as Stoddard solvent[1] and diesel- and oil-range organics by NWTPH-Dx
- Resource Conservation and Recovery Act list of 8 metals by USEPA Method 6020B/ 1631E trace level
- Semivolatile organic compounds (SVOCs; including pentachlorophenol and carcinogenic polycyclic aromatic hydrocarbons [cPAHs]) by USEPA Method 8270E/ 8270E SIM
- VOCs by USEPA Method 8260D
- Extractable petroleum hydrocarbons/volatile petroleum hydrocarbons (EPH/VPH) by WA MTCA EPH/WA MTCA VPH
- PCB Aroclors by USEPA Method 8082A; with additional analysis of PCB congeners by USEPA Method 1668 if Aroclors are detected[2]
- Dioxins/furans by USEPA Method 1613B
- Total organic carbon by USEPA Method 9060A

3.3 REPORTING LIMITS

The analytical methods identified in this SAP/QAPP result in method detection limits (MDLs) and RLs (or practical quantitation limits) that are achievable with standard methodology. Table C.2 presents the target MDLs and RLs for each analytical method as performed by F&B. These RLs are

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1 Stoddard solvent may be analyzed by using either the NWTPH-Gx or NWTPH-Dx methods because this petroleum mixture contains alkanes in both the gasoline and diesel ranges. Stoddard solvent is a petroleum product with hydrocarbon constituents that have between 8 and 12 carbon atoms (i.e., C_8 to C_{12}). At the Site, where the Stoddard solvent release occurred at least 30 years ago, review of the chromatograms from prior investigations indicates that the lighter end is not present and the majority of the Stoddard solvent (greater than 90 percent) is between C_9 and C_{12}. The purge-and-trap extraction methodology used in gasoline-range analysis is designed to volatilize C_4 to C_{12} and is less effective at volatilizing the heavier hydrocarbon constituents that comprise the Stoddard solvent mixture, whereas the total solvent extraction methodology used in diesel-range analysis is readily able to extract the lightest hydrocarbons (i.e., in the C_9 to C_{12} range) that are quantified using this methodology. Therefore, higher quality chromatograms and more accurate quantitation are achieved using the NWTPH-Dx method, and Stoddard solvent at the Site is most appropriately analyzed using this method.

2 If PCBs are detected by USEPA Method 8082A, the two greatest results in the medium where PCBs were detected will be selected for further characterization by USEPA Method 1668. If PCBs are detected by USEPA Method 8082 in only one location, only that location will be selected for further characterization by USEPA Method 1668.

goals only, insofar as instances may arise where high sample concentrations, non-homogeneity of samples, or matrix interferences preclude achieving the desired RL and associated QA/QC criteria. In such instances, the laboratory will report the reason for any deviation from these RLs.

3.4 SPECIFIC DIOXIN/FURAN DATA ANALYSES

Dioxins/furans are generally present in the environment as a complex mixture of chemical congeners that differ in terms of the number and location of chlorine atoms. The most toxic and best-studied of the dioxin/furan congeners is 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD). Because of the need to evaluate the risks associated with the mixture of congeners, the toxic equivalent factor (TEF) methodology is used. A TEF value is assigned to each congener relative to the toxicity of TCDD. The total toxic equivalent (TEQ) of a mixture is the sum of the products of the concentration of each congener in a sample and the congener's corresponding TEF value. The TEF values used to calculate the TEQs are those resulting from the World Health Organization re-evaluation of TEFs for dioxins performed in 2005 (Van den Berg et al. 2006), as presented in Model Toxics Control Act (MTCA) Table 708-1 (Ecology 2007). The calculated TEQ value will be used to compare against the dioxin/furan TEQ PSL.

3.5 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL OBJECTIVES

Laboratory QA/QC objectives include obtaining data that are technically sound and properly documented, having been evaluated against established criteria for the principle data quality indicators (i.e., precision, accuracy, representativeness, completeness, and comparability) as defined in Ecology and USEPA guidance (Ecology 2004b and USEPA 2002). Data QA/QC criteria are presented in Table C.3 and are described in detail in the following sections.

3.5.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, precision is a quantitative measure of the variability of a group of measurements compared to their average values. Analytical precision is measured through matrix spike (MS), matrix spike duplicate (MSD) samples for organic analysis, through laboratory duplicate samples for inorganic analyses, and on samples from this project.

Analytical precision measurements will be carried out on project-specific samples at a minimum frequency of one per laboratory analysis group. Laboratory precision will be evaluated against quantitative relative percent difference (RPD) performance criteria.

Field precision will be evaluated by the collection of blind field duplicates. Currently, no performance criteria have been established for field duplicates. Field duplicate precision will, therefore, be screened against an RPD of 75 percent for all samples. However, no data will be qualified based solely on field duplicate precision.

Precision measurements can be affected by the nearness of a chemical concentration to the MDL, where the percent error (expressed as RPD) increases. The equation used to express precision is as follows:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

Where:
RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

3.5.2 Accuracy

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Analytical accuracy may be assessed by analyzing "spiked" samples with known concentrations (surrogates, laboratory control samples [LCSs], and/or MS) and measuring the percent recovery. Accuracy measurements on MS samples will be carried out at a minimum frequency of one per laboratory analysis group per matrix analyzed. Because MS/MSDs measure the effects of potential matrix interferences of a specific matrix, the laboratory will perform MS/MSDs only on samples from this investigation and not from other projects. Surrogate recoveries will be determined for every sample analyzed for organics.

Laboratory accuracy will be evaluated against quantitative LCSs, MS, and surrogate spike recoveries using limits for each applicable analyte. Accuracy can be expressed as a percentage of the true or reference value, or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is as follows:

$$\%R = 100\% \times (S-U)/C_{sa}$$

Where:
%R = percent recovery
S = measured concentration in the spiked aliquot
U = measured concentration in the unspiked aliquot
C_{sa} = actual concentration of spike added

3.5.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Care has been taken in the design of the sampling program to ensure sample locations are properly selected, sufficient numbers of samples are collected to accurately reflect conditions at the location(s), and samples are representative of the sampling location(s). A sufficient volume of sample will be collected at each sampling location to minimize bias or errors associated with sample particle size and heterogeneity.

3.5.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another. In order to ensure results are comparable, samples will be analyzed using standard USEPA methods and protocols. Calibration and reference standards will be traceable to certified standards and standard data reporting formats will be employed. Data will also be reviewed to verify that precision and accuracy criteria were achieved and, if not, that data were appropriately qualified.

3.5.5 Completeness

Completeness is a measure of the amount of data that is determined to be valid in proportion to the amount of data collected. Completeness will be calculated as follows:

$$C = \frac{\text{(Number of acceptable data points)} \times 100}{\text{(Total number of data points)}}$$

The QA/QC objectives for completeness for all components of this project is 95 percent. Data that were qualified as estimated because the QA/QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that were qualified as rejected will not be considered valid for the purpose of assessing completeness.

3.6 FIELD QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Field QC is evaluated through the analysis of field duplicates, rinse blanks, and trip blanks. Field duplicates are used to assess proper homogenization in the field, reproducibility of the sample preparation and analysis, and heterogeneity of the matrix. Rinse blanks are used to evaluate potential field cross contamination and will be collected after decontamination of sampling equipment. Trip blank samples are used to evaluate potential cross contamination from volatile compounds from ambient conditions or from other samples during sample handling and transport. The frequency, procedures, and nomenclature for collecting each type of field QC sample is summarized below:

- Field duplicates will be collected at a rate of 1 per 20 investigation samples, per environmental medium. If there are less than 20 investigation samples collected during a given event, one field duplicate will be collected. Field duplicates will be labeled with a fictitious sample location by adding 100 to the sample location. For example, a field duplicate collected from monitoring well MW-01 on December 1, 2022, would be named “MW-101-120122.”
- Rinse blanks will be collected at a rate of 1 per event per sampling methodology/ equipment type by pouring distilled water over decontaminated, non-dedicated field equipment. Rinse blanks will be labeled using the following format: “RB”-“Number”-“Date.” For example, a rinse blank collected on December 1, 2022, would be named “RB-1-120122.”

- Trip blanks will be collected at a rate of 1 per cooler with samples for VOC analysis per event. Trip blanks will be prepared by the analytical laboratory and consist of a sealed container containing clean sample matrix that is carried (unopened) to the field and back with the other sample containers. Trip blanks will be placed in any coolers containing samples that will be analyzed for VOCs. These samples will be labeled using the following format: "TB"-"Date." For example, a trip blank collected on December 1, 2022, would be named "TB-120122."

3.7 LABORATORY AND QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

The quality of analytical data generated by the laboratory is assessed by the frequency and type of internal laboratory QA/QC checks developed for analysis type and method. Laboratory results will be evaluated by reviewing analytical results of method blanks, MS/MSD, field duplicate samples, LCS, calibrations, performance evaluation samples, and interference checks as specified by the specific analytical methods.

Results of the QA/QC samples from each laboratory analysis group will be reviewed by the laboratory analyst immediately after a laboratory analysis group has been analyzed. The QA/QC sample results will then be evaluated to determine whether control limits were exceeded. If control limits are exceeded in the laboratory analysis group, corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

All primary chemical standards and standard solutions used in this project will be traceable to documented and reliable commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities identified in the standard will be documented.

The procedures that will be used to assess data quality throughout laboratory sample analysis are summarized below.

3.7.1 Laboratory Duplicates

Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates are subsamples of the original sample that are prepared and analyzed as a separate sample. A minimum of one duplicate will be analyzed per laboratory analysis group if applicable per the approved method. When there are fewer than 20 samples, a laboratory duplicate will still be analyzed.

3.7.2 Matrix Spikes and Matrix Spike Duplicates

Analysis of MS samples provides information on the extraction efficiency of the method on the sample matrix. By performing MSD analyses, information on the precision of the method is also provided for organic analyses. A minimum of one MS/MSD will be analyzed for every laboratory analysis group for which MS/MSD sample analysis is applicable per the approved method. When feasible, MS/MSD analyses will be performed on project-specific samples. When there are fewer than 20 samples, a MS/MSD will still be analyzed.

3.7.3 Laboratory Control Samples and Laboratory Control Sample Duplicate

An LCS is a method blank sample carried throughout the same process as the samples to be analyzed, with a known amount of standard added. The blank spike compound recovery assesses analytical accuracy in the absence of any sample heterogeneity or matrix effects. All LCS data for metals and organic compounds will be reported. The LCS will be performed once per laboratory analysis group.

3.7.4 Surrogate Spikes

All project samples analyzed for organic compounds will be spiked with appropriate surrogate compounds as defined in the analytical methods. Surrogate recoveries will be reported by the laboratories; however, no sample result will be corrected for recovery using these values.

3.7.5 Method Blanks

Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. A minimum of one method blank will be analyzed for every extraction batch.

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4.0 Data Reduction, Validation, and Reporting

Initial data reduction, evaluation, and reporting at the laboratory will be carried out as described in the appropriate analytical protocols and the laboratory QA/QA Manuals. QA/QC data resulting from methods and procedures described in this document will also be reported.

4.1 DATA REDUCTION AND LABORATORY REPORTING

The laboratory will be responsible for internal checks on data reporting and will correct errors identified during the QA review. Close contact will be maintained with the laboratory to resolve any QA/QC problems in a timely manner. The analytical laboratory will be required, where applicable, to report the following:

- **Project Narrative.** This summary, in the form of a cover letter, will discuss problems, if any, encountered during any aspect of analysis. This summary should discuss, but not be limited to, QA/QC, sample shipment, sample storage, and analytical difficulties. Any problems encountered (actual or perceived) and their resolutions will be documented in as much detail as necessary.
- **Sample Identification Codes.** Records will be produced that clearly match all blind duplicate QA/QC samples with laboratory sample identification codes.
- **Chain-of-Custody Records.** Legible copies of the custody forms will be provided as part of the data package. This documentation will include the time of receipt and condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented.
- **Sample Results.** The data package will summarize the results for each sample analyzed. The summary will include the following information when applicable:
  - Field sample identification code and the corresponding laboratory identification code:
    - Sample matrix.
    - Date of sample extraction.
    - Date and time of analysis.
    - Weight and/or volume used for analysis.
    - Final dilution volumes or concentration factor for the sample.
    - Percent moisture in solid samples.
    - Identification of the instrument used for analysis.
    - Method reporting and quantitation limits.
  - Analytical results reported with reporting units identified.
  - All data qualifiers and their definitions.
  - Electronic data deliverables.

- **QA/QC Summaries.** This section will contain the results of all QA/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results (refer to above). No recovery or blank corrections will be made by the laboratory. The required summaries are listed below; additional information may be requested.
  - **Method Blank Analysis.** The method blank analyses associated with each sample and the concentration of all compounds of interest identified in these blanks will be reported.
  - **Surrogate Spike Recovery.** All surrogate spike recovery data for organic compounds will be reported. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed.
  - **MS Recovery.** All MS recovery data for metals and organic compounds will be reported. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed. The RPD for all duplicate analyses will be reported.
  - **Matrix Duplicate.** The RPD for all matrix duplicate analyses will be reported.
  - **LCS.** The LCS for metals and organic compounds will be reported. If a duplicate LCS is analyzed, the RPD for all duplicate analyses shall be reported.
  - **Duplicates.** Duplicates will be reported in the same format as any other sample. RPDs will be calculated for duplicate samples and evaluated as part of the data quality review.

4.2 DATA VALIDATION

Floyd|Snider will conduct a USEPA Stage 2A Compliance Screening on all the analytical data. If dioxins/furans are detected, a USEPA Stage 4 Data Quality Review (Full Validation) will be conducted by EcoChem, Inc., on dioxin/furan data.

All chemical data will be reviewed with regard to the following:

- Chain-of-custody/documentation
- Sample preservation and holding times
- Method blanks
- RLs
- Surrogate recoveries
- MS/MSD recoveries
- LCS recoveries
- Laboratory and field duplicate RPDs

The full validation for dioxins/furans will also include the following components:

- Evaluation of instrument performance and calibration
- Evaluation of compound identification and quantitation (transcription and calculation)

Data validation will be based on the QA/QC criteria as recommended in the methods identified in this SAP/QAPP, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods (USEPA 1986), National Functional Guidelines for Organic Superfund Methods Data Review* (USEPA 2020a), and *National Functional Guidelines for Inorganic Superfund Methods Data Review* (USEPA 2020b). The dioxin/furan data will also be evaluated using the *National Functional Guidelines for High Resolution Superfund Methods Data Review* (USEPA 2020c).

Data usability, conformance with the QA/QC objectives, and any deviations that may have affected the quality of the data, as well as the basis of application of qualifiers, will be included in the final reporting of the data. Details on qualifiers used during data validation are included in Section 5.3.3. Any required corrective actions based on the evaluation of the analytical data will be determined by the laboratory and EcoChem (for dioxins/furans) in consultation with the Floyd|Snider Project Manager and may include qualification or rejection of the data.

The data validation summary report(s) will be presented as an appendix to the RI/FS.

4.3 DATA REPORTING

Data will be standardized, stored, and managed according to the procedures outlined in Section 5.0. Validated chemical data will be tabulated and presented in tables containing soil boring and monitoring well locations, concentrations with qualifiers as appropriate, and comparison to relevant soil and groundwater screening levels. These data will be incorporated into the Site RI/FS.

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5.0 Data Management

This section describes data standardization, handling, and management procedures for historical data and data gathered as part of the RI Work Plan, including summation rules for select analytes. The data management procedures are consistent with those outlined in the MTCA regulation (WAC 173-340), as well as related Ecology and USEPA guidance documents (Ecology 2013; USEPA 2020a, 2020b, 2020c).

5.1 DATA STANDARDIZATION

The following sections describe the procedures that will be used to ensure that geospatial and analytical data are displayed and reported in a consistent manner in the project data base and deliverables.

5.1.1 Geospatial Information

Elevation datum, spatial coordinates, and depth information for each location and sample are reviewed for completeness prior to loading the data into the project database. QA/QC checks are performed to ensure that the total number of imported locations from each data source within the Site match the total number of locations shown in tables and figures associated with the data source. Additionally, as described in the sections that follow, all geospatial information is standardized to a consistent set of units, coordinates, or datum for data reporting.

5.1.1.1 Vertical Datum

Elevation data are recorded using the North American Vertical Datum of 1988 (NAVD 88). The Floyd|Snider database stores elevations for each sample location at the Site in NAVD 88, reported in feet. All elevations are rounded to the nearest one-tenth of a foot.

5.1.1.2 Horizontal Datum and Geospatial Characterization

All x and y location coordinates are stored in the horizontal North American Datum of 1983, 2011 National Adjustment (NAD 83 (2011)), Washington State Plane Coordinate System, North Zone (International Feet). Coordinates provided to Floyd|Snider in other horizontal datums (i.e., by subcontractors) will be converted to NAD 83 (2011), reported in feet, prior to storage in the database. Locations that are missing x and y coordinates in the source database or electronic data deliverable may be digitized from available figures showing the sampling location. The accuracy of digitized and standardized location coordinates is reviewed by comparing the plotted location coordinates stored in the database against figures showing sample locations in the original data source.

Latitude and longitude coordinates are also retained for each location using the World Geodetic System (WGS84) coordinate system, which facilitates the uploading of location information into Global Positioning System devices for use in the field.

For any locations in the database that represent composite sample locations, coordinates associated with these locations will be equivalent to the centroid of the subsampling locations.

5.1.1.3 Depth Characterization

Sample depth information for each sample result are reviewed for completeness. All upland soil and groundwater sample depth information is standardized by media and retained in the project database. Upland soil data are stored in units of feet bgs. Sample depths stored in feet bgs are rounded to one decimal place.

5.1.2 Analyte Nomenclature

Analyte grouping and naming conventions are reviewed for completeness and standardized prior to loading the data in the database.

5.1.2.1 Analyte Groups

Each analyte is categorized into an analyte group in the database based on commonly accepted analyte groups for environmental media. Analyte groups consider chemical structure and properties, laboratory analysis, and reporting method.

Project-specific analyte groups are further subcategorized by media to reflect analytes that were needed to perform sums for comparison of total results to criteria, analyte groups containing individual analytes with criteria, and “other” analyte groups containing analytes that do not have relevant criteria. Project-specific analyte groups are presented in Table C.2.

5.1.2.2 Analyte Nomenclature

Differences in analyte naming conventions may include slight variations in analyte name for summed results, use of synonyms for the same analyte, and differences in presentation of analyte names for isomers and congener coelutions. To facilitate consistent data reporting, analyte names are standardized to Floyd|Snider standard analyte naming conventions.

Certain PCB congeners coelute, and different analytical laboratories report the data in different ways. Analyte naming conventions for coeluting PCB congeners are standardized to report all coeluting congeners in a sample as a single analyte, with each coeluting congener included in the name.

5.1.2.3 Chemical Abstracts Service Numbers

Most analytes have a unique Chemical Abstracts Service (CAS) registry number that can be used in table lookups, rather than relying on matching using the analyte name. Some analytes, like calculated analyte totals or results that coelute, do not have an established CAS number. A project-specific CAS number is assigned to these analytes. Project-specific CAS numbers assigned to summed analyte results indicate the treatment of non-detect results in the summation method by inclusion of a suffix. A standardized Floyd|Snider CAS number will be assigned to these summed analytes.

5.1.3 Presentation of Results

Analytical results will be presented in work products using standard data presentation rules.

5.1.3.1 Result Units and Significant Figures

Result units for each analyte class in each medium are converted to a consistent set of units for comparison to criteria. The units selected for each analyte class match the criteria units as reported in MTCA sources, including the Cleanup Levels and Risk Calculation (CLARC) workbook.

Results for conventionals, field parameters, and other analyte classes that lack criteria are standardized to a consistent set of units within each medium with consideration of Ecology conventions.

After completion of unit conversions and standardization, analytical results provided by the laboratory or presented in the source dataset are rounded to a consistent number of significant figures for presentation in figures and data tables. The original results are maintained in the database in the "Lab Result" field, and the rounded result is presented by the "Use Result" field. Conventionals results are rounded to four significant figures; high-resolution method results (i.e., dioxins/furans and PCB congeners) are rounded to three significant figures; and all other results are rounded to two significant figures. This is consistent with rounding rules applied in the dataset and is consistent with the level of accuracy of regulatory criteria.

5.1.3.2 Treatment of Non-Detects

Certain results that are measured at concentrations less than the RL are modified for presentation in Floyd|Snider work products.

Results for chemicals that are detected at concentrations reported between the RL and the MDL are qualified J to indicate they should be considered estimated due to the quantitation between the RL and MDL.

PCB congeners and dioxins/furans are reported to the MDL or estimated DL consistent with the project-specific reporting rules for the source dataset. Results for non-detect chemicals that are less than the RL, and that do not require sums, were used as presented in the source database or report, rather than reporting to the MDL.

5.1.3.3 Definition and Propagation of Qualifiers

The database stores original laboratory qualifiers as well as interpreted qualifiers assigned after data validation. Certain interpreted qualifiers present in the source datasets had different definitions between datasets. Interpreted qualifiers were reviewed and standardized prior to storage and use.

Interpreted qualifiers in the Project Dataset are defined as follows:

- J = the chemical is positively identified; however, the associated numerical value is an estimated concentration.
- U = not detected at DL shown.
- UJ = not detected; sample DL is estimated.
- R = result rejected during data validation.
- DNR = result rejected in favor of a more appropriate result/analysis.

Qualifiers are assigned as follows for calculated total and average results:

- If one or more of the results is qualified as estimated (J qualified), then the calculated result is similarly qualified.
- If all analyte results were qualified as non-detect, the calculated result is qualified as non-detect (U or UJ).
- If one or more of the results in an analyte group total are qualified as non-detect and one or more of the other results are detected, the calculated result is qualified as detected.
- Results qualified as R are not used in calculated results.

5.2 DATA HANDLING PROCEDURES

This section describes manipulation of the raw data for presentation in project deliverables following data management rules consistent with MTCA requirements for establishing cleanup standards (173-340 WAC, Part VII – Cleanup Standards).

5.2.1 Identification of Preferred Results

This section describes identification of preferred results based on laboratory analysis performed on the sample, which results in a simple true/false categorization of results. Setting the "Preferred Result" field to "true" will identify results for chemicals that should be compared to criteria and used in data reporting. Data handling rules used to assign results into preferred and non-preferred categories are described in the sections that follow.

5.2.1.1 Metals Results in Water Media

In water, it is appropriate for the result fraction to match the regulated fraction in the applicable media. When both total and dissolved metals results are analyzed in a particular sample, the result fraction matching the regulated fraction in that medium is flagged as the preferred result. Otherwise, the result in the only reported fraction is retained as the preferred result.

5.2.1.2 Total Polychlorinated Biphenyls Results in All Media

When PCB analysis is performed using both Aroclor and congener analysis methods in a particular sample, the total PCB result associated with the congener method is assigned a preferred result flag of "true" and the total PCB result associated with Aroclor method is assigned a preferred result flag of "false."

5.2.1.3 Total Petroleum Hydrocarbons: Silica Gel-Treated Results in All Media

TPH results are often analyzed with and without a silica gel treatment to "clean up" results the sample extract before it is analyzed for TPH so that the extract contains primarily hydrocarbons, rather than including both hydrocarbons and nonhydrocarbons. When both silica gel-treated and non-silica gel-treated results are analyzed in a particular sample, the non-silica gel-treated result is flagged as the preferred result. If the non-silica gel-treated result is not reported, the silica gel-treated results are retained as the preferred result.

5.2.2 Treatment of Duplicates

Duplicate samples are collected and analyzed in environmental datasets to ensure data meet the project's data quality objectives. This section describes the QA/QC review process duplicate samples are subjected to. It also describes data handing and reporting procedures relevant to duplicate sample results.

The "Preferred Result" field is set to "true" for data mapping and surface-weighted average analysis. For reporting of data in tables and statistical analysis, the "Preferred Result Comment" field should be used instead, such that individual sample results can be retained rather than the average of duplicate results. More information on treatment of duplicate results is provided in the following sections.

5.2.2.1 Laboratory Duplicates and Chemicals Analyzed by More Than One Method

As standard practice, Floyd|Snider does not average laboratory duplicate results. Instead, the initial and subsequent laboratory result (e.g., the initial result and the result after reanalysis) are evaluated on a chemical-specific basis for each method, and the better result is selected as the preferred result for use in reporting and data analysis.

As an example, naphthalene is commonly reported in both VOC and SVOC analysis methods. Naphthalene is a component analyte required for calculation of the total polycyclic aromatic hydrocarbons (PAHs) sum. Therefore, the naphthalene result analyzed by the SVOC method (e.g., USEPA 8270 or USEPA 8270-SIM) is set as the preferred result when results by both methods are available for a sample.

5.2.2.2 *Field Duplicates*

Field duplicate and field replicate sample results that are retained as acceptable for use are averaged consistent with averaging rules developed by Ecology (173-340 WAC, Part VII – Cleanup Standards). The following averaging rules are applied when addressing these three general combinations of detected and non-detected results:

- If the analyte is detected in two or more samples, only the detected results are averaged (the non-detected results are ignored).
- If the analyte is detected in only one sample, the detected value is reported as the average (the non-detected results are ignored).
- If the analyte is not detected in any samples, the result with the lowest non-detect result is reported as the average regardless of qualifiers.

Qualifiers are assigned as described in Section 5.3.3.

The database stores calculated averages as “dummy” field samples that have the suffix “AVG,” with a preferred flag of “true,” and flags the results used to create the average as non-preferred (preferred flag of “false”).

5.2.3 Data Quality and Usability Review

Data are reviewed relative to data quality objectives of completeness, accuracy, and integrity as part of the data loading and QA review process described in Section 3.0. However, USEPA guidance indicates that data usability is also affected by temporal factors like natural attenuation, maintenance dredging events, and other factors unrelated to quality of the data at the time of sampling.

Replacement of data may be appropriate in some cases when data do not meet data quality objectives or are not representative of current conditions. The appropriateness of data replacement is determined on a site- and location-specific basis with consideration of trends over time. The following are considerations for data replacement:

- Presence of outliers
- Heterogeneity of the substrate
- Natural recovery occurrence
- Deposition
- Erosion/scour potential
- Sampling density/resolution
- Age of the data

Additionally, differences in sample dates and locations between sample pairs must be considered.

Any data that meet Ecology approval for replacement will be flagged in the database, using the non-preferred result flag and comment, and will be excluded from future RI/FS work.

Additionally, non-detect data with elevated DLs will be flagged as non-preferred. These data are not useful for setting boundaries for remedy considerations because the actual chemical concentration within these samples is unknown.

5.3 SUMMATION RULES

This section describes summation rules used for calculation of total results for comparison to criteria applicable to each media. Summation rules are consistent with MTCA requirements (173-340 WAC, Part VII – Cleanup Standards). Total analyte results are calculated for each chemical with criteria for additive exposures (e.g., PCBs and PAHs). General and analyte class-specific summation rules applicable to upland media (i.e., soil and groundwater) are described in the sections that follow.

5.3.1 General Summation Rules

Calculation of results for summed analytes is performed consistent with MTCA, as follows:

1. Calculated totals are the sum of all detected component analyte results.
2. If no component analytes are detected in a sample, the greatest DL is used as the result. The result is assigned a U qualifier and flagged as non-detect.
3. Analytes not detected within a dataset for a given medium are excluded from sums (assumed to be absent and treated as zero). Analytes that are assumed to be absent are still counted when determining the number of component analytes present in a sample.

For total cPAHs, total PCB, and total dioxin/furan TEQs, if the number of component analytes reported in a sample is less than the minimum number of analytes listed in Table 2 of Ecology 2016, a total is not calculated for that sample.

5.3.2 Polychlorinated Biphenyls

The total PCB result for comparison to criteria can be calculated as either the sum of Aroclors or the sum of PCB congeners. The total PCB result for each sample analyzed for PCBs using an Aroclor analysis method is calculated as the simple sum of concentrations of all detected Aroclor results. For a sample analyzed using a PCB congeners analysis method, results for coeluting congeners are counted as a singular analyte result when performing the total PCB sum. Qualifiers are assigned according to general summation rules.

5.3.3 Dioxins/Furans

The total dioxin/furan TEQ for each sample is calculated in two steps. First, results for all 17 dioxin/furan congeners are multiplied by their TEFs to obtain a TEQ result for each congener. Dioxin/furan TEFs are consistent with mammalian TEF values listed in Table 2 of Ecology 2016. Second, the TEQ results for detected congeners are summed using simple addition. Non-detected congeners are not included. Qualifiers for the summed result are assigned following the general summation rules.

5.3.4 Polycyclic Aromatic Hydrocarbons

5.3.4.1 Carcinogenic Polycyclic Aromatic Hydrocarbons

The total cPAH TEQ for each sample is also calculated in two steps. First, results for all seven cPAHs are multiplied by their TEFs to get a TEQ result for each component analyte. cPAH TEFs are consistent with those listed in Table 1 of Ecology 2015, and non-detect results are not included. Second, TEQ results for detected component analytes are summed using simple addition. Qualifiers for the summed result are assigned following the general summation rules.

If none of the cPAH component analytes are detected in a sample, the DLs are multiplied by their respective TEFs and the maximum individual value is used as the cPAH TEQ result. A U qualifier is then added to the total, and the result is flagged as non-detect.

Results for benzo(b)fluoranthene and benzo(k)fluoranthene are used preferentially in cPAH TEQ calculations when available. Exceptions could occur when samples are missing results for benzo(b)fluoranthene and benzo(k)fluoranthene as individual component analytes:

- If the sample has results for total benzofluoranthenes, the total benzofluoranthenes result is multiplied by the TEF for benzo(b)fluoranthene and used in the sum. This approach is conservative, because the TEF for benzo(b)fluoranthene is greater than the TEF for benzo(k)fluoranthene.
- If the sample has results for benzo(j,k)fluoranthene (rather than benzo(k)fluoranthene), the result for benzo(j,k)fluoranthene is multiplied by the TEF for benzo(k)fluoranthene and used in the sum.

5.3.4.2 Total Polycyclic Aromatic Hydrocarbons

Total PAHs is calculated as the sum of total low molecular weight PAHs (LPAHs) and total high molecular weight PAHs (HPAHs). If both the total HPAH and total LPAH results are non-detect, the total PAHs result is also non-detect and given a U qualifier. In this case, the maximum individual value is used as the total PAH result.

Total LPAH is calculated as the sum of acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene. Total LPAH results are calculated and assigned qualifiers following the general summation rules.

Total HPAH is calculated as the sum of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. Results for benzo(b)fluoranthene and benzo(k)fluoranthene are used preferentially in HPAH calculations when available. Exceptions could occur when samples are missing results for benzo(b)fluoranthene and benzo(k)fluoranthene as individual component analytes:

- If results are reported as total benzofluoranthenes, rather than individual benzo(b)fluoranthene and benzo(k)fluoranthene results, the total benzofluoranthene result is used in the sum and is counted as two analytes when calculating the number of HPAH component analytes in the sample.
- If results are reported as benzo(j,k)fluoranthene, rather than benzo(k)fluoranthene, the benzo(j,k)fluoranthene result is used in the sum and counted as an analyte when calculating the number of HPAH component analytes in the sample.

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6.0 Work Plan Implementation and Coordination

6.1 PROJECT ORGANIZATION AND RESPONSIBILITIES

The various management, laboratory, and field responsibilities of key project personnel are defined in this section.

6.1.1 Management Responsibilities

Lynn Grochala, Floyd|Snider, is the Project Manager. She will lead project planning, technical analysis, and Ecology coordination necessary to produce the RI/FS document in a manner consistent with the Agreed Order and Ecology requirements. She will have day-to-day responsibility for project implementation, maintaining QA on the project, and ensuring that the RI Work Plan objectives are met.

Allison Geiselbrecht, PhD, is the Principal-in-Charge and Site Coordinator for the project and is responsible for overall project implementation and Ecology coordination.

6.1.2 Quality Assurance Responsibilities

Floyd|Snider's data manager, Chell Black, will be responsible for the data validation of all sample results from the analytical laboratories, unless an external validator is used. Data validation responsibilities include reviewing laboratory reports, advising on data corrective action procedures, and performing QA/QC on analytical data reports. If dioxins/furans are detected, EcoChem, Inc., will perform a Level IV, Tier III Data Quality Review (Full Validation) on dioxin/furan data.

Additionally, Chell will enter all data into Floyd|Snider's proprietary database, as well as Ecology's Environmental Information Management (EIM) system, and perform data management and queries.

6.1.3 Laboratory Responsibilities

Freidman & Bruya, in Seattle, Washington, will perform analytical services in support of the RI activities and will be responsible for implementing specific requirements outlined in this SAP/QAPP.

6.1.4 Field Responsibilities

A Floyd|Snider geologist will be the Field Manager and responsible for leading and coordinating the day-to-day activities in the field. They will report directly to the Project Manager and will provide overall direction for the field sampling in terms of logistics, personnel assignments, and field operations. They will supervise collection of the field samples and will be responsible for: accurate sample positioning; recording sample locations, depths, and identification; ensuring conformance to sampling and handling requirements including field decontamination procedures; performing physical evaluation and logging of the samples; and ensuring chain-of-custody of the sample.

6.2 PERMITS AND ACCESS

The field investigation may require access or permits to perform the soil and groundwater sampling described in this SAP/QAPP.

For soil boring and monitoring well installation, a Right-of-Way (ROW) permit may be required from the Seattle Department of Transportation if sampling operations will block or alter traffic patterns in S. Myrtle Street and/or 7th Avenue South. If step-out borings are necessary in the vicinity of the railroad tracks in S. Myrtle Street, an access agreement with the railroad owner may be needed to perform these borings.

For groundwater monitoring, access will be required for sampling of off-Property Fox Avenue Site wells. As these wells are located in public ROWs, access will be coordinated through the Fox Avenue Site management and coordination with facility operations will not be necessary. Additionally, the proposed locations for WT-SB-29, WT-SB-30, and WT-MW-113 are within, or directly adjacent to, the S. Myrtle Street or 7th Avenue South ROWs. Therefore, access permits will be required for those locations.

6.3 CULTURAL RESOURCE MONITORING

According to the Washington State Department of Archaeology and Historic Preservation (DAHP) predictive model for encountering historic and pre-historic period cultural resources, the Site is located within a high-probability area on the Lower Duwamish Waterway. A Monitoring and Inadvertent Discovery Plan was completed by Historical Research Associates, Inc. (HRA) in 2017 that was subsequently approved by the DAHP and implemented by Cardno for the 2017/2018 interim action (IA; Attachment C.2). HRA and Cardno have monitored numerous borings and extensive excavation in fill and native sediments across the Site.

During IA grading activities, Cardno identified a 90-linear-foot segment of a partially intact poured concrete historic-period foundation that was exposed near the surface of the fill, and a structure that appeared to resemble a dry kiln. Cardno determined that the foundation was likely associated with former historic structures demolished during the 1980s. Due to the lack of integrity, Cardno recommended that Site was not eligible for listing in the National Register of Historic Places. The DAHP concurred with Cardno's findings and recommendations. No other cultural resources were identified on the Site. Modern debris consisting of plastic, metal debris, and glass bottles were observed in fill throughout the Site.

Due to the unlikelihood of identifying cultural resources in a 2- to 8-inch-diameter boring, as well as the results of previous cultural resources survey and assessments, in lieu of full-time monitoring, an on-call Professional Archaeologist will be available for consultation to determine the provenance of any suspected find observed in soil samplers. Should cultural resources be identified and confirmed with the on-call archaeologist, all project personnel will follow the Archaeological Inadvertent Discovery Plan included in Attachment C.2.

7.0 References

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Whitehead Tyee Site

Remedial Investigation Work Plan

Appendix C
Sampling and Analysis Plan/
Quality Assurance Project Plan

Tables

Table C.1
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Parameter	Method	Bottle Type	Preservative	Holding Time
Soil Samples				
Gasoline-range organics	NWTPH-Gx	Pre-tared 40-mL VOA	None, cool to <6 °C	Freeze to <-7 °C within 48 hours, 14 days to analyze
Total Petroleum Hydrocarbons—Stoddard solvent, diesel- and oil-range organics	NWTPH-Dx	One 4-oz WMG	None, cool to <6 °C	14 days to extract, then 40 days to analyze
SVOCs	USEPA Methods 8270D/ 8270D SIM	One 4-oz WMG	None, cool to <6 °C	14 days to extract, then 40 days to analyze
			None, freeze to -18°C	1 year to extract, then 40 days to analyze
RCRA 8 Metals	USEPA Methods 6020/1631E	One 4-oz WMG	None, cool to <6°C, or freeze to -18°C	Metals: 6 months Mercury: 28 days
VOCs	USEPA Method 8260 direct sparge	Four pre-tared 40-ml VOA	None, cool to <6 °C	Freeze to <-7 °C within 48 hours, 14 days to analyze
PCBs as Aroclors	USEPA Method 8082	One 4-oz WMG	None, cool to <6 °C, or freeze to -18°C	None

Table C.1
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Parameter	Method	Bottle Type	Preservative	Holding Time
Soil Samples (cont.)				
PCBs as Congeners	USEPA Method 1668	From PCB Aroclors jar	None, cool to <6 °C, or freeze to -18°C	None
Dioxins/Furans	USEPA Method 1613B	One 4-oz WMG amber glass	None, cool to <6 °C, or freeze to -18°C	1 year
EPH	WA MTCA EPH	One 4-oz WMG	None, cool to <6 °C	14 days to extract, then 40 days to analyze
VPH	WA MTCA VPH	Pre-tared 40-ml VOA	None, cool to <6 °C	Freeze to <-7 °C within 48 hours, 14 days to analyze
Groundwater Samples				
Gasoline-range organics	NWTPH-Gx	Three 40-ml VOA	Cool to <6 °C, HCl to pH<2, no headspace	14 days
Total Petroleum Hydrocarbons—Stoddard solvent, diesel- and oil-range organics	NWTPH-Dx	One 500-ml amber glass	None, cool to <6 °C	7 days to extract, then 40 days to analyze
Pentachlorophenol and cPAHs	USEPA Methods 8270D/8270D SIM	Two 500-ml amber glass	None, cool to <6 °C	7 days to extract, then 40 days to analyze

Table C.1
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Parameter	Method	Bottle Type	Preservative	Holding Time
Groundwater Samples (cont.)				
VOCs (including cVOCs and benzene)	USEPA Method 8260 SIM	Three 40-ml VOA	Cool to <6 °C, HCl to pH<2, no headspace	14 days
PCBs as Aroclors	USEPA Method 8082	One 1-liter amber glass	None, cool to <6 °C	None
PCBs as Congeners	USEPA Method 1668	Two 1-liter amber glass	None, cool to <6 °C	None
Dioxins/Furans	USEPA Method 1613B	Two 1-liter amber glass	None, cool to <6 °C	1 year
EPH	WA MTCA EPH	500 ml amber glass	None, cool to <6 °C	7 days to extract, then 40 days to analyze
VPH	WA MTCA VPH	Three 40-ml VOA	Cool to <6 °C, HCl to pH<2, no headspace	14 days

Abbreviations:

°C Degrees Celsius
cPAH Carcinogenic polycyclic aromatic hydrocarbon
cVOC Chlorinated volatile organic compound
EPH Extractable petroleum hydrocarbons
HCl Hydrogen chloride
ml Milliliters
oz Ounces
PCB Polychlorinated biphenyl
RCRA Resource Conservation and Recovery Act
SVOC Semivolatile organic compound
VOA Volatile organic analysis
VOC Volatile organic compound
VPH Volatile petroleum hydrocarbons
WMG Wide-mouth glass jar

Table C.2
Analytical Methods, Detection Limits, and Reporting Limits

Analyte	CAS No.	Method	Method Detection Limit	Reporting Limit	Preliminary Screening Level
Soil (mg/kg)					
Conventionals					
Total Organic Carbon	TOC	USEPA Method 9060A	none	none	none
Petroleum Hydrocarbons					
Gasoline-Range Organics	TPHG	NWTPH-Gx	0.19	5	30
Diesel-Range Organics	TPHD	NWTPH-Dx	1.3	50	2,000
Oil-Range Organics	TPHO	NWTPH-Dx	39	250	2,000
Stoddard Solvent	TPHSS	NWTPH-Dx	2.3	50	2,000
Metals					
Arsenic	7440-38-2	USEPA Method 6020B	0.15	1	7.3
Barium	7440-39-3		0.031	1	8.3
Cadmium	7440-43-9		0.02	1	0.77
Chromium	7440-47-3		0.11	1	27
Lead	7439-92-1		0.02	1	56
Selenium	7782-49-2		0.036	1	0.26
Silver	7440-22-4		0.11	1	0.016
Mercury, inorganic	7439-97-6	Method 1631E, trace-level	0.0023	0.01	0.07
Pentachlorophenol and Polycyclic Aromatic Hydrocarbons					
Pentachlorophenol	87-86-5	USEPA Method 8270E/8270E SIM	0.013	0.05	0.0000018
Acenaphthene	83-32-9		0.00042	0.002	0.028
Anthracene	120-12-7		0.00046	0.002	0.051
Benzo(a)anthracene	56-55-3		0.00043	0.002	na
Benzo(b)fluoranthene	205-99-2		0.00052	0.002	na
Benzo(a)pyrene	50-32-8		0.00048	0.002	na
Benzo(k)fluoranthene	207-08-9		0.00046	0.002	na
Chrysene	218-01-9		0.00053	0.002	na
Dibenz(a,h)anthracene	53-70-3		0.00091	0.002	na
Fluoranthene	206-44-0		0.00053	0.002	0.090
Fluorene	86-73-7		0.00037	0.002	0.029
Indeno(1,2,3-cd)pyrene	193-39-5		0.00056	0.002	na
Naphthalene	91-20-3		0.00032	0.002	0.0021
Pyrene	129-00-0		0.00037	0.002	0.14
Other Semivolatile Organic Compounds					
Bis(2-ethylhexyl) phthalate	117-81-7	USEPA Method 8270E/8270E SIM	0.023	0.16	0.0051
Butyl benzyl phthalate	85-68-7		0.019	0.1	0.00018
Bis(2-chloroethyl)ether	111-44-4		0.0017	0.01	0.000014
4-Chloroaniline	106-47-8		0.35	1.0	0.000077
2-Chlorophenol	95-57-8		0.0054	0.1	0.011
Dibutyl phthalate	84-74-2		0.0099	0.1	0.015
1,2-Dichlorobenzene	95-50-1		0.0028	0.01	0.0031
1,4-Dichlorobenzene	106-46-7		0.0018	0.01	0.0081
2,4-Dichlorophenol	120-83-2		0.0044	0.01	0.0043
Diethyl phthalate	84-66-2		0.017	0.1	0.034
2,4-Dimethylphenol	105-67-9		0.024	0.1	0.0031
2,4-Dinitrophenol	51-28-5		0.024	0.3	0.0092
2,4-Dinitrotoluene	121-14-2		0.014	0.05	0.00016
2,6-Dinitrotoluene	606-20-2		0.0042	0.05	0.0073
Hexachlorobenzene	118-74-1		0.002	0.01	0.00000040
Hexachlorobutadiene	87-68-3		0.0018	0.01	0.00054
Hexachloroethane	67-72-1		0.0018	0.01	0.000041
Isophorone	78-59-1		0.00099	0.01	0.015
2-Methylphenol	95-48-7		0.0082	0.1	0.010
Nitrobenzene	98-95-3		0.0029	0.01	0.0065
n-Nitrosodi-n-propylamine	621-64-7		0.002	0.01	0.0000039
Phenol	108-95-2		0.0033	0.1	0.12
1,2,4-Trichlorobenzene	120-82-1		0.019	0.01	0.0019
2,4,6-Trichlorophenol	88-06-2		0.024	0.1	0.0027
Volatile Organic Compounds					
Benzene	71-43-2	USEPA Method 8260D	0.00015	0.003	0.00056
Bromoform	75-25-2		0.00031	0.005	0.0050
Bromomethane	74-83-9		0.0018	0.05	0.0033
Carbon tetrachloride	56-23-5		0.00014	0.005	0.00015
Chloroform	67-66-3		0.00016	0.005	0.0048
Dibromochloromethane	124-48-1		0.00022	0.005	0.00077
Dichlorobromomethane	75-27-4		0.000062	0.005	0.00096
1,1-Dichloroethane	75-34-3		0.00024	0.005	0.0026
1,2-Dichloroethane	107-06-2		0.00025	0.005	0.0016
1,1-Dichloroethylene	75-35-4		0.00027	0.005	0.0025
cis-1,2-Dichloroethylene	156-59-2		0.00022	0.005	0.0052
trans-1,2-Dichloroethylene	156-60-5		0.00024	0.005	0.032
1,2-Dichloropropane	78-87-5		0.0002	0.005	0.0010
cis-1,3-Dichloropropene	10061-01-5		0.00014	0.005	0.00014

Table C.2
Analytical Methods, Detection Limits, and Reporting Limits

Analyte	CAS No.	Method	Method Detection Limit	Reporting Limit	Preliminary Screening Level
Soil (mg/kg) (cont.)					
Volatile Organic Compounds (cont.)					
trans-1,3-Dichloropropene	10061-02-6	USEPA Method 8260D	0.00012	0.005	0.00014
Ethylbenzene	100-41-4	USEPA Method 8260D	0.00013	0.005	0.010
Methyl tert-butyl ether	1634-04-4	USEPA Method 8260D	0.00021	0.005	0.0072
Methylene chloride	75-09-2	USEPA Method 8260D	0.045	0.1	0.0015
1,1,2,2-Tetrachloroethane	79-34-5	USEPA Method 8260D	0.00013	0.005	0.000080
Tetrachloroethylene	127-18-4	USEPA Method 8260D	0.00017	0.005	0.0016
Toluene	108-88-3	USEPA Method 8260D	0.000096	0.005	0.044
1,1,2-Trichloroethane	79-00-5	USEPA Method 8260D	0.00016	0.005	0.00033
Trichloroethylene	79-01-6	USEPA Method 8260D	0.0002	0.003	0.00027
1,2,3-Trichloropropane	96-18-4	USEPA Method 8260D	0.00017	0.005	0.00000015
Vinyl chloride	75-01-4	USEPA Method 8260D	0.00029	0.005	0.000055
m,p-Xylene	179601-23-1	USEPA Method 8260D	0.00025	0.01	na
o-Xylene	95-47-6	USEPA Method 8260D	0.00023	0.005	na
Total xylenes	1330-20-7	USEPA Method 8260D	na	0.015	0.055
Extractable Petroleum Hydrocarbons		WA MTCA EPH	0.86 to 2.1	10 to 20	na
Volatile Petroleum Hydrocarbons		WA MTCA VPH	0.19 to 2.2	0.6 to 3	na
Polychlorinated Biphneyls (PCBs)					
PCBs as Aroclors	1336-36-3	USEPA Method 8082A	0.0008	0.01	0.0000022
PCBs as Congeners	1336-36-3	USEPA Method 1668	0.00000007 to 0.00000042	0.000002	0.0000022
Dioxins/Furans					
Dioxins/Furans	DFTEQ	USEPA Method 1613B	0.000000027 to 0.00000017	0.0000005 to 0.000005	0.0000052
Groundwater (µg/L)					
Petroleum Hydrocarbons					
Gasoline-Range Organics	TPHG	NWTPH-Gx	11	100	1,000
Diesel-Range Organics	TPHD	NWTPH-Dx	5.4	50	50
Oil-Range Organics	TPHO	NWTPH-Dx	52	250	500
Stoddard Solvent	TPHSS	NWTPH-Dx	16	250	500
Metals					
Arsenic	7440-38-2	USEPA Method 6020B	0.071	1	8.0
Barium	7440-39-3	USEPA Method 6020B	0.039	1	200
Cadmium	7440-43-9	USEPA Method 6020B	0.043	1	1.2
Chromium	7440-47-3	USEPA Method 6020B	0.18	1	27
Lead	7439-92-1	USEPA Method 6020B	0.12	1	5.6
Selenium	7782-49-2	USEPA Method 6020B	0.12	1	50
Silver	7440-22-4	USEPA Method 6020B	0.057	1	1.9
Mercury, inorganic	7439-97-6	Method 1631E, trace-level	0.0007	0.1	0.025
Pentachlorophenol and Polycyclic Aromatic Hydrocarbons					
Pentachlorophenol	87-86-5	USEPA Method 8270E/8270E SIM	0.0028	0.1	0.0020
Acenaphthene	83-32-9	USEPA Method 8270E/8270E SIM	0.0083	0.02	5.3
Anthracene	120-12-7	USEPA Method 8270E/8270E SIM	0.014	0.02	2.1
Benzo(a)anthracene	56-55-3	USEPA Method 8270E/8270E SIM	0.0097	0.02	0.00016
Benzo(b)fluoranthene	205-99-2	USEPA Method 8270E/8270E SIM	0.011	0.02	0.00016
Benzo(a)pyrene	50-32-8	USEPA Method 8270E/8270E SIM	0.0088	0.02	0.000016
Benzo(k)fluoranthene	207-08-9	USEPA Method 8270E/8270E SIM	0.013	0.02	0.0016
Chrysene	218-01-9	USEPA Method 8270E/8270E SIM	0.014	0.02	0.016
Dibenz(a,h)anthracene	53-70-3	USEPA Method 8270E/8270E SIM	0.019	0.02	0.000016
Fluoranthene	206-44-0	USEPA Method 8270E/8270E SIM	0.0099	0.02	1.8
Fluorene	86-73-7	USEPA Method 8270E/8270E SIM	0.0055	0.02	3.7
Indeno(1,2,3-cd)pyrene	193-39-5	USEPA Method 8270E/8270E SIM	0.014	0.02	0.00016
Naphthalene	91-20-3	USEPA Method 8270E/8270E SIM	0.0057	0.2	1.4
Pyrene	129-00-0	USEPA Method 8270E/8270E SIM	0.016	0.02	2.0
Other Semivolatile Organic Compounds					
Bis(2-ethylhexyl) phthalate	117-81-7	USEPA Method 8270E/8270E SIM	0.59	3.2	0.046
Butyl benzyl phthalate	85-68-7	USEPA Method 8270E/8270E SIM	0.67	2	0.013
Bis(2-chloroethyl)ether	111-44-4	USEPA Method 8270E/8270E SIM	0.046	0.2	0.040
4-Chloroaniline	106-47-8	USEPA Method 8270E/8270E SIM	0.62	20	0.22
2-Chlorophenol	95-57-8	USEPA Method 8270E/8270E SIM	0.27	2	17
Dibutyl phthalate	84-74-2	USEPA Method 8270E/8270E SIM	0.15	2	8.0
1,2-Dichlorobenzene	95-50-1	USEPA Method 8270E/8270E SIM	0.051	0.2	4.6
1,4-Dichlorobenzene	106-46-7	USEPA Method 8270E/8270E SIM	0.046	0.2	4.9
2,4-Dichlorophenol	120-83-2	USEPA Method 8270E/8270E SIM	0.23	2	10
Diethyl phthalate	84-66-2	USEPA Method 8270E/8270E SIM	0.44	2	93

Table C.2
Analytical Methods, Detection Limits, and Reporting Limits

Analyte	CAS No.	Method	Method Detection Limit	Reporting Limit	Preliminary Screening Level
Groundwater (µg/L) (cont.)					
Other Semivolatile Organic Compounds (cont.)					
2,4-Dimethylphenol	105-67-9	USEPA Method 8270E/8270E SIM	0.49	2	6.3
2,4-Dinitrophenol	51-28-5		5.1	6	32
2,4-Dinitrotoluene	121-14-2		0.41	1	0.18
2,6-Dinitrotoluene	606-20-2		0.2	1	7
Hexachlorobenzene	118-74-1		0.098	0.2	0.0000050
Hexachlorobutadiene	87-68-3		0.072	0.2	0.010
Hexachloroethane	67-72-1		0.084	0.2	0.020
Isophorone	78-59-1		0.058	0.2	46
2-Methylphenol	95-48-7		0.28	2	27
Nitrobenzene	98-95-3		0.029	0.2	16
n-Nitrosodi-n-propylamine	621-64-7		0.05	0.2	0.013
Phenol	108-95-2		0.17	2	370
1,2,4-Trichlorobenzene	120-82-1		0.069	0.2	0.96
2,4,6-Trichlorophenol	88-06-2		0.23	2	4.0
Volatile Organic Compounds					
Benzene	71-43-2	USEPA Method 8260D	0.017	0.2	1.6
Bromoform	75-25-2		0.057	0.2	12
Bromomethane	74-83-9		0.13	0.2	11
Carbon tetrachloride	56-23-5		0.03	0.2	0.35
Chloroform	67-66-3		0.048	0.2	1.2
Dibromochloromethane	124-48-1		0.03	0.2	2.2
Dichlorobromomethane	75-27-4		0.057	0.2	1.8
1,1-Dichloroethane	75-34-3		0.047	0.2	7.7
1,2-Dichloroethane	107-06-2		0.051	0.2	4.2
1,1-Dichloroethylene	75-35-4		0.05	0.2	7.0
cis-1,2-Dichloroethylene	156-59-2		0.025	0.2	16
trans-1,2-Dichloroethylene	156-60-5		0.03	0.2	77
1,2-Dichloropropane	78-87-5		0.047	0.2	3.1
cis-1,3-Dichloropropene	10061-01-5		0.041	0.2	0.44
trans-1,3-Dichloropropene	10061-02-6		0.049	0.2	0.44
Ethylbenzene	100-41-4		0.032	0.2	21
Methyl tert-butyl ether	1634-04-4		0.046	0.2	24
Methylene chloride	75-09-2		1.9	5	5.0
1,1,2,2-Tetrachloroethane	79-34-5		0.049	0.2	0.22
Tetrachloroethylene	127-18-4		0.024	0.2	2.9
Toluene	108-88-3		0.033	0.2	100
1,1,2-Trichloroethane	79-00-5		0.043	0.2	0.90
Trichloroethylene	79-01-6		0.037	0.2	0.70
1,2,3-Trichloropropane	96-18-4		0.04	0.2	0.00038
Vinyl chloride	75-01-4		0.067	0.2	0.18
m,p-Xylene	179601-23-1		0.074	0.2	na
o-Xylene	95-47-6		0.038	0.2	na
Total xylenes	1330-20-7		na	0.6	110
Extractable Petroleum Hydrocarbons		WA MTCA EPH	2.9 to 8.9	20 to 40	na
Volatile Petroleum Hydrocarbons		WA MTCA VPH	3.7 to 18	10 to 40	na
Polychlorinated Biphneyls (PCBs)					
PCBs as Aroclors	1336-36-3	USEPA Method 8082A	0.0055	0.01	0.000007
PCBs as Congeners	1336-36-3	USEPA Method 1668	0.0000005 to 0.0000036	0.00002	0.000007
Dioxins/Furans					
Dioxins/Furans	DFTEQ	USEPA Method 1613B	0.00000026 to 0.0000011	0.000005 to 0.00005	5.1E-09

Note:
Site-specific conditions such as high sample concentrations, matrix interference, or sample dilution may preclude achieving the targeted RL.

Abbreviations:
CAS Chemical Abstracts Service
µg/L Micrograms per liter
mg/kg Milligrams per kilogram
RL Reporting limit

Table C.3
Data Quality Assurance and Quality Control Criteria

Parameter	Reporting Limit	Precision	Accuracy	Completeness	Reference
Soil Samples					
Gasoline-Range Organics	5 mg/kg	± 30%	50–150%	95%	NWTPH-Gx
Stoddard Solvent and Diesel-Range Organics	50 mg/kg	± 30%	50–150%	95%	NWTPH-Dx
Oil-Range Organics	250 mg/kg	± 30%	50–150%	95%	NWTPH-Dx
RCRA 8 metals	1 mg/kg 0.01 mg/kg for mercury	± 20%	80–120%	95%	USEPA Method 6020/ 1631E trace level
PCBs as Aroclors	0.01 mg/kg	± 30%	50–150%	95%	USEPA Method 8082A
PCBs as Congeners	0.000002 mg/kg	± 30%	5.0–145%	95%	USEPA Method 1668
Dioxins/Furans	0.0000005 to 0.000005 mg/kg	± 30%	50–150%	95%	USEPA Method 1613B
SVOCs	0.002 to 1.0 mg/kg	± 30%	50–150%	95%	USEPA Method 8270E/8270E SIM
VOCs	0.003 to 0.05 mg/kg	± 30%	50–150%	95%	USEPA Method 8260D direct sparge
Extractable Petroleum Hydrocarbons	10 to 20 mg/kg	± 30%	50–150%	95%	WA MTCA EPH
Volatile Petroleum Hydrocarbons	0.6 to 3 mg/kg	± 30%	50–150%	95%	WA MTCA VPH

Table C.3
Data Quality Assurance and Quality Control Criteria

Parameter	Reporting Limit	Precision	Accuracy	Completeness	Reference
Groundwater Samples					
Gasoline-Range Organics	100 µg/L	± 30%	50–150%	95%	NWTPH-Gx
Stoddard Solvent and Diesel-Range Organics	50 µg/L	± 30%	50–150%	95%	NWTPH-Dx
Oil-Range Organics	250 µg/L	± 30%	50–150%	95%	NWTPH-Dx
RCRA 8 metals	1 µg/L	± 30%	80–120%	95%	USEPA Method 6020/ 1631E trace level
PCBs as Aroclors	0.01 µg/L	± 30%	50–150%	95%	USEPA Method 8082
PCBs as Congeners	0.00002 µg/L	± 30%	Varies per congener; refer to method limits	95%	USEPA Method 1668
Dioxins/Furans	0.000005 to 0.00005 µg/L	± 30%	Varies per congener; refer to method limits	95%	USEPA Method 1613B
Pentachlorophenol	0.1 µg/L	± 30%	20–137%	95%	USEPA Method 8270E SIM
SVOCs	0.02 to 20 µg/L	± 30%	50–150%	95%	USEPA Method 8270E/8270E SIM
VOCs	0.1 to 1.0 µg/L	± 30%	50–150%	95%	USEPA Method 8260D

Table C.3
Data Quality Assurance and Quality Control Criteria

Parameter	Reporting Limit	Precision	Accuracy	Completeness	Reference
Groundwater Samples (cont.)					
Extractable Petroleum Hydrocarbons	20 to 40 µg/L	± 30%	50–150%	95%	WA MTCA EPH
Volatile Petroleum Hydrocarbons	10 to 40 µg/L	± 30%	50–150%	95%	WA MTCA VPH

Note:

1 All reporting limits shown are method PQLs or LOQs from Friedman & Bruya, located in Seattle, Washington.

Abbreviations:

LOQ Limit of quantitation
µg/L Micrograms per liter
mg/kg Milligrams per kilogram
PCB Polychlorinated biphenyl
PQL Practical quantitation limit
RCRA Resource Conservation and Recovery Act
SVOC Semivolatile organic compound
VOC Volatile organic compound

Whitehead Tyee Site

Remedial Investigation Work Plan

Appendix C
Sampling and Analysis Plan/
Quality Assurance Project Plan

Attachment C.1
Floyd|Snider Standard Guidelines

FLOYD | SNIDER
strategy ▪ science ▪ engineering

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F|S STANDARD GUIDELINE:
Special Condition

Utility Clearance

DATE/LAST UPDATE: October 17, 2018

This Special Condition applies to ground-disturbing work including drilling, excavation, and trenching. Standard Guideline(s) to which this Special Condition is appended include:

1. Soil Logging
2. Well Construction
3. Soil Sample Collection

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines and special procedures for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines and special conditions with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines and special conditions.

1.0 Special Condition Applicability

This Special Condition Standard Guideline should be used by the field staff prior to performing subsurface activities, such as collecting subsurface soil samples, monitoring well installation, excavation, or trenching activities. A public locate should always be conducted and scheduled at least 3 to 5 days prior to conducting the private locate and in compliance with the guidelines herein.

2.0 Equipment and Supplies

Logging Equipment and Tools:

- 100-foot tape measure or measuring wheel
- Handheld Global Positioning System (GPS)
- Spray paint:
  - White for proposed work area (boring locations or limits of work)
  - Optional colors for utilities:
    - Red for electrical
    - Green for sewers and drain lines
    - Blue for water
    - Orange for fiber optics, communications, or cable
    - Yellow for natural gas or fuel lines
- Flagging or wax lumber pencils if raining (preferably **white**; if white is not available choose **a color other than designated utility colors** above such as pink)
- Hammer and roofing nails to nail flagging if raining
- Pry bar or manhole lift for lifting heavy sewer or manhole lids
- Camera

Paperwork:

- Work Plan and/or Sampling and Analysis Plan (SAP) and/or Quality Assurance Project Plan (QAPP)
- Health and Safety Plan (HASP)
- Copies of figures showing proposed boring locations or work area and all known utilities
- Public locate ticket
- As-built drawings, if available

Personal Equipment:

- Steel-toed boots
- Safety vest
- Safety glasses
- Rain gear
- Work gloves

3.0 Special Condition Guidelines and Procedures

3.1 PUBLIC UTILITY LOCATE

A public utility locate notification must be completed in accordance with state law approximately 3 to 5 days prior to conducting the private locate and subsurface disturbance activities. Prior to contacting the public locate service, the outer limits of the work area or the proposed soil boring locations should be marked out in white spray paint. The public locate can then be submitted online (http://www.callbeforeyoudig.org/washington) or by calling 811. The ticket number should be submitted to the drilling and excavation subcontractors and logged on the attached utility clearance field checklist.

3.2 METHODOLOGIES FOR LOCATING UTILITIES

Surface and subsurface conditions can affect the accuracy of a specific locating technology, and no single method is universally fail proof. Review each project and its site-specific conditions to choose the proper technique(s). Below are the four most common techniques used for locating utilities; however, locating activities should not be limited to those described here.

1. **Pipe Tracing Transmitter and Receiver**

   This technique can be used to detect metal utilities, tracing wires, or warning tapes. The metal pipes or tracer wire must be exposed in order to transmit the signal to be traced. The limitations of this methodology are (1) that it is not useful for nonconductible utilities, and (2) that the metallic pipes or tracer wire must be exposed.

2. **Electromagnetic**

   This technique locates buried materials that have a high conductance, such as buried pipes, tanks, and drums, by inducing alternating electromagnetic waves at the surface into the ground. Any buried conducting body can be detected at the surface with a receiver. The limitations of this technique are that results are affected by nearby or adjacent power lines, metal fences, cars, and metal debris and it cannot detect utilities constructed of nonconductive material such as PVC or concrete sewer lines.

3. **Ground Penetrating Radar (GPR)**

   This technique is an extremely useful for locating shallow nonconductible features, such as concrete conduits, polyvinyl chloride (PVC) piping, underground storage tanks (USTs), former excavations, trenches, buried drums, other metallic objects, or hydrogeologic features. GPR can also be useful in locating voids beneath concrete or asphalt. The limitation of this technique is that penetration depth can be limited in soils with high electrical conductivity such as clayey or wet soil.

4. **Metal Taping or Radio Frequency Transmitter**

   This technique can be used to locate drain or sewer lines that extend from a building out to the main sewer line. Generally, sewer and drain lines are constructed of PVC and cannot be detected using electromagnetic or pipe tracing, as a result they are sometimes missed during these surveys. Metallic fish tape or a radio frequency transmitter is inserted into the pipe from the building or a cleanout and then a radio frequency is sent along a wire. The signal is detected aboveground with a receiver that can determine the location of the centerline and approximate depth.

3.3 PRIVATE LOCATE

A private locate is also necessary since public locates generally are useful only up to the property line or to their own meters; rarely do public locates mark the utilities on the property if there is not a meter present on the property. Therefore, if the interior of the site is likely to have complex buried utilities or the alignments of utilities running through the site interior are unknown (i.e., accurate utility plans are not available), it is appropriate to conduct a private locate.

Upon arriving at the site, confirm that all entities, notified per the public locate ticket, have marked their respective utilities. Even if a utility does not exist on the property, the site should still be marked (e.g., "No Gas" or "No Fiber") by all utilities listed on the public locate ticket. Take care to note the path of utilities marked at the street and directed toward the property. For example, a water line at the street may connect to a faucet or bathroom on property. The private locating subcontractor should use the public locating marks to help locate utilities on the property.

Mark all proposed boring locations or the limits of work in white spray paint so that the private utility locator can be thorough in these areas. Some projects may require additional soil borings beyond the initial scope of work. In this case, either mark a larger limit of work area prior to utility locate or have a private utility locate conducted throughout the property, including inside existing structures if needed.

Identify other subsurface features on the property such as, sewer/storm/roof drains and aboveground electrical lines that have not been identified by the public locate. During the private locate conduct all activities in the following list that apply to the subject property.

- Open all sewer lids and storm drains, and mark the direction of the visible pipes.
- Open any utility vaults (e.g., fiber optics, fire alarm, or electrical vaults) and mark the direction of lines, then extrapolate these lines to the building.
- Locate all roof drains and take care to note how these drains may connect to subsurface drainage lines.
- If multiple drains are visible, take care to notice possible subsurface connections (e.g., straight lines between drains).
- Look for subsidence features, such as former filled in trenches (which may contain subsurface lines), and including patched concrete/asphalt.
- Note the location of other relevant features, such as building water faucets, bathrooms, and water valve shut-offs at the street (attempt to extrapolate potential lines from these features).

- Identify aboveground utilities on the property (i.e., electrical lines along walls of buildings, lines on telephone poles). Confirm with subcontractor (driller or excavator) that overhead utilities will not obstruct subsurface work activities.
- Communicate with property owners or site managers to gain information on the location of subsurface utilities or other features. If possible, focus on utilities that may not have been located by standard techniques, such as plastic or PVC lines.
- Take care to locate irrigation lines and sprinklers in planters.
- Locate emergency stops for fuel lines if working on an active service station.

Plot all utilities, overhead and subsurface, on the site map so that investigations are not carried out in these areas.

3.4 ESTABLISHING A BUFFER

Establish a buffer around identified overhead and subsurface features where work should not be conducted. Maintain at least a 3-foot buffer on either side of a marked utility or in-line inference of a pipe or storm drain connections. Mark the buffer zone on the site map so that subsurface work is not completed in these locations. The buffer zone for overhead utilities may be greater than 3 feet, depending on the overhead line. For example, noninsulated electrical lines can arc over a certain distance. Confirm overhead buffer zones with the drillers or excavators.

Utilities such as electrical, fiber optics, or natural gas should have a 5-foot buffer, if possible. If subsurface activities need to be conducted within 5 feet of a fiber optics/communications line, notify the utility company. Generally, fiber optics/communication companies want to have their personnel on site to observe any subsurface activities within 5 feet as a safety precaution.

In the event of uncertainty on pipe location, determine if an air knife/vacuum truck is needed to safely clear the boring to a depth of 5 feet below ground surface or other appropriate depth to safely clear the utility line.

3.5 MARKING MAINTENANCE

Public locate marks expire after 45 days if the markings are not maintained. Best practices for maintaining locate marks include:

- Using stakes or nail flagging with roofing nails along the markings if markings are continuously destroyed by weather or traffic;
- Using wax lumber pencils if raining;
- Using white spray paint to maintain the original markings;
- Bookending the original marks with solid white painted squares;
- Painting dots between the original markings; and
- Requesting relocates, if needed.

3.6 EMERGENCY CONTACT NUMBERS

If any damage is caused to a utility, immediately notify the property owner and the respective utility company. Keep emergency contact numbers on hand in case of damage.

4.0 Field Documentation

The attached utility clearance checklist should be reviewed and completed at the beginning of each project, prior to conducting subsurface activities, or before establishing sample locations. If appropriate, the checklist should be reviewed and completed for each proposed sampling location or subsurface disturbance area.

Enclosure: Utility Clearance Field Checklist

Project: ____________________

Completed by: ____________________

Date Completed: ____________________

Public Ticket No: ____________________

This checklist is intended for use prior to field activities associated with subsurface site investigations. The field manager should complete this checklist in its entirety before beginning work or establishing sample locations. There may be site-specific features that are not included on this form so be sure to complete a thorough review of all available information and complete a pre-field inspection prior to the work.

SUBSURFACE UTILITIES

- ☐ **PUBLIC UTILITY LOCATE** completed for the property.
  Mark limits of work in white paint. Call the appropriate Call Before You Dig hotline (dial 811 in Washington) or complete online utility locate request; provide public locate service with location info including cross streets and/or other geographic features to locate work area. If not present for the utility locate, make sure to verify all marked utilities. Plot marked utilities on the site map and record location (by GPS survey or licensed surveyor if feasible, or by measurement from existing features). Take care to note the path of utilities marked at the street and directed toward the private property (i.e., water line at street may connect to faucet or bathroom on property).
- ☐ **PRIVATE UTILITY LOCATE** completed inside and outside existing structures on the property.
  If not present for the utility locate, make sure to verify all marked utilities. Plot marked utilities on the site map and record location (by GPS survey or licensed surveyor if feasible, or by measurement from existing features).
  - ☐ Is the method of utility locate appropriate for the site conditions (i.e., metal taping may be necessary for undetected PVC drain lines where the outlet is visible in a storm drain)?
- ☐ **FACILITY PLAN REVIEW** completed.
  If not readily available, request utility or as-built plans from the client that may include subsurface utilities or other features (i.e., tanks or vaults).

UTILITY COMPANIES

- ☐ Natural Gas Marked (YELLOW)
  Natural gas emergency contact number(s): ____________________
- ☐ Electrical Marked (RED)
  Electrical emergency contact number(s): ____________________
- ☐ Water Marked (BLUE)
  Water emergency contact number(s): ____________________
- ☐ Sewer/Drain Lines Marked (GREEN)
  Sewer emergency contact number(s): ____________________
- ☐ Communications/Fiber Optics/Cable Marked (ORANGE)
  Communications emergency contact number(s): ____________________

PRIVATE SUBSURFACE FEATURES

IDENTIFY OTHER SUBSURFACE FEATURES on the property, such as storm/sewer drains or aboveground electrical lines that have not already been discovered by the public or private locate.

- ☐ Open sewer lids and storm drains and mark the direction of visible pipes.
- ☐ Open any utility vaults (e.g., fiber optics, fire alarm, or electrical vaults), mark the direction of lines, and extrapolate these lines to the building.
- ☐ Locate all roof drains and take care to note how these drains may connect to subsurface drainage lines.
- ☐ If multiple drains are visible, take care to notice possible subsurface connections (straight lines between drains).
- ☐ Look for subsidence features (former filled in trenches) that may contain subsurface lines; including patched concrete/asphalt.
- ☐ Note location of other relevant features, such as building water faucets, bathrooms, and water shut-offs at the street (attempt to extrapolate potential lines from these features).
- ☐ Identify aboveground utilities on the property (electrical lines along walls of buildings, lines on telephone poles). Confirm with drillers that overhead utilities will not obstruct drill rig activities.
- ☐ Locate yard or parking lot lights and confirm electrical connections.
- ☐ Communicate with property owners or site managers to gain information on the location of subsurface utilities or other features, such as nonconductible plastic or PVC lines.
- ☐ Locate emergency stops for fuel lines if working on an active service station.
- ☐ Locate any irrigation or sprinklers that may be present in planters.

ESTABLISH A BUFFER around identified subsurface features (or aboveground lines) where investigations should not be conducted. Maintain at least a 3-foot buffer on either side of a marked utility or in-line inference of a pipe. Utilities such as electrical, fiber optics, or natural gas should have a 5-foot buffer. Mark the buffer zone on the site map clearly so that investigations are not carried out in these locations.

- ☐ Is an air knife/vacuum truck needed to safely clear the boring to a depth of 5 feet below ground surface?

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F|S STANDARD GUIDELINE

Soil Sample Collection

DATE/LAST UPDATE: December 2022

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field but are not intended to be step by step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

This standard guideline presents commonly used procedures for collection of soil samples for characterization and laboratory analysis. The methods presented in this guideline apply to the collection of soil samples during the following characterization activities: soil borings via drilling, manual collection of shallow soil samples, test pit excavation, excavation confirmation, and stockpile characterization. Specific details regarding the collection of discrete and composite samples, and special sampling techniques for volatile organic compounds (VOCs) are also included. The guideline is intended to be used by staff who collect soil samples in the field.

It is important that the field staff completing the soil sample collection discusses the specific needs for a particular investigation with the project geologist, the project manager, or whoever will ultimately be responsible for interpreting the findings of the field investigation. This discussion is in addition to field training and general knowledge about soil sampling, and should happen prior to entering the field, with additional follow-up before finalizing the field forms, after the investigation is complete.

2.0 Equipment and Supplies

Soil Sampling Equipment and Tools:

- Tape measure or measuring wheel
- Stainless steel bowls and spoons
- Trowel, hand auger, or shovel (if needed)
- Table and disposable sheeting, tape or clamps to hold down sheeting (if needed).
- White board and dry erase pen
- Graduated plunger and collection tubes for VOC samples (if needed)
- Photoionization detector (PID) (if needed)
- Ziploc bags (sandwich and gallon sizes)
- Trash bags
- Decontamination tools including:
    - Paper towels or shop towels
    - Spray bottles of Alconox (or similar) solution
    - Deionized or distilled water
    - Scrubbing brush and bucket
- Adhesive drum labels, and paint or grease pen
- Washington State Department of Transportation- (WSDOT) approved drums for investigation-derived waste (IDW) disposal, if needed (if drilling, to be provided by driller)
- Camera
- Hand-held global position system (GPS; if needed)
- Coolers, sample jars, labels, ice

Paperwork:

- Work Plan and/or Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP)
- Field map printed on Rite in the Rain paper
- Site-specific Health and Safety Plan (HASP)
    - Tailgate meeting form (for each day you expect to be on Site)
    - Safety Data Sheets
- Floyd|Snider's Accident Prevention Plan (APP)

- Sample collection forms printed in Rite in the Rain paper
- Boring Logs
- Rite in the Rain field notebook
- Chain of custody forms
- Emergency contact numbers for utilities, property owner/manager, etc. (as needed)

Safety Equipment:

- Steel-toed boots
- Safety vest
- Safety glasses
- Nitrile gloves
- Rain gear
- Work gloves
- Hard hat
- Ear protection
- Traffic barricades or cones
- Vehicle emergency kit (road flares, fire extinguisher, first aid kit, etc.)
- Sunscreen if needed
- Hand and foot warmers, if needed
- Mosquito repellent, Hornet Spray, if needed
- Drinking water
- Rain or sun shelter, if needed
- Cell phone and charger cables

3.0 Standard Procedures

3.1 OFFICE PREPARATION

Prior to going into the field, review the SAP and QAPP to become familiar with the sampling goals, data quality objectives, desired sample intervals and nomenclature, field Quality Assurance (QA) samples (i.e., frequency of field duplicates, MS/MSDs) to be collected, analytes, sample containers, and holding times for each analytical method.

At least one week prior to sampling, coordinate with the laboratory specified in the SAP/QAPP to receive coolers and appropriate sample containers (including additional containers for

QA samples). Familiarize yourself with the volume requirements and container types, preservation methods, and holding times for each class of analytes.

If drilling or digging test pits, mark the sample area and sample locations with white spray paint prior to sampling, then submit an 811 public utility locate request at least 3 business days prior to work. Hire a private utility locator and schedule to locate utilities on private property and ensure proposed boring and/or excavation locations are free of utilities (Note: not all locators are equipped to mark non-conductible utilities).

3.2 TAILGATE SAFETY MEETING

Conduct a tailgate safety meeting prior to beginning work at the Site. Include any subcontractors working with you at the Site in this meeting. The safety meeting should cover the hazards specific to soil sampling. Typical hazards include:

- Heavy machinery/drill rig awareness (overhead hazards, pinch points, noise, uncontrolled release of energy). Always make eye contact before approaching an operator.
- Physical hazards (heavy lifting, uneven ground/trip hazards)
- Chemical hazards (dust, site-specific contaminants of concern, lab preservatives)
    - Refer to HASP for specific air monitoring requirements, permissible exposure limits (PELs), and actions if PELs are exceeded.

Additional hazards that may be present at any job site include traffic, adverse weather, slips, trips, falls, biological hazards (such as insects, plants, animals), and worksite distractions (such as pedestrians or other onsite activities).

Record the meeting attendees and topics discussed on the front page of the tailgate safety meeting form. All attendees should sign the form.

3.3 OTHER HEALTH AND SAFETY GUIDELINES

The following are additional health and safety guidelines that should be followed in the field. These guidelines are intended to supplement the guidelines and requirements identified in the HASP and are not intended to replace the HASP.

- Review and sign the HASP prior to going out into the field.
- Conduct a tailgate safety meeting prior to beginning work at the site as discussed in Section 3.2.
- If conditions change (e.g., weather or personnel) or when moving between sampling locations/switching to different sampling tasks, assess any additional hazards that may be associated with the new condition or location/task. Record additional hazards noted and corrective actions to address those hazards on the second page of tailgate safety meeting form.

Record near misses and incidents on the Near Miss and Incident Reporting Form (included as an attachment to the HASP) and conduct management/client notifications according to the protocols detailed in the HASP.

3.4 GENERAL SOIL SAMPLE COLLECTION PROCEDURES

1. Locate the desired sample location and depth interval using a handheld GPS or by taking field measurements from known site features. Record the soil type and any other observations or indications of contamination on a soil boring log (enclosed), soil sample collection form, or field notebook, as described in the Soil Logging Standard Guideline. Note the location and depth of the sample on the whiteboard or notecard and take a photograph with a scale (e.g., tape measure), if possible.
2. Refer to Sections 3.4.1 through 3.4.4 for the appropriate soil collection procedures for drilling, shallow soil, test pit excavation, excavation confirmation, and stockpiles. If collecting samples for VOC analysis by the U.S. Environmental Protection Agency (USEPA) Method 5035, refer to Section 3.5 for specific sample collection procedures for this method. If composite soil sampling is recommended, refer to Section 3.6 for details.
3. Once soil has been collected from the desired depth or interval, mix thoroughly in a disposable or decontaminated stainless-steel bowl until the sample is homogenous in color, texture, and moisture.
4. Fill the required laboratory-provided jars, taking care not to overfill. If large gravels (diameter greater than ~ 1 inch) are encountered, these should be discarded to ensure that an adequate soil volume is collected for analysis. If necessary, use a clean paper towel to remove soil particles from the threaded mouth of the jar before securing lids to ensure a good seal. Remove any soil or dirt from the outside of the jar with a clean paper or shop towel.
5. Label each jar with the sample name, date, time, field staff initials and required analyses. If collecting a field duplicate, use the sample nomenclature specified in the SAP\QAPP and note the field duplicate name and sample time in the sample log and/or field notebook. If extra volume for matrix spike/matrix spike duplicate (MS/MSD) analysis is required, use the same name on all jars. Soil samples should be protected from moisture by placing the filled sample jars into separate sealed Ziploc bags before placing them into a cooler.
6. Upon completion of each day of sampling, complete a chain-of-custody form for all samples, including sample names, date and time of collection, number of containers, and required analyses and methods. Write neatly and make sure information on the chain is legible. If you need to correct an entry, strike the incorrect entry out once, and add your initials next to the strike out. Samples collected for waste characterization purposes should be recorded on a separate chain-of-custody. Keep samples on ice (unless otherwise specified in the SAP/QAPP) to maintain

temperatures of 4-6 degrees Celsius (°C) and transport to the laboratory under chain-of-custody procedures.

3.4.1 Soil Sample Collection via Drilling

These procedures should be used for drilling via direct-push, hollow stem auger, or roto-sonic methods where a pre-designated sample interval (i.e., 0 to 5 feet below ground surface [bgs]) is retrieved from the subsurface using a split spoon sampling device, lined core, or bag sampler.

1. Ensure that reusable sampling equipment has been thoroughly decontaminated prior to sampling.
2. Collect PID measurements and other field tests, if necessary. PID measurements should be collected using the head-space method: put a small amount of soil from the selected interval into a sandwich bag and seal the bag. Label the bag with the soil interval. After at least 10 seconds, insert the tip of the PID into the bag and record the PID reading on the boring log or field collection form. If a sheen test is necessary, place a small amount of soil into a disposable or decontaminated stainless steel bowl, spray it with tap water or deionized water and observe whether a sheen appears on the water. Record results on the boring log or sample collection form.
3. Prior to sample collection, log soil on the boring log or sample collection form following the Soil Logging Standard Guideline.
4. Use a stainless-steel spoon or trowel, or disposable scoop to remove an equal volume of soil across the targeted depth interval from the sampler.
    a. If using a split spoon sampler or other reusable sampler, avoid collecting the soil that is touching the sides of the sampler to the extent practical.
    b. If the soil touching a reusable sampler must be collected to obtain adequate volume for analysis, notify the PM and record in the field logbook.

3.4.2 Manual Collection of Shallow Soil Samples

These procedures should be used for shallow soil sampling via scoop, trowel, shovel, or hand auger.

1. Dig or auger to the bottom depth of the shallowest sample to be collected, using a tool that has been thoroughly decontaminated. Verify that the target depth has been reached using a measuring tape.
2. If using a scoop or trowel, collect the soil directly into a decontaminated stainless-steel bowl.
3. If using a shovel, the soil may either be collected in bowls or set as aside on plastic sheeting in favor of collecting the sample from the sidewall of the hole. If sampling the sidewall, use a decontaminated or disposable scoop or trowel to collect soil from the target depth, or scrape along the sidewall to collect soil across a target depth

interval. Transfer soil to a disposable or decontaminated stainless-steel bowl, repeating until a sufficient volume has been collected.

4. If using a hand auger, empty the cylinder of the auger directly into a disposable or decontaminated stainless-steel bowl. It may be necessary to empty the hand auger onto plastic sheeting or into a bowl to reach the target depth without overflowing the sampler.
5. Any soil from depth intervals that are not targeted for sampling should be set aside on plastic sheeting and returned to the hole after sampling.
6. Collect PID measurements and other field tests as described in Section 3.4.1.

3.4.3 Sample Collection from Test Pits or Limited Soil Excavations

These procedures should be used for collecting samples from test pit explorations excavated using a backhoe or excavator. These same general procedures should also be followed for post-excavation soil samples used to confirm that an excavation has removed contaminated material or to document post-excavation conditions after target excavation limits have been reached.

1. Measure the length, width, and depth of the test pit or excavation area to verify that the target extents have been reached. The lateral spacing of the test pit or excavation confirmation samples, or exact location of samples should be specified in the work plan and typically depend on the size of the excavation area but can vary significantly by project.
2. If not specified in the work plan, sidewall samples may be collected either midway between the ground surface and base of the excavation, or incrementally along the entire height of the sidewall. Both sidewall and base (bottom) samples should penetrate a minimum of 6 inches into the excavated surface.
3. If the test pit or excavation is less than 4 feet deep, or has been benched to accommodate safe entry, a sample may be collected directly from the sidewall(s). Do not enter an excavation before reviewing and verifying the necessary safety requirements. Most excavations can be sampled without entering, which is preferred. If entering is safe, based on the depth or accommodations to support entry, to collect soil from a sidewall, use a decontaminated or disposable scoop, trowel, or shovel to obtain soil from the desired depth or depth interval directly into a decontaminated stainless-steel bowl.
4. If a test pit or excavation cannot be safely entered, instruct the excavator operator to scoop sidewall material from the target depth or depth interval. Collect the soil sample from the excavator bucket using a decontaminated stainless-steel spoon, trowel, or disposal scoop, avoiding material that has come into contact with the teeth or sides of the bucket. Place an adequate volume of soil into a decontaminated stainless-steel bowl. If necessary, follow the compositing procedures in Section 3.6.

3.4.4 Stockpile Sampling

These procedures should be used for classifying stockpiled soil, including excavated soil and imported backfill material.

1. Where potentially contaminated soils have been previously excavated and stockpiled on site, Washington State Department of Ecology (Ecology) guidance recommends using a decontaminated or disposable scoop or trowel, penetrating 6 to 12 inches beneath the surface of the pile at several locations until sufficient volume for analysis is achieved. A decontaminated shovel may also be used to facilitate collection of soil from large piles. The locations for soil collection should be where contamination is most likely to be present based on field screening (i.e., staining, odor, sheen, or elevated photoionization detector [PID] readings). If there are not field indications of contamination, the locations should be distributed evenly around the stockpile.
2. The stockpile may need to be broken up into sections for sample collection depending on the size of the pile (i.e., segregate the pile in half or quarters). If this is necessary, it is important to document where each set of samples were collected from (i.e., north quadrant) and create a field sketch in the project notebook of the pile for reference and mark sample locations with flags.
3. If a sampling frequency is not specified in the work plan, the general rule of thumb for contaminated soil stockpile profiling is to collect and submit 3 analytical samples (these samples can be multi-point composites or grabs) for stockpiles less than 100 cubic yards (CY), 5 samples for stockpiles between 100 and 500 CY, 7 samples for stockpiles 500 to 1,000 CY, 10 samples for stockpiles 1,000 to 2,000 CY, and 10 samples for stockpiles larger than 2,000 CY with an additional sample collected for every 500 CY of material. This rule of thumb is consistent with the Washington State Guidance for Remediation of Petroleum Contaminated Site (Ecology 2016).
4. Samples for characterization of stockpiles of imported backfill or other presumed clean material should also be collected as described under 3. If not described in the work plan, the typical sample frequency for imported or clean material characterization is one sample per 500 CY.

3.5 SOIL SAMPLE COLLECTION FOR VOC ANALYSIS

If collecting soil samples for VOC analysis by USEPA Method 5035, collect these samples first before disturbing the soil. This method uses a soil volume gauge fitted with a disposable soil sampling plunger tube to collect a soil plug that can be discharged directly to a VOA vial, limiting the loss of volatiles during sampling. The collection of VOC samples using the 5035 method specifies use of an airtight VOA vial with a septum lid. Ecology's interpretation of the USEPA 5035 method allows for field preservation of the sample with methanol or sodium bisulfate, or laboratory preservation (i.e., field collection into an un-preserved vial). It is important to note that if laboratory preservation is the selected method, samples must be received at the laboratory within 48-hours of sample collection. The method of sample preservation for the 5035 method will vary for each site and is dependent on site-specific conditions. Preservation method selection should be coordinated with the laboratory and specified in the sampling plan. Note that not all labs use the soil volume gauge as described below (some use syringes or Terra Core samplers) and that it is important to verify the sampling process with the lab.

1. Note the volume of soil needed for analysis as specified by the laboratory (commonly 5 or 10 grams). Raise the handle of the soil volume gauge to the slot in the gauge body corresponding to the desired volume and turn clockwise until the tabs in the handle lock into the slot.
2. Insert a sample tube at the open end of the gauge body and turn clockwise until the tabs on the tube lock into the “0 gram” slot. Remove the cap from the sample tube and press directly (where possible) into the shallow soil, soil core/sampler, excavation base or sidewall, or stockpile.
3. Continue pressing the sample tube until the plunger is stopped by the sample volume gauge. If a depth interval (for example 9 to10 feet) is targeted for VOC sampling, collect small volumes of soil across this interval until the sample tube is filled
4. Twist counterclockwise to disengage the sample tube, then depress the plunger to eject the soil plug directly into a laboratory-provided VOA vial. Wipe off any soil particles on the VOA vial threads before tightening the lid. Grit on the VOA vial threads can cause a poor seal and interfere with the laboratory analyses. If multiple vials per sample are required, the same plunger may be re-used to fill the remaining vials.

3.6 COMPOSITE SAMPLE COLLECTION

For this guideline, composites are considered samples that are collected across more than one location, or multiple depth intervals at a single location. Samples collected over continuous depth intervals within a sampling device (i.e., split spoon) are addressed for each sampling method in Section 3.4 above.

Compositing of sample material may be performed in the field or by the analytical laboratory. To collect a field composite sample, identify the locations and depth(s) that will comprise the composite. Collect soil from the first target sub-sample depth or depth interval and hold in a decontaminated stainless-steel bowl, covered with aluminum foil to prevent cross contamination and label with the location and depth. Continue to collect and hold individual sub-samples until all components of the composite have been collected, then transfer an equal amount of each sub-sample to a clean bowl and homogenize. Fill necessary sample jars from homogenized composite. In some cases, project plans may require that each individual sample that comprised the composite be collected in jars and submitted to the laboratory if individual sample analysis is desired, or if laboratory compositing is requested in addition to field compositing as a field quality control measure. In this case, label each individual jar, but indicate HOLD on the chain-of-custody, and note that the sample is part of composite XYZ.

To collect a laboratory composite sample, collect, and label each sub-sample using the procedures described above in Section 3.4. Record each sub-sample on the chain-of-custody form, and indicate on this form which samples should be composited by the laboratory and the desired name of the composite sample. It is important to communicate to the laboratory if discrete samples will also require analysis (in some cases) or only the composite sample. It is helpful to send a follow up email to the laboratory PM with laboratory compositing details.

4.0 Decontamination

All reusable equipment that contacts soil or dust should be decontaminated prior to moving to the next sampling location.

Stainless-steel bowls and spoons, and any tools used for sample processing will be decontaminated between each sample; alternatively, disposable bowls and spoons may be used. Equipment decontamination will consist of a tap water rinse to remove soil particles, followed by scrubbing with brushes and an Alconox (or other soap)/tap water solution, and a final rinse with distilled or deionized water.

5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, waste soils accumulated as investigation derived waste (IDW) will be contained, transported, disposed of in accordance with applicable laws, and stored in designated drums in a designated area until transported off-site for disposal.

The approach to handling and disposal of these materials is as follows. For IDW that is containerized, such as waste soils, 55-gallon drums approved by WSDOT (or the applicable stage agency) will be used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “soil”), the dates on which the soil was accumulated, the site owner’s name (i.e., the generator), Floyd|Snider name, and the Floyd|Snider field person contact information or front desk telephone number.

Refer to the IDW Special Conditions SOP for further information on IDW storage, sampling, profiling, and handling.

Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy duty garbage bags or other appropriate containers and disposed of as solid waste in the municipal collection system (i.e., site dumpster).

6.0 Field Documentation

All observations including sample collection locations, soil descriptions, sample depths, collection times, analyses, and field QC samples should be recorded on a boring log, soil sample collection form, and/or bound field notebook. Information recorded should additionally include personnel present (including subcontractors), purpose of field event, weather conditions, sample collection date and times, sample analytes, and any deviations from the SAP.

At the end of the day, complete and review the second page of the tailgate safety meeting form detailing additional hazards, corrective actions, near-misses or incidents. Any incidents that result in field staff injuries or have the potential to result in staff injuries (such as hitting buried utility lines when drilling) should be reported immediately to the PM.

7.0 Demobilization

Upon returning to the office, ensure that all equipment is property cleaned and put away in the field room. Equipment with rechargeable batteries should be plugged in as appropriate so it is ready for use by the next person. It is preferable to dispose of trash at the project site, but any trash left in the field vehicle should be brought upstairs, labeled, and placed in the front production room for building staff to dispose of.

If equipment or sample coolers will be placed at the front desk for pickup, clearly label each item with the company picking it up, anticipated pickup time frame, and your contact information so front desk staff can contact you if there are any questions. Notify front desk staff if any items require a signature at pickup.

Within one week of returning from the field, the field lead for the event should review field notes, sampling forms and tailgate safety meeting forms with the PM. Following PM review and approval, field notes will be scanned and saved to the project folder. Hard copies should be filed. The PM will provide copies of near miss and incident reports to the Health and Safety Administrator.

Enclosures: Boring Log
Test Pit Log and Sample Collection Form

Record of Revisions:

Revisions	**Date**
Added H&S information and line edits for clarity.	7/22/2022
Reviewed with minor updates	SD 12/9/2022

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	LOGGED BY:	COORDINATE SYSTEM:	
DRILLED BY:		NORTHING:	EASTING:
DRILLING EQUIPMENT:		GROUND SURFACE ELEVATION:	
DRILLING METHOD:		TOTAL DEPTH (ft bgs):	DEPTH TO WATER (ft bgs):
SAMPLING METHOD:		BORING DIAMETER:	DRILL DATE:

Depth (feet)	USCS	Description	Drive	Recovery	# of Blows	PID (ppm)	Sample ID
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT:		LOCATION:	BORING ID:
LOGGED BY:		COORDINATE SYSTEM:	
DRILLED BY:		NORTHING:	EASTING:
DRILLING EQUIPMENT:		GROUND SURFACE ELEVATION:	
DRILLING METHOD:		TOTAL DEPTH (ft bgs):	DEPTH TO WATER (ft bgs):
SAMPLING METHOD:		BORING DIAMETER:	DRILL DATE:

Depth (feet)	USCS	Description	Drive	Recovery	# of Blows	PID (ppm)	Sample ID
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

ABBREVIATIONS:
ft bgs = feet below ground surface   USCS = Unified Soil Classification System
ppm = parts per million   ▼ = denotes groundwater table

NOTES:

Test Pit Log and Sample Collection Form

Project:				Date:
Field Personnel:				
Test Pit #				
Pit Dimensions	Depth:_______________	Length:_______________	Width:____________	Units:____________
Soil Description: (note depth to native, presence of debris, odor, sheen)				
Sketch				
GPS coordinates				
Other Notes or Observations:				
Samples Details	Sample ID	Depth	Time	Analysis

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F|S STANDARD GUIDELINE

Soil Logging

DATE/LAST UPDATE: October 2019

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step by step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines and should review and understand these procedures prior to going in the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

These soil logging standard guidelines should be used by the field staff performing subsurface investigations, such as a direct push or roto-sonic soil boring, installation of a monitoring well via hollow stem auger, or roto-sonic or mud rotary drilling. While many projects will not necessarily have a Licensed Geologist (LG) or Hydrogeologist (LHG) who reviews and stamps every boring log, it is important that the field staff discusses the soil logging needs for a particular investigation with the project geologist, the project manager, or whoever will ultimately be responsible for interpreting the findings of the field investigation. This discussion is in addition to field training and general knowledge about soil logging, and should happen prior to entering the field, with additional follow-up before drafting a final set of electronic logs, after the investigation is complete.

2.0 Equipment and Supplies

Logging Equipment and Tools:

- 100-foot tape measure or measuring wheel
- Handheld Global Positioning System (GPS; optional)
- Unified Soil Classification System (USCS) Soil Classification Field Guide
- Soil logging kit containing:

  - Stainless steel spoons
  - Paint scraper or trowel
  - Small Ziploc bags
  - Small stainless steel bowls or black mining pans for sheen testing
  - Spray bottle filled with water
  - Paper towels (preferably white)
  - Engineers tape
  - Note cards
  - Optional items include:
    - Empty VOA vials or small glass jars
    - Munsell color chart
    - Sieves
    - White and grayscale color cards for photographs
- Plastic sheeting and duct tape or clamps to cover the sampling table
- Camera
- Trash bags
- Coolers
- Jars
- Labels
- Ice

Paperwork:

- Work Plan and/or Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP)
- Health and Safety Plan (HASP)
- Copies of figures showing previous boring locations and boring logs from previous investigations, if available
- Boring log forms (enclosed) appropriate for drilling method, printed in Rite in the Rain paper and/or bound field notebook
- Permanent markers and pencils

Personal Equipment:

- Steel-toed boots
- Hard hat
- Safety vest

- Safety glasses
- Nitrile gloves
- Ear plugs
- Rain gear
- Work gloves

3.0 Standard Procedures

3.1 OFFICE PREPARATION

First, meet with the project manager or field manager to identify the key information and goals of the soil boring investigation. These may include fill history, known or suspected sources of contamination and potential field indications of these contaminants, identification of specific units, or important geotechnical measurements. If possible, select a boring log template that is appropriate for the project needs.

Next, review the work plan and all available existing materials such as cross-sections or boring logs from previous investigations to familiarize yourself with the site geology. In addition (or alternatively if other information is not available), you may also review a geologic map of the area from a reputable source such as United States Geological Survey (USGS).

Finally, check the area of the site where drilling will occur for underground objects. At minimum, a OneCall locate request should be made at least one week in advance of drilling in order to give public utility locators time to mark known buried utility lines. All planned boring locations should be marked on the ground with white spray paint prior to making a locate request. In almost all cases, a private utility locator should also clear the area of drilling any underground objects using electromagnetic techniques. If drilling is to occur in close proximity to buried utilities, the work plan may specify use of an air knife or vacuum to clear the borehole to a depth below the utility lines.

3.2 COLLECTING SOIL SAMPLES FOR CLASSIFICATION

1. Before beginning drilling, record the following information on each log:
    a. Operator’s name and company, equipment make/model, equipment measurements (i.e., sampler length and diameter, hammer weight and stroke if using hollow stem auger, boring diameter)
    b. Your name, date, project, boring name and approximate descriptive location (i.e., where is the soil boring relative to known site features). Include a description of the ground surface and whether or not coring was necessary, if coring was necessary, include core diameter, concrete thickness, and subcontractor information.

c. A small hand drawn map showing your location with measurements to a stationary reference point, or GPS coordinates (ideally, both). This is also a good place to note if you have had to move a boring location because of underground utilities, access issues, etc. It is important to note the reason for relocation and the direction and distance moved (i.e., moved 10 feet to the north due to presence of subsurface water line).

2. If you are using a hollow stem auger drilling method, it is important to communicate to the driller how often you would like a split spoon sample collected. Typically this would be continuous or every 5 feet but may be different depending on the project needs.
3. Note any feedback from the driller about the drilling conditions. This may include difficult drilling or rig chatter (usually caused by hard materials), heaving sands (usually caused by hydrostatic pressure on the borehole), caving, or hole instability.
4. For split spoon samples, record the number of hammer blows (blow counts) necessary to drive the sampler each 6-inch increment, as reported by the driller. If more than 50 blows are needed, record the distance that the sampler was driven in 50 blows (i.e., 2-inches in 50 blows). This is referred to as the standard penetration test.
5. Cover the sampling table with plastic sheeting. Lay an engineer's tape lengthwise across the sampling table. Once a sample has been collected, orient it on the table so that the top is aligned with the 0-foot mark on the tape.
6. Split open the sampler, core barrel liner, or sample collection bag. Record the depth interval that the sampler was driven and the depth interval of soil that was recovered. For split spoons or single-cased core barrels, such as Geoprobe direct-push rods, determine whether any loose 'slough' soil has been dislodged by the drilling equipment and deposited at the top of your core (AMS direct push rods are double cased and do not create slough). Do not include slough in the measurement of the soil recovered. Often the core will be filled with an uninterrupted column of soil that is shorter in length than the total drive interval. In such cases, record the recovery interval as it is situated in the core unless you are able to determine the actual depth where the soil sample originated. For the purposes of recording soil observations and collecting samples for analysis, assume that the recovered column of soil has been evenly compressed unless you are able to determine the interval(s) in which compression has occurred. Decompress the recovered soil when making further observations (e.g., if the recovered soil column is 80 percent of the length of the drive interval, assume 0.8 feet of recovered soil represent 1 foot of soil in situ).
7. Before further disturbing the soil, take volatile organic compound (VOC) measurements with a photoionization detector (PID), if using. Take measurements by making crevices in the soil with a spoon or scraper and inserting the PID probe into these openings. Alternatively, collect small spoonfuls of soil into Ziploc bag(s), seal the bag(s), gently shake the bag(s), and insert the PID probe through the top of the bag(s) and into the headspace once the soil vapor has been allowed to equilibrate with the

surrounding air (headspace method). The bag headspace screening method is typically more accurate and is useful at sites with low concentrations of VOCs, whereas the in-situ method is a faster and more qualitative method, best used at sites with higher VOC concentrations. If sampling for VOCs by the U.S. Environmental Protection Agency (USEPA) Method 5035, these soil samples should also be collected prior to disturbing the core. Soil sampling procedures using USEPA Method 5035 are described in detail in the Soil Sample Collection Standard Guideline.

8. Use a straight edge to scrape the soil level and expose the center of the core. Photograph the core alongside the measuring tape and an index card displaying the soil boring location/ID and depth interval.

3.3 SOIL CLASSIFICATION

Soils are described using the following characteristics: Color, consistency, MAJOR CONSTITUENT, minor constituent, geotechnical properties, moisture content, other observations (e.g. visual or olfactory indications of contamination). The USCS field guide is included in this guidance for reference. The steps below should help guide the logger in classifying soils according to the USCS.

1. Record the color of the soil. A descriptive color (i.e., light brown) or a color identified using the Munsell color chart are both valid.
2. Determine whether organic matter influences the properties of the material. If so, record as an organic soil.
3. If the soil is predominantly inorganic, identify whether the major constituent is coarse- or fine-grained. Coarse-grained soils include sands and gravels; fine-grained soils include silts and clays.
   a. For coarse grained soils, determine:
      i. Grain size(s) present including fine, medium, or coarse, and grain size distribution including well-graded (a mixture of fine to coarse grains) or poorly-graded (uniform in size). The USCS guide is helpful for determining grain sizes. If the major constituent is gravel, note its angularity using “rounded,” “sub-angular” or “angular.”
      ii. Minor constituent(s). If a minor constituent represents less than approximately 15% of the sample, note this as “with [minor constituent]” and optionally, whether it is “trace” (<5%) or “few” (5-15%). If a minor constituent represents more than 15% of the sample, use “[minor constituent]-y.” For example, a sand with 5% silt would be classified as a “SAND with trace silt” and sand with 30% silt would be classified as a “SILTY SAND.” For coarse-grained soils with fines between 5% and 15%, the USCS includes several dashed classifications, such as SW-SM. It is often helpful to record an estimated percentage for soil constituents to aid in classification according to the USCS.

b. For fine-grained soils, determine:

    i. Major constituent. To determine whether a material is silt or clay, a simple settling test may be performed in a glass vial or gloved hand by spraying a small amount of the sample with water. Silt particles will settle out of suspension in water within a few minutes, whereas clay particles will remain suspended for a longer period of time.

    ii. Minor constituent(s). As described above, determine the approximate percentage and record as “with [minor constituent]” or “[minor constituent]-y” as appropriate. It is often helpful to record an estimated percentage to aid in classification according to the USCS.

    iii. Geotechnical properties. Depending on project data needs, geotechnical properties may be optional but often provide helpful information. Geotechnical properties include plasticity (ranging from “non-plastic” to “highly plastic” as determined by a thread test) and consistency (ranging from “loose” to “very dense” for coarse-grained soils and “soft” to “hard” for fine-grained soils). When using split spoon samplers, blow counts recorded during the standard penetration test (also referred to as N-values) are used to determine consistency; when using direct-push or sonic drilling, consistency is described qualitatively.

4. Using the USCS guide and the description of the soil, determine the appropriate USCS symbol and record it on the log. If it is difficult to distinguish the major constituent of a soil, a borderline “/” symbol may be used to denote the two potential major constituents present. This is not the same as the USCS classifications that utilize a dash, such as SW-SM.

5. Determine whether contacts between stratigraphic units are abrupt, or gradational. Note abrupt contacts using a solid line and gradational contacts using a dotted line. If the contact between units is not visible and was missed between sample depths, a dashed line is used.

6. If the site or area geology is known, and you are confident in your identification of a specific stratum, note the geologic unit. At a site where the geology is uncertain, you may make some more general notes about the depositional environment, such as identifying probable estuarine deposits, colluvium, glacial till, etc.

7. Note the moisture content of the soil, using “dry,” “moist,” “wet,” or “saturated.” Mark the water table at the time of drilling on the log at the depth where saturated soil is first observed.

3.4 OTHER OBSERVATIONS

1. Record other materials observed in the sample. These may include minor amounts of rootlets or other plant matter, evidence of organisms such as shell fragments, and/or anthropogenic debris such as brick fragments, plastic, or metal debris.
2. Record potential indications of contamination. These may include odors, colored or black staining on soils, colored crystals, hydrocarbon sheens, or non-aqueous phase liquid (NAPL) product.
    a. To test for hydrocarbon sheen, put a small amount of soil in a bowl, saturate with water and swirl, noting whether a rainbow sheen appears on the surface of the water. Alternatively, place a small amount of water in the bottom of the bowl and a small amount of soil along the side, then tilt the bowl so that the water slowly touches the soil. If observed, note the color of the sheen and describe as slight (discontinuous on the water surface), moderate (continuous but spreading slowly) or high (rainbow sheen covering entire surface water).
    b. To test for the presence of NAPL, use a clean paper towel to blot the surface of the core and note the proportion of the towel that is saturated with oil (be sure to allow the towel to dry when blotting moist to wet soils to distinguish between saturation due to NAPL and due to water).
3. Note the final depth of the boring and any reasons for early termination of the boring (i.e., refusal).
4. If monitoring wells will be installed, follow the Standard Guidelines for monitoring well construction and well development.

4.0 Decontamination

All reusable equipment that comes into contact with soil should be decontaminated as follows prior to moving to the next sampling location.

Split spoons, stainless steel bowls and spoons, and any other tools used for soil classification must be decontaminated between boring locations. If collecting soil samples for chemical analysis, split spoons and any tools used for sample processing must be decontaminated between each sample; alternatively, disposable bowls and spoons may be used. Equipment decontamination will consist of a tap water rinse to remove soil particles, followed by scrubbing with brushes and an alconox (or similar)/clean water solution and a final rinse with distilled or deionized water.

5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, waste soils and other drilling materials generated during soil boring activities will be contained, transported, disposed of in accordance with applicable laws, and stored in a designated area until transported off-site for disposal.

The approach to handling and disposal of these materials is as follows. For investigation-derived waste (IDW) that is contained, such as waste soils, 55-gallon drums approved by the Washington State Department of Transportation (WSDOT) will be supplied by the driller and used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., "soil cuttings"), the dates on which the wastes were placed in the container, the owner's name, contact information for the field person who generated the waste, and the site name.

Whenever possible, IDW contained within drums will be characterized relative to applicable waste criteria using data from the sampling locations. Material that is designated for off-site disposal will be transported to an off-site facility that is permitted to accept the waste. Manifests will be used as appropriate for disposal.

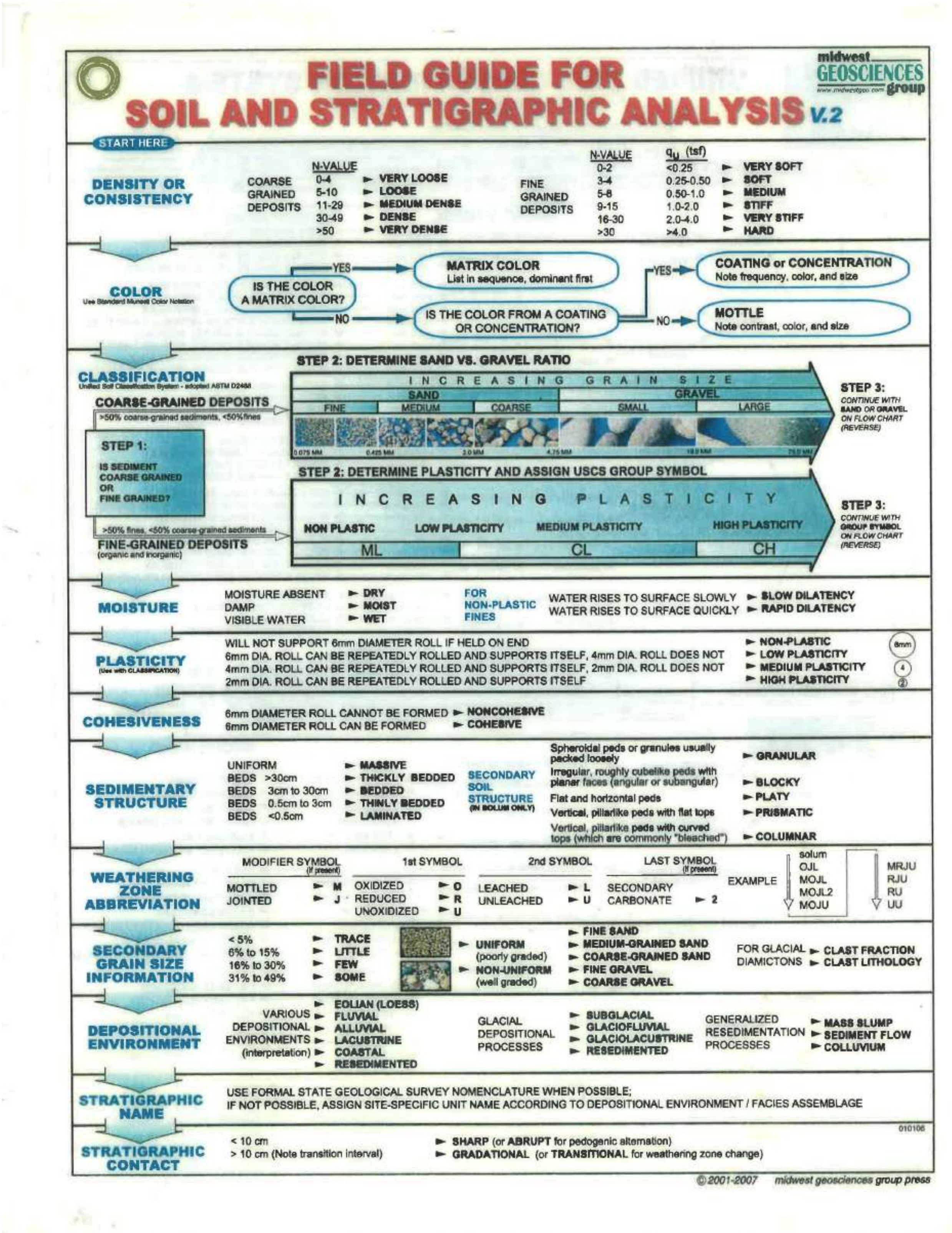
Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy duty garbage bags or other appropriate containers and disposed of as solid waste in the municipal collection system (i.e., site dumpster).

6.0 Field Documentation

All observations should be recorded on a soil boring form appropriate for the drilling method or in a bound field notebook. Field staff should make an effort to record as much detail as possible in the field log. After the field work is complete, a set of final logs (usually electronic) that serve as the record for the project will be completed in consultation with the project manager or field manager.

Enclosure: USCS Soil Classification Field Guide
Boring Log

USCS SOIL CLASSIFICATION FIELD GUIDE



FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS v.2

midwest GEOSCIENCES group www.midwestgeo.com

START HERE

DENSITY OR CONSISTENCY

COARSE GRAINED DEPOSITS N-VALUE		FINE GRAINED DEPOSITS N-VALUE	q_u (tsf)	
0-4	VERY LOOSE	0-2	<0.25	VERY SOFT
5-10	LOOSE	3-4	0.25-0.50	SOFT
11-29	MEDIUM DENSE	5-8	0.50-1.0	MEDIUM
30-49	DENSE	9-15	1.0-2.0	STIFF
>50	VERY DENSE	16-30	2.0-4.0	VERY STIFF
		>30	>4.0	HARD

COLOR (Use Standard Munsell Color Notation)

IS THE COLOR A MATRIX COLOR?
- YES ► MATRIX COLOR — List in sequence, dominant first
- NO ► IS THE COLOR FROM A COATING OR CONCENTRATION?
  - YES ► COATING or CONCENTRATION — Note frequency, color, and size
  - NO ► MOTTLE — Note contrast, color, and size

CLASSIFICATION (Unified Soil Classification System - adopted ASTM D2488)

STEP 1: IS SEDIMENT COARSE GRAINED OR FINE GRAINED?

COARSE-GRAINED DEPOSITS (>50% coarse-grained sediments, <50% fines)

STEP 2: DETERMINE SAND VS. GRAVEL RATIO

INCREASING GRAIN SIZE — SAND: FINE, MEDIUM, COARSE; GRAVEL: SMALL, LARGE (0.075 MM, 0.425 MM, 2.0 MM, 4.75 MM, 19.0 MM, 75.0 MM)

STEP 3: CONTINUE WITH SAND OR GRAVEL ON FLOW CHART (REVERSE)

FINE-GRAINED DEPOSITS (organic and inorganic) (>50% fines, <50% coarse-grained sediments)

STEP 2: DETERMINE PLASTICITY AND ASSIGN USCS GROUP SYMBOL

INCREASING PLASTICITY — NON PLASTIC, LOW PLASTICITY, MEDIUM PLASTICITY, HIGH PLASTICITY — ML, CL, CH

STEP 3: CONTINUE WITH GROUP SYMBOL ON FLOW CHART (REVERSE)

MOISTURE

MOISTURE ABSENT	DRY	FOR NON-PLASTIC FINES	WATER RISES TO SURFACE SLOWLY	SLOW DILATENCY
DAMP	MOIST		WATER RISES TO SURFACE QUICKLY	RAPID DILATENCY
VISIBLE WATER	WET			

PLASTICITY (Use with CLASSIFICATION)

WILL NOT SUPPORT 6mm DIAMETER ROLL IF HELD ON END	NON-PLASTIC
6mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 4mm DIA. ROLL DOES NOT	LOW PLASTICITY
4mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 2mm DIA. ROLL DOES NOT	MEDIUM PLASTICITY
2mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF	HIGH PLASTICITY

COHESIVENESS

- 6mm DIAMETER ROLL CANNOT BE FORMED ► NONCOHESIVE
- 6mm DIAMETER ROLL CAN BE FORMED ► COHESIVE

SEDIMENTARY STRUCTURE

UNIFORM	MASSIVE
BEDS >30cm	THICKLY BEDDED
BEDS 3cm to 30cm	BEDDED
BEDS 0.5cm to 3cm	THINLY BEDDED
BEDS <0.5cm	LAMINATED

SECONDARY SOIL STRUCTURE (IN SOLUM ONLY)

Spheroidal peds or granules usually packed loosely	GRANULAR
Irregular, roughly cubelike peds with planar faces (angular or subangular)	BLOCKY
Flat and horizontal peds	PLATY
Vertical, pillarlike peds with flat tops	PRISMATIC
Vertical, pillarlike peds with curved tops (which are commonly "bleached")	COLUMNAR

WEATHERING ZONE ABBREVIATION

MODIFIER SYMBOL (if present)		1st SYMBOL		2nd SYMBOL		LAST SYMBOL (if present)	
MOTTLED	M	OXIDIZED	O	LEACHED	L	SECONDARY CARBONATE	2
JOINTED	J	REDUCED	R	UNLEACHED	U		
		UNOXIDIZED	U				

EXAMPLE: solum OJL, MOJL, MOJL2, MOJU; MRJU, RJU, RU, UU

SECONDARY GRAIN SIZE INFORMATION

< 5%	TRACE
6% to 15%	LITTLE
16% to 30%	FEW
31% to 49%	SOME

- UNIFORM (poorly graded)
- NON-UNIFORM (well graded)

FINE SAND, MEDIUM-GRAINED SAND, COARSE-GRAINED SAND, FINE GRAVEL, COARSE GRAVEL

FOR GLACIAL DIAMICTONS ► CLAST FRACTION ► CLAST LITHOLOGY

DEPOSITIONAL ENVIRONMENT

VARIOUS DEPOSITIONAL ENVIRONMENTS (interpretation) ► EOLIAN (LOESS), FLUVIAL, ALLUVIAL, LACUSTRINE, COASTAL, RESEDIMENTED

GLACIAL DEPOSITIONAL PROCESSES ► SUBGLACIAL, GLACIOFLUVIAL, GLACIOLACUSTRINE, RESEDIMENTED

GENERALIZED RESEDIMENTATION PROCESSES ► MASS SLUMP, SEDIMENT FLOW, COLLUVIUM

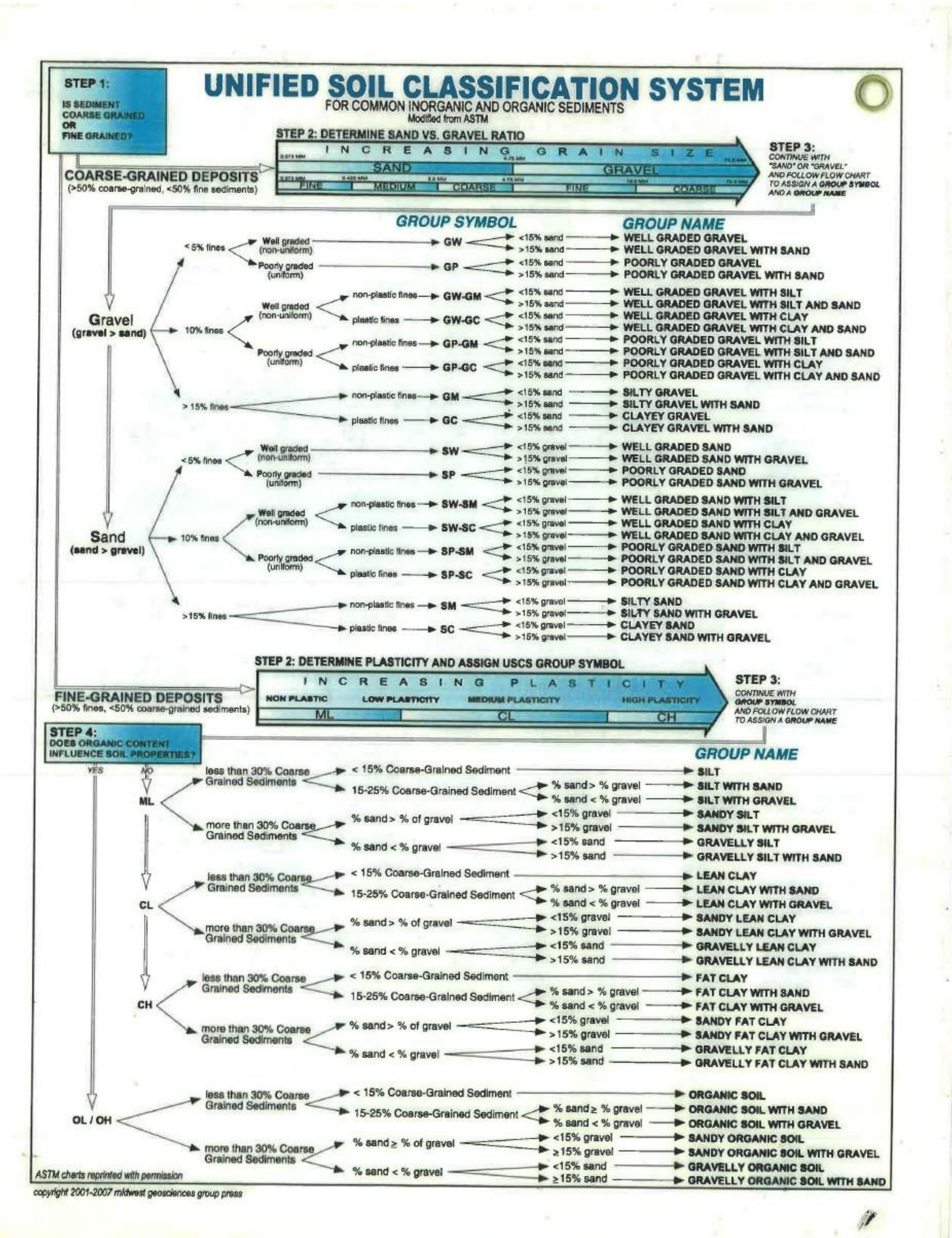
STRATIGRAPHIC NAME

USE FORMAL STATE GEOLOGICAL SURVEY NOMENCLATURE WHEN POSSIBLE;
IF NOT POSSIBLE, ASSIGN SITE-SPECIFIC UNIT NAME ACCORDING TO DEPOSITIONAL ENVIRONMENT / FACIES ASSEMBLAGE

STRATIGRAPHIC CONTACT

- < 10 cm ► SHARP (or ABRUPT for pedogenic alternation)
- > 10 cm (Note transition interval) ► GRADATIONAL (or TRANSITIONAL for weathering zone change)

010106


STEP 1:
IS SEDIMENT COARSE GRAINED OR FINE GRAINED?
UNIFIED SOIL CLASSIFICATION SYSTEM
FOR COMMON INORGANIC AND ORGANIC SEDIMENTS
Modified from ASTM
STEP 2: DETERMINE SAND VS. GRAVEL RATIO
INCREASING GRAIN SIZE
SAND
GRAVEL
FINE
MEDIUM
COARSE
FINE
COARSE
COARSE-GRAINED DEPOSITS
(>50% coarse-grained, <50% fine sediments)
STEP 3:
CONTINUE WITH "SAND" OR "GRAVEL" AND FOLLOW FLOW CHART TO ASSIGN A GROUP SYMBOL AND A GROUP NAME
GROUP SYMBOL
GROUP NAME
Gravel
(gravel > sand)
<5% fines
Well graded (non-uniform)
Poorly graded (uniform)
GW
GP
<15% sand
>15% sand
WELL GRADED GRAVEL
WELL GRADED GRAVEL WITH SAND
POORLY GRADED GRAVEL
POORLY GRADED GRAVEL WITH SAND
10% fines
non-plastic fines
plastic fines
GW-GM
GW-GC
GP-GM
GP-GC
WELL GRADED GRAVEL WITH SILT
WELL GRADED GRAVEL WITH SILT AND SAND
WELL GRADED GRAVEL WITH CLAY
WELL GRADED GRAVEL WITH CLAY AND SAND
POORLY GRADED GRAVEL WITH SILT
POORLY GRADED GRAVEL WITH SILT AND SAND
POORLY GRADED GRAVEL WITH CLAY
POORLY GRADED GRAVEL WITH CLAY AND SAND
> 15% fines
GM
GC
SILTY GRAVEL
SILTY GRAVEL WITH SAND
CLAYEY GRAVEL
CLAYEY GRAVEL WITH SAND
Sand
(sand > gravel)
SW
SP
<15% gravel
>15% gravel
WELL GRADED SAND
WELL GRADED SAND WITH GRAVEL
POORLY GRADED SAND
POORLY GRADED SAND WITH GRAVEL
SW-SM
SW-SC
SP-SM
SP-SC
WELL GRADED SAND WITH SILT
WELL GRADED SAND WITH SILT AND GRAVEL
WELL GRADED SAND WITH CLAY
WELL GRADED SAND WITH CLAY AND GRAVEL
POORLY GRADED SAND WITH SILT
POORLY GRADED SAND WITH SILT AND GRAVEL
POORLY GRADED SAND WITH CLAY
POORLY GRADED SAND WITH CLAY AND GRAVEL
>15% fines
SM
SC
SILTY SAND
SILTY SAND WITH GRAVEL
CLAYEY SAND
CLAYEY SAND WITH GRAVEL
STEP 2: DETERMINE PLASTICITY AND ASSIGN USCS GROUP SYMBOL
INCREASING PLASTICITY
NON PLASTIC
LOW PLASTICITY
MEDIUM PLASTICITY
HIGH PLASTICITY
ML
CL
CH
FINE-GRAINED DEPOSITS
(>50% fines, <50% coarse-grained sediments)
STEP 3:
CONTINUE WITH GROUP SYMBOL AND FOLLOW FLOW CHART TO ASSIGN A GROUP NAME
STEP 4:
DOES ORGANIC CONTENT INFLUENCE SOIL PROPERTIES?
YES
NO
less than 30% Coarse Grained Sediments
more than 30% Coarse Grained Sediments
< 15% Coarse-Grained Sediment
15-25% Coarse-Grained Sediment
% sand > % gravel
% sand < % gravel
% sand > % of gravel
% sand < % gravel
<15% gravel
>15% gravel
<15% sand
>15% sand
SILT
SILT WITH SAND
SILT WITH GRAVEL
SANDY SILT
SANDY SILT WITH GRAVEL
GRAVELLY SILT
GRAVELLY SILT WITH SAND
LEAN CLAY
LEAN CLAY WITH SAND
LEAN CLAY WITH GRAVEL
SANDY LEAN CLAY
SANDY LEAN CLAY WITH GRAVEL
GRAVELLY LEAN CLAY
GRAVELLY LEAN CLAY WITH SAND
FAT CLAY
FAT CLAY WITH SAND
FAT CLAY WITH GRAVEL
SANDY FAT CLAY
SANDY FAT CLAY WITH GRAVEL
GRAVELLY FAT CLAY
GRAVELLY FAT CLAY WITH SAND
OL / OH
% sand ≥ % gravel
% sand ≥ % of gravel
≥15% gravel
≥15% sand
ORGANIC SOIL
ORGANIC SOIL WITH SAND
ORGANIC SOIL WITH GRAVEL
SANDY ORGANIC SOIL
SANDY ORGANIC SOIL WITH GRAVEL
GRAVELLY ORGANIC SOIL
GRAVELLY ORGANIC SOIL WITH SAND
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	PROJECT:	LOCATION:	BORING ID:
	LOGGED BY:	COORDINATE SYSTEM:	
DRILLED BY:		NORTHING:	EASTING:
DRILLING EQUIPMENT:		GROUND SURFACE ELEVATION:	
DRILLING METHOD:		TOTAL DEPTH (ft bgs):	DEPTH TO WATER (ft bgs):
SAMPLING METHOD:		BORING DIAMETER:	DRILL DATE:

Depth (feet)	USCS	Description	Drive	Recovery	# of Blows	PID (ppm)	Sample ID
0							

ABBREVIATIONS:
ft bgs = feet below ground surface USCS = Unified Soil Classification System
ppm = parts per million ▼ = denotes groundwater table

NOTES:

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PROJECT:		LOCATION:	BORING ID:
LOGGED BY:		COORDINATE SYSTEM:	
DRILLED BY:		NORTHING:	EASTING:
DRILLING EQUIPMENT:		GROUND SURFACE ELEVATION:	
DRILLING METHOD:		TOTAL DEPTH (ft bgs):	DEPTH TO WATER (ft bgs):
SAMPLING METHOD:		BORING DIAMETER:	DRILL DATE:

Depth (feet)	USCS	Description	Drive	Recovery	# of Blows	PID (ppm)	Sample ID

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NOTES:

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	PROJECT:	LOCATION:	WELL ID:
	LOGGED BY:	DRILL DATE:	ECOLOGY WELL ID:
DRILLED BY:	BORING DIAMETER:	COORDINATE SYSTEM:	
DRILLING EQUIPMENT:	SCREENED INTERVAL:	NORTHING:	EASTING:
DRILLING METHOD:		GROUND SURFACE ELEV.:	TOC ELEVATION:
SAMPLING METHOD:		TOTAL DEPTH (ft bgs):	DEPTH TO WATER (ft bgs):

Depth (feet)	USCS	Description	Drive	Recovery	# of Blows	PID (ppm)	Sample ID	Well Construction

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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	PROJECT:	LOCATION:	WELL ID:
	LOGGED BY:	DRILL DATE:	ECOLOGY WELL ID:
DRILLED BY:	BORING DIAMETER:	COORDINATE SYSTEM:	
DRILLING EQUIPMENT:	SCREENED INTERVAL:	NORTHING:	EASTING:
DRILLING METHOD:		GROUND SURFACE ELEV.:	TOC ELEVATION:
SAMPLING METHOD:		TOTAL DEPTH (ft bgs):	DEPTH TO WATER (ft bgs):

Depth (feet)	USCS	Description	Drive	Recovery	# of Blows	PID (ppm)	Sample ID	Well Construction

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

F|S STANDARD GUIDELINE

Well Construction

DATE/LAST UPDATE: May 2015

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines and should review and understand these procedures prior to going in the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

This standard guideline presents commonly used procedures for the installation of resource protection wells, in accordance with applicable sections of the Washington State Minimum Standards for Construction and Maintenance of Wells (Washington Administrative Code [WAC] 173-160, Part Two) and ASTM Standard Practice for Design and Installation of Groundwater Monitoring Wells (ASTM D5092-04[2010]e1). These wells may include groundwater monitoring wells, piezometers, groundwater extraction wells, injection wells, or vapor extraction wells. The guideline is intended to be used by field staff who are overseeing well drilling and construction.

2.0 Equipment and Supplies

Well Installation Equipment and Tools:

- Tape measure or measuring wheel
- Weighted tape or leadline
- Water level meter
- Hand-held Global Positioning System (GPS; optional)
- Camera
- Trash bags

- Well construction materials including polyvinyl chloric (PVC) screen and riser, sandpack, bentonite and well monument will be provided by the drilling subcontractor.

Paperwork:

- Work Plan and/or Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP)
- Health and Safety Plan (HASP)
- Copies of figures showing previous boring locations and boring logs from previous investigations and historical depth to water levels, if available
- Well installation forms (printed on Rite in the Rain paper)
- Permanent markers and pencils

Personal Equipment:

- Steel-toed boots
- Hard hat
- Safety vest
- Safety glasses
- Nitrile gloves
- Ear plugs
- Rain gear
- Work gloves

3.0 Standard Procedures

3.1 PREPARATION

First, before going into the field, it is important to discuss the project needs with the Project Manager (PM). These include the appropriate aquifer for well screening (especially if it is not the shallowest aquifer), soil sampling interval (if applicable to drilling method), screen length and placement (especially important at tidally influenced sites), well construction materials (i.e., screen slot size and grain size of the filter pack), surface completion of the wells, and any other important construction details. Any non-standard materials needed for well construction should also be communicated to the drilling firm when the work is scheduled, or a minimum of two weeks prior to the field event. Select a boring log template that is appropriate for the project needs.

Next, review the work plan and existing materials such as cross-sections, historical depth to water levels, or boring logs from previous investigations (if available) to familiarize yourself with the site geology. In addition to site-specific information (or alternatively if other information is not available), a geologic map of the area from a reputable source such as the U.S. Geological Survey (USGS) may also be reviewed.

Finally, check the area of the site where drilling will occur for underground objects. A OneCall locate request should be made at least one week and no less than three days prior to commencement of drilling in order to give public utility locators time to mark known, buried utility lines. All planned boring locations should be marked on the ground with white spray paint prior to making a locate request. In almost all cases, site maintenance managers or equivalent should be consulted for site selection and a private utility locator should clear any underground objects using electromagnetic techniques from the drilling area. If drilling in close proximity to buried utilities, field staff may need to request authorization for use of an air knife or vacuum extraction to clear the borehole to a depth below the utility lines.

3.2 DRILLING

1. Mark the desired well location using coordinates pre-loaded into a handheld GPS, or by measuring from known Site features. It is best to use both methods, if possible.
2. Before drilling begins, record the following information on each log:
    a. Operator's name and company, equipment make/model, equipment measurements (i.e., sampler length and diameter, hammer weight and stroke if using hollow stem auger, boring diameter).
    b. Your name, date, project, boring name, and approximate descriptive location relative to existing site features. Include a description of the ground surface and whether or not concrete coring was necessary; if so, include core diameter, concrete thickness, and subcontractor information.
    c. A small hand drawn map showing your location with measurements to a stationary reference point, or GPS coordinates (or ideally, both). This is also a good place to note if you have had to move a boring location because of underground utilities, access issues, etc. It is important to record the reason for relocation and the direction and distance moved (i.e., moved 10 feet to the north due to presence of subsurface water line).
3. If you are using a hollow stem auger, it is important to communicate to the driller how often you would like a split spoon sample collected. Typically this would be continuous or every 5 feet but may be different depending on the project needs. Usually this is established before the driller issues a quote. Any changes will affect the cost of the work and should be discussed with the PM.
    a. Record any feedback from the driller about the drilling conditions. This may include difficult drilling or rig chatter (usually caused by hard materials), heaving sands (usually caused by hydrostatic pressure on the borehole), caving, or hole instability.

4. For split spoon samples, record the number of hammer blows (blow counts) necessary to drive the sampler each 6-inch increment, as reported by the driller. If more than 50 blows are needed, record the distance that the sampler was driven in 50 blows (i.e., 2-inches in 50 blows). This is referred to as the standard penetration test (SPT).
5. For all drilling methods, create a log of the soils encountered according to the Floyd|Snider Soil Logging Standard Guideline. Pay particular attention to the moisture content of the soils, making careful notation of the water table where free water is first encountered. After drilling has been completed to the desired depth, confirm the depth to the water table using a water level meter.

3.3 WELL DESIGN AND CONSTRUCTION

1. Determine the length and placement of the well screen based on the observed depth to the water table, the specifics of the work plan, and the observed lithology. The well screen is typically set across the water table of shallow aquifers for monitoring wells and piezometers. However, the screened interval may be fully submerged for groundwater extraction wells, sites with very shallow groundwater, or wells installed in deeper aquifers below confining units. If an area is tidally influenced, note the tide elevation during well completion; if the tide is at a high or low at the time of drilling the well screen may need to be lowered or raised accordingly so that the screen spans the water table when the tide is at zero. The hydraulic conductivity of the aquifer material will also factor into well screen placement. For example, wells screened in tight silts may not produce enough water to adequately develop and sample. In this case, it may be preferable to screen the well in a more transmissive unit. Include the length of any required bottom caps or sumps below the well casing when determining the total depth of the boring required to place the well screen at the desired interval. The Washington State minimum standards also require that the diameter of the well screen relative to the diameter of the borehole (annual space) be small enough to allow placement of a filter pack that is 4 inches in diameter larger than the screen. For example, a 2-inch diameter monitoring well should be completed within a borehole that has a minimum 6-inch diameter.
2. Determine the filter pack material. The purpose of the filter pack is to prevent fine-grained aquifer material from entering the well while still allowing groundwater to flow through. Filter pack is composed of clean, rounded, relatively uniform silica sand. The choice of sand for the filter pack will depend on the grain size range of the aquifer material, with emphasis on the finest aquifer material. Filter pack material should be approximately 10 to 15 times the grain size of the surrounding aquifer material. The particle size ranges of fine, medium, and coarse sand, and the particle size ranges of common filter pack materials are given in the two tables below. As indicated in these tables, suitable filter pack choices for an aquifer with appreciable fine sand would include a range from 20-40 to 10-20 sand. For aquifers where the smallest particle size is medium sand, a filter pack of 2-12 sand or similar may be appropriate. More precise filter pack designs are possible based on grain size curves (see Driscoll 1986, Blair 2006).

Unified Soil Classification System (USCS) Classification	U.S. Sieve Size	Grain Size (inches)	Grain Size (millimeters)
Fine Sand	40 to 200	.003 to 0.16	.074 to .42
Medium Sand	10 to 40	.016 to .06	.42 to 1.68
Coarse Sand	10 to 4	.06 to 0.19	1.68 to 4.76

Example Sand Pack Gradations (U.S. Sieve Sizes)	Grain Size (inches)	Grain Size (millimeters)
32-40	.016 to .02	.42 to .55
20-40	.016 to .03	.42 to .84
16-30	.05 to .02	.59 to 1.2
10-20	.03 to .08	.84 to 2
2-12	.06 to .3	1.7 to 8

3. Determine the screen slot diameter. The purpose of the well screen is to allow groundwater to flow into and through the well screen for sample collection. Monitoring well casings are typically constructed of PVC (Washington State minimum standards require Schedule 40 or thicker-walled PVC for borings up to 200 feet deep); however, materials such as stainless steel may be used for the purposes of longevity, heat, specific chemical resistance, or other site-specific concerns. The screened interval of the well consists of a series of slots that are commonly 0.01 inch or 0.02 inch in width. Similar to filter pack material, narrower slots allow less fine-grained material and also less groundwater to pass through them. The screen slot size should be selected to retain approximately 90% or greater of the filter pack material. The largest screen slot size practical should be selected.

4. Once the driller has assembled the well casing of the appropriate length, oversee placement of the casing and filter pack. The casing should be centered in the borehole and level. When using a hollow stem auger, the sand is typically poured from the surface while the augers are being lifted from the borehole. When using sonic drilling or other methods where the drill rods are removed prior to sand placement, it is preferable to use a Tremie tube lowered to the bottom of the borehole to deliver the sand, which helps to ensure that the sand has actually reached the bottom of the borehole. As the driller is pouring sand into the annular space, monitor the height of the sand in the borehole using a weighted tape or leadline to ensure that the space is being filled evenly. If possible, use a surge block to force water from the well out into the sand pack periodically to eliminate any bridges or gaps in the sand. The sand pack

placement is complete when it has reached a height minimum of 1 foot (but no more the 5 feet) above the top of the well screen.

5. A bentonite seal must be placed above the sand pack to isolate the screened interval of the aquifer and to prevent the annular space from acting as a preferential pathway for surface water, water above the screen zone, or other liquid (i.e., free product). The purpose of the bentonite plug is to prevent downward migration inside the borehole, which has the potential to cause groundwater contamination. Monitor the placement of the bentonite plug above the sand pack. The bentonite plug is typically composed of dehydrated bentonite chips, which are poured into the annual space from the surface; or a bentonite slurry, which is pumped into the space via a Tremie tube. A bentonite chip seal is still recommended (but not necessary) immediately above the sand pack when using bentonite slurry to minimize migration of the slurry into the sandpack. Pumping is preferable in situations where bentonite will be placed below the water table. The U.S. Environmental Protection Agency (USEPA) recommends that the bentonite seal consist of a minimum of 2 feet of bentonite placed above the sand pack. If using a bentonite chip seal, hydrate the chips with clean water so that they expand to seal the borehole.
6. Communicate the desired surface completion to the driller (i.e., an aboveground well monument or a monument flush with the ground surface) if you have not already done so. Verify that the well monument has been installed correctly. For flush-mounted wells, ensure that the well is level with the surrounding grade, especially in areas with pedestrian or vehicle traffic. In areas with frequent or heavy vehicle traffic, heavy-duty traffic-rated monuments or manholes should be used. For aboveground well monuments (i.e., stand pipes), ensure that the monument is level, anchored in a minimum of 2 feet of concrete, and protected by steel bollards, unless otherwise specified in the work plan. The concrete surrounding any well monument should seal the borehole at the ground surface.

4.0 Decontamination

All reusable equipment that comes into contact with soil and groundwater should be decontaminated as follows prior to moving to the next sampling location.

Split spoons, stainless steel bowls and spoons, the water level tape, and any other tools used for well drilling and installation must be decontaminated between boring locations. If collecting soils samples for chemical analysis, split spoons and any tools used for sample processing will be decontaminated between each sample; alternatively, disposable bowls and spoons may be used. Equipment decontamination will consist of a tap water rinse to remove soil particles, followed by scrubbing with brushes and an alconox (or similar)/clean water solution, and a final rinse with distilled or deionized water.

5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, waste soils, liquids, and other drilling materials generated during well drilling and installation will be contained in accordance with applicable laws, and stored in a designated area until transported off-site for disposal.

The approach to handling and disposal of these materials is as follows. For investigation-derived waste (IDW) that is contained, such as waste soils, 55-gallon drums approved by the Washington State Department of Transportation (WSDOT) will be supplied by the driller and used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled with its contents (e.g., “soil cuttings”), the date(s) on which the wastes were placed in the container, the owner’s name, contact information for the field person who generated the waste, and the site name.

IDW contained within drums will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used as appropriate for disposal.

Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy-duty garbage bags or other appropriate containers and disposed of as solid waste in the municipal collection system (i.e., site dumpster).

6.0 Field Documentation

All observations should be recorded on a soil boring/well completion form appropriate for the drilling method or in a bound field notebook. Field staff should record as much detail as possible in the field log (including well construction materials, Ecology well ID tag number, and surface completions) and note any anomalies or details that varied from the SAP. After the field work is complete, a set of final well construction logs (usually electronic) that serve as the record for the project will be completed in consultation with the project manager or field manager.

F|S STANDARD GUIDELINE

Well Development

DATE/LAST UPDATE: May 2015

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines and should review and understand these procedures prior to going in the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

This Standard Guideline for Well Development presents commonly used procedures for monitoring well development for newly installed monitoring wells and/or existing wells that may require redevelopment. Monitoring well development restores hydraulic conductivity with the surrounding formations that were disturbed during the drilling process. Development removes residual fines from well filter pack materials and the borehole wall and reduces the turbidity of the water, which provides more representative groundwater samples. These wells may include groundwater monitoring wells, piezometers, or groundwater extraction wells. This guideline describes the purge and surge method of development and is intended to be used by field staff who are overseeing or completing well development. Often, the drilling subcontractors are asked to complete well development activities subsequent to new well installations, in which case, Floyd|Snider staff would oversee the development. Other development methods, such as jetting, are not described herein, but may be used if specified in the project-specific Work Plan or Sampling and Analysis Plan (SAP).

Well development shall be completed by continuous pumping at a steady rate using a portable pump and polyethylene tubing, with regular surging (e.g., using a surge block) to force water through the filter pack and surrounding formation. Wells should ideally be developed either during installation (following sand placement but prior to sealing) or soon after installation, unless otherwise specified in the work plan, using the described methodologies or equivalents. For wells that are completed using a grout or concrete seal, if development does not take place prior to sealing, it should be completed within 48 hours following well installation in order allow for grout and concrete to cure.

2.0 Equipment and Supplies

Well Development Equipment and Tools:

- Appropriate high volume pump (centrifugal, submersible, etc.) and correct diameter tubing, or bailer
- Hose clamps (optional)
- Power source (generator, 12-volt battery, or car battery) and appropriate power adapter for pump
- Water quality meter or turbidity meter (if needed)
- 2-, 4-, or 6-inch surge block (typically provided by the driller)
- Water level meter
- Washington State Department of Transportation (WSDOT)-approved 55-gallon drums
- Equipment decontamination supplies including:
  - Scrub brushes
  - Alconox or other soap
  - Distilled or deionized water
  - Paper towels
- Trash bags
- Camera

Paperwork:

- Work Plan and/or SAP/Quality Assurance Project Plan (QAPP)
- Bound field notebook or appropriate field forms
- Well development form (printed on Rite in the Rain paper)
- Health and Safety Plan (HASP)
- Well installation forms (printed on Rite in the Rain paper)

Personal Equipment:

- Steel-toed boots
- Safety vest
- Safety glasses
- Nitrile gloves
- Rain gear
- Work gloves

3.0 Standard Procedures

3.1 OFFICE PREPARATION

Meet with the project manager to identify key information and goals of the well development, including how long after construction the wells should be developed. Determine if Floyd|Snider or the driller will be doing the development.

3.2 WELL DEVELOPMENT PROCEDURES

The following procedures are general guidelines for monitoring well development. These same procedures are also appropriate for extraction wells, injection wells, and/or piezometers. Specific instructions provided in individual work plans shall supersede these procedures in the event there are discrepancies.

Visually inspect all well development equipment for damage; repair as necessary.

1. Decontaminate all hoses, surge blocks, and/or submersible pump by scrubbing with brush and alconox or other soap solution and rinsing with deionized water.
2. Prior to development, use a water level meter to measure the depth in each well to the static water level and total depth to a reference mark on the top of the well casing.
3. Attach a length of clean or disposable tubing, approximately 5 feet longer than the well casing, to the outlet of the submersible pump.
4. Each well development cycle consists of surging followed by well evacuation (pumping). Surging may be accomplished with a surge block sized to fit snugly inside the well casing, or with the submersible pump. Surging using a pump increases the hydraulic gradient and velocity of groundwater near the well by drawing the water level down and moving more fine-grained soil particles into the well casing. Surging using a pump is only effective if the well produces enough water for continuous pumping and the pump is of a large enough diameter relative to the well casing. If

pumping must be stopped to allow the well to recharge, a surge block is preferable for surging. If using a surge block, connect polyvinyl chloride (PVC) pipe or other rods longer than the well casing to the surge block. Lower the surging device into the well to a depth within the screened interval. A bailer can be used to surge in situations when a surge block is not available and the well has insufficient recharge for the submersible pump.

5. During development, it is important to note the color and clarity of the water and any other visual or olfactory observations on the field form or in the field notebook. Note any significant changes as development progresses.

6. Surging should consist of a minimum of ten consecutive surges (i.e., quickly raise and lower surge block or pump in well) with an appropriately sized surge block or pump over the full length of the screen. For long well screens (greater than 10 feet), surging should be done in short intervals of 2 to 3 feet at a time. In cases where the screen extends to above the water table, clean water may have to be added to the well to develop the top of the filter pack.

7. After surging, water is purged from well until the pumped stream starts to run clear. At that point, stop pumping and initiate another surge cycle. If a well has more hydraulic head than the pump is able to overcome, or if an insufficient volume of water for pumping is present, a disposable bailer may also be used for purging.

8. Repeat this procedure until evacuated water is visibly clear and essentially free of sediment. Perform a minimum of three surge and pump cycles.

9. Well development will be terminated when the variation in the turbidity Nephelometric Turbidity Units (NTUs) readings is less than 10 percent or until the discharge is visibly clear and free of sediment after a minimum of three surge and purge cycles. As an alternative, periodic water samples can be collected for field measurements of temperature, specific conductivity, and pH; well development should continue until field parameters stabilize to within ±5 percent on three consecutive measurements or 10 well volumes have been purged. If it is not possible reduce the turbidity further, the well should be purged up to a maximum of four hours or as determined sufficient by the field geologist or project manager.

10. Report field observations and volume of water removed on the standard well development form (attached). Take final water level measurements and record then on the field form or in the field notebook.

11. Contain the purged water and manage in accordance with the project-specific SAP or Section 5.0 below. Prior to developing the next well or after the completion of development activities, decontaminate all reusable equipment used in development in accordance with Section 4.0 below.

12. If feasible, it is best to wait at least two weeks after development to sample the wells. Wells can be sampled a minimum of 48 hours after the completion of development if

the project schedule requires a quick turnaround. However, the groundwater sample will be more representative of static conditions in the aquifer if allowed to stabilize for at least one to two weeks after development.

4.0 Decontamination

All reusable equipment that comes into contact with groundwater should be decontaminated as follows prior to moving to the next sampling location.

Water level meter and surge block: The water level indicator and tape will be decontaminated between sampling locations and at the end the day by spraying the entire length of tape that came in contact with groundwater with an Alconox (or similar)/clean water solution followed by a thorough rinse with distilled or deionized water. Surge block decontamination will consist of a tap water rinse to remove soil particles, followed by scrubbing with brushes and an alconox (or similar)/clean water solution and a final rinse with distilled or deionized water.

Submersible Pump: Decontaminating the pump requires running the pump in three progressively cleaner grades of water. Place the pump and the length of the power cord that was in contact with water into a bucket containing approximately four gallons of an Alconox (or similar)/clean water solution. Run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted. Next, place the pump and cord into a second bucket containing approximately four gallons of clean water and run the pump for approximately two minutes or until the volume of water in the bucket is exhausted. Lastly, place the pump and power cord into a third bucket containing approximately four gallons of distilled or deionized water and run the pump for approximately two minutes or until the volume of water in the bucket is exhausted. The soap/water solution and rinse water may be re-used. When done for the day, dry the exterior of the pump and power cord with clean paper towels to the extent practical prior to storage. All decontamination water and rinse water (including soapy solution) should be managed in accordance with Section 5.0 below.

5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, well development and decontamination water generated during development and any drilling materials will be contained and stored in a designated area until transported off-site for disposal in accordance with applicable laws.

The approach to handling and disposal of these materials is as follows. For investigation-derived waste (IDW) that is contained, such as well development water, WSDOT-approved 55-gallon drums will be supplied by the driller and used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “MW-1 Well development water”), the date(s) on which the wastes were placed in the container, the owner's name, contact information for the field person who generated the waste, and the site name.

IDW contained within drums will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used as appropriate for disposal.

Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy duty garbage bags or other appropriate containers and disposed of as trash in the municipal collection system (i.e., site dumpster).

6.0 Field Documentation

Well development procedures will be documented on the well development field form (attached) or a bound field notebook. Information recorded will at a minimum include date, personnel present (including subcontractors), purpose of field event, weather conditions, depth of water, well construction details for the well(s) being developed (i.e., diameter, total depth, screen interval), water quality field measurements (if collected), amount of purged water generated, and any deviations from the SAP.

Enclosure: Well Development Field Form

WELL DEVELOPMENT FIELD FORM

FLOYD | SNIDER

Project Name:______________________________ Date: ______________

Project Number:____________________________ Field Personnel: ______________________________

Driller (if applicable): ____________________

Purge Data

Well ID:	**Total Well Depth:**	**Well Condition/Damage Description:**
Well Casing Type/Diameter/Screened Level:	**One Casing Volume (gal):**	
Method of Development (Circle): Surge Block Pump Surge Bailer	**Equipment Used (type of pump, etc.):**	

Begin Purge (time):
End Purge (time):
Gallons Purged (time):
Purge Water Disposal Method (circle): On-site Storage Tank On-site Treatment Drum Other:

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼″	1.660″	1.380″	0.08	0.64
2″	2.375″	2.067″	0.17	1.45
3″	3.500″	3.068″	0.38	3.2
4″	4.500″	4.026″	0.66	5.51
6″	6.625″	6.065″	1.5	12.5

Time	Depth to Water (feet)	Vol. Purged (gallons)	Rate (gpm)	pH	Conductivity	Turbidity	Temp	Comments
			--	--	--	--	--	Prior to purging

Notes:

Two Union Square
601 Union Street, Suite 600
Seattle, WA 98101
tel: 206.292.2078 fax: 206.682.7867

F|S STANDARD GUIDELINE

Low-Flow Groundwater Sample Collection

DATE/LAST UPDATE: December 2022

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

This standard guideline provides details necessary for collecting representative groundwater samples from monitoring wells using low-flow methods. These guidelines are designed to meet or exceed guidelines set forth by the Washington State Department of Ecology (Ecology). Low-Flow sampling provides a method to minimize the volume of water that is purged and disposed from a monitoring well, and minimizes the impact that purging has on groundwater chemistry during sample collection.

2.0 Equipment and Supplies

Groundwater Sampling Equipment and Tools

- For wells with head less than 25 feet:
  - Peristaltic pump with fully charged internal battery or standalone battery and appropriate connectors
- For wells with head greater than 25 feet:
  - Bladder pump and controller, as well as an air cylinder, or air compressor (with extension cord if near an electrical outlet; with battery and appropriate connectors or generator if not near an outlet)

    OR

  - Low-flow submersible pump and controller (with extension cord if near an electrical outlet; with battery and appropriate connectors or generator if not near an outlet)
- Multi-parameter water quality meter
- Water level meter
- Polyethylene tubing, Teflon tubing, or similar (assume polyethylene unless otherwise specified in SAP) and tubing weights (for wells deeper than approximately 10 feet)
- Silicone tubing
- Filters (if field filtering)
- Tools for opening wells and drums (1/2-inch, 9/16-inch, 5/8 and 15/16-inch sockets ratchet, screwdriver, hammer/rubber mallet, bung wrench; any other necessary tools if non-standard monuments have been used)
- Well keys
- Tube cutters, razor blade, or scissors
- 5-gallon buckets, lids, and clamp
- Decontamination supplies: Alconox (or similar), distilled or deionized water, spray bottles, and paper towels
- Bailer or hand pump to drain well box if full of stormwater
- Trash bags

Lab Equipment

- Sample jars/bottles
- Coolers
- Chain-of-Custody Forms
- Labels
- Ice
- Ziploc bags

Paperwork

- Field notebook with site maps
- Table of well construction details and/or well logs, if available
- Sampling forms (enclosed)
- Purge water plan
- Rite-in-the-Rain pens, paper, and permanent markers

- Site-Specific Health and Safety Plan (HASP) and F|S Accident Prevention Plan (APP)
- List of emergency contacts for the Site or facility
- Safety Data Sheets (SDS) binder
- Sampling and Analysis Plan (SAP) and/or Quality Assurance Project Plan (QAPP) (including tables of analytes and bottle types)

Safety Equipment

- PPE:
  - Waterproof boots (safety toed, depending on site)
  - Safety vest
  - Safety glasses
  - Rain gear
  - Nitrile gloves
  - Work gloves
- First Aid kit
- Emergency kit (fire extinguisher, road flares)
- Traffic barricades or cones

3.0 Standard Procedures

Low-flow groundwater sampling consists of purging groundwater within the well casing at a rate equal to or less than the flow rate of representative groundwater from the surrounding aquifer into the well screen. The flow rate will depend on the hydraulic conductivity of the aquifer and the drawdown, with the goal of minimizing drawdown within the monitoring well. Field parameters are monitored during purging and groundwater samples are collected after field parameters have stabilized. Deviations from these procedures should be approved by the Project Manager and fully documented.

3.1 OFFICE PREPARATION

First, meet with the PM to identify the key objectives of the groundwater sampling effort. This may include the order of wells to be sampled (e.g., if using non-dedicated equipment, wells may need to be sampled in order of least contaminated to most contaminated), whether any wells require redevelopment at least 24-hours prior to sampling, and/or key stabilization parameters (e.g., elevated turbidity may require purging beyond 30 minutes, even if the readings are within 10%).

Conduct a kick-off meeting with the sampling team to discuss site health and safety protocols, data quality objectives, and any site-specific special considerations or sampling procedures.

3.2 TAILGATE SAFETY MEETING

Conduct a tailgate safety meeting prior to beginning work at the site. Emergency evacuation procedures, rally points, and onsite communication protocols should be discussed at the first tailgate meeting and repeated if new personnel join the field team onsite.

The safety meeting should cover the hazards specific to groundwater sampling. Typical hazards include the following:

- Chemical hazards (refer to HASP for site chemical exposure hazards)
- Site hazards
  - Traffic hazards onsite (e.g., truck traffic, heavy machinery)
  - Biological hazards (e.g., spiders or wasps within well monuments)
- Physical hazards associated with lifting and carrying heavy equipment and repeated bending while sampling
- Cuts and abrasions associated with using blades and tools
- Electrical hazards (make sure all wires/cables are in good condition and connections to battery or outlet are secure)
- Heat stress and cold stress

Record the meeting attendees and topics discussed on the front page of the tailgate safety meeting form (included as an attachment to the HASP). All attendees should sign the form.

3.3 OTHER HEALTH AND SAFETY GUIDELINES

The following are additional health and safety guidelines that should be followed in the field. These guidelines are intended to supplement the guidelines and requirements identified in the HASP and are not intended to replace the HASP.

- Review and sign the HASP prior to going into the field.
- Conduct a tailgate safety meeting prior to beginning work at the site as discussed in Section 3.2
- When moving between monitoring wells or switching to different tasks (e.g., transitioning from sampling to cooler QC prior to lab pickup), assess any additional hazards that may be associated with the new location or task. Record additional hazards noted and corrective actions to address those hazards on the Daily Tailgate Safety Meeting and Debrief Form (included as an attachment to the HASP).
- Record near misses and incidents on the Near Miss and Incident Reporting Form (included as an attachment to the HASP) and conduct management/client notifications according to the protocols detailed in the HASP.

3.4 CALIBRATION OF WATER QUALITY METERS

All multi-parameter water quality meters to be used will be calibrated prior to each sampling event. Calibration procedures are outlined in each instrument's specific user manual.

3.5 MONITORING, MAINTENANCE, AND SECURITY

Prior to sampling, depth to water and total depth measurements will be collected and recorded for accessible monitoring wells onsite (or an appropriate subset for larger sites). Check for an existing measuring point (notch or visible mark on top of casing). If a measuring point is not observed, a measuring point should be established on the north side of the casing. The conditions of the well box and bolts will also be observed, and deficiencies will be recorded on the sampling forms or logbook (i.e., missing or stripped bolt). The following should also be recorded:

- Condition of the well box, lid, bolts, locks, and gripper cap, if deficiencies
- Condition of gasket if deficient and if water is present in the well box
- Note any obstructions or kinks in the well casing
- Note any equipment in the well casing, such as transducers, bailers, or tubing
- Condition of general area surrounding the well, such as subsidence, potholes, or if the well is submerged within a puddle.

Replace any missing or stripped bolts and redevelop wells if needed.

3.6 LOW-FLOW PURGING METHOD AND SAMPLING PROCEDURES

Groundwater samples will be collected using low-flow purging and sampling procedures consistent with Ecology guidelines and the U.S. Environmental Protection Agency (USEPA) standard operating procedures (USEPA 1996). The following describes the Low-Flow purging and sampling procedures for collecting groundwater samples using a peristaltic pump. If the water level is greater than approximately 20 to 25 feet below ground surface (bgs), Grundfos or Geotech submersible pumps or bladder pumps can be used since their pumping rates can be adjusted to low-flow levels. Submersible pumps are preferable to bladder pumps in situations where less than 5 feet of water column are present in the well casing.

- Place the peristaltic pump and water quality equipment near the wellhead. Slowly lower new poly tubing down into the well casing approximately to the middle of the well screen. When sampling wells with a bottom screen depth greater than approximately 10 feet, it is important to measure the length of tubing prior to placement as longer lengths of tubing are more likely to get caught or otherwise obstructed and feel like it has reached the well bottom; this issue can be mitigated by using decontaminated stainless steel tubing weights. If the depth of the well screen is not known, lower the appropriate length of tubing to the bottom of the well, making sure that the tubing has not been caught on the slotted well casing, and then raise the tubing 3 to 5 feet off the bottom of the casing (limit this distance to 2 feet for wells with total depth less than 10 feet). Document the estimated depth of the tubing placement within the well. Connect the tubing to the peristaltic pump using new flex tubing and connect the discharge line to the flow-through cell of the water quality meter. The discharge line from the flow cell should be directed to a bucket to contain the purged water.

- If using a low-flow submersible pump, connect the pump head to dedicated or disposable tubing. If using a bladder pump, connect both the air intake and water discharge ports to decontaminated or disposable tubing, using the manufacturer's instructions to ensure a secure connection. Lower the pump with tubing into the well as described above and connect the water discharge tubing directly to the flow-through cell.
- Measure the depth to water to the nearest 0.01 foot with a decontaminated water level meter and record the information on a sampling form.
- Start pumping the well at a purge rate of 0.1 to 0.2 liters per minute and slowly increase the rate. Purge rate is adjusted using a speed control knob or arrows on peristaltic and low-flow submersible pumps. The purge rate for bladder pumps is controlled by the air compressor, which first pressurizes the pump chamber in order to compress the flexible bladder and force water through the discharge line, and then vents the chamber in order to allow the bladder to refill with water.
  - A good rule of thumb is to pressurize to 10 psi + 0.5 psi/foot of tubing depth and begin with 4 discharge/refill cycles per minute; using greater air pressure and accelerating the pump cycles will increase the purge rate.
- Check the water level. If the water level is dropping, lower the purge rate. Maintain a steady flow with no or minimal drawdown (less than 0.33 feet according to USEPA 2002). Maintaining a drawdown of less than 0.33 feet may not be feasible depending on hydrogeological conditions. If possible, measure the discharge rate of the pump with a graduated cylinder or use a stopwatch when filling sampling jars (500 milliliters [mL] polyethylene or glass ambers) to estimate the rate. When purging water through a flow cell, the maximum flow rate for accurate water quality readings is about 0.5 liters per minute (L/minute).
- The discharge tubing should be connected to the flow cell immediately upon initial water discharge, unless the discharge water is visibly turbid or flocculant is observed. Monitor and record water quality parameters every three to five minutes after one tubing volume (including the volume of water in the flow cell) has been purged.
  - One foot of ¼-inch interior diameter tubing holds about 10 mL of water, and flow-through cells typically hold less than 200 mL of water; one volume should be purged after about 5 minutes at a flow rate of 0.1 L/minute.
- Water-quality indicator parameters that will be monitored and recorded during purging include:
  - pH
  - Specific conductivity

  - Dissolved oxygen
  - Temperature
  - Turbidity
  - Oxidation reduction potential (ORP)

- Continue purging until temperature, pH, turbidity, and specific conductivity are approximately stable (when measurements are within 10 percent) for three consecutive readings, or 30 minutes have elapsed. Because these field parameters (especially dissolved oxygen and ORP) may not reach the stabilization criteria, collection of the groundwater sample will be based on the professional judgment of field personnel at the time of sampling. A minimum of 5 water quality readings should be collected prior to sampling.
- The water sample can be collected once the criteria above have been met.
- If drawdown in the well cannot be maintained at 0.33 feet or less, reduce the flow or turn off the pump for 15 minutes and allow for recovery. If the water quality parameters have stabilized, and if at least two tubing volumes and the flow cell volume have been purged, then sample collection can proceed when the water level has recovered, and the pump is turned back on. This should be noted on the sampling form.
- To collect the water sample, maintain the same pumping rate. After the well has been purged and the sample bottles have been labeled, the groundwater sample will be collected by directly filling the laboratory-provided bottles from the pump discharge line prior to passing through the flow cell. All sample containers should be filled with minimum disturbance by allowing the water to flow down the inside of the bottle or vial. When collecting a volatile organic compound (VOC) sample, fill to the top to form a meniscus over the mouth of the vial prior to placing the cap to eliminate air bubbles. Be careful not to overflow preserved bottles/pre-cleaned Volatile Organic Analyte (VOA) vials.
- If sampling for filtered metals, collect these samples last and fit an in-line filter at the end of the discharge line. Take note of the flow direction arrow on the filter prior to fitting, invert filter to eliminate air bubbles, and allow minimum of 0.5 to 1 liter of groundwater to pass through the filter prior to collecting the sample.
- Sample labels will clearly identify the project name, sampler's initials, sample location and unique sample ID, analysis to be performed, date, and time. After collection, place samples a cooler maintained at a temperature of approximately 4 to 6 degrees Celsius (°C) using ice (if required). Complete the chain-of-Custody forms. Upon transfer of the samples to the laboratory, the Chain-of-Custody Form will be signed by the persons transferring custody of the sample containers to document change in possession.
- When sample collection is complete at a designated location, remove and properly dispose of the non-dedicated tubing. In most cases, this waste is considered solid waste and can be disposed of as refuse. Close and lock the well.

4.0 Decontamination

All reusable equipment that comes into contact with groundwater should be decontaminated using the processes described in this section prior to moving to the next sampling location.

Water Level Meter: The water level indicator and tape will be decontaminated between sampling locations and at the end the day by spraying the entire length of tape that came in contact with groundwater with an Alconox (or similar)/clean water solution followed by a thorough rinse with distilled or deionized water.

Water Quality Sensors and Flow-Through Cell: Distilled water or deionized water will be used to rinse the water quality sensors and flow-through cell. No other decontamination procedures are recommended since they are sensitive equipment. After the sampling event, the water quality meters will be cleaned and maintained according to the specific manual.

Submersible Pump (if applicable): Decontaminating the pump requires running the pump in three progressively cleaner grades of water.

1. Fill a bucket with approximately 4 gallons of an Alconox (or similar)/clean water solution to sufficiently cover the pump. Place the pump and the length of the power cord (if applicable) that was in contact with water into the bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.
2. Fill a second bucket containing approximately 4 gallons of clean water to sufficiently cover the pump. Place the pump and cord into this bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.
3. Fill a third bucket with approximately 4 gallons of distilled or deionized water to sufficiently cover the pump. Place the pump and cord into this bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.

The soap/water solution may be reused; however, rinse water should be collected for disposal as described in Section 5.0 below. When done for the day, dry the exterior of the pump and cord with clean towels to the extent practical prior to storage.

Bladder Pump: Clean the inside and outside of the pump body with an Alconox (or similar)/clean water solution, followed by a thorough rinse with distilled or deionized water. The outside of the air supply line that came in contact with groundwater may also be cleaned with Alconox (or similar) solution and re-used; bladders and water discharge lines must be replaced after each sample is collected.

5.0 Investigation-Derived Waste (IDW)

Unless otherwise specified in the project work plan, water generated during groundwater sampling activities will be contained, transported, disposed of in accordance with applicable laws, and stored in a designated area until transported off-site for disposal. This includes purge water and decontamination waste water.

The approach to handling and disposal of these materials for a typical cleanup site is as follows.

For IDW that is containerized, such as purge water, 55-gallon drums (or other smaller sized drums) approved by the Washington State Department of Transportation will be used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “purge water”), the dates on which the wastes were placed in the container, the owner’s name and contact information for the field person who generated the waste, and the site name.

IDW containerized within drums will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used, as appropriate for disposal. Refer to the FS Special Condition Standard Guideline for Investigation Derived Waste for additional information regarding proper profiling and disposal of wastewater generated by groundwater sampling.

Disposable sampling materials and incidental trash such as tubing, paper towels and gloves/other disposable used in sample processing will be placed in heavy-duty garbage bags or other appropriate containers and disposed of as trash in the municipal collection system unless otherwise specified in the SAP.

6.0 Field Documentation

Groundwater sampling activities will be documented in field sampling forms and/or field notebooks, and Chain-of-Custody Forms. Information recorded will, at a minimum, include personnel present (including subcontractors or client representatives), purpose of field event, weather conditions, sample collection date and times, sample analytes, depths to water, water quality parameters, well box/lid conditions, amount of purged water generated, and any deviations from the SAP. Photographs of damaged well casings or well boxes should be taken.

At the end of the day, complete and review the second page of the tailgate safety meeting form detailing additional hazards, corrective actions, near-misses or incidents. Any incidents that result in equipment damage or field staff injuries should be reported immediately to the PM.

7.0 Demobilization

Upon returning to the office, ensure that all equipment is property cleaned and put away in the field room. Equipment with rechargeable batteries should be plugged in as appropriate. It is preferable to dispose of trash on-site, but any trash left in the field vehicle should be disposed as regular trash at Two Union Square.

If rented equipment or sample coolers will be placed at the front desk for pickup, clearly label each item with the company picking it up, anticipated pickup time frame, and your contact information so front desk staff can contact you if there are any questions. Notify front desk staff if any items require a signature at pickup.

Within one week of returning from the field, the field lead for the event should review field notes, sampling forms and tailgate safety meeting forms with the PM. Following PM review and approval, field notes will be scanned and saved to the project folder. Hard copies should be filed. The PM will provide copies of near miss and incident reports to the Safety Program Manager.

8.0 References

U.S. Environmental Protection Agency (USEPA). 1996. Low-Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, Revision 2. Region 1. July 30, 1996.

_____. 2002. Groundwater Sampling Guidelines for Superfund and CAR Project Managers. Office of Solid Waste and Emergency Response. EPA 542.S-02-001. May 2002.

Enclosures: Groundwater or Surface Water Sample Collection Form

Record of Revisions:

Revisions	**Date**
Added health and safety information, reviewed EPA guidance, and added revisions table.	12/9/2022

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project:________________________________ Date of Collection: ________________________________

Task:________________________________ Field Personnel: ________________________________

Purge Data

Well ID: ____________ Secure: ☐ Yes ☐ No Ecology Tag #: ____________ Casing Type/Diameter/Screened Interval ________________________

Replacement Required: ☐ Monument ☐ Lid ☐ Lock ☐ Bolts: Missing (#) _____ Stripped (#) _____ Other Damage: ____________________________

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No One Casing Volume (gal): ____

Depth of water (from TOC):__________________Time: ______________

Total Depth (from log or field measurement): ______________________

After 5 minutes of purging (from top of casing): ______________________

Begin purge (time): ______________End purge (time): ______________

Volume purged:___________ Purge water disposal method_____________

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water (ft)	Vol. Purged (_____)	pH (s.u.)	DO (mg/L)	Specific Conductivity (µs/cm)	Turbidity (NTU)	Temp (°C)	ORP (mV)	Comments

Sampling Data

Sample No: ____ Location and Depth: ____

Date Collected (mo/dy/yr):____________________ Time Collected: ____________ Weather:________________________________

Type: ☐ Ground Water ☐ Surface Water Other: ________________________ Sample: ☐ Filtered ☐ Unfiltered Filter Type: ______________________

Sample Collected with: ☐ Bailer ☐ Pump Other: ____________ Type: ☐ Peristaltic ☐ Bladder ☐ Submersible Other: ____________________

Water Quality Instrument Data Collected with: Type: ☐ YSI ProDSS ☐ Tudbidity Meter ☐ Other: ____

Sample Decon Procedure: Sample collected with: ☐ decontaminated <u>all</u> tubing; ☐ disposable tubing ☐ dedicated silicon and poly tubing; ☐ dedicated tubing replaced

Sample Description (Color, Turbidity, Odor, Other): ____

Sample Analyses

Analyte	Analysis Method	Sample Container	Quantity	Preservative	Notes

QC samples

Duplicate Sample No: __________________________ Duplicate Time: _________ MS/MSD: ☐ Yes ☐ No

Signature: ____ **Date:** ____________________________

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F|S STANDARD GUIDELINE: *Special Condition*

Tidally Influenced Sites

DATE/LAST UPDATE: November 2018

Standard Guideline(s) this Special Condition may be appended to include:

1. Soil Logging
2. Well Construction
3. Low-Flow Groundwater Sample Collection
4. Groundwater Sample Collection with a Submersible Pump
5. Groundwater Sample Collection with a Direct-Push Drill Rig

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines and special conditions for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines and special conditions with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines and special conditions.

1.0 Special Condition Applicability

This Special Condition applies to sites that are immediately adjacent to or within close proximity to tidally influenced waterways.

It presents protocols for field measurements and field equipment that should be used to obtain representative data at tidally influenced sites. Field measurements to determine salinity and tidal influence are also important for determining groundwater potability. Additional considerations for laboratory analysis of samples collected at tidally influenced sites should be addressed in a site-specific sampling and analysis plan/quality assurance project plan (SAP/QAPP) that is tailored to the particular data needs for the site.

2.0 Equipment and Supplies

In addition to the equipment outlined in the applicable Standard Guidelines, the following equipment is necessary:

- Equipment to measure salinity, total dissolved solids (TDS), or conductivity, which include any of the following:
  - Refractometer (measures salinity directly).
  - Handheld water quality meter or multiparameter water quality meter capable of measuring salinity or TDS and manufacturer-provided calibration solution (measures salinity or TDS directly).
  - Handheld water quality meter or multiparameter water quality meter capable of temperature-corrected conductivity (used to calculate salinity) and manufacturer-provided calibration solution. If the meter does not display temperature-corrected conductivity, a means of measuring temperature (multi-meter that displays temperature or thermometer) is also necessary.
- Tide prediction chart(s) for the nearest observation station to the site

3.0 Special Condition Guidelines and/or Procedures

At all tidally influenced sites, the field staff should familiarize themselves with the daily predicted tide elevations for the closest tide station in order to complete or phase shoreline site work according to tidal conditions specified in the SAP/QAPP (i.e., at high tide or low tide). If there is a known lag time between low tide and the lowest tidally influenced effects at the shoreline at a Site, this tide lag should additionally be accounted for when scheduling shoreline work. In general, it is preferable to collect soil and groundwater samples nearest to the shoreline at low tide or in the 1–3 hours immediately after low tide to minimize the effects of tidal influence such as matrix interference that causes false positive detections for metals. Specific considerations for soil logging, well construction, and groundwater sampling when adjacent to a tidally influenced waterway are presented in the following sections.

3.1 SOIL LOGGING

When logging soil at sites with potential tidal influence, perform field screening to measure salinity and determine the tidally influenced smear zone using the procedures in the following sections.

3.1.1 Determination of Salinity

When groundwater is encountered during drilling or test pit excavations, collect groundwater samples for field screening of salinity, TDS, or conductivity using the equipment listed above and consistent with the site-specific SAP. Groundwater samples for field screening can be collected using one of the following methods.

1. Collect a groundwater sample from the drill casing or a retractable screen or directly from a test pit using a peristaltic pump or disposable bailer. This method is preferred because the water sample can be used directly for measurement without further processing.
2. Collect a sample of saturated soil from the recovered soil core or test pit. Place the sample in a volumetric flask and record the soil volume. Dilute with *distilled* water to create a sufficient volume for measurement; if possible, try to add less than twice the soil volume to avoid overly diluting the sample. Record the solution volume and use the ratio of soil sample volume to solution volume to apply a dilution factor to the measured TDS, salinity, or conductivity. This method is less preferable because it requires additional mathematical steps to calculate the in-situ values. Refer to Equations for Salinity Calculation (enclosed) for equations to calculate in situ values from diluted samples.

Field procedures for measurement of salinity, TDS, or conductivity using the equipment listed above are as follows:

1. Measure salinity with a refractometer: Lift the protective cover of the angled lens and place a few drops of water onto the lens. Close the lid and peer through the eyepiece. Record the salinity result that appears along a scale within the eyepiece. Rinse the lens with distilled water and pat dry with a clean cloth between readings.
2. Measure salinity or TDS with a water quality meter: Place the water sample in a jar large enough to hold the meter. Submerge the sensors and allow salinity or TDS to stabilize (generally 30 seconds or less), then record the salinity or TDS reading. Rinse the sensors with distilled water between readings.
3. Measure conductivity: Place water sample in a jar large enough to hold the conductivity meter and other measuring devices, if using. Allow conductivity to stabilize (generally 30 seconds or less), then record temperature-corrected conductivity or conductivity and temperature. Calculate salinity using the equations provided in Equations for Salinity Calculation (enclosed). Rinse the meter between readings.

If collecting field screening samples in soil or groundwater, take the same measurements from the adjacent waterway for direct comparison. The general classifications of water based on salinity or TDS, assuming salinity and TDS are primarily influenced by tidal fluctuation and are therefore roughly equivalent, are as follows:

- Fresh: <1,000 milligrams per liter (mg/L), or <1 part per thousand (ppt)
- Brackish: 1,000 to 10,000 mg/L, or 1 to 10 ppt
- Saline: >10,000 mg/L, or >10 ppt

Tidal influence is assumed when groundwater has a salinity or TDS measurement greater than freshwater (i.e., > 1 ppt). If the adjacent water body is brackish (i.e., tidally influenced river), the salinity or TDS effect from tidal influence may be more subtle and can be evaluated by comparing these values in shoreline locations relative to locations farther upland.

If apparent tidal influence based on field measurements is encountered at locations where it is not expected (i.e., farther upland), field staff should consult the SAP/QAPP and contact the project manager. Additional soil or groundwater samples may be necessary for laboratory analysis to determine the potential for matrix interference due to salinity.

3.1.2 Determination of Tidally Influenced Smear Zone

When sampling at tidally influenced sites with the potential for light non-aqueous phase liquid (LNAPL) contamination such as petroleum, field staff should also be familiar with the average tidal fluctuations, which can cause the smear zone to be thicker closer to the shoreline. Record the estimated top and bottom depths of the smear zone based on field indications of contamination.

3.2 WELL CONSTRUCTION AND GROUNDWATER SAMPLE COLLECTION

Well locations with potential elevated groundwater salinity due to tidal influence should be identified during soil logging as described above. Permanent wells in locations with the potential for tidal influence should be installed with non-corrosive materials such as PVC.

When collecting groundwater samples within the area of potential tidal influence, record the predicted tide elevation, as well as the time, depth to water, conductivity, pH, temperature, and salinity/TDS (if reported by the water quality meter) during purging. Additional parameters to evaluate salinity (such as analytical data) may be specified in the site-specific SAP. Groundwater samples should be collected at the tide-stage specified in the site-specific SAP, typically at low tide to minimize salinity interference and accounting for tide lag if this information is known.

4.0 Field Documentation

Record field observations and measurements of tidal influence as described in the above sections on the appropriate field log forms or in the project field book.

Enclosure: Equations for Salinity Calculation

Equations for Salinity Calculation

Equation 1: Calculate in situ salinity, total dissolved solids (TDS), or conductivity from a diluted sample (use when taking measurements of a soil sample that has been diluted in distilled water for field screening).

$$C_1 = C_2 * (V_2/V_1)$$

where:
C_1 = in situ salinity, TDS, or conductivity
C_2 = diluted screening sample salinity, TDS, or conductivity
V_1 = volume of soil sample
V_2 = volume of soil sample plus distilled water added to dilution

Equation 2: Calculate temperature-corrected conductivity (use to correct conductivity measurements to a reference temperature of 25 °C when using a conductivity meter that is not temperature-corrected; rule of thumb using a temperature variation coefficient of 2%).

$$C_{25} = C / (1+ 0.02 * (T-25))$$

where:
C_{25} = corrected conductivity at reference temperature of 25 °C
C = conductivity of sample
T = temperature of sample

Equation 3: Calculate salinity from conductivity at reference temperature of 25 °C (rule of thumb for average seawater).

$$S = C^{1.0878} * 0.4665$$

where:
S = salinity (in parts per thousand)
C = conductivity at 25 °C (in microsiemens per centimeter)

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F|S STANDARD GUIDELINE: *Special Condition*

Investigation-Derived Waste

DATE/LAST UPDATE: October 2, 2020

Standard Guideline(s) to which this Special Condition is appended:

1. Groundwater Sample Collection with a Submersible Pump
2. Groundwater Sample Collection with a Direct-Push (i.e., Geoprobe) Drill Rig
3. Low-Flow Groundwater Sample Collection
4. Sediment Coring
5. Sediment Grab Sample Collection
6. Shallow Soil Sample Collection
7. Soil Sample Collection
8. Well Development

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines and special procedures for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines and special conditions with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines and special conditions.

1.0 Special Condition Applicability

This special condition applies to any sampling method that may produce investigation-derived waste (IDW) solids or liquids that will be containerized for characterization and offsite disposal. These wastes may include excess sample material; drill cuttings; or well development, purge, or equipment decontamination water. Field staff should always consult their work plan to determine whether IDW must be containerized; some sampling methods such as sediment grab sampling and shallow soil sampling may allow for returning excess sample material to the sample station. Additionally, some facilities may have existing permits or regulatory agreements governing waste disposal that should be followed in addition to this special condition. It is also important to note that additional precautions must be taken when handling pure non-aqueous phase liquid (NAPL) product as detailed in the special condition for light non-aqueous phase liquid in groundwater.

2.0 Equipment and Supplies

Management of IDW may require the equipment outlined in the standard guidelines to which this special condition is attached, and also may require the following items:

- U.S. Department of Transportation (USDOT)-approved drums
- Adhesive labels identifying nonhazardous waste, waste pending characterization, and/or hazardous waste as appropriate for the site and waste stream (refer to Section 3.4 for details regarding preliminary waste designation)
- Broad-tip indelible marker
- Grease pen or paint marker
- Photoionization detector (PID)
- 1-gallon ziplock bags or large jars
- Bung wrench and socket or speed wrench with 15/16-inch socket
- Screw auger or push tube (for solids)
- Composite Liquid Waste Sampler (COLIWASA), drum thief or bailer (for liquids)
- Stainless steel spoon and bowl
- Sufficient laboratory-provided jars or bottles for required analyses
- Cooler with ice
- Site-specific Health and Safety Plan (HASP)

3.0 Special Condition Guidelines and/or Procedures

This section details protocols for IDW storage, waste sampling methods, sample frequency and waste characterization.

3.1 IDW STORAGE

Before arriving at the field site, ensure that there will be adequate drums on site for the scope of work. For drilling projects, drums are typically supplied by the drilling company, but for well development or groundwater sampling, field staff may need to purchase a drum from a local vendor (these companies are usually referred to as barrel companies). Reconditioned drums are acceptable if they are inspected and found to be in good condition (free of large dents, rust, debris, and residues). For drums that will be used to store liquids, a lid with a bung (i.e., a small opening with a threaded cap) is recommended. When planning for drummed storage of IDW, the following quantities of material represent an approximate volume of 55 gallons, or one standard-sized drum:

- 20 feet of soil boring or sediment coring by hollow-stem auger or rotosonic methods (generally 6 to 8 inches in diameter); larger diameter borings will require additional drum volume
- 100 to 200 feet of direct push soil samples
- Development water from a 2-inch well with a screened interval of 5 to 10 feet (some sites may require additional volume for well development if fines in the formation necessitate additional pumping)
- Development water from four to five prepacked wells with ¾-inch or 1-inch casing
- Decontamination water from steam cleaning rods/casing for 1 day of drilling
- Purge water from 10 to 20 wells sampled using low-flow sampling methodology

First determine the location of the temporary drum staging area at the site. This area should be secured from the public when possible and out of the way of any active site operations or traffic. When staging IDW at an active facility, always coordinate the location of the drum staging with your facility manager or contact. The drum staging area should ideally be accessible by truck, or easily accessible via a level and solid surface for moving drums with a drum dolly or other equipment (i.e., forklift) to a truck for offsite transport.

During field activities, label each drum with its contents as it is filled. Use a grease or paint pen to write on sides and lid of the drum. Include contact info (Floyd|Snider main phone line) on at least one drum. Affix appropriate labels with generator information and Floyd|Snider contact information; note, however, that these labels fade quickly outdoors so should always be backed up with grease/paint pen. If there are existing site data, the drums may be labeled as hazardous or nonhazardous as appropriate (refer to Section 3.4 for waste categorization). When in doubt, label the drums as IDW pending characterization.

Before leaving the site each day, make sure the drum lids are closed securely and that the storage area is secured, if applicable.

3.2 IDW SAMPLE COLLECTION

IDW samples of the same medium and from the same investigation at a site can generally be composited for characterization. A frequency of one sample per three 55-gallon drums is typically required for waste disposal characterization, but always check with your preferred disposal vendor to verify the number of samples needed. If sampling drums with unknown contents, compositing may be guided by field observations or screening, and the presence of irregular material or NAPL may necessitate individual drum samples for proper characterization.

The most efficient way to characterize IDW solids (i.e., soil or sediment) is to collect samples during your field event. Collect representative material from each location and place immediately into a large ziplock bag or unpreserved jar stored on ice in your sample cooler. Alternately, if the scope of field sampling includes all required IDW analyses, discrete field samples collected for the investigation may also be used for IDW characterization. Liquid samples may be collected at the end of the field event by sampling directly from the drums, or in the case of purged groundwater, representative samples collected during groundwater sampling may be sufficient for characterization.

In some instances, field staff may need to characterize drums that were not generated by Floyd|Snider but were left on a site. If existing drums will be sampled, it is important to determine their likely contents. This information may be obtained by reviewing labels or markings on the drum(s) if legible, reviewing prior site reports that describe field sampling and IDW management, communicating with facility operators or generators, or communicating with prior consultants who performed work at the site. If a remediation system is or was in place (such as NAPL recovery), it is especially important to verify whether drums left on site contain environmental media (i.e., soil, sediment, or groundwater) or remediation system waste that may have specific handling and disposal requirements.

The procedure for drum sampling varies slightly depending on whether the contents are known or unknown. For drums with known contents:

- Assess the condition of the drums. Look for indications of pressurization (bulging), crystals around opening, rust, and holes/weeping/leaking. Do not open drums exhibiting pressurization or crystal formation; these drums should be handled by a professional hazardous waste contractor. Ground any drums not in contact with the earth using grounding wires, alligator clips, and a grounding rod or metal structure.
- Record the contents of the drums. Group drums of like material for compositing and record composite groups in the field notebook.
- For solids: Open the lid. If volatile contaminants are known or suspected at the site, measure the headspace volatile organic compound (VOC) concentration above the drum with a PID to determine whether it is safe to proceed with sampling in accordance with the air monitoring action levels provided in the site-specific HASP. Use a screw auger or push tube to collect a core sample. Discharge the sample to a decontaminated stainless steel bowl. Repeat as needed to generate the representative sample amount of the composite needed for analysis. Once all representative samples of the composite have been collected, fill volatile organic analysis (VOA) vials (refer to Soil Sample Collection standard guideline) prior to homogenizing.

- For water: Open the bung (if present) or lid. If volatile contaminants are known or suspected at the site, measure the headspace VOC concentration above the drum with a PID to determine whether it is safe to proceed with sampling in accordance with the air monitoring action levels provided in the site-specific HASP. Collect a sample with a COLIWASA, drum thief, or bailer by lowering the sampler to bottom of the drum and closing the inner tube of the COLIWASA, plugging the upper end of the drum thief with a gloved fingertip, or pulling up on the bailer to engage the ball plug. Fill each container with a representative amount of the needed composite volume, collecting additional volume from each drum as needed to fill the sample containers.
- For all media: Record field observations such as overlying water (in drums containing solids) sheen, odor, and the presence of NAPL in the field notebook. If overlying water is present in solids drums, estimate the percentage of the drum volume occupied by water. If NAPL is encountered in water drums, estimate the percentage of drum volume that is occupied by NAPL. Contact the intended disposal company to determine whether additional NAPL samples are needed for characterization and report field observations to the disposal company to ensure an accurate disposal profile.

For drums with unknown contents:

- Assess the condition of the drums. Look for indications of pressurization (bulging), crystals around opening, rust, and holes/weeping/leaking. Do not open drums suspected to contain hazardous materials or drums exhibiting pressurization or crystal formation; these drums should be handled by a professional hazardous waste contractor. Ground any drums not in contact with the earth using grounding wires, alligator clips, and a grounding rod or metal structure.
- Record the contents of the drums. Check for a label indicating drum contents. Designate drums with media type and number if the label listing the contents is missing or illegible (i.e., “Solids-01”). The contents (solid or liquid) of an IDW drum with a missing or illegible label can be determined by knocking on the outside of the drum with a steel-toe boot or rubber mallet and listening for reverberation indicating that the drum is filled with liquid. The drum type may also indicate the contents; drums containing water are often fitted with a lid that has a bung, whereas drums containing solids are often fitted with a lid that does not have a bung. Group drums of like material for compositing and record composite groups in the field notebook.
- For solids: Open the lid. If volatile contaminants are known or suspected at the site, measure the headspace VOC concentration above the drum with a PID to determine whether it is safe to proceed with sampling in accordance with the air monitoring action levels provided in the site-specific HASP. Use a screw auger or push tube to collect a core sample. Discharge the sample to a decontaminated stainless steel bowl. Repeat as needed to generate the representative sample amount of the composite needed for analysis. Once all representative samples of the composite have been

collected, fill VOA vials (refer to Soil Sample Collection standard guideline) prior to homogenizing.

- For water: Open the bung (if present) or lid. If volatile contaminants are known or suspected at the site, measure the headspace VOC concentration above the drum with a PID to determine whether it is safe to proceed with sampling in accordance with the air monitoring action levels provided in the site-specific HASP. Collect a sample with a COLIWASA, drum thief, or bailer by lowering the sampler to bottom of the drum and closing the inner tube of the COLIWASA, plugging the upper end of the drum thief with a gloved fingertip, or pulling up on the bailer to engage the ball plug. Fill each container with a representative amount of the needed composite volume, collecting additional volume from each drum as needed to fill the sample containers.
- For all media: Record field observations such as overlying water (in drums containing solids) sheen, odor, and the presence of NAPL in the field notebook. If overlying water is present in solids drums, estimate the percentage of the drum volume occupied by water. If NAPL is encountered in water drums, estimate the percentage of drum volume that is occupied by NAPL. Contact the intended disposal company to determine whether additional NAPL samples are needed for characterization and report field observations to the disposal company to ensure an accurate disposal profile.

3.3 LABORATORY ANALYSIS

IDW samples should be analyzed for the Resource Conservation and Recovery Act (RCRA) list of contaminants that define hazardous waste on the basis of toxicity, other wastes with disposal restricted by federal statutes, and contaminants that are defined as Washington State dangerous wastes. These contaminants may include the following:

- Metals: arsenic, cadmium, chromium, lead, mercury, selenium, and silver
- VOCs: benzene, carbon tetrachloride, chlorobenzene, chloroform, 1,4-dichlorobenzene, 1,2-dichloroethane, 1,1-dichloroethene, methyl ethyl ketone, tetrachloroethene, trichloroethene, vinyl chloride, and other halogenated VOCs
- Semivolatile organic compounds (SVOCs): cresol (m-, o-, and p- isomers), 2,4-dinitrotoluene, hexachlorobenzene, hexachlorobutadiene, hexachloroethane, nitrobenzene, pentachlorophenol, pyridine, 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, 2,4,5-TP (Silvex), and polycyclic aromatic hydrocarbons (PAHs)
- Pesticides: chlordane, 2,4-D, endrin, heptachlor (and epoxide), lindane, methoxychlor, and toxaphene
- Polychlorinated biphenyls (PCBs)

If a contaminant was known to never have been used on a site, or existing analytical data from likely contaminated areas of a site demonstrate that a contaminant is not present, this generator knowledge may be used to eliminate some analyses. However, at a minimum, waste characterization generally requires analysis for metals, VOCs, SVOCs, and PCBs, which are common industrial contaminants. Specific analytical requirements should be provided by the disposal vendor to ensure that adequate characterization is performed.

3.4 WASTE CATEGORIZATION

Wastes generated by environmental investigations are often suitable for disposal as unregulated materials at a Subtitle D landfill. However, there are some instances where wastes are regulated under RCRA, the Toxic Substances Control Act (TSCA), or Washington States dangerous waste regulations and may require specialized disposal at a Subtitle C/hazardous waste landfill. Situations where wastes may require specialized handling and disposal are described in the following sections.

It is important to note that the information in this section should be used as a guideline for waste characterization only. Staff should always verify the proper waste designation with the waste disposal company in accordance with the appropriate rules and regulations, noting that there are some exemptions to certain rules.

3.4.1 Resource Conservation and Recovery Act

Wastes are categorized by RCRA according to the processes by which they are generated and their characteristics including ignitability, corrosivity, reactivity, and toxicity. Toxicity is the most common characteristic that may cause IDW to be regulated under RCRA; however, other wastes (for example, water with very high or low pH) may also require specialized handling and disposal. Wastes that may require specialized handling and disposal on the basis of toxicity are discussed in further detail below.

Toxicity is determined by contaminant concentrations in liquid or leachate. For solids, a rule of thumb can be applied to predict a solid concentration that will produce a leachate concentration equivalent to the RCRA Regulatory Level. The rule of thumb conservatively assumes that the leachate concentration in milligrams per liter (mg/L) will be one-twentieth of the solid concentration in milligrams per kilogram (mg/kg).

Contaminant	RCRA Regulatory Level (mg/L)
Arsenic	5.0
Barium	100
Benzene	0.5
Cadmium	1.0
Carbon tetrachloride	0.5
Chlordane	0.03
Chlorobenzene	100

Contaminant	**RCRA Regulatory Level (mg/L)**
Chloroform	6.0
Chromium	5.0
o-Cresol	200
m-Cresol	200
p-Cresol	200
2,4-D	10
1,4-Dichlorobenzene	7.5
1,2-Dichloroethane	0.5
1,1-Dichloroethylene	0.7
2,4-Dinitrotoluene	0.13
Endrin	0.02
Heptachlor (and its epoxide)	0.008
Hexachlorobenzene	0.13
Hexachlorobutadiene	0.5
Hexachloroethane	3.0
Lead	5.0
Lindane	0.4
Mercury	0.2
Methoxychlor	10
Methyl ethyl ketone	200
Nitrobenzene	2.0
Pentachlorophenol	100
Pyridine	5.0
Selenium	1.0
Silver	5.0
Tetrachloroethene	0.7
Toxaphene	0.5
Trichloroethene	0.5
2,4,5-Trichlorophenol	400
2,4,6-Trichlorophenol	2.0
2,4,5-TP (Silvex)	1.0
Vinyl chloride	0.2

If a contaminant concentration is greater than 20 times the RCRA Regulatory Level, follow-up analysis using the Toxicity Characteristic Leaching Procedure (TCLP) to determine the leachability of the contaminant should be completed. TCLP results may demonstrate that the contaminant does not produce leachate concentrations exceeding its RCRA Regulatory Level. Waste requires specialized handling and disposal under RCRA if the liquid or leachate concentration of any contaminant exceeds its RCRA Regulatory Level.

3.4.2 Toxic Substances Control Act

TSCA regulates wastes containing PCBs. Wastes require specialized handling and disposal if they contain total PCBs greater than 5 mg/L in liquids or 50 mg/kg in solids.

3.4.3 Washington State Dangerous Waste

Wastes may also be categorized as Washington State dangerous waste or extremely hazardous waste requiring specialized handling and disposal on the basis of total halogenated VOC or PAH concentrations. Washington State categorization includes the following:

- Dangerous waste: total halogenated VOCs 0.01% to 1.0%
- Extremely hazardous waste: total halogenated VOCs or PAHs greater than 1.0%

3.5 DISPOSAL PROFILE PREPARATION

A disposal profile is typically created by the selected waste disposal company using laboratory analytical data and drum inventories supplied by Floyd|Snider. In some instances, additional information regarding site history may be needed to complete portions of a disposal profile based on generator knowledge.

Sites and vendors may vary; however, the property owner or operator is usually listed as the generator of a waste. Floyd|Snider personnel may sign a disposal profile, when allowed and approved by the property owner or operator, as the authorized representative of the generator.

4.0 Field Documentation

The number of drums filled during the field investigation, contents of each drum, and location of the drum staging area should be documented in the field notebook. IDW sample logs should also be recorded in the field notebook and include the date and time, sample collection method, and drums represented by each composite sample as well as any field observations.

Disposal records are mailed by the disposal company. These records should be retained in the project files and provided to the property owner/generator.

Whitehead Tyee Site

Remedial Investigation Work Plan

Appendix C
Sampling and Analysis Plan/
Quality Assurance Project Plan

Attachment C.2
Final—Archeological Inadvertent Discovery Plan for the Whitehead-Tyee Site Project

Final—Archaeological Inadvertent Discovery Plan for the Whitehead-Tyee Site Project, City of Seattle, King County, Washington

June 14, 2017

1. Introduction

Floyd|Snider (F|S), on behalf of Seattle Iron & Metals (SIM), contracted Historical Research Associates, Inc. (HRA),to provide cultural resources services for the Whitehead Tyee Project Site (Project Site). The Project Site is at 730 South (S) Myrtle Street (St.) in the Georgetown neighborhood of Seattle, King County, Washington. It is located in Township 24 North, Range 4 East, Section 29, Seattle South United States Geological Survey (USGS) Quadrangle Willamette Meridian (Figures 1-1 and 1-2).

The Whitehead Tyee Project is part of Ecology's Lower Duwamish Waterway (LDW) source-control effort (Ecology 2017; Floyd|Snider 2017). The LDW was added to the Superfund National Priorities List by the U.S. Environmental Protection Agency (EPA) in 2001, and Ecology added it to the Washington Hazardous Sites List in 2002. The entire segment of the LDW in the area of impacts (AI) vicinity is designated as a Superfund Site by the EPA due to sediment contamination (Floyd|Snider 2017). EPA is leading the effort to clean up river soils, while Ecology is tasked with controlling pollution sources from the surrounding land to minimize recontamination of the river. Several early sediment-cleanup projects have been completed, and many source-control actions are underway (Ecology 2017; Floyd|Snider 2017).

An extensive desktop analysis was prepared for the Project entitled *Cultural Resource Records Search and Literature Review for the Whitehead Tyee Site Project, City of Seattle, King County, Washington* (Dellert 2017). This Inadvertent Discovery Plan (IDP) is included as an appendix to that document and also serves as a stand-alone construction document. Details on the cultural and environmental background of the Project and surrounding vicinity are included within the desktop-analysis document but are also summarized herein to aid understanding of the cultural context of the project area for Project Site personnel who will use this IDP.

The following IDP outlines procedures to follow, in accordance with state and federal laws, if archaeological materials or human remains are discovered during any ground-disturbing activity. All Project Site personnel shall receive a copy of the IDP.

The Project Site was identified as having soil contamination and falls under the Model Toxics Control Act (MTCA) as a "site." The Department of Ecology (Ecology) issued Agreed Order (AO) No. DE 13458 to SIM, which stipulated that an Interim Action Work Plan (IAWP) was necessary to remediate known subsurface contamination in areas where construction of a stormwater conveyance system could preclude future access to these contaminated soils. This stormwater conveyance and treatment system is being installed pursuant to Administrative Order No. 13739 issued by Ecology's Water Quality Program. F|S has tasked HRA with preparing an extensive desktop analysis and IDP ahead of the Project Site remediation and construction work. Interim action (IA) construction activities will include the excavation of approximately

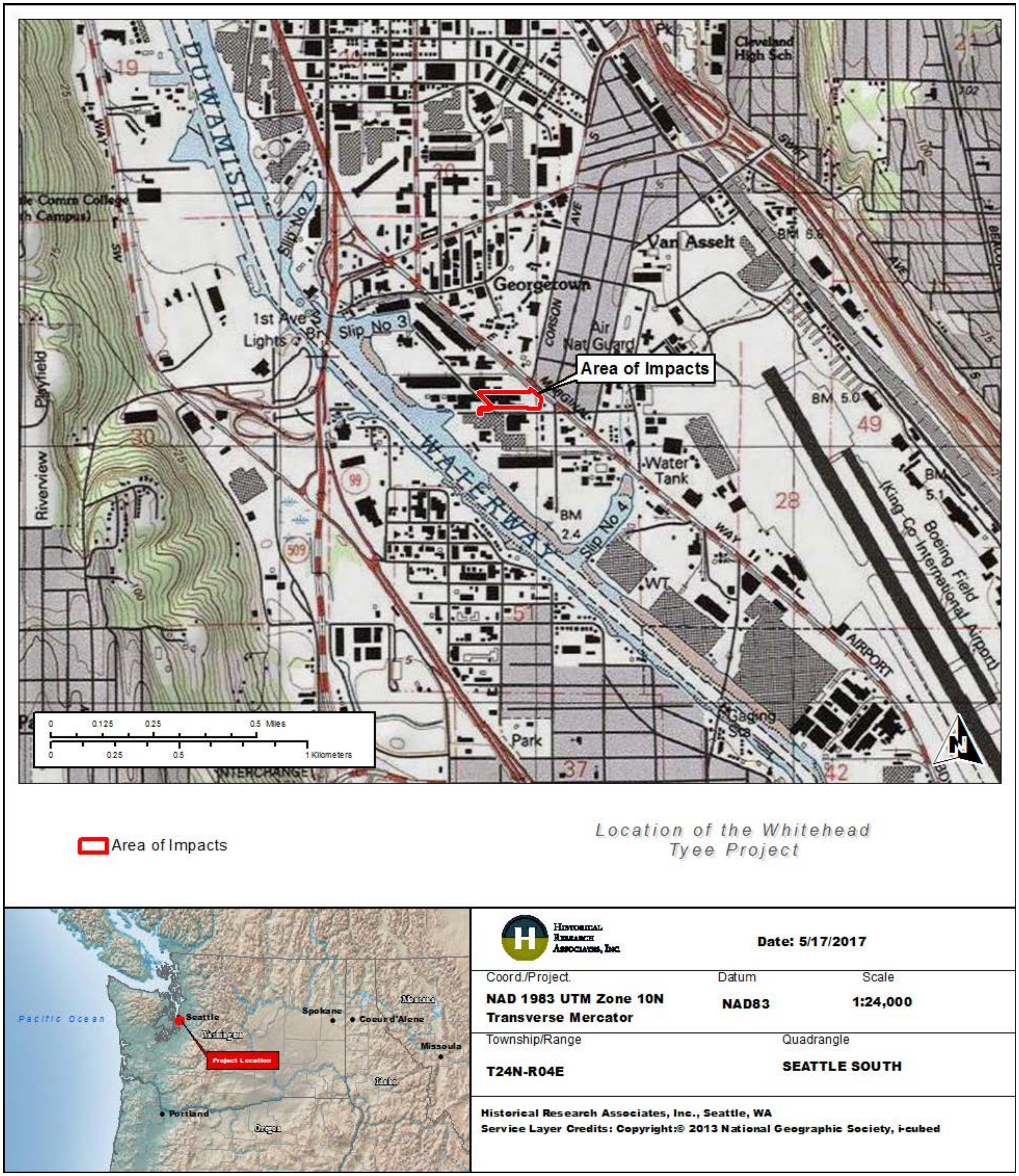

Figure 1-1. Project location and vicinity.

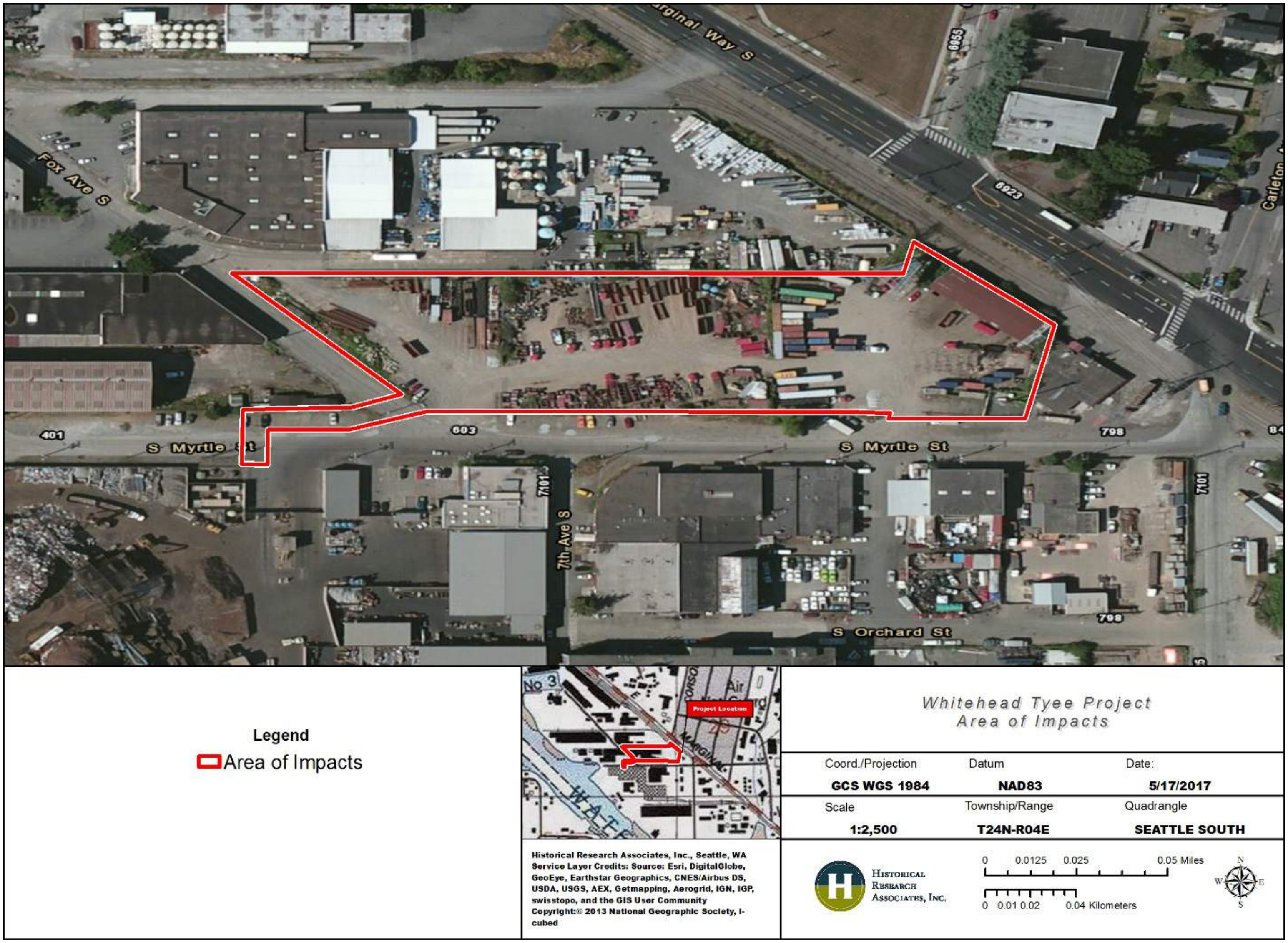

Figure 1-2. Aerial of the Project Site AI.

1,200 cubic yards of contaminated soil at the property, as described in the IAWP (Floyd|Snider 2017). Excavation will also be conducted for installation of a stormwater system. As part of a water quality order, SIM must install a stormwater treatment system on the property, including pavement, to improve water quality that runs off-site into the LDW.

Project elements include general grading and paving across the entire AI. Excavations for stormwater pipes, manholes, vaults, catch basins, and a pretreatment structure within the AI are also proposed (Table 1-1). Construction will also include installation of some stormwater pipe segments, treatment vaults, and manholes to the southwest of the AI boundary, and within the S Myrtle St. and Fox Avenue (Ave.) rights-of-way (ROWs). The stormwater pipes will be installed via bore and jack (drilling) beneath the railroad tracks and into the ROW for Fox Ave. and S Myrtle St., within the existing fill layer. The discharge pipe will be connected to the existing City of Seattle stormwater system.

Previously, historic-period buildings associated with the lumber-mill operations were in the AI, but were demolished in the mid-1980s. The demolished building debris, including a majority of the concrete-slab foundations, was removed at that time. Remnant chunks of concrete from the slabs may be present in the upper 1 to 2 feet (ft) of fill soils, although it is believed that no intact foundations remain.

This IDP approaches the project work in two stages: initial removal of contaminated soils for remediation off-site and the installation of the stormwater system elements described above. Most, of the excavation for the stormwater system likely represent fill deposits, while excavation of contaminated soils and some deeper stormwater vaults is expected to extend to native soils under the fill. Soil borings conducted within the AI indicate fill extends to below approximately 6 ft below ground surface (bgs) (the project elements coded blue and purple) in the eastern and central portions of the AI (Figure 1-3). In the south and western portions of the AI, the borings show that fill extends to approximately 8 ft bgs (the project elements coded purple) (Figure 1-3). Farther to the west, where the stormwater system will connect up with existing stormwater infrastructure, disturbances from installation of extant utilities is expected to extend to at least 10 ft bgs and perhaps to 12 ft bgs.

HRA recommends monitoring of all excavations that extend below the fill by a Professional Archaeologist, and a regular inspection process of excavations within the fill deposits with oversight by a Professional Archaeologist. For both stages of work, Project Site personnel from F|S and/or KPFF Consulting Engineers (KPFF), including a Professional Geologist with a firm understanding of the soils that occur in the project area, will be present or immediately available whenever ground-disturbing activity occurs. For removal of contaminated fill soils, these Project Site personnel will monitor for intact historic-period cultural features (e.g., building foundations), and a Cultural Resources Specialist will conduct daily inspections of the worked ground and excavated soils. In particular, the Professional Geologist will watch for evidence that excavation has exposed the interface of fill and native soils. During excavation activities that may extend below the fill into native soils a Professional Archaeologist will monitor Project work. As this is a Toxics Cleanup Site and contaminated soils may be found throughout the AI, the monitoring archaeologist will be 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) certified.

1.1 Regulatory Context

The remediation and construction is subject to the State Environmental Policy Act (SEPA). Revised Code of Washington (RCW), RCW 27.53 *Archaeological Sites and Resources* (as amended), and RCW 27.44 *Indian Graves and Records* apply as well. Ecology is the lead agency for environmental review of the interim action (contaminated soil removal) and the City of Seattle is the lead agency for environmental review of the planned stormwater system construction. The SEPA review process has been finalized and a Determination of Non-Significance (DNS) for the Project was issued by Ecology on February 2, 2017 (Timm 2017) (Appendix B); the DNS has not yet been formally issued by the City of Seattle, but is anticipated to be issued in June 2017 (public comment process completed). Ecology has consultation responsibilities with the Washington State Department of Archaeology and Historic Preservation (DAHP) and affected Tribes for the Project.

1.2 Summary of Cultural Resource Review

The body of this report includes a cultural overview based on review of archival records and background literature for the project area and surrounding area. This section of the IDP summarizes the cultural overview as it relates to the specific monitoring recommendations relevant to IDP procedures applicable to the different soils present in the Project site.

While evidence of human use of the Puget Sound region dates back to approximately 16,000 years ago, the area of the Project Site was within an estuary that gradually filled in with alluvial sediments from the Duwamish River and soils from the Osceola Mudflow lahar event from Mount Rainier, which occurred approximately 5,000 years ago. Availability of the landform on which the Project Site is located for human use probably began sometime after this lahar, during the Pacific period of the area's most recent cultural chronology (Ames and Maschner 1999). The Pacific period extends to the beginning of the ethnographic period, when Native populations were first introduced to European influences, such as the smallpox epidemic of 1775.

A seasonal subsistence strategy and winter villages characterize the Pacific period. Microenvironments were utilized for seasonal and specialized resources. Nelson (1990) described Whitlam's (1983) model of intensification, in which more microenvironments became exploited over time, reflecting greater economic complexity. Overall increasing social and cultural traits, such as intensification of resources, innovations in technology, permanent winter village locations, and social stratification, occurred over this period of time.

Fluctuations in the environment occurred between approximately 5,000 and 3,000 years ago. As sea levels stabilized, some rivers drained affecting areas available for use by humans. This encouraged resource specialization and intensification. It was during this phase that specialization of resources such as camas (*Camassia quamash*) and shellfish were first noted. Thick shell midden sites lend credence to the rise of sedentism and increase in food production (Ames and Maschner 1999:90).

By the middle of the Pacific period, evidence of canoes and large cedar plank houses accumulate in villages. Diversification in tool assemblages is evident with the use of bone, antler, and groundstone tools. The toggling harpoon was an innovation that occurred during the Middle Pacific. Use of groundstone as net weights provides a link to an expansion of fishing-related activities (Ames and Maschner 1999:94).

Changes in population demographics and subsistence and settlement patterns are seen during the late Pacific period. An escalation in warfare occurred, as well as development of mortuary rituals. Use of chipped stone tools declined, although an expansion in woodworking tools occurs in the Late Pacific (Ames and Maschner 1999:96). Areas near water resources would have been used for habitation sites, fishing, gathering riverine and lacustrine plants, and hunting waterfowl. The Duwamish River likely represented a well-used travel route in the late Pacific period.

The Project Site is in the traditional territory of the Duwamish (Spier 1936:42; Suttles and Lane 1990:486). Seasonal dwellings were situated near resource locations, such as areas for hunting game and gathering berries. These structures housed from two to ten families and were portable gable-roofed shelters with pole frames covered in mats or brush, and were easily transported (Haeberlin and Gunther 1930; Lane 1975:24; Suttles 1990; Suttles and Lane 1990:491, 493–494). Winter villages featured multiple family dwellings consisting of cedar planks attached to heavy wooden frames (Suttles and Lane 1990:491, 493–494).

Small task groups traveled to seasonal camps to hunt, fish, and gather plants. Staples of the Southern Coast Salish diet included terrestrial game such as deer, elk, and bear. Salmon and other fish, waterfowl, and shellfish were also important provisions (Belcher 1985; Suttles and Lane 1990; 489). Traps, weirs, dip and trawl nets, gaff hooks, harpoons, and leister were used to catch fish in rivers. In saltwater, seines, gill nets, and trolling were used. Meat and fish were dried, boiled in watertight baskets, or roasted in a large pit or on a spit over a fire. Shellfish were roasted on long sticks slanted over a fire on the beach or smoked and strung on buckskin for winter storage (Haeberlin and Gunther 1930:23–24).

Roots, bulbs, nuts, and sprouts were frequently used plants. A large variety of berries, including blackberry, elderberry, salmonberry, thimbleberry, blackcap, salal berry, huckleberry, and blueberry, were noted by Gunther (1945). Plant foods were eaten fresh or dried either by the sun or spread on cedar bark over a fire, for winter storage. Plant materials were used not only for nutrition but also for mats, baskets, clothing, and dwellings. Native populations were devastated by European diseases that New World peoples had never encountered and, therefore, against which they had no resistance. By the time the first Euroamericans arrived in Puget Sound they found a greatly diminished population of Native Americans.

Based on review of historical maps and archival data, there are no previously recorded archaeological sites, isolates, cemeteries, historic register properties, or ethnographic place names or sites within the AI; however, the records also indicate that the AI has not been previously surveyed. Resources in the vicinity include historic-period isolated artifacts and debris found in fill soils. Several precontact shell midden and lithic sites have been identified on somewhat similar landforms ¾-mile (mi) from the project area. The ethnographic place names represent descriptions of locations, a legendary reference, and a village site that does not correspond with the shell midden archaeological sites. Archival records note two cemeteries and a burial find, the nearest of which was located approximately ⅛-mi from the Project Site. However, the Duwamish Tribe reports oral history accounts of potential burials under the roadway adjacent to the Project Site. The Project Site housed numerous commercial enterprises throughout the historic period and the twentieth century, all of which were demolished and fragmentary remnants are likely to be within the fill soils documented by the soil bore surveys.

Because the site has not previously been surveyed, but the depth of fill soils and the presence of contaminants in those soils argues against subsurface archaeological survey methods, monitoring for intact significant cultural materials is a practical approach to meeting cultural resources regulatory obligations. The likelihood of significant historic-period materials remaining intact within the fill soils is low. Fragments of building foundations or railroad grades may be present but are unlikely to represent resources that meet national, state, or local historic register criteria as significant resources. Nonetheless, because most of the activities that will take place within the AI for this environmental remediation project target the fill soils, this IDP includes provisions to identify such features in the fill soils and, if they are present, procedures for examination and recording by professional archaeologists. Of greater concern is the native soils below the fill soils. These soils have a greater potential to retain undisturbed archaeological features and artifacts associated with the use of the AI by Native Americans, including potential burial features such as those referenced by a Duwamish informant. If present, such cultural materials more directly reflect the factors of significance to the archaeological record that register criteria describe. As such, this IDP focuses mostly on the native soils with provisions for archaeological monitoring by professional archaeologists and specific procedures to be followed in the event of cultural material finds.

1.3 Regional and Site Geology

Site excavation activities will be conducted primarily in the fill, with deeper excavations occurring in native soil. The transition from fill to native is readily apparent at the Project Site. A licensed Professional Geologist will be providing environmental oversight during construction, and will be able to identify the transition into native material at the Project Site. A brief summary of regional and Project Site geology is included below for reference.

1.3.1 Regional Geology

The Project Site is located in the Lower Duwamish River Valley within the Puget Sound Basin. Within the last 100 years, the delta/estuary was extensively modified by hydraulic dredging to form the straightened waterway, by fill that raised the elevation of adjacent lowlands, and by large-scale industrial development in the area. The younger Duwamish alluvial deposits have a relatively uniform thickness and depth, with a base that is within 5 to 10 ft of the modern sea level. These deposits, which consist of silt, sand, and sandy silt with abundant wood and organics, represent channel and floodplain deposits laid down by the modern Duwamish River. Overlying the younger alluvium are varying amounts of fill that range in thickness from 3 to 10 ft. The fill material is composed of a mixture of sand, gravel, silt, and miscellaneous construction debris.

1.3.2 Site Geology

There have been more than 50 soil borings advanced at the Project Site, with specific focus on areas with proposed excavation. Near-surface soil at the Project Site predominantly consists of fill material, which ranges in depth from 6 to 12 ft bgs. The fill is shallowest on the eastern portion of the Project Site towards E Marginal Way and gets thicker moving west and closer to the Lower Duwamish River. Fill material is predominately composed of poorly graded silty fine sand to gravelly sand or sandy silt to gravelly sandy silt. Locally, fill includes some organic matter, wood, and debris. The first native soils encountered beneath the fill are interpreted to represent recent (i.e., pre-development) alluvial deposits of the Lower Duwamish Valley. These younger alluvial deposits host the first occurrence of groundwater at the Project Site, which is approximately 10 ft bgs.

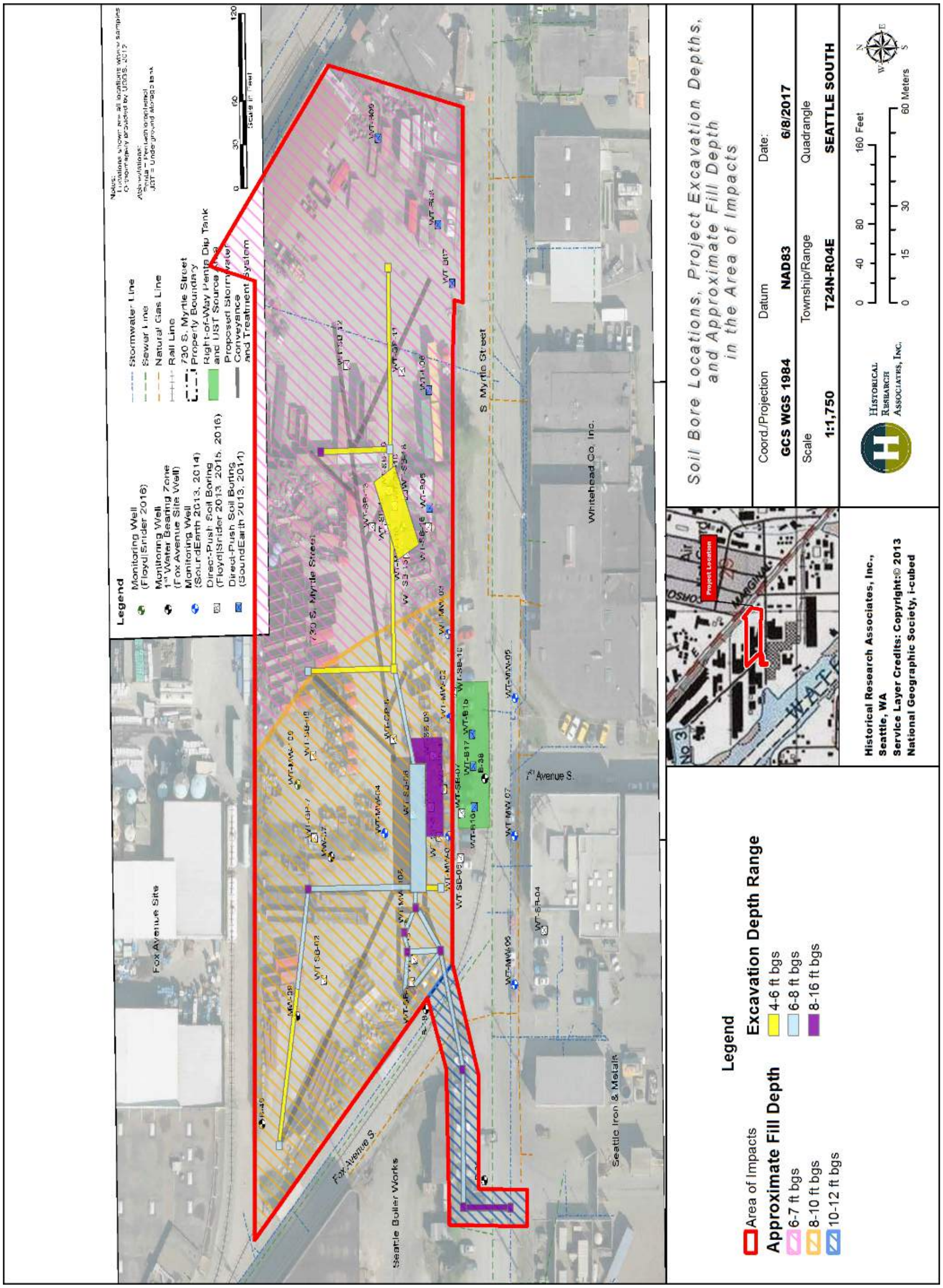

Figure 1-3. Soil borings and approximate depths of fill within the AI.

2. Recognizing Cultural Resources

A cultural resource discovery could be precontact, ethnographic-period, or historic (Appendix A).

Examples include:

- An accumulation of shell, burned rocks, or other food-related materials;
- Bones or small pieces of bone;
- An area of charcoal or very darkly stained soil with artifacts;
- Stone tools or waste flakes (i.e., projectile point, stone chips);
- Clusters of tin cans or bottles, logging or agricultural equipment that appears to be older than 50 years (hole-in-top or lead soldered); or
- Buried railroad tracks, decking, or other industrial materials.

Figure 2-1 shows the outline of former buildings overlaid with proposed project excavation depths. Remnants of former buildings or materials associated with the lumber mill operations may be found in these areas.

When in doubt, assume the material is a cultural resource.

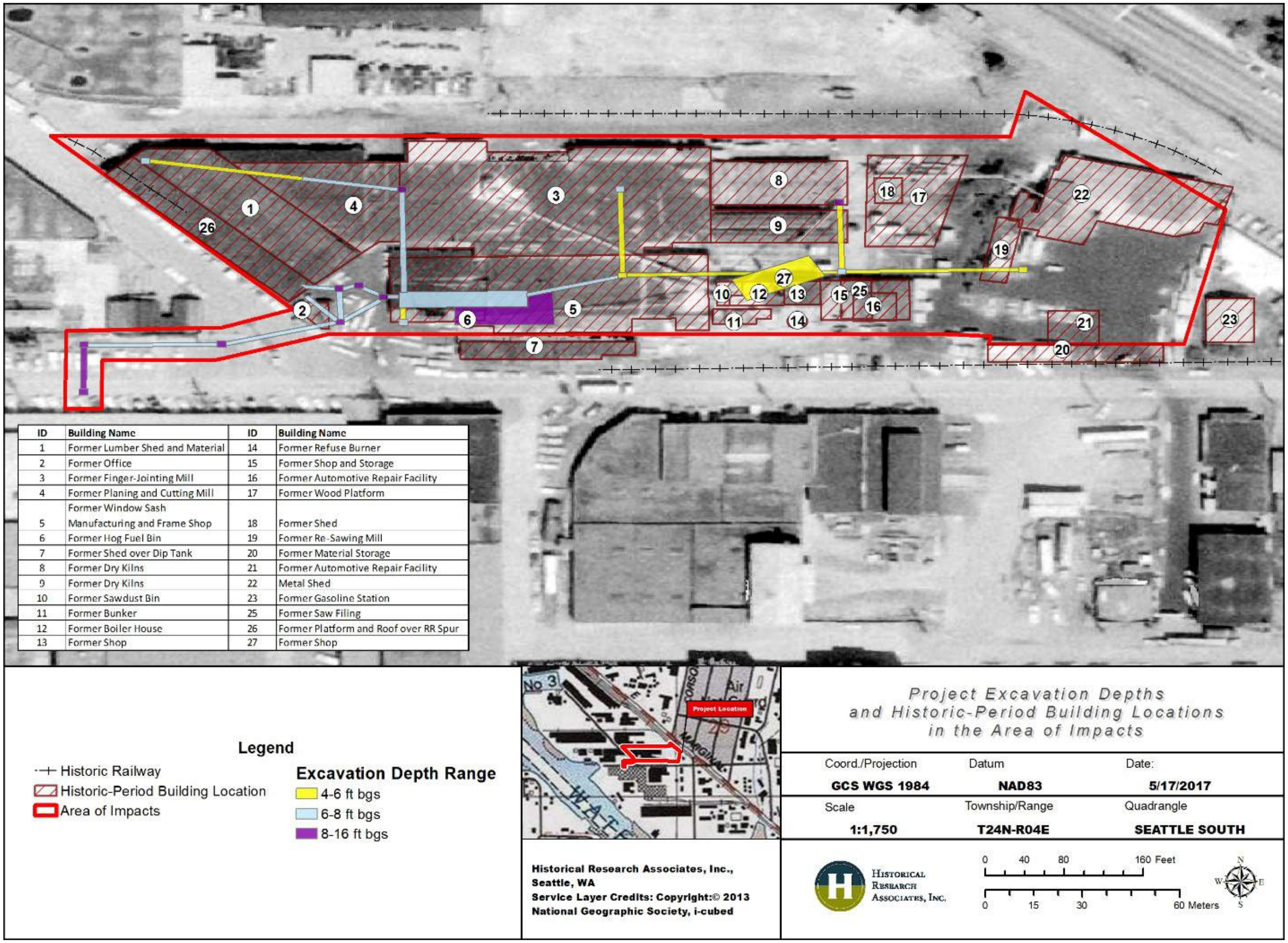

Figure 2-1. Project excavation depths atop former historic-period building locations in the AI.

3. Personnel Roles for Site Monitoring During Excavations

During construction, various Project Site personnel, including Professional Geologists, Professional Engineers, Cultural Resource Specialists, and Professional Archaeologists, will be available for monitoring of all excavation activities. Much of the project work will take place in fill soils as identified by the soil bore surveys. The responsibilities of project personnel will vary for monitoring excavations in fill soils, native soil, and the off-property utility trench locations (see Figure 1-3). Figure 3-1 details monitoring recommendations-in the green areas excavation will be within fill soils and will be observed as described in Section 3.1; a Cultural Resource Specialist will make daily site inspections. The purple areas in Figure 3-1 indicate excavation that will extend to native soils and archaeological monitoring as described in Section 3.2. Specific monitoring procedures are detailed in Sections 4-8. The Professional Archaeologist will provide a pre-construction training to introduce the terms and procedures of this IDP to Project Site personnel, including the Site Foreman and construction crew members.

3.1 Roles for Excavations in Fill:

a) A Professional Archaeologist will be on-call and available during excavation in fill materials. The Professional Archaeologist will provide oversight of monitoring activities by other Project Site personnel consistent with the approach when a Professional Archaeologist supervises a monitoring archaeologist that does not meet the Professional Archaeologist standard (RCW 27.53.030(11)).

b) A Cultural Resource Specialist will conduct a daily site visit to document field conditions, photograph open excavations, and inspect open-excavations and stockpiles of excavated sediment for the presence of native soils and/or cultural resources. The Cultural Resource Specialist will promptly notify the Professional Archaeologist by telephone of any finds that require additional technical review or interpretation. The Cultural Resource Specialist will also communicate with the Professional Archaeologist daily by telephone or email to provide a summary of their daily site visit.

c) During excavation in fill material, the Site Representative (the Cultural Resource Specialist, Professional Geologist, and/or Professional Engineer) will closely observe the work to identify historic-period cultural features that may be encountered and to identify if the contact between fill and native soil is encountered. If it is suspected that a cultural feature has been exposed or if native soil is encountered at a depth shallower than anticipated (see Figure 2-1), the Field Representative will stop excavation work immediately and implement the steps in Section 4 of this IDP.

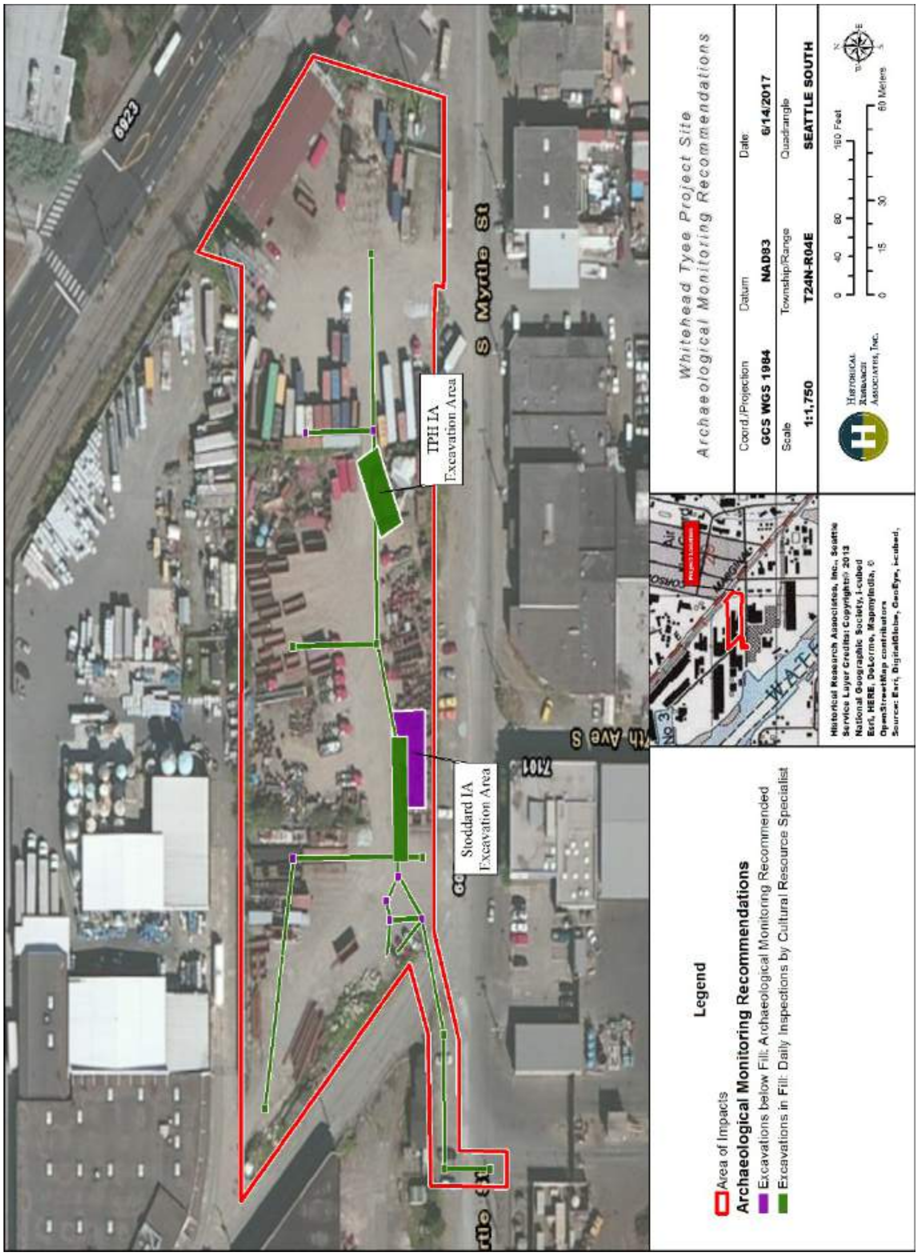

Figure. 3-1. Monitoring recommendations for the AI.

3.2 Roles for Monitoring in Native Soil:

a) During excavation activities that may extend below the fill, and starting at 1 ft above the anticipated interface of fill and native soils throughout the entire AI, a Professional Archaeologist will be onsite full-time to monitor project work during excavation in native soil until the final excavation depth is achieved.

3.3 Roles for Monitoring Off-Property and in City of Seattle Right-of-Ways (ROWs):

a) Due to the presence of known utilities, areas under the City's ROWs are highly disturbed and expected to be composed of fill soils. The same roles and procedures for "Monitoring in Fill" as specified above will be followed in open excavations off-property and/or in City of Seattle ROWs. However, if native soil is encountered, the roles and procedures for "Monitoring in Native Soil" as specified above will be implemented.

b) Monitoring will not be conducted during jack and bore drilling, as this work entails horizontal drilling and soil will not be visible. However, the excavation of any ingress and egress pits will be addressed in the same way as "Monitoring in Fill."

4. On-Site Procedures in the Event of an Inadvertent Discovery

Compliance with all applicable laws pertaining to archaeological resources (RCWs 27.53 (Archaeological Sites and Resources), 27.44 (Indian Graves and Records), and WAC 25-48 [Archaeological Excavation and Removal Permit]) and to human remains (RCW 68.50 [Human Remains]) is required. Failure to comply with these requirements could result in a misdemeanor and possible civil penalties and/or may constitute a Class C felony.

HRA recommended an archaeological monitor for excavations that extend beneath the fill and at the intersection of fill and native soils in the AI. The archaeological monitor should be a Professional Archaeologist who meets the Secretary of the Interior's (SOI) qualifications (36 CFR Part 61; required by the State of Washington in RCW 27.53.030.11). The archaeologist will oversee all cultural-resources-related activities on the Project Site. If an archaeologist meeting the SOI qualifications is not available, an experienced archaeologist (e.g., one with several years' experience in a variety of archaeological field situations) may be allowed to monitor construction activities provided that a "Supervisory Plan for Archaeological Monitoring" has been filed with DAHP prior to their work at the site. F|S's Cultural Resource Specialist will be similarly supervised by a Professional Archaeologist.

In the event that any ground-disturbing activities or other project activities related to this project or in any future project uncover protected cultural material (e.g., bones, shell, antler, horn, stone tools), the following actions will be taken:

<u>STEP 1: STOP WORK</u>. If any F|S or KPFF employee, contractor or subcontractor believes that he or she has uncovered a cultural resource at any point in the project, all work adjacent to the discovery must stop. The discovery location should be secured at all times. A Project Site Representative is responsible for taking appropriate steps to protect the discovery site. All work will stop in an area adequate to provide for the total security, protection, and integrity of the resource (30 ft buffer). Vehicles, equipment, and unauthorized personnel will not be permitted to traverse the discovery site.

<u>Project Site personnel must contact the Project Manager:</u>

Floyd|Snider
Lynn Grochala, Project Manager
Two Union Square
601 Union Street, Suite 600
Seattle, WA 98121
Office: (206) 292-2078
Cell: (603) 491-3952
Email: lynn.grochala@floydsnider.com

KPFF
Bill Armour, Project Engineer
2402 North 31st Street, Suite 100
Tacoma, WA 98407
Office: (253) 396-0150
Cell: (253) 579-3346

Work in the immediate area will not resume until treatment of the discovery has been completed, following provisions for treating archaeological/cultural material as set forth in this document. The Project Manager or Project Site Representative may direct construction away from cultural resources to work in other areas prior to contacting the concerned parties.

STEP 2: NOTIFY MONITOR. If an archaeological monitor is not present at the time of discovery, the Project Manager or Site Representative will be responsible for stopping excavation work and immediately contacting the archaeological monitor, Professional Archaeologist, or Cultural Resource Specialist who will verify whether the find is archaeological.

Professional Archaeologist:
To Be Determined Prior to Construction

Cultural Resource Specialist:

Lisa Meoli, BA, Archaeology, MA, History
Floyd|Snider
Two Union Square
601 Union Street, Suite 600
Seattle, WA 98121
Office: (206) 292-2078
Cell: (206) 257-9714

If the find is determined to be archeological, proceed to Step 3. If it is not, construction may resume.

STEP 3: NOTIFY DAHP. The Project Manager or Site Representative will be responsible for contacting DAHP staff:

Gretchen Kaehler
Assistant State Archaeologist, Local Governments
Department of Archaeology and Historic Preservation (DAHP)
1110 S. Capitol Way, Suite 30
Olympia, WA 98501
Office: (360) 586-3088
Cell: (360) 628-2755

Or:

Dr. Rob Whitlam
State Archaeologist
Department of Archaeology and Historic Preservation (DAHP)
Office: (360) 586-3080
Cell: (360) 890-2615
Email: Rob.whitlam@dahp.wa.gov

An SOI qualified professional archaeologist will examine the find to determine if it is archaeological. If the find is determined not archaeological, work may proceed with no further delay. If the find is determined to be archaeological, it will be documented as described in Section 6.

DAHP will notify the Tribes. Tribes that will be notified should a discovery be made on this project include:

Duwamish Tribe
John Rasmussen, Cultural Resources
4705 West Marginal Way SW
Seattle, WA 98106
Office: (206) 431-1582
Email: DTS@eskimo.com

Snoqualmie Nation

Steve Mullen-Moses, Director of Archaeology and Historic Preservation
P O Box 969
8130 Railroad Avenue, Suite 103
Snoqualmie, WA 98065
Telephone: (425) 495-6097
Email: steve@snoqualmietribe.us

Muckleshoot Indian Tribe
Laura Murphy, Archaeologist
39015 172nd Avenue SE
Auburn, WA 98092
Office: (253) 876-3272
Email: laura.murphy@muckleshoot.nsn.us

Suquamish Tribe

Dennis Lewarch, THPO Cultural Resources
PO Box 498
Suquamish, WA 98392-0498
Telephone: (360) 394-8529
Email: dlewarch@Suquamish.nsn.us

If the find may be human remains or funerary objects, treat them with dignity and respect at all times. Do not take photographs. Cover the remains with a tarp or other similar materials (not soil or rocks) for temporary protection in place and to shield them from being photographed. The procedures to follow are legally required by RCW 27.44 (Indian Graves and Records) and are outlined in Section 5.

STEP 4: NOTIFY ECOLOGY PROJECT MANAGER. Contact the Ecology Project Manager or applicable contacts:

Washington State Department of Ecology (TCP Project Manager)
Maureen Sanchez, Toxics Cleanup Program
Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008
Office: (425) 649-7254
Email: masa461@ecy.wa.gov

Washington State Department of Ecology (WQ Project Manager)
Robert Wright, Water Quality
Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008
Office: (425) 649-7000
Email: rowr461@ecy.wa.gov

5. Special Procedures for the Discovery of Human Skeletal Material

If ground disturbing activities encounter human skeletal remains during the course of construction, then all activity **will** cease that may cause further disturbance to those remains. The area of the find will be secured and protected from further disturbance. The finding of human skeletal remains **will** be reported to the King County Medical Examiner **and** local law enforcement in the most expeditious manner possible. The remains will not be touched, moved, or further disturbed.

5.1 Notify Law Enforcement Agency or Medical Examiner's Office:

In addition to the actions described in Sections 3 and 4, the Project Manager will immediately notify the local law enforcement agency or Medical Examiner's office.

King County Medical Examiner
Richard Harruff, Medical Officer
Harborview Medical Center
325 9th Avenue, Box 359792
Seattle, WA 98104-2499
Office: (206) 731-3232
Fax: (206) 731-8555
Email: richard.harruff@kingcounty.gov

Seattle Police Department
Kathleen O'Toole, Police Chief
Headquarters: 610 Fifth Avenue
Seattle, WA 98124
Office: (206) 625-5011

The Medical Examiner (with assistance of law enforcement personnel) will assume jurisdiction over the human skeletal remains, will determine if the remains are human, whether the discovery site constitutes a crime scene, and will notify DAHP.

If the King County Medical Examiner determines the remains are non-forensic, then they will report that finding to DAHP, who will then take jurisdiction over the remains. DAHP will notify any appropriate cemeteries and all affected tribes of the find. The State Physical Anthropologist will make a determination of whether the remains are Indian or Non-Indian and report that finding to any appropriate cemeteries and the affected tribes. DAHP will then handle all consultation with the affected parties as to the future preservation, excavation, and disposition of the remains.

When consultation and documentation activities are complete, construction in the discovery area may resume as described in Section 7.

6. Documentation of Archaeological Materials

If the Professional Archaeologist believes a find represents a potentially intact archaeological site, excavation will halt completely at that location. The archaeologist will then inform F|S and DAHP of the find. Depending on the nature and size of the archaeological resource, it is feasible that construction may continue elsewhere in the AI, provided that an archaeologist is available to continue monitoring and that a safe buffer zone is maintained between the archaeological resource and construction area. This will be decided between the archaeologist, F|S, and DAHP.

All precontact, ethnographic-period, and historic-period cultural material discovered during project construction will be recorded by a professional archaeologist on a cultural resource site or isolate form using standard techniques. Site overviews, features, and artifacts will be photographed; stratigraphic profiles and soil/sediment descriptions will be prepared for subsurface exposures. Discovery locations will be documented on scaled site plans and site location maps.

Under RCW 27.53, all precontact archaeological sites are protected regardless of significance or eligibility for national, state, and/or local historic registers. A determination of eligibility for listing on the state or national register by DAHP must be obtained for archaeological resources. DAHP, in coordination with affected Tribes, will determine an appropriate form of treatment for the archaeological site.

Within 90 days of concluding fieldwork, a summary of any and all monitoring and resultant archaeological excavations will be included in the Interim Action Report, which will be provided to the Ecology Project Manager. The Ecology Project Manager will forward the report to interested parties and/or stakeholders.

7. Proceeding with Construction

Project construction outside the discovery location may continue while documentation and assessment of the cultural resources proceed. Construction may continue at the discovery location only after the process outlined in this plan is followed and Ecology and DAHP, in consultation with affected Tribes, determine that compliance with state and federal laws is complete.

If the assessment determines that the site is a register-eligible resource, mitigation/treatment measures may be necessary and will be determined in consultation between Ecology and DAHP. Treatment measures may include mapping, photography, subsurface testing, sample collection, and/or other activities. Eligible precontact and historic-period resources will require a State of Washington Archaeological Site Alteration and Excavation Permit to disturb under RCW 27.53. Appropriate treatment measures will be stipulated under the permit obtained from DAHP.

8. Recipient Responsibility

Per Ecology's guidance, the IDP must be immediately available by request by any party. An IDP must be immediately available and be implemented to address any discovery. The archaeological resources procedures and IDP are included in Sections 3 and 4 of this document.

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Appendix A. Examples of Cultural Resources

I might implement the IDP if …

I see chipped stone artifacts.

- Glass-like material
- Angular
- “Unusual” material for area
- “Unusual” shape
- Regularity of flaking
- Variability of size

I might implement the IDP if ...

I see ground or pecked stone artifacts.

- Striations or scratching
- Unusual or unnatural shapes
- Unusual stone
- Etching
- Perforations
- Pecking
- Regularity in modifications
- Variability of size, function, and complexity

I might implement the IDP if …

I see bone or shell artifacts.

- Often smooth
- Unusual shape
- Carved
- Often pointed if used as a tool
- Often wedge-shaped like a “shoe horn”

I might implement the IDP if ...

I see bone or shell artifacts.

- Often smooth
- Unusual shape
- Perforated
- Variability of size

I might implement the IDP if …

I see fiber or wood artifacts.

- Wet environments needed for preservation
- Variability of size, function, and complexity
- Rare

I might implement the IDP if …

I see historic period artifacts.

I might implement the IDP if …

I see strange, different or interesting-looking dirt, rocks, or shells.

- Human activities leave traces in the ground that may or may not have artifacts associated with them
- “Unusual” accumulations of rock (especially fire-modified rock)
- “Unusual” shaped accumulations of rock (e.g., similar to a fire ring)
- Charcoal or charcoal-stained soils
- Oxidized or burnt-looking soils
- Accumulations of shell
- Accumulations of bone or artifacts
- Look for the “unusual” or out of place (e.g., rock piles or accumulations in areas with few rock)

I might implement the IDP if …

I see strange, different or interesting-looking dirt, rocks, or shells.

- "Unusual" accumulations of rock (especially fire-modified rock)
- "Unusual" shaped accumulations of rock (e.g., similar to a fire ring)
- Look for the "unusual" or out of place (e.g., rock piles or accumulations in areas with few rock)

I might implement the IDP if …

I see strange, different or interesting-looking dirt, rocks, or shells.

- Often have a layered or “layer cake” appearance
- Often associated with black or blackish soil
- Often have very crushed and compacted shell

I might implement the IDP if ...

I see historic foundations or buried structures.

Whitehead Tyee Site

Remedial Investigation Work Plan

Appendix D
Health and Safety Plan

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List of Abbreviations

Abbreviation	Definition
CRZ	Contamination reduction zone
cVOC	Chlorinated volatile organic compound
EZ	Exclusion zone
°F	Degrees Fahrenheit
Fox Avenue Site	Fox Avenue MTCA Cleanup Site
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations Training
HSA	Hollow-stem auger
HSO	Health and Safety Officer
OSHA	Occupational Safety and Health Act
penta	Pentachlorophenol
PID	Photoionization detector
PM	Project Manager
PPE	Personal protective equipment
Property	730 S. Myrtle Street property
ROW	Right-of-way
Site	Whitehead Tyee Site
SS	Site Supervisor
SSO	Site Safety Officer
SZ	Support zone
VOC	Volatile organic compound
WAC	Washington Administrative Code

1.0 Plan Objectives and Applicability

This Health and Safety Plan (HASP) has been written to comply with the standards prescribed by the Occupational Safety and Health Act (OSHA) and the Washington Industrial Safety and Health Act (WISHA).

The purpose of this HASP is to establish protection standards and mandatory safe practices and procedures for all personnel involved with investigation activities comprising soil boring installation, monitoring well installation and development, and soil and groundwater sample collection at the Whitehead Tyee Site (Site), located at the 730 S. Myrtle Street property (Property). For clarity in this HASP and consistent with the RI Work Plan main text, “Site” will be used when referring to the area of known contamination, which extends off-Property, and “Property” will be used when referring to the 730 S. Myrtle Street property only.

This HASP assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may occur during field work activities. The plan consists of Site descriptions, a summary of work activities, an identification and evaluation of chemical and physical hazards, monitoring procedures, personnel responsibilities, a description of site zones, decontamination and disposal practices, emergency procedures, and administrative requirements.

The provisions and procedures outlined by this HASP apply to all Floyd|Snider personnel on-site. Contractors, subcontractors, other oversight personnel, and all other persons involved with the field work activities described herein are required to develop and comply with their own HASP, except for those subcontractors whose scope of work does not require contact with potentially contaminated materials (surveyors, utility locators, etc.). All Floyd|Snider staff conducting field activities are required to read this HASP and indicate that they understand its contents by signing the Health and Safety Officer/Site Supervisor’s (HSO/SS) copy of this plan.

It should be noted that this HASP is based on information that was available as of the date indicated on the title page. It is possible that additional hazards that are not specifically addressed by this HASP may exist at the work site, or may be created as a result of on-site activities. It is the firm belief of Floyd|Snider that active participation in health and safety procedures and acute awareness of on-site conditions by all workers is crucial to the health and safety of everyone involved. Should project personnel identify a site condition that is not addressed by this HASP or have any questions or concerns about site conditions, they should immediately notify the HSO/SS and an addendum will be provided to this HASP.

The HSO/SS has field responsibility for ensuring that the provisions outlined herein adequately protect worker health and safety and that the procedures outlined by this HASP are properly implemented. In this capacity, the HSO/SS will conduct regular site inspections to ensure that this HASP remains current with potentially changing site conditions. The HSO/SS has the authority to make health and safety decisions that may not be specifically outlined in this HASP should site conditions warrant such actions. In the event that the HSO/SS leaves the Site while work is in progress, an alternate Site Safety Officer (SSO) will be designated. Personnel responsibilities are further described in Section 4.0.

This HASP has been reviewed by the Project Manager (PM) and the HSO/SS prior to commencement of work activities. All Floyd|Snider personnel shall review the plan and be familiar with on-site health and safety procedures. A copy of the HASP will be on-site at all times.

2.0 Emergency Contacts and Information

2.1 DIAL 911

In the event of any emergency, DIAL 911 to reach fire, police, and first aid.

2.2 HOSPITAL AND POISON CONTROL

Nearest Hospital Location and Telephone:	Harborview Medical Center 325 Ninth Avenue Seattle, WA 98104 (206) 731-3000
Washington Poison Control Center:	(800) 222-1222

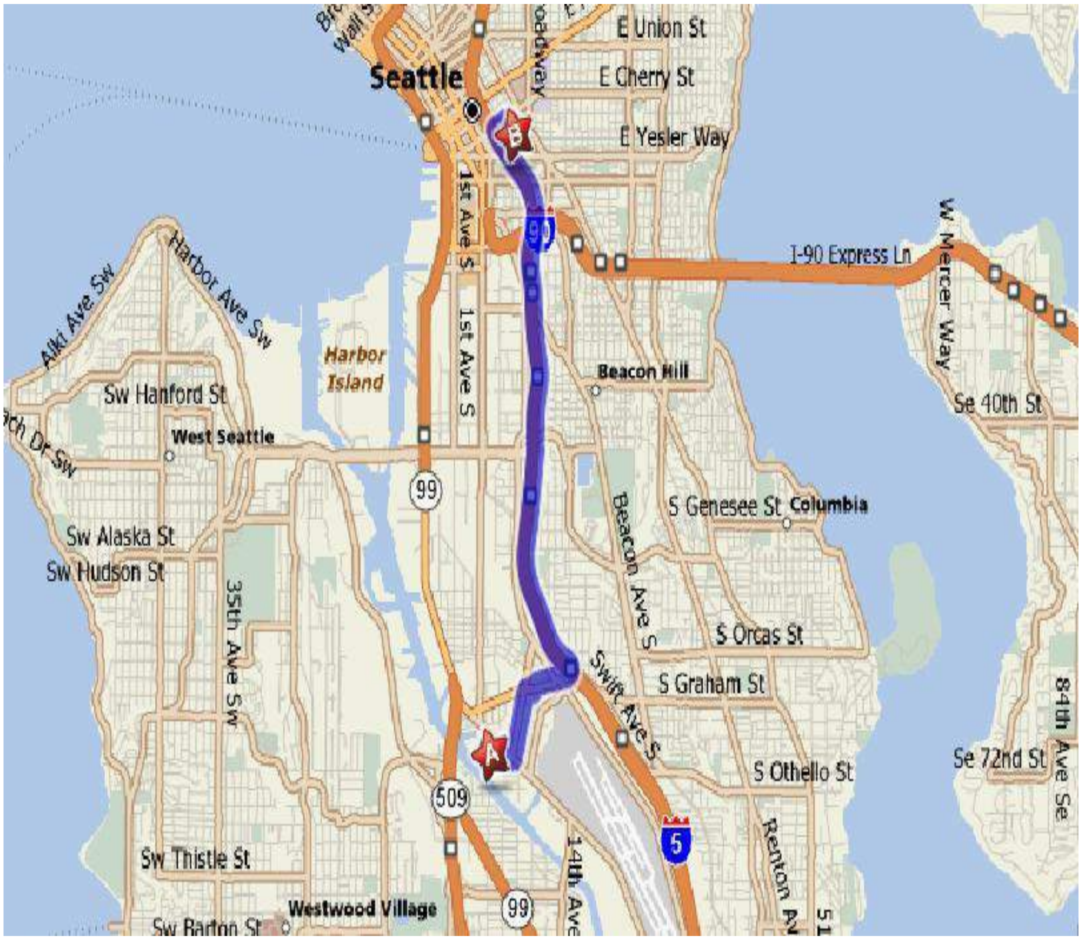
Directions to Hospital:

1. Go NORTHWEST on FOX AVE S toward S BRIGHTON ST. (go 0.1 miles)
2. Turn RIGHT onto S BRIGHTON ST. (go 0.1 miles)
3. Turn RIGHT onto E MARGINAL WAY S (go 0.1 miles)
4. Turn LEFT onto CORSON AVE S (go 0.5 miles)
5. Turn RIGHT onto S BAILEY ST (go 0.1 miles)
6. Merge onto I-5 N via the ramp on the LEFT toward VANCOUVER BC (go 3.1 miles)
7. Take the DEARBORN ST./JAMES ST. exit, EXIT 164A, toward MADISON ST. (go 1.0 miles)
8. Take the JAMES ST exit (go 0.3 miles)
9. Turn RIGHT onto JAMES ST. (go 0.1 miles)
10. Turn RIGHT onto 9TH AVE (go 0.2 miles)
11. End at 325 9th Ave Seattle, WA 98104

In case of emergency, also notify:

- Seattle Iron & Metals Company (SIM): Alan Sidell, President, (206) 682-0400
- Floyd|Snider Project Manager, Lynn Grochala, (206) 292-2078

Figure D.1
Medical Facility Access Route



2.3 PROVIDE INFORMATION TO EMERGENCY PERSONNEL

All Floyd|Snider project personnel should be prepared to give the following information:

Information to give to Emergency Personnel	
Site Location:	730 S Myrtle Street Seattle, WA 98108
Number that you are calling from:	Refer to the phone you are calling from.
Describe accident and/or incident and numbers of personnel needing assistance.	Type of Accident Type(s) of Injuries

2.4 FLOYD|SNIDER AND SEATTLE IRON & METALS EMERGENCY CONTACTS

After contacting emergency response crews as necessary, contact the Floyd|Snider PM or a Principal to report the emergency. The Principal may then contact SIM or direct the field staff to do so.

Floyd|Snider Emergency Contacts:

Lynn Grochala	Office: (206) 292-2078	Cell: (603) 491-3952
Allison Geiselbrecht	Office: (206) 292-2078	Cell: (206) 722-2460
Gillian Sweeney	Office: (206) 292-2078	Cell: (510) 316-6679
Kate Snider	Office: (206) 292-2078	Cell: (206) 375-0762
Jessi Massingale	Office: (206) 292-2078	Cell: (206) 683-4307

Seattle Iron & Metals Emergency Contacts:

Alan Sidell Office: (206) 682-0040

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3.0 Background Information

3.1 SITE BACKGROUND

Floyd|Snider will conduct field investigation and data collection activities on behalf of SIM at the former Tyee Lumber and Manufacturing Company (Tyee Lumber) facility, located at 730 S. Myrtle Street in Seattle, Washington. The Site includes the Property and off-Property in the S. Myrtle Street Right-of-Way (ROW). The purpose of the field investigation is to characterize the nature and extent (both vertically and horizontally) of contamination in soil and groundwater at the Site to provide sufficient information to evaluate and select cleanup actions.

Known historical operations on the Property include Tyee Lumber's sawmill and finishing operations, which included a pentachlorophenol (penta) dip tank situated adjacent to the Property in the S. Myrtle Street ROW. Previous environmental investigations have identified soil and groundwater contamination from penta and Stoddard solvent resulting from releases at and surrounding the penta dip tank. An auto garage also formerly operated in the south-central portion of the Property, and previous environmental investigations identified a limited area of shallow soil impacted by heavy oil-range organics resulting from these operations (now removed as part of the Interim Action, described in Section 3.2 of the main text). Since 1999, SIM has used the Property for truck and container storage and light maintenance on containers. No metal processing has ever occurred on the Property, and no metal shred, automobile shredder residue, or related materials were or are currently stored on-Property.

The Fox Avenue MTCA Cleanup Site (Fox Avenue Site) lies immediately north of the Property and is currently undergoing remedial actions. The Fox Avenue Site is contaminated with chlorinated volatile organic compounds (cVOCs) in both deep groundwater and soil. A chlorinated solvent groundwater plume from the Fox Avenue Site crosses the western third of the Property toward the S. Myrtle Street Embayment, where it discharges into the Lower Duwamish Waterway. The water table at the Property is located at depths of approximately 8 to 11 feet below ground surface (bgs), whereas contamination from the Fox Avenue Site is typically deeper. However, Site groundwater may contain low levels of cVOCs.

3.2 SCOPE OF WORK

The scope of work for this field investigation and data collection activities is described in detail in the RI Work Plan. Floyd|Snider will conduct the following field work activities:

- Install soil borings, including Geoprobe® and hollow-stem auger (HSA) borings.
- Construct groundwater monitoring wells in boring locations completed with HSA and develop the new monitoring wells.
- Collect soil samples for analytical testing during boring and monitoring well installation.
- Collect groundwater samples.

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4.0 Primary Responsibilities and Requirements

4.1 PROJECT MANAGER

The PM will have overall responsibility for the completion of the project, including the implementation and review of this HASP. The PM will review health and safety issues as needed and as consulted, and will have authority to allocate resources and personnel to safely accomplish the field work.

The PM will direct all Floyd|Snider personnel involved in field work at the Site. If the project scope changes, the PM will notify the HSO/SS so that the appropriate addendum can be included in the HASP. The PM will ensure that all Floyd|Snider personnel on-site have received the required training, are familiar with the HASP, and understand the procedures to follow should an accident and/or incident occur on-site.

4.2 HEALTH AND SAFETY OFFICER AND SITE SUPERVISOR

The HSO/SS will approve this HASP and any amendments, thereof, and will ultimately be responsible for full implementation of all elements of the HASP.

The HSO/SS will advise the PM and project personnel on all potential health and safety issues of the field investigation activities to be conducted at the Site. The HSO/SS will specify required exposure monitoring to assess Site health and safety conditions, modify the Site HASP based on field assessment of health and safety accidents and/or incidents, and recommend corrective action if needed. The HSO/SS will report all accidents and/or incidents to the PM. If the HSO/SS observes unsafe working conditions by Floyd|Snider personnel or any contractor personnel, the HSO/SS will suspend all work until the hazard has been addressed.

4.3 SITE SAFETY OFFICER

The SSO may be a person dedicated to this task, to assist the HSO/SS during field work activities. The SSO will ensure that all personnel have appropriate personal protective equipment (PPE) on-site and PPE is properly used. The SSO will assist the HSO/SS in field observation of Floyd|Snider personnel safety. If a health or safety hazard is observed, the SSO shall suspend all work activity. The SSO will conduct on-site safety meetings daily before work commences. All health and safety equipment will be calibrated daily and records kept in the daily field logbook and/or accompanying field daily forms. The SSO may perform exposure monitoring if needed and will ensure that equipment is properly maintained.

4.4 FLOYD|SNIDER PROJECT PERSONNEL

All Floyd|Snider project personnel involved in field work activities will take precautions to prevent accidents and/or incidents from occurring to themselves and others in the work areas.

Employees will report all accidents, incidents, and/or other unsafe working conditions to the HSO/SS or SSO immediately. Employees will inform the HSO/SS or SSO of any physical conditions that could impact their ability to perform field work.

4.5 TRAINING REQUIREMENTS

All Floyd|Snider project personnel must comply with applicable regulations specified in the Washington Administrative Code (WAC) Chapter 296-843, Hazardous Waste Operations Training (HAZWOPER), administered by the Washington State Department of Labor and Industries. Project personnel will be 40-hour HAZWOPER trained and maintain their training with an annual 8-hour refresher. Personnel with limited tasks and minimal exposure potential will be required to have 24-hour training and a site hazard briefing, and be escorted by a trained employee. Personnel with defined tasks that do not include potential contact with disturbed Site soils or waste or exposures to visible dust are not required to have any level of hazardous waste training beyond a site emergency briefing and hazard orientation by the HSO/SS. Floyd|Snider project personnel will fulfill the medical surveillance program requirements.

In addition to the 40-hour course and 8-hour refreshers, the HSO/SS will have completed an 8-hour HAZWOPER Supervisor training as required by WAC 296-843-20015. At least one person on-site during field work will have current cardiopulmonary resuscitation (CPR)/First Aid certification. All field personnel must have a minimum of 3 days of hazardous materials field experience under the direction of a skilled supervisor. Documentation is readily available at the Floyd|Snider's main office.

Additional site-specific training that covers on-site hazards, PPE requirements, use and limitations, decontamination procedures, and emergency response information as outlined in this HASP will be given by the HSO/SS before on-site work activities begin. Daily health and safety meetings will be documented on the Daily Tailgate Safety Meeting form included as Attachment D.1.

4.6 MEDICAL SURVEILLANCE

All Floyd|Snider field personnel are required to participate in Floyd|Snider's medical surveillance program, which includes biennial audiometric and physical examinations for employees involved in HAZWOPER projects. The program requires medical clearance before respirator use or participating in HAZWOPER activities. Medical examinations must be completed before conducting field work activities and on a biennial basis.

5.0 Hazard Evaluation and Risk Analysis

In general, there are three broad hazard categories that may be encountered during site work: chemical exposure hazards, fire/explosion hazards, and physical hazards. Sections 5.1 through 5.3 discuss the specific hazards that fall within each of these broad categories.

5.1 CHEMICAL EXPOSURE HAZARDS

This section describes potential chemical hazards associated with soil boring, monitoring well installation, and soil and groundwater sampling. Based on previous Site investigations, the following chemicals could be present:

- Stoddard solvent in soil and groundwater
- Penta in soil and groundwater
- Dioxins/furans in soil
- Volatile organic compounds (VOCs) and cVOCs in groundwater.

Human health hazards of these chemicals are discussed in the table below. This information covers potential toxic effects which might occur if relatively significant acute and/or chronic exposure were to happen. This information does not mean that such effects will occur from the planned activities. Potential routes of exposure include inhalation, dermal contact, ingestion, and eye contact. The primary exposure route of concern during site work is ingestion of contaminated soil, though such exposure is considered unlikely and highly preventable. In general, the chemicals which may be encountered are not expected to be present at concentrations which could produce significant exposures. The types of planned work activities and use of monitoring procedures and protective measures will limit potential exposures. The use of appropriate PPE and decontamination practices will assist in controlling exposure through all pathways to the key contaminants of concern listed in the table below.

Chemical Hazard	DOSH Permissible Exposure Limits (8-hr TWA/STEL)	Routes of Exposure	Potential Toxic Effects
Stoddard solvent	100 ppm	Inhalation, Ingestion, skin/eye contact	Irritation to eyes, nose, throat; dizziness; dermal irritation; chemical pneumonitis (if liquid solvent is aspirated)
Pentachlorophenol	0.5 mg/m^3 / 1.5 mg/m^3 (skin)	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, nose, throat; sneezing, coughing, weakness; weight loss; sweating; headache; dizziness; nausea; chest pain; fever; dermatitis.

Chemical Hazard	DOSH Permissible Exposure Limits (8-hr TWA/STEL)	Routes of Exposure	Potential Toxic Effects
Dioxins/Furans (as 2,3,7,8-tetrachloro-dibenzo-*p*-dioxin)	NA	Inhalation, skin absorption, ingestion, skin/eye contact	Eye irritation; dermatitis; chloracne; porphyria; GI disturbance; possible reproductive effects.
Benzene	1 ppm	Inhalation, skin absorption, ingestion, skin/eye contact	Central nervous system depression; convulsions and paralysis; polyneuritis; eye, mucous membrane, and skin irritation
Tetrachloroethene	25 ppm / 38 ppm	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, nose, throat, nausea, flushed skin, vertigo, dizziness, incoherence, sleepiness, liver damage.
Trichloroethene	50 ppm / 200 ppm	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, skin; headache; vertigo; vision disturbance; fatigue; tremors/jitters; sleepiness; nausea; dermatitis; cardiac arrhythmia; paresthesia; liver injury.
cis-1,2-Dichloroethene	200 ppm	Inhalation, skin absorption, ingestion, skin/eye contact	Eye, respiratory system irritation; nervous system depression, light-headedness, dizziness, euphoria, nausea, vomiting, weakness, tremor, gastric cramps; dermatitis.
Vinyl Chloride	1 ppm /100 ppm	Inhalation, skin absorption, ingestion, skin/eye contact	Liver and kidney damage, neurological effects, cardiovascular effects
Alconox soap (used for equipment decontamination)	Not applicable	Dermal contact, eye contact	Irritation to skin or eyes; Avoid contact through proper use of PPE

Abbreviations:

DOSH	Division of Occupational Safety and Health
GI	Gastro-intestinal
hr	Hour
mg/m^3	Milligrams per cubic meter
ppm	Parts per million
STEL	Short-term exposure limit
TWA	Time-weighted average

Chemical and physical properties for hazardous substances expected at the Site, including those listed above are located in the Material Safety Data Sheets notebook maintained in the field vehicle.

5.2 FIRE AND EXPLOSION HAZARDS

Flammable and combustible liquid hazards may occur from fuels and lubricants brought to the Site to support heavy equipment. When on-site storage is necessary, such material will be stored in containers approved by the Washington State Department of Transportation (WSDOT) in a location not exposed to strike hazards and provided with secondary containment. A minimum 2-A:20-B fire extinguisher will be located within 25 feet of the storage location and where refueling occurs. Any subcontractors bringing flammable and combustible liquid hazards to the Site are responsible for providing appropriate material for containment and spill response, and such hazards should be addressed in their respective HASP. Transferring of flammable liquids (e.g., gasoline) will occur only after making positive metal to metal connection between the containers. A bonding strap may be necessary to achieve this. Storage of ignition and combustible materials will be kept away from storage and fueling operations.

5.3 PHYSICAL HAZARDS

When working in or around any hazardous or potentially hazardous substances or situations, all site personnel should plan all activities before starting any task. Site personnel shall identify health and safety hazards involved with the work planned and consult with the HSO/SS as to how the task can be performed in the safest manner. Personnel will also consult the HSO/SS if they have any concerns or uncertainties.

All field personnel will adhere to general safety rules including wearing appropriate PPE, hard hats, steel-toed boots, safety vests, and safety glasses. Eating, drinking, and/or use of tobacco or cosmetics will be restricted in all work areas. Personnel will prevent splashing of liquids containing chemicals and minimize dust emissions.

The following table summarizes a variety of physical hazards that may be encountered on the Site during work activities. For convenience, these hazards have been categorized into several general groupings with recommended preventative measures.

Hazard	Cause	Prevention
Head Strike	Falling and/or sharp objects, bumping hazards.	Hard hats will be worn by all personnel at all times when overhead hazards exist, such as around large, heavy equipment.
Foot/ankle Twist, Crush, Slip/trip/fall	Sharp objects, dropped objects, uneven and/or slippery surfaces.	Steel-toed boots must be worn at all times on-site while heavy equipment is present. Pay attention to footing on uneven or wet terrain and do not run. Keep work areas organized and free from unmarked trip hazards.
Hand Cuts, Splinters, and Chemical Contact	Hands or fingers pinched or crushed. Cut or splinters from handling sharp/rough objects and tools.	Nitrile safety gloves will be worn to protect the hands from dust and chemicals. Leather or cotton outer gloves will be used when handling sharp-edged rough materials or equipment. Refer to the preventive measures for Mechanical Hazards below.

Hazard	Cause	Prevention
Eye Damage from Flying Materials, or Splash Hazards	Sharp objects, poor lighting, exposure due to flying debris or splashes.	Safety glasses will be worn at all times on-site. If a pressure washer is used to decontaminate heavy equipment, a face shield will be worn over safety glasses or goggles. Care will be taken during decontamination procedures to avoid splashing or dropping equipment into decontamination water. Face shields may be worn over safety glasses if splashing is occurring during decontamination
Electrical Hazards	Underground utilities, overhead utilities, electrical cord hazards.	Utility locator service will be used prior to any investigation to locate all underground utilities. Visual inspection of work areas will be conducted prior to starting work. Whenever possible, avoid working under overhead high voltage lines. Make sure that no damage to extension cords occurs. If an extension cord is used, make sure it is the proper size for the load that is being served and inspected prior to use for defects. The plug connection on each end should be of good integrity. Insulation must be intact and extend to the plugs at either end of the cord. All portable power tools will be inspected for defects before use and must either be a double-insulated design or grounded with a ground-fault circuit interrupter (GFCI).
Mechanical Hazards	Heavy equipment such as drills, etc.	Ensure the use of competent operators, backup alarms, regular maintenance, daily mechanical checks, and proper guards. Subcontractors will supply their own HASP. All project personnel will make eye contact with operator and obtain a clear OK before approaching or working within swing radius of heavy equipment, staying clear of swing radius. Obey on-site speed limits. Personnel will stand clear of machinery at all times unless specific instructions are given by the person in authority. Steel-toed boots will be worn at all times and hardhats will be worn when overhead hazards are present. When possible, appropriate guards will be in place during equipment use.
Traffic Hazards	Vehicle traffic and hazards when working near public right-of-ways.	When working around active site operations, orange cones and/or flagging will be placed around the work area. Safety vests will be worn at all times while conducting work. Multiple field staff will work together (buddy system) and spot traffic for each other if necessary. Avoid working with your back to traffic whenever possible. **Further details on traffic hazards are provided in Section 5.3.4.**

Hazard	Cause	Prevention
Hearing Damage due to Noise	Machinery creating more than 85 decibels TWA, less than 115 decibels continuous noise, or peak at less than 140 decibels.	Wear earplugs or protective ear muffs when a conversational level of speech is difficult to hear at a distance of 3 feet; when in doubt, a sound level meter may be used on-site to document noise exposure.
Strains from Improper Lifting	Injury due to improper lifting techniques, overreaching/ overextending, or lifting overly heavy objects.	Use proper lifting techniques and mechanical devices where appropriate. The proper lifting procedure first involves testing the weight of the load by tipping it. If in doubt, ask for help. Do not attempt to lift a heavy load alone. Take a good stance and plant your feet firmly with legs apart, one foot farther back than the other. Make sure you stand on a level area with no slick spots or loose gravel. Use as much of your hands as possible, not just your fingers. Keep your back straight, almost vertical. Bend at the hips, holding load close to your body. Keep the weight of your body over your feet for good balance. Use large leg muscles to lift. Push up with one foot positioned in the rear as you start to lift. Avoid quick, jerky movements and twisting motions. Turn the forward foot and point it in the direction of the eventual movement. Never try to lift more than you are accustomed to.
Cold Stress	Cold temperatures and related exposure on and offshore.	Workers will wear appropriate clothing, stay dry, and take breaks in a heated environment when working in freezing temperatures. **Further details on cold stress are provided in Section 5.3.1.**
Heat Exposure	High temperatures exacerbated by PPE and/or dehydration.	Workers will ensure adequate hydration, shade, and breaks when temperatures are elevated. **Further details on heat stress are provided in Section 5.3.2.**
Poor Air Quality Exposure	Typically related to higher concentrations of particulates in wildfire smoke in late summer/fall.	Workers monitor ambient air quality and potential symptoms of exposure to higher-than-normal levels of particulates from wildfire smoke. **Refer to Section 6.1 for more details on-site monitoring for wildfire smoke.**
Accidents due to Inadequate Lighting	Improper illumination.	Work will proceed during daylight hours only or under sufficient artificial light.

5.3.1 Cold Stress

During field work, exposure to cold temperature and rain may occur. Exposure to moderate levels of cold can cause the body's internal temperature to drop to a dangerously low level, causing hypothermia. Symptoms of hypothermia include slow, slurred speech; mental confusion; forgetfulness; memory lapses; lack of coordination; and drowsiness.

To prevent hypothermia, site personnel will stay dry and avoid exposure. Site personnel will have access to a warm, dry area, such as a vehicle, to take breaks from the cold weather and warm up. Site personnel will be encouraged to wear sufficient clothing in layers such that outer clothing is wind- and waterproof and inner layers retain warmth (wool or polypropylene), if applicable. Site personnel will keep hands and feet well protected at all times. The signs and symptoms and treatment for hypothermia are summarized below:

Signs and Symptoms

- Mild hypothermia (body temperature of 98–90 degrees Fahrenheit [°F])
  - Shivering.
  - Lack of coordination, stumbling, fumbling hands.
  - Slurred speech.
  - Memory loss.
  - Pale, purplish gray, or dusky cold skin.
- Moderate hypothermia (body temperature of 90–86 °F)
  - Shivering stops.
  - Unable to walk or stand.
  - Confused and irrational.
- Severe hypothermia (body temperature of 86–78 °F)
  - Severe muscle stiffness.
  - Very sleepy or unconscious.
  - Ice-cold skin.
  - Death.

Treatment of Hypothermia (Proper treatment depends on the severity of the hypothermia.)

- Mild hypothermia
  - Move to warm area.
  - Stay active.
  - Remove wet clothes and replace with dry clothes or blankets and cover the head.
  - Drink warm (not hot) sugary drinks.

- Moderate hypothermia
  - All of the above, plus:
    - call 911 for an ambulance,
    - cover all extremities completely, and
    - place very warm objects such as hot packs or water bottles on the victim's head, neck, chest, and groin.
- Severe hypothermia
  - Call 911 for an ambulance.
  - Treat the victim very gently.
  - Do not attempt to re-warm—the victim should receive treatment in a hospital.

Frostbite

Frostbite occurs when the skin actually freezes and loses water. In severe cases, amputation of the frostbitten area may be required. While frostbite usually occurs when the temperatures are 30 °F or lower, windchill factors can allow frostbite to occur in above-freezing temperatures. Frostbite typically affects the extremities, particularly the feet and hands. Frostbite symptoms include cold, tingling, stinging, or aching feelings in the frostbitten area followed by numbness and skin discoloration: Paler skin may change from red to purple, then to white or very pale, and darker skin may become more pale, dusky, or purplish. Frostbitten skin will be waxy and firm while still frozen and may redden, swell, or blister when thawed. Should any of these symptoms be observed, wrap the area in soft cloth—do not rub the affected area—and seek medical assistance. Call 911 if the condition is severe.

Protective Clothing

Wearing the right clothing is the most important way to avoid cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. The following are recommendations for working in cold environments:

- Wear *at least three layers* of clothing:
  - An outer layer to break the wind and allow some ventilation (like Gortex or nylon).
  - A middle layer of down or wool to absorb sweat and provide insulation even when wet.
  - An inner layer of cotton or synthetic weave to allow ventilation.
- Wear a hat—up to 40 percent of body heat can be lost when the head is left exposed.
- Wear insulated boots or other footwear.
- Keep a change of dry clothing available in case work clothes become wet.
- Do not wear tight clothing—loose clothing allows better ventilation.

Work Practices

- Drinking: Drink plenty of liquids, avoiding caffeine and alcohol. It is easy to become dehydrated in cold weather.
- Work Schedule: If possible, heavy work should be scheduled during the warmer parts of the day. Take breaks out of the cold in heated vehicles.
- Buddy System: Try to work in pairs to keep an eye on each other and watch for signs of cold stress.

5.3.2 Heat Stress

To avoid heat-related illness, current regulations in WAC 296-62-095 through 296-62-09570 will be followed during all outdoor work activities. These regulations apply to any outdoor work environment from May 1 through September 30, annually when workers are exposed to temperatures above 89 °F when wearing breathable clothing, above 77 °F when wearing double-layered woven clothing such as jackets or coveralls, or above 52 °F when wearing non-breathing clothing such as chemical resistant suits or Tyvek. Floyd|Snider will identify and evaluate temperature, humidity, and other environmental factors associated with heat-related illness including but not limited to the provision of rest breaks that are adjusted for environmental factors, and encourage frequent consumption of drinking water. Drinking water will be provided and made readily accessible in sufficient quantity to provide at least 1 quart per employee per hour. All Floyd|Snider personnel will be informed and trained for responding to signs or symptoms of possible heat-related illness and accessing medical aid.

Employees showing signs or demonstrating symptoms of heat-related illness must be relieved from duty and provided with a sufficient means to reduce body temperature, including rest areas or temperature controlled environments (i.e., air conditioned vehicle). Any employee showing signs or demonstrating symptoms of heat-related illness must be carefully evaluated to determine whether it is appropriate to return to work or if medical attention is necessary.

Any incidence of heat-related illness must be immediately reported to the employer directly through the HSO/SS.

The signs, symptoms, and treatment of heat stress are given in the table on the next page.

Condition	Signs/Symptoms	Treatment
Heat Cramps	Painful muscle spasms and heavy sweating.	Increase water intake, rest in shade/cool environment.
Heat Syncope	Brief fainting and blurred vision.	Increase water intake, rest in shade/cool environment.
Dehydration	Fatigue, reduced movement, headaches.	Increase water intake, rest in shade/cool environment.
Heat Exhaustion	Pale and clammy skin, possible fainting, weakness, fatigue, nausea, dizziness, heaving, sweating, blurred vision, body temperature slightly elevated.	Lie down in cool environment, increase water intake, and loosen clothing; call 911 for ambulance transport if symptoms continue once in cool environment.
Heat Stroke	Cessation of sweating, skin hot and dry, red face, high body temperature, unconsciousness, collapse, convulsions, confusion or erratic behavior, life threatening condition.	**Medical Emergency! Call 911** for ambulance transport. Move victim to shade and immerse in water.

If site temperatures are forecast to exceed 85 °F and physically demanding site work will occur in impermeable clothing, the HSO/SS will promptly consult with a certified industrial hygienist (CIH) and a radial pulse monitoring method will be implemented to ensure that heat stress is properly managed among the affected workers. The following heat index chart indicates the relative risk of heat stress:

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution Extreme Caution Danger Extreme Danger

5.3.3 Biohazards

Bees and other insects may be encountered during the field work tasks, though less commonly during winter months. Persons with allergies to bees will make the HSO/SS aware of their allergies and will avoid areas where bees are identified. Controls such as repellents, hoods, nettings, masks, or other personal protection may be used. Report any insect bites or stings to the HSO/SS and seek first aid if necessary.

Site personnel will maintain a safe distance from any urban wildlife encountered, including raccoons and rodents, to preclude a bite from a sick or injured animal. Personnel will be gloved and will use tools to lift covers from catch basins and monitoring wells.

5.3.4 Traffic Hazards

While work is being performed near any haul lanes established for construction traffic or in the ROW, barricades should be utilized. Spotters will be used to ensure traffic is monitored during work activities because signs, signals, and barricades do not always provide appropriate protection. All workers will wear reflective high visibility neon/orange vests. Although street closures are not anticipated for off-Site work, traffic control plans and City-issued permits will be required for any street closures. If street closures are required, an addendum to this HASP will be required to document the health and safety procedures associated with street closure and use of flaggers.

5.4 SITE CONTROLS FOR AIRBORNE DISEASE

At the time of the preparation of this HASP, workplaces in the State of Washington are under restrictions designed to mitigate the spread of COVID-19. These restrictions include requirements to stay home when sick, maintain distance between workers, and wear face coverings. Detailed protocols for the known best practices regarding COVID-19 safety are presented in Attachment D.2. These best practices will be implemented as applicable at the time that the work is conducted. Work areas and work practices will also be designed to comply with any additional state and facility operational requirements, if established, at the time of work.

6.0 Site Monitoring

The following sections describe site monitoring techniques and equipment that will be used during site field activities. The HSO/SS, or a designated alternate, is responsible for site control and monitoring activities.

6.1 SITE MONITORING

Since the Property is in an active industrial area, and noise generating activities will be conducted within the Property boundary and adjacent ROW, noise levels are expected to be below the allowable levels.

Visual monitoring for dust will be conducted by the HSO/SS to ensure inhalation of contaminated soil particles does not occur during sampling activities. If visible dust is present in the work area, work will cease and the area will be cleared until the dust settles.

If wildfire smoke is present, the on-site HSO will inform field personnel of the AQI forecast for the day and will regularly inform field personnel of any changes to the AQI. The HSO will monitor the AQI using U.S. Environmental Protection Agency AirNow, available at www.airnow.gov, or a similar state or federal AQI modeling service. Additionally, the HSO will monitor real-time air quality using an air quality detector capable of measuring $PM_{2.5}$. Table D.1 shows the AQI categories, equivalent $PM_{2.5}$ measurement in micrograms per cubic meter ($\mu g/m^3$), the level of health concern, and associated actions.

Table D.1
Air Quality Measures and Actions

AQI Categories for $PM_{2.5}$	$PM_{2.5}$ ($\mu g/m^3$)	Levels of Health Concern	Action
0 to 50	0 to 12.0	Good	None (1)
51 to 100	12.1 to 35.4	Moderate	None (1)
101 to 150	35.5 to 55.4	Unhealthy for Sensitive Groups	None (1)
151 to 200	55.5 to 150.4	Unhealthy	Respirator use
201 to 300	150.5 to 250.4	Very Unhealthy	Respirator use
301 to 500	250.5 to 500.4	Hazardous	Stop Work

Note:
1 Respirators can be worn at lower AQI levels based on personal preference.

Concentrations of VOCs, total petroleum hydrocarbon (TPH), or penta in soil are not expected to result in vapor concentrations that exceed allowable OSHA levels. All work will be conducted outdoors in an open-air ventilated environment. A photoionization detector (PID) will be used on-site for characterization of soil samples collected. This PID will also be used to monitor vapor concentrations in breathing air of total volatile chemicals in parts per million that can be detected using this method. Should the PID read a sustained concentration of total volatile chemicals above the lowest action level sustained for 15 minutes, the HSO/SS will stop work and evacuate the area until vapor concentrations return to background levels. As needed, actions may be taken to reduce exposure to vapor concentrations in the work area by covering exposed soil, and leaving the work area until odor dissipates.

The HSO/SS will visually inspect the work site at least daily to identify any new potential hazards. If new potential hazards are identified, immediate measures will be taken to eliminate or reduce the risks associated with these hazards.

Monitoring Equipment	Readings (1)	Action (2)
PID	<1 ppmv (8-hour TWA for volatiles); <5 ppm for 15 mins	Continue operations in Level D PPE
	>5 and <10 ppmv; intermittent	Identify source of concentrations if possible (vehicle emissions, exposed contaminated material, etc.) Implement engineering controls to reduce concentrations for continued operations (move work area upwind of operating equipment, cover exposed contaminated material, etc.); resume work only if PID indicates VOC is less than the OSHA PEL of 5 ppm in breathing zone.
	>10 ppmv; sustained	Stop operations and evacuate area, identify source of concentrations if possible (vehicle emissions, exposed contaminated material, etc.) Implement engineering controls to reduce concentrations for continued operations (move work area upwind of operating equipment, cover exposed contaminated material, etc.); resume work only if PID indicates VOC is less than the OSHA PEL of 5 ppm in breathing zone.

Notes:
1 Action levels prior to and during drilling activities.
2 OSHA short-term exposure limit (STEL) is a 15-minute TWA exposure that should not be exceeded at any time during a workday.

Abbreviation:
PEL Permissible Exposure Limit
ppmv Parts per million by volume

7.0 Hazard Analysis by Task

The following section identifies potential hazards associated with each task listed in Section 3.2 of this HASP. Tasks have been grouped according to the types of potential hazard associated with them.

Task	Potential Hazard
Installation of soil borings and wells, well development	Exposure to loud noise; overhead hazards; head, foot, ankle, hand, and eye hazards; electrical and mechanical hazards; lifting hazards; dust inhalation hazards; potential dermal or eye exposure to Site contaminants in groundwater and soil; fall hazards; traffic hazards; and heat and cold exposure hazards.
Soil and groundwater sampling	Chemical hazards include potential dermal or eye exposure to Site contaminants in soil and groundwater. Physical hazards include slip, trip, or fall hazards; dust inhalation hazards; heat and cold exposure hazards.

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8.0 Personal Protective Equipment

All work involving heavy equipment will proceed in Level D PPE, which shall include hard hat, steel-toed boots, hearing protection, eye protection, and protective gloves.

All personnel will be properly fitted and trained in the use of PPE. The level of protection will be upgraded by the HSO/SS whenever warranted by conditions present in the work area. The HSO/SS will periodically inspect equipment such as gloves and hard hats for defects.

For all work involving potential exposure to soil, workers will wear nitrile gloves and Level D PPE. Safety vests will be worn at all times on-site. Personnel will wear rain suits on windy, rainy days to prevent hypothermia.

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9.0 Site Control and Communication

9.1 SITE CONTROL

The Property is fenced and access will be restricted to designated personnel. Activities conducted off-Site in the ROW will be controlled through the use of barricades, flagging, or similar measures. If members of the public enter the work area, field staff will stop work until the public have left the work area.

The purpose of site control is to minimize the public's potential exposure to site hazards, to prevent vandalism in the work area and access by children and other unauthorized persons, and to provide adequate facilities for workers.

Work area controls and decontamination areas will be provided to limit the potential for chemical exposure associated with site activities, and transfer of contaminated media from one area of the Site to another. The support zone (SZ) for the work area includes all areas outside the work area and decontamination areas. An exclusion zone (EZ), contamination reduction zone (CRZ), and SZ will be set up for activities conducted within the Property or in the ROW. Only authorized personnel shall be permitted access to the EZ/CRZ. Staff will decontaminate all equipment and gear as necessary prior to exiting the work area.

9.2 COMMUNICATION

The primary means of communication on-site and with off-site contacts will be via cell phones. An agreed-upon system of alerting via air horns and/or vehicle horns may be used around heavy equipment to signal an emergency if shouting is ineffective.

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10.0 Decontamination

Decontamination procedures will be strictly followed to prevent off-site spread of contaminated materials. Decontamination effectiveness will be assessed by visual inspection by the HSO/SS.

Before eating, drinking, and use of tobacco, hands must be thoroughly washed.

Decontamination for activities requiring Level D protection will consist of the following (note that not all of the equipment described below must be used for Level D PPE):

- Remove and dispose of gloves
- Remove, wash, and rinse hard hat (if soiled)
- Remove, wash, and rinse goggles
- Remove safety boots or shoes
- Wash and rinse face and hands

Vehicle and large equipment decontamination will be conducted on a temporary decontamination pad. Equipment and vehicle decontamination generally consists of pressure washing with detergent solution followed by a potable water rinse. Equipment decontamination water will be contained and managed by the construction Contractor. Decontamination fluids and/or waste soils generated during sampling will be disposed off-site. Soil disposal will be the managed by the construction Contractor.

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11.0 Emergency Response and Contingency Plan

This section defines the emergency action plan. It will be rehearsed with all site personnel and reviewed whenever the plan is modified or the HSO/SS believes that site personnel are unclear about the appropriate emergency actions.

A point of refuge will be identified by the HSO/SS and communicated to the field team each day. This point will be clear of adjacent hazards and preferably upwind or crosswind for the entire day. In an emergency, all site personnel and visitors will evacuate to the point of refuge for roll call. It is important that each person on-site understand their role in an emergency, and that they remain calm and act efficiently to ensure everyone's safety.

After each emergency is resolved, the entire project team will meet and debrief on the incident—the purpose is not to fix blame, but to improve the planning and response to future emergencies. The debriefing will review the sequence of events, what was done well, and what can be improved. The debriefing will be documented in a written format and communicated to the PM. Modifications to the emergency plan will be approved by the PM.

Reasonably foreseeable emergency situations include medical emergencies, accidental release of hazardous materials (such as gasoline or diesel) or hazardous waste, and general emergencies such as vehicle accident, fire, thunderstorm, and earthquake. Expected actions for each potential incident are outlined below.

11.1 MEDICAL EMERGENCIES

In the event of a medical emergency, the following procedures should be used:

- Stop any imminent hazard if you can safely do so.
- Remove ill, injured, or exposed person(s) from immediate danger if moving them will clearly not cause them harm and no hazards exist to the rescuers.
- Evacuate other on-site personnel to a safe place in an upwind or crosswind direction until it is safe for work to resume.
- If serious injury or life-threatening condition exists, call 911 for paramedics, the fire department, and police.
- Clearly describe the location, injury, and conditions to the dispatcher. Designate a person to go to the Site entrance and direct emergency equipment to the injured person(s). Provide the responders with a copy of this HASP to alert them to chemicals of potential concern.
- Trained personnel may provide first aid/cardiopulmonary resuscitation if it is necessary and safe to do so. Remove contaminated clothing and PPE only if this can be done without endangering the injured person.
- Call the HSO/SS and PM.
- Immediately implement steps to prevent recurrence of the accident.

A map showing the nearest hospital location is located in Section 2.

11.2 ACCIDENTAL RELEASE OF HAZARDOUS MATERIALS OR WASTES

1. Evacuate all on-site personnel to a safe place in an upwind direction until the HSO/SS determines that it is safe for work to resume.
2. Instruct a designated person to contact the PM and confirm a response.
3. Contain the spill, if it is possible and can be done safely.
4. If the release is not stopped, call 911 to alert the fire department.
5. Contact the Washington State Emergency Response Commission at 1-800-258-5990 to report the release.
6. Initiate cleanup.
7. The PM will coordinate follow-up written reporting to the Washington State Department of Ecology in the event of a reportable release of hazardous materials or wastes.

11.3 GENERAL EMERGENCIES

In the case of fire, explosion, earthquake, or imminent hazards, work shall be halted and all on-site personnel will be immediately evacuated to a safe place. The local police/fire department shall be notified if the emergency poses a continuing hazard by calling 911.

In the event of a thunderstorm, outdoor work will be discontinued until the threat of lightning has abated. During the incipient phase of a fire, the available fire extinguisher(s) may be used by persons trained in putting out fires, if it is safe for them to do so. Contact the fire department as soon as feasible.

11.4 EMERGENCY COMMUNICATIONS

In the case of an emergency, an air horn or car horn will be used as needed to signal the emergency. One long (5-second) blast will be given as the emergency/stop work signal. If the air horn is not working, a vehicle horn and/or overhead waving of arms will be used to signal the emergency. In any emergency, all personnel will evacuate to the designated refuge area and await further instruction.

11.5 EMERGENCY EQUIPMENT

The following minimum emergency equipment will be readily available on-site and functional at all times:

- First Aid Kit—contents approved by the HSO/SS.

- Sorbent materials capable of absorbing the volume of liquids/fuels brought to the Site by Floyd|Snider personnel.
- Portable fire extinguisher (2-A:10 B/C min).
- A copy of the current HASP.

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12.0 Administrative

12.1 MEDICAL SURVEILLANCE

Floyd|Snider personnel involved with field activities must be covered under Floyd|Snider's medical surveillance program that includes biennial physical examinations. These medical monitoring programs must be in compliance with all applicable worker health and safety regulations.

12.2 RECORD KEEPING

The HSO/SS, or a designated alternate, will be responsible for keeping attendance lists of personnel present at site health and safety meetings, accident reports, and signatures of all personnel who have read this HASP. A daily tailgate safety meeting form and near-miss and incident reporting form are provided in Attachment D.1.

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13.0 Approvals

Project Manager	Date
Project Health & Safety Officer	Date

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14.0 Signature Page

I have read this Health and Safety Plan and understand its contents. I agree to abide by its provisions and will immediately notify the HSO/SS if site conditions or hazards not specifically designated herein are encountered.

Name (Print)	Signature	Date

Whitehead Tyee Site

Remedial Investigation Work Plan

Appendix D
Health and Safety Plan

Attachment D.1
Daily Tailgate Safety Meeting Form

DAILY TAILGATE SAFETY MEETING AND DEBRIEF FORM

Instructions:
To be completed by supervisor prior to beginning of work each day, when changes in work procedures occur, or when additional hazards are present. Please maintain a copy of this form with the site-specific HASP for the record.

PROJECT NAME AND ADDRESS:	**WORK COMPLETED/TOOLS USED:**

TOPICS/HAZARDS DISCUSSED:

Chemicals of concern:
Slip, trip, fall:
Heat or cold stress:
Required PPE:
Other Potential Hazards:
• Environmental:
• Physical:
• Biological:
• Other :

INFORMAL TRAINING CONDUCTED (Name, topics):

NAMES OF EMPLOYEES:

ADDITIONAL HAZARDS IDENTIFIED AT END OF WORK DAY:

Near Misses/Incidents? If so proceed to Page 2 Near Miss and Incident Reporting Form

Supervisor's Signature/Date: ____

NEAR MISS AND INCIDENT REPORTING FORM

INCIDENTS:

INJURIES:

NEAR MISSES:

CORRECTIVE ACTIONS:

Supervisor's Signature/Date: ____

Whitehead Tyee Site

Remedial Investigation Work Plan

Appendix D
Health and Safety Plan

Attachment D.2
Floyd|Snider Standard Guideline:
COVID-19 Health and Safety Guidelines

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F|S STANDARD GUIDELINE

COVID-19 Health and Safety Guidelines

This Special Condition must be appended to all Floyd|Snider Standard Guidelines beginning immediately (March 26, 2020) and until such a time that the COVID-19 crisis is no longer a Washington health risk as determined by the Governor of the State of Washington.

Floyd|Snider is dedicated to helping our community during this unique time in history. Our work is essential to the continued protection of our community and the environment. As such, this special condition is to inform our staff on how to comply with the "Washington Ready" Order issued by the Washington Governor effective July 1, 2021, and the Department of Labor and Industries Division of Occupational Safety and Health's *General Coronavirus Prevention Under Stay Safe – Stay Healthy Order*, updated on July 7, 2021, as well as continue our business safely.

Much of our work can be done from home, but there is vital work that must be done in the field to collect data, implement construction, and move forward our clients' essential work. We will continue our field work in a safe and thoughtful manner, acknowledging that there may be cases where it is determined that field work will be delayed, due to lack of needed supplies; concerns with availability of staff or teaming partners; or concerns regarding potential exposure risks to our staff members, clients, subcontractors or the public. This Special Condition follows Washington State Department of Health Recommendations and Guidance to Protect Critical Infrastructure Workers during COVID-19 Pandemic (April 2020) and, where applicable, incorporates COVID-19-specific protocols for job sites issued in the Washington Governor's Phase 3 plan to resume non-essential construction. We also look to daily updates in health guidance around the Delta variant.

DATE/LAST UPDATE: August 2021

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines and special procedures for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines and special conditions with the field manager or project manager and identify any deviations from *these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines and special conditions.*

1.0 Special Condition Applicability

Much of our field work is done outside and can be done while maintaining safe social distancing (defined as maintaining 6 feet of distance between people at all times). Adjustments will be made as needed to move field work forward while ensuring staff safety. Decisions regarding going forward with field work or postponing will be made on an event-by-event basis by the Project Manager (PM), in consultation with Principals as necessary.

ALL field staff have stop work authority. If at any time you feel uncomfortable with the planned work, or cannot safely complete a task once onsite, stop work and communicate with your project team. Employee health and safety takes precedence over schedule and budget. Keep your PM informed of any concerns so the team can identify a solution.

2.0 Equipment and Supplies

The following is a list of additional equipment and supplies necessary to maintain health and safety during the COVID-19 pandemic. This list is intended as a guide to facilitate planning and preparation and is not intended to be all encompassing.

- Project-specific personal protection equipment (PPE), including but not limited to, disposable nitrile gloves, work gloves, safety glasses, and cloth face coverings (when appropriate)
- Hand cleaner, including soap and water or hand sanitizer. 5-gallon buckets may be used to create a temporary wash station.
- Surface cleaner, including disinfection wipes, paper towels, and spray disinfectant
    - Household bleach intended for disinfection according to the manufacturer's label, 70% isopropyl alcohol and/or a USEPA-registered household disinfectant
    - Distilled or deionized water
    - Spray bottles
- Trash bags

3.0 Special Condition Guidelines and/or Procedures

This special condition outlines Floyd|Snider's general requirements to keep employees safe including requirements regarding staying home when sick, considerations in determining if field work can proceed, additional field preparation requirements, safety precautions to take while in the field, and communication protocols at the completion of field events.

If you or someone you are in direct extended contact with are at high-risk for severe illness from COVID-19 (are age 65 or older; live in a nursing home or long-term care facility; suffer from heart conditions, lung disease, asthma; are immunocompromised; or are pregnant) and you are not available to perform field work due to heightened risk, communicate with your PM and help to identify suitable backup personnel to complete the field work.

As mentioned above, everyone has stop work ability. If you feel uncomfortable with an assigned task, before or during fieldwork, pause and speak with your PM.

3.1 FLOYD|SNIDER GENERAL REQUIREMENTS AROUND COVID-19

Floyd|Snider employees must follow Centers for Disease Control and Prevention (CDC) guidance for quarantine and self-isolation in the event of COVID-19 exposure or infection (https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/quarantine.html). It is critical that individuals NOT report to work, which includes field work, while they or anyone they have come in direct contact with is experiencing symptoms of illness such as fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, sore throat, new loss of sense of taste or smell, congestion or runny nose, nausea or vomiting, or diarrhea. Individuals should consult their doctor over the phone and potentially seek medical attention if they develop these symptoms, especially any respiratory illness. Employees should stay at home in the following situations:

- If you come into close contact with a person with confirmed or suspected COVID-19, monitor your health for the symptoms listed above during the 14 days after the last day you were in close contact. Close contact is defined by the CDC as being within 6 feet of a person for a cumulative time of 15 or more minutes over a 24-hour period, unless you have been fully vaccinated. People who are fully vaccinated do not need to quarantine after contact with someone who had COVID-19 unless they have symptoms. However, fully vaccinated people should get tested 3 to 5 days after their exposure, even if they don't have symptoms and wear a mask indoors in public for 14 days following exposure or until their test result is negative. Unvaccinated/partially vaccinated people should not go to work or school and avoid public places for 14 days after exposure, or for 7 days if a COVID-19 test result administered at least 5 days after the potential exposure is negative.
- If you suspect that you have been exposed to COVID-19, notify your PM if you are part of a field team and help to identify suitable backup personnel to complete the field work.
- If you are experiencing any of the symptoms listed above, stay home and do not return to work until you are free of fever (100.4 °F [38.0 °C] or greater using an oral thermometer), signs of a fever, and any other symptoms for at least 24 hours,[1] without the use of fever-reducing or other symptom-altering medicines (e.g., cough suppressants), and at least 10 days have passed since symptoms first appeared. If you

[1] Excludes loss of taste and smell, which may persist for weeks or months after recovery in the absence of an active viral infection.

test positive for COVID-19 but do not experience symptoms, do not return to work for at least 10 days after receiving a positive test.

- If you have a confirmed case of COVID-19, you must tell Tiffany Volosin immediately, and she will relay information to the firm and any subconsultants you have come in contact with in the field, without revealing your identity. You will then be required to remain home until cleared by a medical professional.

3.1.1 Interim Guidance for Fully Vaccinated People

Vaccines are highly effective at protecting vaccinated people against symptomatic and severe COVID-19. For the purpose of these guidelines, people are considered fully vaccinated for COVID-19 2 weeks after receiving the second dose of a two-dose vaccine (Pfizer-BioNTech or Moderna), or 2 weeks after receiving a single-dose vaccine (Johnson and Johnson). Vaccines are widely available and all staff are encouraged to get vaccinated. According to the CDC guidelines, fully vaccinated personnel can share indoor space with other fully vaccinated people without wearing masks or physical distancing under some circumstances; however, masks are still required to be worn when working indoors at a client facility and in common spaces in the Floyd|Snider office and are highly encouraged for all indoor gatherings of Floyd|Snider staff.

Fully vaccinated personnel should continue to:

- Avoid medium- and large-sized in-person gatherings
- Get tested if experiencing COVID-19 symptoms
- In public spaces, continue to wear masks, practice physical distancing, and adhere to other prevention measures. The level of precautions taken should be determined by the risk profile of the unvaccinated people, who remain unprotected against COVID-19, or those who provide direct care for unvaccinated individuals.

If an employee begins to experience COVID-19 symptoms, they must follow the self-isolation, testing, and notification steps described above. While interim CDC guidance advises that persons who are fully vaccinated or have recovered from a COVID-19 infection within the past 3 months do not need to self-isolate after coming into close contact with a person who has a suspected or confirmed case of COVID-19, Floyd|Snider staff with a known COVID-19 exposure should still follow self-isolation protocols.

3.2 GENERAL CDC GUIDANCE ON STAYING HEALTHY

Current CDC guidance advises that COVID-19 is primarily spread through close contact with infected individuals, where respiratory droplets created by coughing, sneezing, or talking may be inhaled by others nearby. In poorly ventilated indoor settings, respiratory droplets may also remain in the air and be inhaled even after an infected person has left the vicinity. Contact with contaminated surfaces is a less common way for the virus to spread. General guidelines from the CDC can be found at https://www.cdc.gov/coronavirus/2019-nCoV/index.html. Basic hygiene requirements provided by the CDC include the following:

- Practice and encourage good respiratory etiquette.
    - Avoid close (within 6 feet) contact with other people. Because COVID-19 can be carried by people who do not show symptoms, proper distancing is necessary to reduce potential for transfer.
    - Wear a face covering (cloth mask or filtering facepiece) to supplement social distancing practices and further reduce the potential for transfer.
    - Avoid poorly ventilated shared indoor spaces; whenever possible, let outdoor air in.
    - If you or someone you are in direct contact with are ill, you must stay home.
- Practice and encourage good hand hygiene.
    - Wash your hands often with soap and water for at least 20 seconds, especially after coming in contact with high-touch surfaces; direct contact with another person; going to the bathroom; before eating; and after blowing your nose, coughing, or sneezing.
    - If soap and water are unavailable, use an alcohol-based hand sanitizer that contains at least 60 percent alcohol to clean hands.
    - Avoid touching your face and your face covering.
    - Routinely disinfect high-touch surfaces such as doorknobs, light switches, cell phones, toilets, faucets and sinks, and vehicle controls.

3.3 PLANNING FOR FIELD WORK

The primary consideration for field work is whether the work can be performed without exacerbating the risk that a member of the team or members of the community where the team is working may experience health impacts due to a COVID-19 infection. As part of the field work planning process, the project team must review the following to make a threshold decision regarding whether the work may go forward or should be postponed.

- Will the work expose unvaccinated people or people at high risk of complications to potential COVID-19 infection?
    - Does the work require use of subcontractors or equipment or involve other conditions that would make maintaining a safe social distance (6 feet) difficult?
    - Can the work be conducted outdoors or in other large and well-ventilated spaces?
    - Does the work require anyone (vaccinated or unvaccinated) to gather in a group larger than 10 individuals?
- Is interacting closely with the public required to conduct the work?

Decisions regarding postponing a field event will be made on an event-by-event basis by the PM, in consultation with Principals as necessary. Reasons for postponing may include management concerns, field staff concerns, availability of field equipment or PPE necessary to complete the work, or subcontractor availability or safety concerns.

If it is determined that the field work will move forward, field planning must include the following steps:

- Designate a COVID-19 Supervisor. This may be the Health and Safety Officer (HSO), Site Safety Officer (SSO), or another member of the field team. The COVID-19 Supervisor is responsible for ensuring that all field staff read, understand, and follow this Special Condition.
- Confirm subcontractor/subconsultants have COVID-19 policies/procedures in place for their and your protection:
  - What is their corporate stance on the current condition?
  - What protocols will they put in place to ensure that their workers are safe?
  - What protocols will they put in place to reduce potential exposure to our workers and the public?
- If multiple subcontractors will be performing work at the site, stagger their work times when possible to minimize the number of personnel onsite at one time.
- Confirm with your laboratory and equipment vendors (if using rental equipment) what protocols they have in place for pickup/drop off, business hours, and any other changes from their standard operating procedures and turnaround times that may affect your fieldwork.
- If fieldwork is out of town:
  - If feasible, consider commuting to jobsites from home rather than staying overnight to minimize potential exposure.
  - If an overnight stay is necessary, avoid accommodations with shared hallway spaces or ventilation systems. Coordinate with the accommodations to confirm they are still open and ensure they are disinfecting high touch surfaces in rooms appropriately.
  - Avoid shared accommodations among unvaccinated staff or with staff who may be at increased risk of complication from COVID-19 infection.
- Discuss potential risk factors that may arise during the work with your project team. Take extra caution to limit the potential for these risk factors to impact you.
- Prior to mobilization, coordinate with the client or local businesses to identify restroom and hand-washing facilities available for use and confirm their sanitation practices.
  - Consider renting portable restrooms and hand-washing stations for field events that do not have a restroom onsite. It may not be possible to find a nearby business that will allow you to enter and use the restroom.
  - Request additional/increased sanitation (disinfecting) of portable toilets and hand-washing stations, at least twice per week, and ensure they are fully stocked.

- Conduct an inventory check for PPE including gloves, paper towels, soap and water, sanitizer wipes and spray disinfectant, and hand sanitizer. If any of these necessary items are not available in sufficient quantity, coordinate with Tyler Scott or Terry Duncan, and if not available in time, coordinate with your PM to determine if work can be rescheduled. Identify additional supplies to bring to the site to support safe work. For example:
  - **Work Stations:** Think through how you will maintain social distancing (minimum of 6 feet) on your site. If you are processing soil or sediment samples, bring two tables to allow for two different workspaces. Identify alternative methods for moving heavy equipment if it is usually a two-person job, and have the equipment necessary to complete this work in a safe manner. Move indoor tasks outdoors whenever possible and avoid prolonged use of shared indoor spaces.
  - **Hand-Washing Stations:** If you will not have access to a restroom facility, bring extra buckets, deionized water, and soap to set up your own hand-washing station onsite.
- Bring sufficient copies of field documents/forms and pens, etc., to allow for each employee to have their own set and use electronic communication whenever possible. Determine which staff member will use field notebooks and pens and maintain that individual setup throughout the day's work.
- Coordinate with the client and/or facility manager if the site is located at an active facility to ensure that this Special Condition meets the COVID-19 safety requirements of that facility. Brief field staff on any additional facility-specific COVID-19 safety requirements.

3.4 PERFORMING FIELD WORK

3.4.1 Prior to Fieldwork and Entering the Site

The day before fieldwork: The HSO should call all employees to confirm healthy status prior to mobilization to the field. If a staff member answers "yes" to any of the questions below, they will not be allowed to complete the fieldwork. For all subcontractors, the HSO should contact the subcontractor to ask the following questions to their field staff assigned to the job prior to their arrival at the site. Note that subcontractors may have different policies regarding self-quarantine requirements for fully vaccinated personnel. If a subcontractor answers "yes" to any of the questions, a project-specific determination must be made in coordination with the PM to decide whether the work can safely proceed.

- Have you had any potential exposure to COVID-19 that requires you to self-isolate per the CDC guidelines?
  - Have you, or anyone in your household, been in contact with a person that has tested positive for COVID-19 within the last 14 days?
  - Have you, or anyone in your household, been in contact with a person that is in the process of being tested for COVID-19 or suspects they are ill from COVID-19?

- Have you been medically directed to self-quarantine due to possible exposure to COVID-19?
- Have you experienced symptoms within the past 48 hours, including temperature greater than 100.4 °F or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, sore throat, new loss of sense of taste or smell, congestion or runny nose, nausea or vomiting, or diarrhea?

Prior to Entering the Site: The SSO or COVID-19 Supervisor must ask the above questions again to all staff (Floyd|Snider and subcontractors) prior to beginning work and should continue to assess throughout the day.

- Anyone who has met any of the above criteria and **is not displaying symptoms** must immediately leave the site, the HSO shall notify their PM, and the employee may not return to the site for 14 days.
- Anyone meeting any of the above criteria who **is displaying symptoms** or starts to feel unwell onsite must immediately leave the site, should seek immediate medical advice, notify Tiffany Volosin (and their office manager if a subcontractor), and remain home until medical clearance is received.
- If any person arriving onsite shows obvious symptoms of illness, they will be sent home immediately, prior to accessing the jobsite.
- If possible, employees should take their temperature at the beginning of the work day prior to arriving onsite. Anyone with a temperature of 100.4 °F or higher should notify the HSO and should not report to the jobsite. Note that some facilities or clients may require temperature checks for workers at the start of each shift.

3.4.2 During Mobilization

- Wear gloves during equipment and cooler loading.
- Keep field vehicles stocked with disinfecting wipes, hand sanitizer, and spray disinfectant supplies.
- If using the field van or a rental vehicle, wipe down the door handles (inside and out), steering wheel, shifters (gearing, windshield wipers, turn signals, etc.), radio dials, and any other frequently touched area with a disinfecting wipe (or spray and wipe with disinfectant solution) when you enter and when you exit the vehicle.

3.4.3 During Field Work

- Avoid shared vehicles among unvaccinated staff or with staff who may be at increased risk of complication from COVID-19 infection. If necessary, commute separately to field sites to maintain social distancing. Check with your PM to determine whether separate vehicles are a project-billable or admin expense. If shared vehicles among unvaccinated or high-risk staff are necessary due to extraordinary constraints on access to the job site, spread out passengers to the extent possible and open the vehicle windows to provide ventilation.

- Each onsite employee shall keep a copy of this Special Condition at an accessible location (such as a vehicle dashboard) at all times while onsite.
- The designated COVID-19 Supervisor should review the procedures in this Special Condition daily during tailgate safety meetings. By attending the safety meeting, field staff signal their commitment to adhere to these procedures
- Maintain 6-foot distance from others. When close contact is unavoidable, stop work and discuss how to proceed, such as dividing tasks or additional disinfection methods.
    - Conduct Safety Meetings in small groups while maintaining distance. The Field Lead/SSO will note all attendees rather than passing around sign in sheets to confirm attendance.
    - Identify "choke points" where workers may pass by each other closely or congregate and modify work practices or control these areas to ensure that social distancing is maintained.
- Conduct work outdoors or in large, well-ventilated spaces. Minimize the number of people in shared indoors spaces and the time that individuals spend inside these spaces.
- Implement "Take 5"s. Take 5 minutes between EACH task to identify new hazards, possible ways for unacceptable contact to occur, and methods to avoid those conditions. Record results of these Take 5s in the field notebook or the tailgate safety meeting form.
- Gloves should be worn at all times while onsite. This includes wearing gloves when handling coolers and equipment, when packing equipment and gear, during bottle delivery to the laboratory, and during completion of the work. While wearing gloves for all activities, also be cognizant of the limited supply of these materials. Change gloves only when needed per our standard sampling procedures, and for compliance with this Special Condition.
    - The type of glove worn should be appropriate to the task, and work gloves should be used when acceptable rather than nitrile, recognizing the limited supply of these PPE. If gloves are not typically required for the task, then any type of glove is acceptable, and work gloves are recommended.
    - Wash hands after removing gloves to eat or drink, change tasks, or change glove types (for example, from work gloves to nitrile gloves).
- The Washington State Department of Health recommends wearing a face covering to supplement social distancing practices. The following guidelines should be followed:
    - A face covering does not take the place of social distancing and may not be used as an engineering control to implement field activities where 6-foot separation cannot be maintained between workers. A face covering may be used only as a supplement to social distancing, as recommended by health organizations, to further limit the spread of COVID-19. A face covering also does not take the place of adequate ventilation.

  - Face coverings should fit snugly over the wearer's nose and mouth, not restrict breathing, and be secured with ties or ear loops. Reusable face coverings should be constructed of multiple layers of cloth and be able to be laundered and machine dried after each use without damage or change to shape.
  - Wash or sanitize your hands before donning the face covering and do not touch the interior or exterior of the covering while in use. Coverings must be removed to eat or drink. Wash or sanitize your hands before and after removing your face covering. If possible, replace with another clean covering when you are finished eating/drinking. Reusable face coverings that have been worn and discarded should be placed in a sealed bag until they can be washed.
  - The use of face coverings in public spaces and most workplace settings may be mandated by the Washington Governor and many other state agencies. Field staff must comply with the most stringent requirements of: this Special Condition, current requirements issued by the applicable state officials regarding face coverings at the time when field work is being conducted, or by the State of Washington if working in a location where face covering guidance has not been established,
- Isolate sick field staff. CDC recommends that employees who become sick during the day should be sent home immediately. If they are unable to make their way home on their own, the employee or subconsultant should be separated from other employees. If necessary, call 911 for transport and be sure to mention any COVID-19 symptoms so emergency responders are prepared.
  - If an employee becomes sick onsite, all equipment and surfaces that employee may have come in contact with must be disinfected immediately.
  - If an employee no longer feels safe working at the site after another employee reports being ill, they are allowed to leave the site using PTO.
  - All employees should assess whether they may have come into contact (within 6 feet for a cumulative time of 15 or more minutes) within the last 48 hours. Any employee who had potential contact with the sick person should follow the procedures described in Section 3.1.
  - If a possible COVID-19 exposure occurs at the jobsite, the SSO should notify the PM immediately and complete an incident report form including details on the number of personnel who became sick or may have contacted a sick person and the circumstances of the possible exposure.
- Do not share PPE.
- Sanitize reusable PPE per manufacturer's recommendation prior to each use.
- Ensure used disposable PPE is disposed of properly.
- Eye protection should be worn all times while onsite.
- Job site offices/trailers and break/lunchrooms must be cleaned at least twice per day (doorknobs, keyboards, counters, and other high-touch surfaces).

- When possible, take breaks and lunch in shifts to aid in social distancing.
- Do not use a common water cooler. All staff should bring their own filled water bottles sufficient for the day.
- Utilize disposable hand towels and no-touch trash receptacles, when possible.
- Avoid cleaning techniques, such as using pressurized air or water sprays, that may result in the generation of bioaerosols. If these methods are required, ensure that all other staff are outside of and well away from the spray area, and confirm use of proper PPE, including eye protection, before starting cleaning.

3.3.4 During Demobilization

- Wear gloves during equipment and cooler loading and unloading.
- Keep field vehicles stocked with disinfecting wipes and hand sanitizer.
- If using the field van or a rental vehicle, wipe down the door handles (inside and out), steering wheel, shifters (gearing, windshield wipers, turn signals, etc.), radio dials, and any other frequently touched area with a disinfecting wipe when you enter and when you exit the vehicle.
- Disinfect frequently touched items such as clipboards, pens, handheld instrument controls, and devices and accessories. Site-specific decontamination procedures for reusable equipment that comes into contact with sample material and Site-specific decontamination protocols should continue to be followed for these pieces of sampling equipment.
    - If using a commercial disinfectant solution, mix and apply according to the manufacturer's instructions. If using a household bleach solution, dilute at a ratio of 4 teaspoons per quart of water, spray to cover surfaces and allow to sit for at least 1 minute before drying with a disposable towel if needed. Note that bleach solutions must be prepared daily. If using 70-percent isopropyl alcohol solution, spray directly on surfaces and allow to dry for at least 1 minute.