710 S. Myrtle Street

Current Situation Report and Subsurface Investigation Work Plan

Prepared for

Seattle Iron and Metals Corporation
601 South Myrtle Street
Seattle, WA 98108

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DRAFT

FLOYD | SNIDER
strategy ▪ science ▪ engineering
Two Union Square • 601 Union Street • Suite 600
Seattle, Washington 98101 • tel: 206.292.2078

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Table of Contents

List of Tables

List of Figures

List of Appendices

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
Agreement	Settlement Agreement
AO	Agreed Order
bgs	Below ground surface
City	City of Seattle
COC	Contaminant of concern
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
CSR	Current Situation Report

Acronym/ Abbreviation	Definition
cVOC	Chlorinated volatile organic compound
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
Fremont	Fremont Analytical
GWCC	Great Western International Chemical Company
HSA	Hollow-stem auger
ISGP	Industrial Stormwater General Permit
LCS	Laboratory control sample
LCSD	Laboratory control sample duplicate
LDW	Lower Duwamish Waterway
MS	Matrix spike
MSD	Matrix spike duplicate
µg/L	Micrograms per liter
MTCA	Model Toxics Control Act
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PCHB	Pollution Control Hearings Board
penta	Pentachlorophenol
PID	Photoionization detector
ppm	Parts per million
ppt	Parts per trillion
property	730 S. Myrtle Street Property
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RI/FS	Remedial Investigation/Feasibility Study
ROW	Right-of-way
RPD	Relative percent difference
SAP	Sampling and Analysis Plan
SES	Sound Earth Strategies
SIM	Seattle Iron & Metals
SIWP	Subsurface Investigation Work Plan
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin

Acronym/ Abbreviation	Definition
TEF	Toxicity equivalency factor
TEQ	Toxicity equivalent
TPH	Total petroleum hydrocarbon
Tyee Lumber	Tyee Lumber and Manufacturing Company
USEPA	U.S. Environmental Protection Agency
UST	Underground storage tank
VCP	Voluntary Cleanup Plan
WAC	Washington Administrative Code

1.0 Introduction

This Current Situation Report (CSR) and Subsurface Investigation Work Plan (SIWP) was prepared by Floyd|Snider at the request of Seattle Iron & Metals (SIM) and describes the historical operations, surrounding area, and current available subsurface data (soil and groundwater) for the former Tyee Lumber and Manufacturing Company (Tyee Lumber) facility located at 730 S. Myrtle Street Property (the property). The CSR/SIWP includes a Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) that describes the organization, objectives, and specific quality assurance/quality control (QA/QC) procedures for planned field and laboratory activities associated with surface and subsurface soil and groundwater characterization to be conducted to fill associated data gaps at the property. Refer to Figure 1.1 for the geographic location of the property and Figure 1.2 for property specific features.

The primary objective of this investigation is to fill key data gaps related to potential subsurface impacts prior to execution of the stormwater improvement project scheduled for summer 2016. In general, because the stormwater improvements are being constructed on-property, the investigatory focus is on-property or adjacent to the property. Off-property groundwater impacts will be further investigated in subsequent Remedial Investigation/Feasibility Study (RI/FS) work phases. The key data gaps intended to be filled during this investigation phase are presented in Section 1.4 below.

The proposed work will also address a number of secondary objectives, which include:

- Determination of the nature and extent of soil and groundwater contaminant concentrations at the property, focusing on the on-property area that exceed potentially applicable cleanup levels. Potential applicable soil and groundwater cleanup levels for the property include the Washington Department of Ecology (Ecology's) Model Toxics Control Act (MTCA) Method A Unrestricted and Industrial cleanup levels and MTCA Method C cancer and non-cancer cleanup levels for contaminants without MTCA Method A cleanup levels (Washington Administrative Code [WAC] 173-340-820 [Ecology 2007]).
- Development of an understanding of the spatial relationship between the primary contaminants pentachlorophenol (penta) and dioxins/furans (i.e., if penta and dioxins/furans tend to be co-located).
- Evaluation of the potential need for an interim action at the property that would include excavation of contaminated area(s). The additional data would be used to refine the depth of the excavation.
- Collection of supplemental data to inform the handling and disposal requirements for materials excavated during the construction of the water quality treatment system (described further in Section 1.2.2 and Section 1.2.3) and remedial action(s). The data will also be used to develop a construction management plan for Ecology approval that will detail the approach to handling and disposal of any excavated materials.

- Longer term, the data acquired in this subsurface investigation will support a future RI/FS study at the property that will be required post-water quality project construction by Ecology under an Agreed Order (AO). The data would support the development of an RI/FS Work Plan, which could include the need for off-property investigations in addition to the on-property investigations.

The SAP/QAPP presented in Section 2.0 through Section 5.0 of this report was developed in accordance with the U.S. Environmental Protection Agency (USEPA) *Guidance for Quality Assurance Project Plans* (USEPA 2002) and MTCA. The SAP/QAPP describes specific protocols for field procedures, sampling, sample handling and storage, chain-of-custody, and laboratory analyses associated with this investigation.

1.1 PROPERTY DESCRIPTION

The following property information was compiled based on a review of the SoundEarth Strategies (SES) *Phase I Environmental Site Assessment* (SES 2013) and their subsequent *Summary of Subsurface Investigation Activities* (SES 2014a) and *Whitehead/Reliable Property-Off-Property Subsurface Investigation* (SES 2014b), independent historical research conducted by Floyd|Snider, and various reports associated with the adjacent Fox Avenue Site.

1.1.1 Historical Ownership and Operations

Corson Avenue historically passed from northeast to southwest through the eastern portion of the property (Figure 1.3) dividing the property into a smaller eastern portion (“eastern property”) and larger western portion (“western property”).

The western 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, a boiler house, and a lumber shed. The boiler was fueled by a sawdust/refuse burner. According to Sanborn map review, by 1929, the Williams Fir Finish Co. operated at the western property.

By the early 1920s, the sawmill was expanded to include a shop and storage, an office, and a lunch room. A dry kiln was built on the western property in 1928 and a second dry kiln was added in 1947. These kilns were heated by steam from the boiler house. Sometime between 1929 and 1949, Tyee Lumber & Manufacturing, Co. (“Tyee Lumber I”) took over operations on the western property. By the early 1950s, Tyee Lumber I operated on both the western and eastern Property. Tyee Lumber I, which subsequently changed its name to Tyee Industries, Inc. (“Tyee Industries”), operated on the Property until 1981 when mill operations were taken over by a new Delaware company also called Tyee Lumber & Manufacturing Co. (“Tyee Lumber II”). Tyee Lumber II operated on the Property until 1986.

The layout of the facility remained very similar through years of operation. Tyee Lumber I operated a sawmill and finishing operation, which included the treatment of lumber in a penta top-loading dip tank (refer to Figure 1.3 for the location of the dip tank). The dip tank was approximately 10 to 15 feet long, 5 feet wide, and 5 to 6 feet deep. The dip tank was covered by an open shed. Hart Crowser reported that Tyee Lumber I dipped green lumber and moved it to a storage shed in the northwest corner of the property for drying (Hart Crowser 1992). The lumber was then processed and dried in the kiln, as well as being air dried or stored outside the kilns. Tyee Lumber I also had a gluing operation located in the Finger Jointing Mill (Figure 1.3), and associated machines were located in the eastern portion of the building and were used for dying dipped lumber. Hart Crowser reported that interviewees indicated that a whitish liquid would run along the building and pond in the transfer shed along Fox Avenue S. often overflowing onto the former Great Western International Chemical Company (GWCC) property to the north. It is unclear if Tyee Lumber II also used the dip tank and/or gluing facilities when it took over operations of the Property in 1981.

Previous environmental reports and review of aerial photographs indicate that wood treatment and preservation operations occurred south of the property, within the City of Seattle (City) S. Myrtle Street right-of-way (ROW) and not within property boundaries. The dip tank shed was situated within S. Myrtle Street. SES reported that a 300-gallon penta underground storage tank (UST) was located adjacent to the dip tank. The penta UST was reportedly decommissioned in 1986 when The Whitehead Company, Inc. (Whitehead) and Reliable Transfer & Storage Co. (Reliable) purchased the property from William Paul and Ann Duncan (Paul Duncan purchased the Property from Tyee Industries in 1982). The former dip tank and UST area is known to be contaminated with total petroleum hydrocarbons (TPH), specifically Stoddard Solvent, penta, and dioxins/furans associated with historical operations of the penta dip tank and UST.

By 1929, the eastern property was developed with residential properties and a garage. This garage was built in 1927 and remained on the eastern property until at least 1949. An automotive and truck repair shop was also located on the eastern property in 1949. The garage and the automotive and truck repair shop were likely removed in the early 1950s when a resaw mill and lunch room were built on the eastern property. SES subsurface investigation activities did not identify contamination in this area.

Hart Crowser reported that the western property was leased from King County until 1953 when the land transferred to Mesher Supply Co., who then subsequently sold the western property to Tyee Lumber I in 1955 (Hart Crowser 1992). Hart Crowser also reported that Tyee Lumber I also purchased the eastern property in 1950 and constructed additional warehousing and manufacturing space. Tyee Lumber I used the Corson Avenue S. ROW for material laydown until abandonment of the road by the city occurred in 1963.

According to Hart Crowser, in the late-1950s Tyee Lumber I expanded south of S. Myrtle Street. This expansion included construction of the main office building and additional warehouse space at 765 S. Myrtle Street and additional warehousing space (701 S. Myrtle Street). The main operations at Tyee Lumber I included plane-finishing and re-sawing rough-milled lumber for use in finished millwork. As shown of Figure 1.3, the plant including planing mills, steam dry-kilns, a boiler plant, and a wood refuse burner. By 1950, a window sash operation was added in the in the location of a former planing mill area north of S. Myrtle Street.

Table 1.1 summarizes dates of construction and operations in each building or structure and correlates to the numbers on the buildings shown in Figure 1.3.

1.1.2 Current Ownership and Operations

Whitehead and Reliable acquired the property in 1986. Decommissioning and removal of the penta UST, dip tank, and related equipment and improvements was reportedly a condition of taking ownership.

Since 1999, SIM has leased the property for truck and container storage. These containers are used to collect and store scrap metals, but only empty containers are stored on-property. The property is unpaved and unimproved, with no functional stormwater conveyance system. A small open-air metal shed is located on the east/central portion of the property, and is the only structure present. This shed is used for light maintenance activities on containers, such as spot welding. No metal processing is conducted on this property, and no metal shred, automobile shredder residue, or related materials are stored on-property. The property is considered “Local Trucking with Storage” (SIC Code 4214).

The property is divided into three operational areas by internal fencing running north to south. The western most area is used as an equipment staging yard, typically used for truck or car parking, the center area is the container and equipment storage yard, and the eastern most area as the export yard. Normal operations consist of trucks and trailers entering from S. Myrtle Street through the unfenced equipment staging yard and proceeding into the fenced equipment storage yard. Trucks and trailers can also enter the equipment storage yard from S. Myrtle Street through the entrance gate of the export yard. Trucks typically enter in the central equipment storage yard to drop off or pick up empty collection bins.

The export yard on the far eastern side of site is used for staging loaded shipping containers bound for overseas delivery. Trucks entering the export yard via the S. Myrtle Street gate primarily to drop-off or pick-up loaded shipping containers.

1.1.3 Adjacent Properties Description

The property is located approximately 450 to 500 feet from the Lower Duwamish Waterway (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. Additionally, the entire segment of the LDW in the vicinity of the SIM facility is designated as a Superfund Site by the USEPA due to sediment contamination.

The property is bordered by the Fox Avenue Site to the north, Seattle Boiler Works to the west (across Fox Avenue S.), SIM to the southwest (across S. Myrtle Street), a former nightclub to the east (was historically a former gasoline station), and Commercial Welding, Caffe D’Arte Roasting Plant, Sea Native USA WA (seafood processing), and United Rentals Trench Safety to the south. In the vicinity of the property, there is mixed and industrial use consistent with the area’s zoning;

surrounding properties are shown on Figure 1.2. Additional description of the cleanup sites adjacent to the property is included below.

1.1.3.1 Fox Avenue Site Cleanup

Cascade Columbia Distribution, also known as the Fox Avenue Site MTCA cleanup site, is located immediately north and adjacent to the property. The Fox Avenue Site has recently undergone active source removal remedial actions and is currently in a post-remedial polishing stage of remediation (Floyd|Snider 2015). The Fox Avenue Site has documented chlorinated volatile organic compound (cVOC) contamination in both groundwater and soil. A cVOC groundwater plume from the Fox Avenue Site crosses the western third of the subject property toward the S. Myrtle Street Embayment, where groundwater discharges into the LDW (refer to Figure 1.4 for the approximate extent of the total cVOC plume at concentrations greater than 500 micrograms per liter [µg/L]). All active remediation in known source areas was complete in 2013 and the site is in the post-thermal polishing phase, which includes enhanced reductive dechlorination and long-term groundwater monitoring. Further details regarding the Fox Avenue Site, including a summary of existing data, are presented in Section 1.3.1.

1.1.3.2 Lower Duwamish Superfund

The *Final Lower Duwamish Waterway Remedial Investigation Report* (Windward 2010) and *Final Lower Duwamish Waterway Feasibility Study* (AECOM 2012), known collectively as the LDW Final RI/FS under Superfund Order with USEPA, identified contaminants of concern (COCs) including: 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 (WAC 173-204). The Record of Decision (ROD) for the LDW Superfund Site was issued by USEPA in November 2014 and outlines the final cleanup plan for the LDW (USEPA 2014a). This plan requires parties to clean up the LDW and to complete source control actions (primarily stormwater upgrades) to prevent recontamination of the sediments.

The property is not immediately adjacent to the Duwamish, however, groundwater from the property has the potential to be transported through the subsurface soil and discharge to the LDW. The water table at the property is located at depths of approximately 8 to 11 feet below ground surface (bgs). Stormwater runoff from the property discharges to the Duwamish, as does street and ROW runoff, and adjacent property runoff. Currently the property discharges to two separate stormwater outfalls, one at the end of S. Myrtle Street and one at the end of S. Brighton Street.

1.2 REGULATORY HISTORY

The property has a significant regulatory history beginning in 1991 to the present. The timeline of this history is described below.

1.2.1 Model Toxics Control Act

Contamination at the property was identified as early as 1991 as part of investigations conducted for the Fox Avenue Site. These investigations identified an area of elevated penta in groundwater in the S. Myrtle Street ROW area. Since then, information regarding known property contamination has been reported to Ecology as part of the Fox Avenue Site RI/FS process. As per above, this includes a cVOC plume extending across the western portion of the property, and ongoing monitoring of this plume as part of the Fox Avenue Site. While this cVOC groundwater plume is part of the Fox Avenue Site, releases associated with the wood treating activities (i.e., penta dip tank in the right of way) have been considered a separate release relating to Tyee, and not historical operations at the Fox Avenue Site.

On April 24, 2013, the Whitehead's received an Early Notice Letter from Ecology related to the release of solvents. This Letter indicated that Ecology intended to add the property to the known or suspected contaminated sites list. In response, Whitehead's submitted an application and was enrolled in Ecology's Voluntary Cleanup Plan (VCP) program in October 2013. The property is now listed on Ecology's Contaminated Sites list with a Facility/Site Identification No. 9809.

1.2.2 National Pollutant Discharge Elimination System Regulatory History

SIM's operations on the property are covered by an Industrial Stormwater General Permit (ISGP; WAR-125002), issued to SIM by Ecology on May 31, 2011, and as modified on May 16, 2012. The ISGP is a National Pollutant Discharge Elimination System and State permit for stormwater discharges associated with industrial activities. Ecology's Water Quality program requested SIM seek coverage based on the potential for pollutant-generating activities to impact stormwater.

SIM has been working cooperatively with Ecology towards a comprehensive stormwater solution for the property. Because the property is unpaved, stormwater runoff is very turbid, and fully addressing stormwater treatment has been complicated by property ownership and an absence of any stormwater conveyance structures. The best stormwater solution for the property involves grading, paving, installation of a stormwater conveyance system, installation of pre-treatment, and installation of an appropriate stormwater treatment system. SIM has been willing to install stormwater improvements, but only with a clear path to property ownership.

On June 19, 2012 Ecology issued a Notice of Penalty Incurred and Due, Docket No. 9180 (Penalty; Ecology 2012) to SIM for alleged violations of ISGP WAR 125002. On July 20, 2012 SIM filed an appeal to the Pollution Control Hearings Board (PCHB) challenging both the imposition and amount of the Penalty, given the history of cooperation with Ecology. As a result of the appeal the Settlement Agreement (Agreement; PCHB Case No. 12-076 – Motion and Order to Dismiss with Prejudice, dated February 28, 2013 and incorporated attachment PCHB No. 12-076– Settlement Agreement) was reached reducing the amount of the Penalty, requiring the preparation of an Engineering Design Report (EDR) for proposed conveyance system improvements at the property, approval of a revised Stormwater Pollution Prevention Plan, and additional monitoring in compliance with automobile salvage and scrap metal recycling industrial use. Per the terms of the Agreement, KPFF Consulting Engineers prepared the EDR and submitted it to Ecology on April 29, 2013 The EDR has been conditionally approved by Ecology as of November 22, 2013 (Ecology 2013). However the EDR specified a project schedule for a summer 2014 installation that has not been met, and the project is significantly behind schedule.

In addition to Level 1 and 2 corrective actions, to mitigate poor quality stormwater runoff, SIM has installed several rounds of interim measures allowable, including:

- Installation of a filtration berm
- Installation of a sediment trap/settling pond with interception swale to direct flow to trap.
- Enlargement of sediment trap
- On-site deployment of two, above-ground 21,000 gallon tanks and pumping necessary to move stormwater from the sediment trap pond to the above-ground tanks
- Surface flow management measures to direct back into City drainage system.

In general, stormwater quality has shown improvement with these measures, but still exceeds the ISWGP numerical criteria.

1.2.2.1 On-property stormwater improvements

Stormwater improvements, as proposed in the EDR, will collect and convey on-site stormwater to a single on-site storm drain and treatment system, with discharge through the S. Myrtle Street outfall. This configuration will provide a single point of compliance for stormwater compliance monitoring, but will require detention to avoid surcharging the existing City storm drain system in S. Myrtle Street. The proposed storm drain system is comprised of catch basins, collection and conveyance piping, manhole structures, detention piping, flow splitter structure, pre-treatment, and stormwater pump station.

The proposed stormwater collection and conveyance system is shown on Figure 1.5. All collection and conveyance piping will be connected directly to detention where the storm event flow can be directed to treatment, and where peak flows from larger storm events can be reduced to avoid surcharge of the S. Myrtle Street storm drain system. Stormwater passing through a riser at the end of the underground detention pipe will discharge to a flow splitter structure. The flow splitter consists of a 4-foot diameter manhole fitted with a baffle wall. The baffle wall functions to divert stormwater flow to below grade pre-treatment, pump station, and above grade primary treatment.

The project will provide stormwater treatment in two phases. The first phase (Phase 1) will include grading and paving of the property and installation of the stormwater collection and conveyance system, detention, flow control structure, and discharge piping from the property to the City storm drain in S. Myrtle Street, as well as pre-treatment installation and a pump station manhole. After installation of pre-treatment and the rest of Phase 1 improvements, 6 months of data will be collected to target selection of the appropriate primary treatment targeted for property operations. This is in part because existing data (for an unpaved site) does not resemble paved runoff post-pretreatment, even if the property use remains the same. Primary treatment technologies under consideration include sand filtration (un-amended and amended), passive filtration media, as well as electrocoagulation.

Overall, the stormwater conveyance system design has attempted to avoid installation of significant structures in areas known or suspected to be impacted by the penta and TPH release in the adjacent City ROW.

1.3 SUMMARY OF EXISTING DATA

A significant amount of subsurface data has already been collected at the property. The following data summary was compiled using data collected by Floyd|Snider, the SES *Summary of Subsurface Investigation Activities* (SES 2014a) and their subsequent off-property investigation completed in April/May 2014 (SES 2014b, report not generated), and a review of various reports associated with the adjacent Fox Avenue Site.

1.3.1 Fox Avenue Site (1991–2015)

The Fox Avenue Site lies immediately north of the property and is primarily contaminated with cVOCs in both the groundwater and soil.

Since 1991, the Fox Avenue Site has been under investigation and cleanup due to past releases of solvents and other chemicals during the former GWCC operations. Chemicals handled by GWCC include chlorinated solvents, mineral spirits/petroleum solvents, and penta, among others. As a result of GWCC activities, significant contamination was identified in both soil and groundwater at the Fox Avenue Site, and has been well characterized.

Over the years, investigations characterizing the nature and extent of contamination associated with adjacent properties have been conducted, and included limited soil and groundwater data collection at the property. Groundwater contamination originating from the Fox Avenue Site has impacted the northwest portion of property. Shallow and deep groundwater chlorinated solvent plumes have migrated downgradient from the Fox Avenue Site and extend across the northern third of the property to the LDW (refer to Figure 1.4 for plume extent).

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 contamination.

Fox Avenue Site investigations have also targeted penta in order to delineate both soil and groundwater contamination. Soil investigations on the property have not indicated any significant penta contamination present. In groundwater, two original source areas were identified for penta (Floyd|Snider 2011). The first penta source area is located on the south central portion of the Fox Avenue Site, adjacent to the rail corridor between Fox Avenue S. and the property (former Frontenac Street ROW), which includes the penta storage and handling areas from the historical GWCC (refer to Figure 1.6). The second penta source area is off-property near the wood-treating dip tank and UST at the former Tyee Lumber Facility adjacent to S. Myrtle Street in the City ROW and not part of the Fox Ave Site. Historically, lumber was "dipped" into the penta/petroleum spirits treating solution to preserve the wood. Additionally, the area included a UST for stored penta that was removed in 1986. The penta found on the property does not appear to be significantly commingled with the contaminant plumes associated with the Fox Avenue Site; however, there may be some plume overlap in the vicinity of the Fox Avenue Site well MW-7.

Over the years, a number of samples have been collected to determine the extent of penta contamination in groundwater as part of investigations at the Fox Avenue Site. Penta has not been detected in the downgradient wells along S. Myrtle Street. Seep samples (12 samples over multiple years) and surface water samples (6 samples over multiple years) were collected and analyzed for penta. No penta was detected at detection limits as low as 0.5 µg/L. Five surface sediment samples and two sediment cores have been collected in the LDW in areas where groundwater could potentially discharge. No penta was detected in the surface samples. No penta was detected in Core LDW-SC42 in front of SIM; penta was detected in Core LDW-SC41 at the S. Myrtle Street Embayment at concentrations between 16 and 40 µg/kg, considerably less than the SMS Sediment Cleanup Objective of 360 µg/kg and possible attributable to treated wood in the embayment. Penta releases to the subsurface are believed to have occurred in the 1970s and early 1980s, giving them sufficient time to have reached steady state conditions. Therefore, although penta in groundwater exists at the property, these concentrations are bounded; the groundwater plume originating from former Tyee Lumber operations is fairly localized and not reaching the river.

1.3.2 Floyd|Snider Investigation (2013)

In March 2013, Floyd|Snider completed a subsurface soil investigation in advance of the installation of the planned stormwater conveyance system. The primary focus of this investigation was to chemically characterize the soils to be excavated during the installation for disposal characterization. A total of 30 soil samples were collected during this investigation and 22 were analyzed, with both discrete and composite soil samples analyzed. Eight samples were collected but not analyzed because field screening using a PID indicated no evidence of volatile constituents such as TPH/Stoddard Solvent.

Analytical results showed that elevated concentrations of penta and Stoddard Solvent in smear zone soil near the former UST and dip tank appeared to be localized, indicative of a possible release in that area to groundwater. The 2013 soil analytical results are summarized on in Table 1.2 and sample locations are shown on Figure 1.7. At one location within the source area (GP-2), Stoddard Solvent was detected at a concentration of 5,290 parts per million (ppm), greater than MTCA Method A cleanup level of 4,000 ppm. Penta was also detected at this location, at a concentration of 8.95 ppm. At two other locations within the source area (GP-3 and GP-4) Stoddard Solvent was not detected at concentrations greater than MTCA Method A cleanup level, but was detected at concentrations of 109 and 3,950 ppm, respectively. Penta was also detected, at concentrations of 7.11 and 9.76 ppm, respectively. All detected penta concentrations were well below the MTCA Method C cleanup level of 330 ppm.

TPH was detected at a concentration greater than MTCA Method A at one additional location in the northwest of the Site (GP-10). TPH quantified as heavy oil was detected at a concentration of 7,850 ppm. Although trace penta is present at this location (0.19 ppm), TPH at this location is presumed to be the result of an incidental release during normal operations because it is present in surface soils distant from the location of the historical dip tank but in the vicinity of the main entrance and truck route through the gravel lot.

In addition, localized concentrations of tetrachloroethylene (PCE), Stoddard Solvent, and heavy oil-range organics were detected in soil on the western portion of the property; concentrations were all less than applicable cleanup levels. None of the soil samples collected exhibited elevated concentrations of metals.

Overall, results of this investigation indicated that limited contamination is present in soils on the Property, with only two samples exceeding MTCA Method A cleanup levels for TPH (one for Stoddard Solvent and one for heavy oil-range organics) and no other exceedances present. Contamination is primarily located in the historical dip tank area in saturated soils, consistent with historic site use.

1.3.3 Sound Earth Strategies Investigations (2013−2014)

In December 2013, January 2014, and April 2014, SES completed subsurface investigations to assess impacts to soil and groundwater from recognized environmental conditions identified, as summarized in their Phase I ESA. In general, soil and groundwater samples within the vicinity of the penta UST and dip dank, SES reported that concentrations of TPH, Stoddard Solvent, and penta were consistently detected at concentrations greater than their respective MTCA cleanup levels. CVOCs were also detected in soil and groundwater at a lesser frequency, and appear to be associated with the Fox Avenue Site. Other constituents analyzed in soil, including metals, were not detected at concentrations greater than their respective MTCA cleanup levels. Soil analytical results from 2013 and 2014 are summarized in Table 1.3 and sample locations are shown on Figure 1.6 (groundwater) and Figure 1.7 (soil).

1.3.3.1 December 2013 and January 2014 Investigations

Eleven soil borings (B01 through B11, see Figure 1.8) were advanced at the property, each to a depth of 20 feet bgs. Boring locations were selected to assess potential source areas that may have affected soil and groundwater quality at the property. Borings B01 through B04 were advanced on the southern portion of the property, to the north of the former off-property penta UST and dip tank; borings B05 through B08 were advanced in the vicinity of the former on-property automotive repair facilities; B09 was advanced directly west of the eastern property boundary, adjacent to the former off-property gasoline station; and borings B10 and B11 were advanced in the northeast corner of the property. Additionally, SES collected groundwater samples from newly installed monitoring wells MW01 through MW04 and existing Fox Avenue Site monitoring wells MW-7 and B-38.

Soil

In soil sample B01 at 12 feet bgs, concentrations of diesel-range organics, Stoddard Solvent, and penta were detected, but at concentrations below MTCA Method A or Method C cleanup levels respectively. No other soil sample contained detectable concentrations of TPH, Stoddard Solvent, penta, cVOCs, or benzene, toluene, ethylbenzene, and xylenes (BTEX).

Groundwater

In groundwater samples within the vicinity of the penta UST and dip dank, SES reported the following:

- Concentrations of diesel-range organics were detected in the groundwater samples collected from monitoring wells MW01, MW02, MW04, MW-7, and B-38 at concentrations greater that the cleanup level of 500 µg/L.
- Concentrations of oil-range organics were detected in the groundwater samples collected from monitoring wells MW-7 and B-38 at concentrations greater that the MTCA Method A cleanup level of 500 µg/L.
- Concentrations of Stoddard Solvent were detected in the groundwater samples collected from monitoring wells MW01, MW02, MW-7, and B-38 at concentrations greater that the MTCA Method A cleanup level of 500 µg/L.
- Concentration of penta greater than its MTCA Method C cleanup level were detected in the groundwater samples collected from monitoring wells MW01, MW02, MW04, MW-7, and B-38.

CVOCs were also detected in soil and groundwater at a lesser frequency, and appear to be associated with the Fox Avenue Site. Other constituents analyzed in soil, including metals, were not detected at concentrations greater than their respective cleanup levels as presented in Table 1.4.

1.3.3.2 April 2014 Investigation

Three soil borings (B15 to B17) were advanced off-property in the area of the former penta UST and dip tank to the south of the property, each to a depth of 15-feet bgs. The locations of the borings were selected to assess source soils for penta and Stoddard Solvent. Additionally, three 20-foot deep monitoring wells (MW-05/B12, MW-06/B13, MW-07/B14) were installed along the south side of S. Myrtle Street to assess off-property groundwater impacts. Results for soil and groundwater indicated the following:

Soil

- In locations B12, B15, B16, and B17, gasoline-range organics were detected at concentrations greater than the MTCA Method A cleanup level at a depth of 10 feet bgs (below the groundwater table). In location B17, gasoline-range organics were also detected at a concentration greater than the MTCA Method A cleanup level at 7.5 feet bgs.
- In locations B12, B15, B16, and B-17, diesel-range organics were detected at concentrations greater than the MTCA Method A cleanup level at a depth of 10 feet bgs (below the groundwater table). In locations and B-17, diesel-range organics were detected at concentrations greater than the MTCA Method A cleanup level at a depth of 5.0 ft feet bgs and 7.5 feet bgs, respectively.
- In location B-17, oil-range organics were detected at a concentration greater than the MTCA Method A cleanup level at a depth of 7.5 feet bgs.
- In locations B15, and B16, Stoddard Solvent was detected at concentrations greater than MTCA Method A cleanup level at a depth of 10 feet bgs (below the groundwater table).
- In B17, penta and Stoddard Solvent were detected at concentrations greater than their respective cleanup levels at a depth of 7.5 feet bgs. At 10 feet bgs, penta and Stoddard Solvent were detected at concentrations less than their respective MTCA cleanup level. Dioxins/furans were also analyzed in the 7.5 feet bgs sample. Dioxins/furans toxicity equivalent (TEQ) was calculated at a concentration of 8,930 parts per trillion (ppt), approximately 5 times the MTCA Method C cleanup level of 1,680 ppt.
- In B02, B03, B04, B05, B13 or B14, neither penta nor Stoddard Solvent were detected.

Groundwater

Ten monitoring wells were sampled in this monitoring event: MW-01 to MW-07, MW-7, B-18, and B-38. Wells were sampled for TPH (gasoline-, diesel, and heavy oil-range organics), Stoddard Solvent, penta, and cVOCs (PCE, trichloroethene, *cis*-1,2-dichloroethene, and vinyl chloride).

Results are summarized in Table 1.4 and indicate the following:

- MTCA Method A cleanup level exceedances of Stoddard Solvent in MW-01, MW-02, MW-04, MW-05, MW-7, and B-38 at concentrations ranging from 860 µg/L to 11,000 µg/L (in B-38 in the immediate vicinity of the source area).
- MTCA Method C cleanup level exceedances of penta in MW-01, MW-02, MW-04, MW-7, and B-38 at concentrations ranging from 6.5 µg/L to 5,300 µg/L (in B-38).
- Limited exceedances of gasoline-range and oil-range organics were detected (four wells each, with maximum concentrations again in B-38).

- Exceedances of some or all cVOCs were observed in MW-01, MW-04, MW-06, MW-07, MW-7, B-18, and B-38). These locations are spread across the western portion of the property, consistent with the Fox Avenue Site plume.

1.4 DATA GAPS

A subsurface field investigation is proposed and will include the collection of soil and groundwater samples for environmental analysis, and the preparation of a Subsurface Investigation Data Summary Report. Table 1.5 presents a detailed rationale for the field investigation program, designed to address key data gaps at the property. Figures 1.8 and 1.9 present the locations of the proposed soil borings and groundwater monitoring wells. Based on a review of historical information and current available subsurface data summarized above, the key data gaps intended to be filled during this investigation (in order of importance) include the following:

- Evaluate the nature and extent of dioxins/furans in soil around existing soil boring B-17 (depicted in Figure 1.7), where dioxins/furans were identified at elevated concentrations (about 5 times greater than the MTCA Method C cleanup level). There is currently only one soil sample result for dioxins/furans; therefore, additional soil borings are warranted to better define the vertical and horizontal extent of dioxins/furans in the source area (penta dip tank and UST area).
- Because of the high concentration of dioxins/furans present in soil in the smear zone and the fact that dioxins/furans is now a COC for the property, it is necessary to evaluate whether or not dioxins/furans are present in groundwater, and if so, to what extent. Dioxins/furans are hydrophobic, large organic compounds with multiple chlorine atoms. Dioxins/furans, therefore, have extremely low water solubilities and high partitioning coefficients. They are typically sorbed onto suspended soil particles and organic carbon and do not readily solubilize or migrate with groundwater. Dioxins/furans would therefore not be expected to be present in groundwater, or if so at negligible concentrations.
- Better define the extent of the penta and mineral spirit (Stoddard Solvent) plume in groundwater near the source area and downgradient of MW-07 (depicted in Figure 1.6).
- Confirm the elevated penta/Stoddard Solvent results in groundwater collected from wells MW-7 (Fox Avenue Site well) and MW-04 and better define the nature and extent of this plume (i.e., is it connected to an on or off-property source area or associated with the Fox Avenue Site).
- Evaluate the nature and extent of TPH, specifically heavy oil, in soil in the vicinity of boring GP-10, both in soil and groundwater to determine if the presence of TPH is localized in this area.

- Evaluate subsurface conditions in the vicinity of the stormwater treatment vault excavation area, where deep structures (10 to 12 feet bgs) will be installed as part of the stormwater conveyance system construction project.
- Per the March 2014 VCP Opinion letter from Ecology (Ecology 2014), complete preliminary evaluation of other COCs such as PCBs, polycyclic aromatic hydrocarbons (PAHs), and metals in surface soils and potentially subsurface soils (if surface contamination is identified). It should be noted that metals data has already been collected in surficial soil at the property, and metals are not present at concentrations greater than unrestricted or industrial cleanup levels.

The proposed investigation is intended to fill key data gaps in both soil and groundwater associated with known source areas at the former Tyee Lumber facility.

1.5 PROPOSED SUBSURFACE FIELD ACTIVITIES

The field activities will include the following:

- Completion of a field event for the collection of surface and subsurface soil samples at the property and downgradient of the property (12 soil borings). Soil samples will be submitted to a laboratory for analysis of penta and TPH analysis for diesel-range and heavy oil-range organics. The focus of TPH analysis is for Stoddard Solvent, which has historically been found as a contaminant at the property and is analyzed in the diesel-range organics fraction of TPH. Selected soil samples will additionally be submitted for dioxins/furans, PCBs, PAHs, and metals analysis.
- Installation and development of four monitoring wells (proposed MW-108 through MW111).
- Collection of groundwater samples from the seven existing monitoring wells installed by SES (MW-01 through MW-07), four wells on the property associated with the Fox Avenue Site (MW-7, MW-9, B-38, and B-49), and the five newly installed wells (proposed MW-108 through MW-111). If accessible, the off-site monitoring well associated with the Fox Avenue Site along S. Myrtle Street (B-36) will also be sampled.
- Transport and disposal of investigation-derived waste.

1.6 PROJECT TEAM

Lynn Grochala is the project manager and technical lead for this project. Allison Geiselbrecht is Principal-in-Charge and will provide strategic input. Amanda McKay will provide field and technical support related to soil and groundwater evaluation and cleanup levels. Kristin Anderson, GIT, will be the field lead and provide office support for the project, including data report preparation.

1.7 REPORT ORGANIZATION

The remaining sections of this SAP/QAPP present the following material:

- **Section 2.0—Field Procedures, Sampling Collection and Analytical Approach:** summarizes the protocols used for field investigation sampling at the property. Also summarizes the tiered sampling collection and analytical approach designed to meet the data objectives presented above and to minimize costs.
- **Section 3.0—Laboratory Analytical Program and Quality Assurance and Control Objectives:** details the chemicals to be analyzed, and the laboratory procedures for ensuring data quality is maintained for field sampling, following chain-of-custody protocols, laboratory analyses, and reporting.
- **Section 4.0—Data Reduction, Validation, and Laboratory Reporting:** describes the laboratory review and handling of data and reporting, and data validation procedures.
- **Section 5.0—Data Reporting:** summarizes the content of the report that will be produced after the field and laboratory efforts are complete.
- **Section 6.0—References:** lists references used in the development of this SAP/QAPP.

2.0 Sampling and Analysis Plan

The investigation will involve collecting soil and groundwater samples for laboratory analyses at the locations shown on Figure 1.8 and Figure 1.9, with sampling procedures described below, including field methodology, sample nomenclature, and sample handling and custody documentation.

The soil and groundwater sampling program for this investigation has been designed to meet the data quality objectives as previously described in Section 1.0. To minimize analytical costs to the extent practical, a tiered soil sample analytical approach will be conducted. These sampling and analytical programs are summarized below and are presented in detail in Table 1.5.

2.1 SOIL SAMPLE COLLECTION AND ANALYSIS

Floyd|Snider's standard guidelines for soil sample collection (included as Appendix A) provides general details regarding field procedures, sample collection and processing, decontamination, and field documentation. Specific details regarding sample collection at the property that are not described in Appendix A are included in this section.

The proposed 12 soil boring locations (SB-01 through SB-12) are shown on Figure 1.8. Additional soil borings (up to 5) may be advanced if there is sufficient time and if field screening indicates that additional locations are warranted.

2.1.1 Field Methods

Soil samples will be collected using direct-push and hollow-stem auger (HSA) drilling methods. Soil borings will be advanced to a minimum of 15 feet bgs using direct-push drilling. When using direct-push technology, soil cores will be collected continuously using a 5-foot-long lined sampler.

Soil borings for monitoring well installation will be advanced using HSA to a minimum depth of 16 feet 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 a 2-foot long split spoon.

All soil borings will be observed by a field technician, logged, classified according to the Unified Soil Classification System (USCS), and photographed. Soil sampling field forms are included in Appendix A.

After soil boring well and monitoring well installation, each location will be field located using both a handheld global positioning system and by taking field measurements from permanent features on the property.

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 TPH and penta. 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 2.0-foot or smaller representative intervals will be collected in a sealed and labeled bag or jar. After soil vapor has had time to approach equilibration with headspace gas, soil headspace will be screened with the PID; results will be noted on the field log.

2.1.3 Soil Sampling

A total of 12 soil borings will be installed. Soil samples for laboratory analyses will be collected from each direct-push core and HSA boring if field observations indicate potential for contamination (e.g., odors, sheen, staining, LNAPL, elevated PID readings). Sample depths and intervals may include samples above, within, and below the groundwater table. If no impacts are observable, a minimum of one sample will be collected from each boring at the groundwater interface. Samples 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 2.1 summarizes the container type, preservation method, and holding times for the analytes.

Sample collection and analysis will be tiered, as described in Table 1.5 and below.

First tier: The first tier of samples analyzed will be those samples with the greatest apparent impacts based on the field indicators. The first tier will also include a subset of samples for dioxins/furans analysis (SB-07, SB-09, SB-10) to delineate the extent of the dioxins/furans detected in the penta dip tank and UST areas. For surface and subsurface samples collected to target other potential contaminants (PCBs, semivolatile organic compounds, metals) surface soils from a depth of 0 to 2 feet bgs will be analyzed as first tier.

Second tier: Those remaining sample intervals that were collected but not analyzed will be analyzed only if the first round of results indicates the presence of analytes at concentrations greater than the appropriate MTCA Method A or C cleanup levels. For the locations where surface samples were collected for other contaminants, subsurface samples will only be analyzed if the analytes are detected at concentrations greater than their MTCA Method A or C cleanup levels in the surface samples. The laboratory may freeze the additional samples for potential future analysis if needed, extending their holding times to up to 1 year for most analytes.

2.1.4 Soil Sample Nomenclature

The sample naming format that will be used for the soil samples is: “Boring Location number (sample depth interval in feet bgs)—month/day/year of collection.” For example, a soil sample collected from SB-01 in the 0 to 1 foot interval on November 20, 2015, would be labeled

SB01(0-1)-112015. QA/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 1.5, groundwater samples will be collected from the seven existing monitoring wells on the property installed by SES (MW-01 through MW-07), four monitoring wells associated with the Fox Avenue Site (MW-7, MW-9, B-38, and B-49), and the four newly installed wells (proposed MW-108 through MW-111). If accessible, the off-site monitoring well associated with the Fox Avenue Site along S. Myrtle Street (B-36) will also be sampled.

Samples will be analyzed using the approach presented in Table 1.5. Each monitoring well will be analyzed for either TPH (proposed MW-110 only) or penta/Stoddard Solvent. A subset of samples will be also analyzed for dioxins/furans (MW-04, B-38, and proposed MW-111). Other constituents may be recommended based on the results of the soil sampling.

2.2.1 Monitoring Well Installation and Development

Monitoring well construction and development will be performed in accordance with the Floyd|Snider monitoring well construction and development standard guidelines (included as Appendix B). A 2-inch diameter polyvinyl chloride (PVC) well with a 10-foot long screen will be installed using has drilling methods unless the field geologist indicates otherwise based on the material encountered in the subsurface. The screened interval will be 6 to 16 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 in order to move water through the sand pack and surrounding soil formation. Wells will be developed until the purge water achieves visual clarity. 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 one week following the development of the new monitoring wells. All wells will be purged and sampled using low-flow procedures in accordance with the Floyd|Snider low-flow groundwater sample collection guidelines (included as Appendix C). The groundwater sample collection form to be completed during sampling is also included in Appendix C. Table 2.1 summarizes the container type used during sample collection, preservation method, and holding times for the analytes.

2.2.3 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 MW-08 on November 20, 2015, would be labeled MW-08-112015. 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 and field logbook entries will be completed for each soil 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 or 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.

2.4 HEALTH AND SAFETY

The work will be conducted in accordance with a site-specific Health and Safety Plan and workers will wear the appropriate personal protective equipment, which is currently expected to be Level D or modified Level D based on existing data. Level D consists of steel toe boots, safety glasses or goggles, and protective gloves to limit exposure to contaminated media.

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 LABORATORY ANALYSES

Samples will be transported to Fremont Analytical (Fremont) located in Seattle, Washington for chemical analysis. The samples collected will be analyzed for the following chemicals as indicated on Table 3.1, by the methods for soil and groundwater indicated below:

- TPH as diesel-range organics by NWTPH-Dx
- TPH-as heavy oil-range organics by NWTPH-Dx
- Penta by USEPA Method 8051 or USEPA Method 8270SIM
- Heavy metals by USEPA Method 6020/7471
- Semivolatile organic compounds by USEPA Method 8270D (includes cPAHs)
- Aroclor PCBs by USEPA Method 8082
- Dioxins/furans by USEPA Method 1613B

3.2 SAMPLE ARCHIVAL

Tiered soil samples that will be archived for possible future analyses, as necessary, will be frozen and stored at Fremont. Archived soil samples will be stored in a laboratory freezer maintained at a temperature range of -10 to -20 degrees Fahrenheit.

3.3 REPORTING LIMITS

The analytical methods identified in this SAP/QAPP result in method detection limits and reporting limits (or Practical Quantitation Limits) that are low enough to be less than the relevant cleanup levels. Table 3.1 presents the target method detection and reporting limits for each analytical method as performed by Fremont. These reporting limits are goals only, insofar as instances may arise where high sample concentrations, non-homogeneity of samples, or matrix interferences preclude achieving the desired reporting limit and associated QA/QC criteria. In such instances, the laboratory will report the reason for any deviation from these reporting limits.

3.4 SPECIFIC DIOXINS/FURANS 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 dioxins/furans 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 toxicity equivalency factor (TEF) methodology is used. A TEF value is assigned to each congener relative to the toxicity of TCDD. The total 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 MTCA Table 708-1 (Ecology 2007). The calculated TEQ value will be used to compare against the dioxins/furans cleanup level.

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 2004 and USEPA 1998). Data QA/QC criteria are presented in Table 3.2 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 a 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 method detection limit, where the percent error (expressed as RPD) increases. The equation used to express precision is as follows:

$$\mathrm{RPD} = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

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:

$$\%R = 100\% \text{ x } (S\text{-}U)/C_{sa}$$

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 insure 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 LABORATORY AND FIELD QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

The quality of analytical data generated is assessed by both the implementation of field QC procedures, and by the frequency and type of internal laboratory QA/QC checks developed for analysis type and method. Field QC is evaluated through the analysis of trip blanks, rinsate blanks, and blind field duplicates. Rinsate blanks are collected from non-dedicated field equipment (i.e., stainless steel bowl and spoon) to ensure field decontamination procedures are effective. Blind field duplicates are collected to evaluate the efficiency of field decontamination procedures, variability from sample handling, and sample heterogeneity. 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 sample analysis are summarized below.

3.6.1 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. When there are fewer than 20 samples, a laboratory duplicate will still be collected.

3.6.2 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. MS/MSD analyses will be performed on project-specific samples (i.e., batch QA/QC using samples from other projects is not permitted). When there are fewer than 20 samples, a MS/MSD will still be analyzed.

3.6.3 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 and laboratory control sample duplicate (LCSD) data for metals and organic compounds will be reported. The LCS/LCSD will be performed once per laboratory analysis group.

3.6.4 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.

3.6.5 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.

4.0 Data Reduction, Validation, and Laboratory 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 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 and LCSDs.** All LCS/LCSD for metals and organic compounds will be reported. The RPD for all duplicate analyses shall be reported.
    - **Blind Duplicates.** Blind 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 Level I Compliance Screening on all the analytical data, except dioxins/furans. Dioxins/furans will have a Level IV, Tier III Data Quality Review (Full Validation) conducted by EcoChem, Inc.

All chemical data will be reviewed with regard to the following:

- Chain-of-custody/documentation
- Sample preservation and holding times
- Method blanks
- Reporting limits
- 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 and in the *National Functional Guidelines for Organic and/or Inorganic Methods Data Review* (USEPA 2014b and 2014c). The dioxins/furans data will also be evaluated using the *USEPA Region 10 SOP for Validation of Dioxins and Furans* (USEPA 1996).

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. Any required corrective actions based on the evaluation of the analytical data will be determined by the laboratory and EcoChem in consultation with the Floyd|Snider project manager and may include qualification or rejection of the data.

The data validation summary report will be presented as an appendix to the data report.

5.0 Data Reporting

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 standards. A Data Summary Report will be prepared and submitted to Ecology for informational purposes. This data will be incorporated into a Construction Management Plan, which will be prepared for the stormwater conveyance system construction project in summer 2016.

6.0 References

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_____. 2014b. *USEPA National Functional Guidelines for Organic Methods Data Review*. EPA-540/R-99/008. October.

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730 S. Myrtle Street

Current Situation Report and Subsurface Investigation Work Plan

Tables

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Table 1.1
Historical Site Operations[1]

Building Number (As referenced on Figure 1.3)	Name of Building/Structure	Date Constructed[2]	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.	
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 Dip Tank, Former Penta UST, 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 Penta. 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.	
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 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.	
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.	
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 part of Williams Fir Finish Company operations.
13	Former Shop	1918	It is unknown what operations occurred in this building.	
14	Former Refuse Burner	Pre-1929	This building consisted of a 38-foot-high tower used for burning refuse lumber.	Formerly part of Williams Fir Finish Company operations.
15	Former Shop and Storage	1920s	This building was used for general maintenance and storage.	

Table 1.1
Historical Site Operations[1]

Building Number (As referenced on Figure 1.3)	Name of Building/Structure	Date Constructed[2]	Tyee Lumber Historical Operations	Other Historical Operations
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.	
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.	
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 lunch room, which was also connected to the pre-1985 vintage storage shed (#22).	
20	Former Material Storage	Unknown	It is unknown what material was stored in this building.	
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.	
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 lunch room, which was also connected to the re-sawing mill (#19).	
23	Former Gasoline Station	1918	The former gasoline station was not part of Tyee Lumber property but was located on the east-adjacent property, occupied the property from 1918 until 1964 when it was demolished. 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 South 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 764 South Myrtle Street. This property is located across (south) South Myrtle Street from the 730 South Myrtle Street property. This 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.	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 warehouses, 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:
   Hart Crowser. 1992. Technical Memorandum No. 3: Site History and Summary of Site Operations Including Nearby Historical Land Use, Great Western Chemical, Seattle, Washington, J-2489-07. From Michael Baily and Robert Weaver, Hart Crowser, to Ching-Pi Wang, Washington State Department of Ecology. 16 January.
   Tyee Lumber Appraisal Report, 1956.
   Sound Earth 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. Unless otherwise stated, all structures were demolished in 1986.

Abbreviations:

Penta	Pentachlorophenol
UST	Underground

Table 1.2
Summary of Floyd|Snider 2013 Soil Analytical Results

					Location	GP-2				GP-3				GP-4			
					Sample ID	**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	**03/26/2013**	**03/26/2013**	**03/26/2013**	**03/26/2013**	**03/26/2013**	**03/26/2013**	**03/26/2013**	**03/26/2013**	**03/26/2013**	**03/26/2013**	**03/26/2013**	**03/26/2013**
Analytes	**Units**	**MTCA Method A Residential**	**MTCA Method A Industrial**	**MTCA Method C Cancer**	**MTCA Method C Noncancer**												
Total Petroleum Hydrocarbons																	
Gasoline-Range Organics	mg/kg	30/100[1]	30/100[2]	--	--		7.01 U		6.31 U		5.58 U		5.82 U		6.67 U		6.31 U
Diesel-Range Organics	mg/kg	2,000	2,000	--	--	22.5 U		304 JM		22.8 U		129 JM		23 U		307 JM	
Oil-Range Organics	mg/kg	2,000	2,000	--	--	145		88.3		57 U		56.9 U		57.6 U		190	
Stoddard Solvent[1]	mg/kg	4,000	4,000	--	--				**5,290**				109				3,950
Metals																	
Arsenic	mg/kg	20	20	88	1,100	3.08		1.53		3.37		1.68		3.47		1.8	
Barium	mg/kg	--	--	--	700,000	26		12.1		42.1		15		26.1		12.8	
Cadmium	mg/kg	2	2	--	--	0.199 U		0.2 U		0.201 U		0.193 U		0.183 U		0.189 U	
Chromium	mg/kg	19[2]	19[3]	--	11,000[2]	12.1		11.3		13.8		11.8		12.9		12.6	
Lead	mg/kg	250	1,000	--	--	6.06		1.1		10.5		1.33		2.72		2.74	
Mercury	mg/kg	2	2	--	--	0.314 U		0.274 U		0.345 U		0.329 U		0.309 U		0.265 U	
Selenium	mg/kg	--	--	--	18,000	1.05		0.921		0.917		1.08		1.25		0.846	
Silver	mg/kg	--	--	--	18,000	0.128		0.1 U		0.1 U		0.0964 U		0.0913 U		0.0945 U	
Semivolatile Organic Compounds																	
1,4-Dichlorobenzene	mg/kg	--	--	--	--	0.109 U		0.113 U		0.112 U		0.107 U		0.114 U		0.115 U	
2,4,5-Trichlorophenol	mg/kg	--	--	--	--	0.218 U		0.227 U		0.224 U		0.215 U		0.229 U		0.23 U	
2,4,6-Trichlorophenol	mg/kg	--	--	12,000	3,500	0.218 U		0.227 U		0.224 U		0.215 U		0.229 U		0.23 U	
2,4-Dinitrotoluene	mg/kg	--	--	--	--	0.109 U		0.113 U		0.112 U		0.107 U		0.114 U		0.115 U	
2-Methylphenol	mg/kg	--	--	--	--	0.109 U		0.113 U		0.112 U		0.107 U		0.114 U		0.115 U	
4-Methylphenol	mg/kg	--	--	--	--	0.109 U		0.113 U		0.112 U		0.107 U		0.114 U		0.115 U	
Hexachlorobenzene	mg/kg	--	--	--	--	0.109 U		0.113 U		0.112 U		0.107 U		0.114 U		0.115 U	
Hexachlorobutadiene	mg/kg	--	--	--	--	0.109 U		0.113 U		0.112 U		0.107 U		0.114 U		0.115 U	
Hexachloroethane	mg/kg	--	--	--	--	0.109 U		0.113 U		0.112 U		0.107 U		0.114 U		0.115 U	
m-Cresol	mg/kg	--	--	--	--	0.109 U		0.113 U		0.112 U		0.107 U		0.114 U		0.115 U	
Nitrobenzene	mg/kg	--	--	--	--	0.218 U		0.227 U		0.224 U		0.215 U		0.229 U		0.23 U	
Pentachlorophenol	mg/kg	--	--	330	17,500	0.109 U		8.95		0.112 U		7.11		0.114 U		9.76	
Pyridine	mg/kg	--	--	--	--	0.218 U		0.227 U		0.224 U		0.215 U		0.229 U		0.23 U	
Volatile Organic Compounds																	
1,1-Dichloroethene	mg/kg	--	--	--	--		0.0701 U		0.0631 U		0.0558 U		0.0582 U		0.0667 U		0.0631 U
1,2-Dichloroethane	mg/kg	--	--	--	31,500		0.0421 U		0.0379 U		0.0335 U		0.0349 U		0.04 U		0.0378 U
Benzene	mg/kg	0.03	0.03	2,400	14,000		0.0281 U		0.0253 U		0.0223 U		0.0233 U		0.0267 U		0.0252 U
Carbon tetrachloride	mg/kg	--	--	--	--		0.0281 U		0.0253 U		0.0223 U		0.0233 U		0.0267 U		0.0252 U
Chlorobenzene	mg/kg	--	--	--	--		0.0281 U		0.0253 U		0.0223 U		0.0233 U		0.0267 U		0.0252 U
Chloroform	mg/kg	--	--	--	--		0.0281 U		0.0253 U		0.0223 U		0.0233 U		0.0267 U		0.0252 U
Methyl ethyl ketone	mg/kg	--	--	--	2,100,000		0.0877 U		0.0789 U		0.0698 U		0.0727 U		0.0833 U		0.0788 U
Tetrachloroethene	mg/kg	0.05	0.05	63,000	21,000		0.0281 U		0.0253 U		0.0223 U		0.0233 U		0.0267 U		0.0252 U
Trichloroethene	mg/kg	0.03	0.03	2,800	1,750		***0.0421 U***		***0.0379 U***		***0.0335 U***		***0.0349 U***		***0.04 U***		***0.0378 U***
Vinyl chloride	mg/kg	--	--	87.5	10,500		0.00281 U		0.00253 U		0.00223 U		0.00233 U		0.00267 U		0.00252 U

Notes:

Blank cells are intentional.

-- Not analyzed

BOLD Detected exceedance of criteria.

italics Reporting limit exceeds criteria.

1 The mineral oil criterion is used as a surrogate for Stoddard Solvent.

2 Benzene present/No detectable benzene.

3 Criterion is for Chromium VI.

Abbreviations:

mg/kg Milligrams per kilogram

MTCA Model Toxics Control Act

Qualifiers:

JM Analyte was detected, concentration is considered an estimate due to poor chromatographic match to standard.

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

Table 1.2
Summary of Floyd|Snider 2013 Soil Analytical Results

					Location	GP-5		GP-7		GP-8		GP-10		GP-11	
					Sample ID	GP-5 (0-5)	GP-5 (2)	GP-7 (0-5)	GP-7 (3)	GP-8 (0-5)	GP-8 (4-5)	GP-10 (0-5)	GP-10 (4-5)	GP-11 (0-5)	GP-11 (4-5)
					Sample Date	03/26/2013	03/26/2013	03/26/2013	03/26/2013	03/26/2013	03/26/2013	03/26/2013	03/26/2013	03/26/2013	03/26/2013
Analytes	**Units**	**MTCA Method A Residential**	**MTCA Method A Industrial**	**MTCA Method C Cancer**	**MTCA Method C Noncancer**										
Total Petroleum Hydrocarbons															
Gasoline-Range Organics	mg/kg	30/100^1	30/100^1	--	--		6.61 U		7.03 U		6.08 U		6.34 U		7.21 U
Diesel-Range Organics	mg/kg	2,000	2,000	--	--	22.5 U		25 U		20.2 U		21.7 U		21.1 U	
Oil-Range Organics	mg/kg	2,000	2,000	--	--	56.3 U		62.6 U		376		**7,850**		52.7 U	
Stoddard Solvent	mg/kg	2,000	2,000	--	--								196		
Metals															
Arsenic	mg/kg	20	20	88	1,100	3.24		4.88		3.21		3.33		3.6	
Barium	mg/kg	--	--	--	700,000	22.7		30.6		28.7		33.6		57	
Cadmium	mg/kg	2	2	--	--	0.175 U		0.208 U		0.166 U		0.179		0.175 U	
Chromium	mg/kg	19^2	19^2	--	11,000^2	13.1		15.5		17.8		11.1		15.1	
Lead	mg/kg	250	1,000	--	--	4.01		3.28		10		5.64		15.6	
Mercury	mg/kg	2	2	--	--	0.312 U		0.391 U		0.297 U		0.263 U		0.224 U	
Selenium	mg/kg	--	--	--	18,000	0.852		1.13		0.995		0.896		0.91	
Silver	mg/kg	--	--	--	18,000	0.0875 U		0.104 U		0.083 U		0.0843 U		0.0874 U	
Semivolatile Organic Compounds															
1,4-Dichlorobenzene	mg/kg	--	--	--	--	0.109 U		0.115 U		0.101 U		0.101 U		0.0964 U	
2,4,5-Trichlorophenol	mg/kg	--	--	--	--	0.218 U		0.23 U		0.202 U		0.202 U		0.193 U	
2,4,6-Trichlorophenol	mg/kg	--	--	12,000	3,500	0.218 U		0.23 U		0.202 U		0.202 U		0.193 U	
2,4-Dinitrotoluene	mg/kg	--	--	--	--	0.109 U		0.115 U		0.101 U		0.101 U		0.0964 U	
2-Methylphenol	mg/kg	--	--	--	--	0.109 U		0.115 U		0.101 U		0.101 U		0.0964 U	
4-Methylphenol	mg/kg	--	--	--	--	0.109 U		0.115 U		0.101 U		0.101 U		0.0964 U	
Hexachlorobenzene	mg/kg	--	--	--	--	0.109 U		0.115 U		0.101 U		0.101 U		0.0964 U	
Hexachlorobutadiene	mg/kg	--	--	--	--	0.109 U		0.115 U		0.101 U		0.101 U		0.0964 U	
Hexachloroethane	mg/kg	--	--	--	--	0.109 U		0.115 U		0.101 U		0.101 U		0.0964 U	
m-Cresol	mg/kg	--	--	--	--	0.109 U		0.115 U		0.101 U		0.101 U		0.0964 U	
Nitrobenzene	mg/kg	--	--	--	--	0.218 U		0.23 U		0.202 U		0.202 U		0.193 U	
Pentachlorophenol	mg/kg	--	--	330	17,500	0.109 U		0.115 U		0.101 U		0.189		0.0964 U	
Pyridine	mg/kg	--	--	--	--	0.218 U		0.23 U		0.202 U		0.202 U		0.193 U	
Volatile Organic Compounds															
1,1-Dichloroethene	mg/kg	--	--	--	--		0.0661 U		0.0703 U		0.0608 U		0.0634 U		0.0721 U
1,2-Dichloroethane	mg/kg	--	--	--	31,500		0.0397 U		0.0422 U		0.0365 U		0.0381 U		0.0433 U
Benzene	mg/kg	0.03	0.03	2,400	14,000		0.0265 U		0.0281 U		0.0243 U		0.0254 U		0.0289 U
Carbon tetrachloride	mg/kg	--	--	--	--		0.0265 U		0.0281 U		0.0243 U		0.0254 U		0.0289 U
Chlorobenzene	mg/kg	--	--	--	--		0.0265 U		0.0281 U		0.0243 U		0.0254 U		0.0289 U
Chloroform	mg/kg	--	--	--	--		0.0265 U		0.0281 U		0.0243 U		0.0254 U		0.0289 U
Methyl ethyl ketone	mg/kg	--	--	--	2,100,000		0.0827 U		0.0879 U		0.076 U		0.0793 U		0.0902 U
Tetrachloroethene	mg/kg	0.05	0.05	63,000	21,000		**0.142**		**0.16**		**0.133**		0.0254 U		0.0289 U
Trichloroethene	mg/kg	0.03	0.03	2,800	1,750		***0.0397 U***		***0.0422 U***		***0.0365 U***		***0.0381 U***		***0.0433 U***
Vinyl chloride	mg/kg	--	9	87.5	10,500		0.00265 U		0.00281 U		0.00243 U		0.00254 U		0.00289 U

Notes:

	Blank cells are intentional.
--	Not analyzed
BOLD	Detected exceedance of criteria.
italics	Reporting limit exceeds criteria.
1	Benzene present/No detectable benzene.
2	Criterion is for Chromium VI.

Abbreviations:

mg/kg	Milligrams per kilogram
MTCA	Model Toxics Control Act

Qualifiers:

JM	Analyte was detected, concentration is considered an estimate due to poor chromatographic match to standard.
U	Analyte was not detected, concentration given is the reporting limit.

Table 1.3
Summary of Sound Earth Strategies 2013 and 2014 Soil Analytical Results

					Location	B01 (MW01)			B02 (MW02)			B03 (MW03)		B04 (MW04)	
					Sample ID	B01-10	B01-12	B01-15	B02-05	B02-10	B02-15	B03-05	B03-10	B04-05	B04-10
					Sample Date	12/27/2013	12/27/2013	12/27/2013	12/27/2013	12/27/2013	12/27/2013	12/27/2013	12/27/2013	12/27/2013	12/27/2013
Analytes	**Units**	**MTCA Method A Unrestricted Landuse**	**MTCA Method A Industrial**	**MTCA Method C Cancer**	**MTCA Method C Noncancer**										
Total Petroleum Hydrocarbons															
Gasoline-Range Organics	mg/kg	30/100[1]	30/100[2]	--											
Diesel-Range Organics	mg/kg	2,000	2,000	--		50 U	120	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Oil-Range Organics	mg/kg	2,000	2,000	--		250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Stoddard Solvent[1]	mg/kg	4,000	4,000	--		50 U	140	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Benzene, Toluene, Ethylbenzene, Xylenes															
Benzene	mg/kg	0.03	0.03	2,400	14,000										
Toluene	mg/kg	7	7	--	280,000										
Ethylbenzene	mg/kg	6	6	--	350,000										
Xylene (total)	mg/kg	9	9	--	700,000										
Dioxins/Furans															
Dioxins/Furans (MTCA TEQ-calculated using half of the detection limit)	mg/kg	--	--	0.0015	--										
Semivolatile Organic Compounds															
Pentachlorophenol	mg/kg	--	--	330	17,500	0.05 U	0.45	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.5 U	0.05 U
Volatile Organic Compounds															
1,1,1-Trichloroethane	mg/kg	2	2	--	7,000,000										
1,1-Dichloroethane	mg/kg	--	--	--	--										
1,1-Dichloroethene	mg/kg	--	--	--	--										
1,2-Dichloroethane	mg/kg	--	--	--	31,500										
Chloroethane	mg/kg	--	--	--	--										
cis-1,2-Dichloroethene	mg/kg	--	--	--	7,000										
Methylene chloride	mg/kg	0.02	0.02	18,000	210,000										
Tetrachloroethene	mg/kg	0.05	0.05	63,000	21,000										
trans-1,2-Dichloroethene	mg/kg	--	--	--	--										
Trichloroethene	mg/kg	0.03	0.03	2,800	1,750										
Vinyl chloride	mg/kg	--	--	87.5	10,500										

Notes:

Blank cells are intentional. Not analyzed for specific constituent.

-- Not analyzed

1 The mineral oil criterion is used as a surrogate for Stoddard Solvent.

2 Benzene present/No detectable benzene.

Abbreviations:

mg/kg Milligrams per kilogram
MTCA Model Toxics Control Act

Qualifiers:

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

Table 1.3
Summary of Sound Earth Strategies 2013 and 2014 Soil Analytical Results

Location						B05	B06		B07		B08		B09		B12 (MW05)
Sample ID						B05-08	B06-05	B06-12	B07-05	B07-11.5	B08-05	B08-11	B09-05	B09-13	B12-10.0
Sample Date						12/26/2013	12/26/2013	12/26/2013	12/26/2013	12/26/2013	12/26/2013	12/26/2013	12/26/2013	12/26/2013	04/05/2014
Analytes	**Units**	**MTCA Method A Unrestricted Landuse**	**MTCA Method A Industrial**	**MTCA Method C Cancer**	**MTCA Method C Noncancer**										
Total Petroleum Hydrocarbons															
Gasoline-Range Organics	mg/kg	30/100[1]	30/100[2]	--			2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	**1,500 JM**
Diesel-Range Organics	mg/kg	2,000	2,000	--		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	**2,900 JM**
Oil-Range Organics	mg/kg	2,000	2,000	--		250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Stoddard Solvent[1]	mg/kg	4,000	4,000	--		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	3,300
Benzene, Toluene, Ethylbenzene, Xylenes															
Benzene	mg/kg	0.03	0.03	2,400	14,000		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	***0.4 U***
Toluene	mg/kg	7	7	--	280,000		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.4 U
Ethylbenzene	mg/kg	6	6	--	350,000		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	2.1
Xylene (total)	mg/kg	9	9	--	700,000		0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	5.6
Dioxins/Furans															
Dioxins/Furans (MTCA TEQ-calculated using half of the detection limit)	mg/kg	--	--	0.0015	--										
Semivolatile Organic Compounds															
Pentachlorophenol	mg/kg	--	--	330	17,500	0.05 U									0.079
Volatile Organic Compounds															
1,1,1-Trichloroethane	mg/kg	2	2	--	7,000,000										0.05 U
1,1-Dichloroethane	mg/kg	--	--	--	--										0.05 U
1,1-Dichloroethene	mg/kg	--	--	--	--										0.05 U
1,2-Dichloroethane	mg/kg	--	--	--	31,500										0.05 U
Chloroethane	mg/kg	--	--	--	--										0.5 U
cis-1,2-Dichloroethene	mg/kg	--	--	--	7,000										0.05 U
Methylene chloride	mg/kg	0.02	0.02	18,000	210,000										***0.5 U***
Tetrachloroethene	mg/kg	0.05	0.05	63,000	21,000										0.025 U
trans-1,2-Dichloroethene	mg/kg	--	--	--	--										0.05 U
Trichloroethene	mg/kg	0.03	0.03	2,800	1,750										0.02 U
Vinyl chloride	mg/kg	--	--	87.5	10,500										0.05 U

Notes:

Blank cells are intentional. Not analyzed for specific constituent.

-- Not analyzed

1 The mineral oil criterion is used as a surrogate for Stoddard Solvent.

2 Benzene present/No detectable benzene.

Abbreviations:

mg/kg Milligrams per kilogram

MTCA Model Toxics Control Act

Qualifiers:

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

Table 1.3
Summary of Sound Earth Strategies 2013 and 2014 Soil Analytical Results

					Location	**B13 (MW06)**	**B14 (MW07)**	**B15**		**B16**		**B17**	
					Sample ID	**B13-10.0**	**B14-10.0**	**B15-05.0**	**B15-10.0**	**B16-05.0**	**B16-10.0**	**B17-07.5**	**B17-10.0**
					Sample Date	**04/05/2014**	**04/05/2014**	**04/05/2014**	**04/05/2014**	**04/05/2014**	**04/05/2014**	**04/05/2014**	**04/05/2014**
Analytes	**Units**	**MTCA Method A Unrestricted Landuse**	**MTCA Method A Industrial**	**MTCA Method C Cancer**	**MTCA Method C Noncancer**								
Total Petroleum Hydrocarbons													
Gasoline-Range Organics	mg/kg	30/100[1]	30/100[2]	--		2 U	2 U	2 U	**2,600 JM**	2 U	**4,600 JM**	**10,000 JM**	**160 JM**
Diesel-Range Organics	mg/kg	2,000	2,000	--		50 U	50 U	**2,300 JM**	**5,700 JM**	50 U	**6,900 JM**	**23,000 JM**	1,700 JM
Oil-Range Organics	mg/kg	2,000	2,000	--		250 U	250 U	1,100	460	250 U	250 U	**3,000**	250 U
Stoddard Solvent[1]	mg/kg	4,000	4,000	--		50 U	50 U	2,000	**6,600**	50 U	**8,200**	**25,000**	1,800
Benzene, Toluene, Ethylbenzene, Xylenes													
Benzene	mg/kg	0.03	0.03	2,400	14,000	0.02 U	0.02 U	0.02 U	***1 U***	0.02 U	***1 U***	***1 U***	0.02 UJ
Toluene	mg/kg	7	7	--	280,000	0.02 U	0.02 U	0.02 U	1 U	0.02 U	1 U	1 U	0.1 U
Ethylbenzene	mg/kg	6	6	--	350,000	0.02 U	0.02 U	0.02 U	1 U	0.02 U	3.9	1 U	0.1 U
Xylene (total)	mg/kg	9	9	--	700,000	0.06 U	0.06 U	0.06 U	**17**	0.06 U	**53**	**68**	1.3
Dioxins/Furans													
Dioxins/Furans (MTCA TEQ-calculated using half of the detection limit)	mg/kg	--	--	0.0015	--							**0.0089 J**	
Semivolatile Organic Compounds													
Pentachlorophenol	mg/kg	--	--	330	17,500	0.05 U	0.05 U	31	140	0.05 U	22	**340**	85
Volatile Organic Compounds													
1,1,1-Trichloroethane	mg/kg	2	2	--	7,000,000	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
1,1-Dichloroethane	mg/kg	--	--	--	--	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
1,1-Dichloroethene	mg/kg	--	--	--	--	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
1,2-Dichloroethane	mg/kg	--	--	--	31,500	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Chloroethane	mg/kg	--	--	--	--	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	mg/kg	--	--	--	7,000	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Methylene chloride	mg/kg	0.02	0.02	18,000	210,000	***0.5 U***	***0.5 U***	***0.5 U***	***0.5 U***	***0.5 U***	***0.5 U***	***0.5 U***	***0.5 U***
Tetrachloroethene	mg/kg	0.05	0.05	63,000	21,000	0.025 U	0.025 U	0.025 U	**0.067**	0.025 U	0.025 U	**0.06**	0.025 U
trans-1,2-Dichloroethene	mg/kg	--	--	--	--	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Trichloroethene	mg/kg	0.03	0.03	2,800	1,750	0.021	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Vinyl chloride	mg/kg	--	--	87.5	10,500	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U

Notes:

Blank cells are intentional. Not analyzed for specific constituent.

-- Not analyzed

1 The mineral oil criterion is used as a surrogate for Stoddard Solvent.

2 Benzene present/No detectable benzene.

Abbreviations:

mg/kg Milligrams per kilogram

MTCA Model Toxics Control Act

Qualifiers:

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

Table 1.4
Summary of Groundwater Analytical Results

				Location	B01 (MW01)		B02 (MW02)		B03 (MW03)		B04 (MW04)		B12 (MW05)
				Sample ID	**MW01-20140103**	**MW01-20140415**	**MW02-20140103**	**MW02-20140415**	**MW03-20140102**	**MW03-20140411**	**MW04-20140102**	**MW04-20140411**	**MW05-20140408**
				Sample Date	**01/03/2014**	**04/15/2014**	**01/03/2014**	**04/15/2014**	**01/02/2014**	**04/11/2014**	**01/02/2014**	**04/11/2014**	**04/08/2014**
Analytes	**MTCA Method A Groundwater**	**MTCA Method C Cancer**	**MTCA Method C Noncancer**	**Units**									
Total Petroleum Hydrocarbons													
Gasoline-Range Organics	800/1,000[2]	--	--	µg/L		**3,400 JM**		**9,700 JM**		100 U		170	**980**
Diesel-Range Organics	500	--	--	µg/L	**2,000 JM**	**1,800 JM**	**4,300 JM**	**7,800 JM**	76 JM	63 JM	**520 JM**	**3,000 JM**	**890 JM**
Oil-Range Organics	500	--	--	µg/L	250 U	250 U	250 U	250 U	250 U	250 U	250 U	**560 JM**	250 U
Stoddard Solvent[1]	500	--	--	µg/L	**2,300**	**1,600 JM**	**4,800 JM**	**7,100 JM**	50 U	50 U	310 JM	**1,200 JM**	**860**
Benzene, Toluene, Ethylbenzene, Xylenes													
Benzene	5	8	70	µg/L		1 U		1 U		1 U		**5.3**	1 U
Toluene	1,000	--	1,400	µg/L		1 U		1.1		1 U		2.8	1 U
Ethylbenzene	700	--	1,750	µg/L		3.7		2.5		1 U		1 U	1.1
Xylene (total)	1,000	--	3,500	µg/L		74		14		3 U		5.2	3.5
Semivolatile Organic Compounds													
Pentachlorophenol	--	2.2	175	µg/L	**150**	**190**	**11**	**35**	1.3	0.72	**33**	**200**	1
Volatile Organic Compounds													
1,1,1-Trichloroethane	200	--	35,000	µg/L		1 U		1 U		1 U		1 U	1 U
1,1-Dichloroethane	5	--	3,500	µg/L		1 U		1 U		1 U		1 U	1 U
1,1-Dichloroethene	--	--	875	µg/L		1 U		1 U		1 U		1 U	1 U
1,2-Dichloroethane	--	4.8	350	µg/L		1 U		1 U		1 U		1 U	1 U
cis-1,2-Dichloroethene	--	--	35	µg/L		3.7		1 U		1 U		**460**	1 U
trans-1,2-Dichloroethene	--	--	--	µg/L		1 U		1 U		1 U		12	1 U
Chloroethane	--	--	--	µg/L		1 U		1 U		1 U		1 U	1 U
Methylene chloride	5	58	1,050	µg/L		5 U		5 U		5 U		5 U	5 U
Tetrachloroethene	5	210	105	µg/L		2.3		2		2.7		**110**	1 U
Trichloroethene	5	9.4	8.8	µg/L		1 U		1 U		1 U		**47**	1 U
Vinyl chloride	0.2	0.29	52.5	µg/L		**0.29**		0.2 U		0.2 U		**38**	0.2 U

Notes:

Blank cells are intentional.

-- Not analyzed

BOLD Detected exceedance of criteria.
italics Reporting limit exceeds criteria.
1 The mineral oil criterion is used as a surrogate for Stoddard Solvent.
2 Benzene present/No detectable benzene.

Abbreviations:
mg/kg Milligrams per kilogram
MTCA Model Toxics Control Act

Qualifiers:
J Analyte was detected, concentration is considered an estimate.
JM Analyte was detected, concentration is considered an estimate due to poor chromatographic match to standard.
U Analyte was not detected, concentration given is the reporting limit.

Table 1.4
Summary of Groundwater Analytical Results

				Location	**B13 (MW06)**	**MW-7**		**B14 (MW07)**	**B-18**	**B-38**		
				Sample ID	**MW06-20140408**	**MW-7-20140102**	**MW-7-20140411**	**MW07-20140408**	**B18-20140411**	**B38-20140114**	**MW99-20140114**	**B38-20140415**
				Sample Date	**04/08/2014**	**01/02/2014**	**04/11/2014**	**04/08/2014**	**04/11/2014**	**01/14/2014**	**01/14/2014**	**04/15/2014**
Analytes	**MTCA Method A Groundwater**	**MTCA Method C Cancer**	**MTCA Method C Noncancer**	**Units**								
Total Petroleum Hydrocarbons												
Gasoline-Range Organics	800/1,000^2	--	--	µg/L	110 JM		500 U	100 U	100 U			**7,100 JM**
Diesel-Range Organics	500	--	--	µg/L	**760 JM**	**19,000 JM**	**3,500 JM**	340 JM	260 JM	**1,300 JM**	**1,600 JM**	**16,000 JM**
Oil-Range Organics	500	--	--	µg/L	**1,000 JM**	**3,500 JM**	**920 JM**	250 U	250 U	**620 JM**	**840 JM**	**1,100 JM**
Stoddard Solvent^1	500	--	--	µg/L	230 JM	**16,000 JM**	**1,300 JM**	250	50 U	**660 J**	**810 J**	**11,000 JM**
Benzene, Toluene, Ethylbenzene, Xylenes												
Benzene	5	8	70	µg/L	2.1		**8**	1 U	1.1			1 U
Toluene	1,000	--	1,400	µg/L	1 U		18	1 U	1.2			5.5
Ethylbenzene	700	--	1,750	µg/L	1 U		5 U	1 U	1 U			9.9
Xylene (total)	1,000	--	3,500	µg/L	3 U		15 U	3 U	3 U			93
Semivolatile Organic Compounds												
Pentachlorophenol	--	2.2	175	µg/L	0.24	**150**	**6.5**	0.2 U	0.2 U	**330**	**450**	**5,300**
Volatile Organic Compounds												
1,1,1-Trichloroethane	200	--	35,000	µg/L	1 U		2 U	1 U	1 U			1 U
1,1-Dichloroethane	5	--	3,500	µg/L	1 U		2 U	1 U	1 U			1 U
1,1-Dichloroethene	--	--	875	µg/L	1		2 U	1 U	1 U			1 U
1,2-Dichloroethane	--	4.8	350	µg/L	1 U		2 U	1 U	1 U			1 U
cis-1,2-Dichloroethene	--	--	35	µg/L	**210**		**500**	1.6	**85**			4.7
trans-1,2-Dichloroethene	--	--	--	µg/L	3.3		37	1 U	1.7			1 U
Chloroethane	--	--	--	µg/L	1 U		2 U	1 U	1 U			1 U
Methylene chloride	5	58	1,050	µg/L	5 U		***10 U***	5 U	5 U			5 U
Tetrachloroethene	5	210	105	µg/L	22		**56**	1 U	2.4			1 U
Trichloroethene	5	9.4	8.8	µg/L	**110**		**66**	1 U	4.9			1 U
Vinyl chloride	0.2	0.29	52.5	µg/L	**9.7**		**10**	**0.98**	**14**			**0.27**

Notes:

Blank cells are intentional.

-- Not analyzed

BOLD Detected exceedance of criteria.

italics Reporting limit exceeds criteria.

1 The mineral oil criterion is used as a surrogate for Stoddard Solvent.

2 Benzene present/No detectable benzene.

Abbreviations:

mg/kg Milligrams per kilogram

MTCA Model Toxics Control Act

Qualifiers:

J Analyte was detected, concentration is considered an estimate.

JM Analyte was detected, concentration is considered an estimate due to poor chromatographic match to standard.

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

Table 1.5
Proposed Sampling and Analytical Program

Boring/Well Designation	Rationale/Objective	Boring Depth/Soil Sampling	Well Screen Interval/ Groundwater Sampling	Soil Analysis	Groundwater Analysis
Soil					
Subsurface Soil					
SB-05 SB-07 SB-10	• Evaluate the nature and extent of dioxins/furans, penta, and Stoddard solvent soil contamination in the penta dip tank and UST areas and vicinity. • Locations are adjacent to the most elevated soil dioxins/furans concentration previously detected (B-17).	• Minimum of 15 feet bgs, dependent on field indicators. • Collect soil samples if field observations indicate potential for contamination (i.e., odors, sheen, LNAPL, elevated PID readings). • Sample depths and intervals may include samples above, within, and below the groundwater table. • A minimum of one sample will be collected based on field indications. If there are no indications of contamination, the sample will be collected at the groundwater interface.	Not applicable.	• TPH-Dx • Penta • Dioxins/furans	Not applicable.
SB-03 SB-04 SB-06 SB-08 SB-09	• Evaluate the nature and extent of penta/Stoddard solvent soil contamination in the penta dip tank and UST areas and vicinity. • SB-06, SB-09 Locations are peripheral to the source area. • SB-03, SB-04, SB-08: Locations are outside the extent of the known groundwater plume.	• Minimum of 15 feet bgs, dependent on field indicators. • Collect soil samples if field observations indicate potential for contamination (i.e., odors, sheen, LNAPL, elevated PID readings). • Sample depths and intervals may include samples above, within, and below the groundwater table. • A minimum of one sample will be collected based on field indications. If there are no indications of contamination, the sample will be collected at the groundwater interface.	Not applicable.	• First tier: TPH-Dx and penta analyzed in the apparent most impacted sample based on field indicators. • Second tier: If TPH-Dx and/or penta are detected at concentrations greater than the reporting limit, additional sample intervals may be analyzed to delineate the vertical extent of contamination.	Not applicable.
SB-11	• Evaluate the nature and extent of TPH in soil adjacent to previously installed soil boring GP-10.	• Minimum of 15 feet bgs, dependent on field indicators. • Collect soil samples if field observations indicate potential for contamination (i.e., odors, sheen, LNAPL, elevated PID readings). • Sample depths and intervals may include samples above, within, and below the groundwater table. • A minimum of one sample will be collected based on field indications. If there are no indications of contamination, the sample will be collected at the groundwater interface.	Not applicable.	• TPH-Dx	Not applicable.

Table 1.5
Proposed Sampling and Analytical Program

Boring/Well Designation	Rationale/Objective	Boring Depth/Soil Sampling	Well Screen Interval/ Groundwater Sampling	Soil Analysis	Groundwater Analysis
Soil (continued)					
Surface Soils					
SB-01	• Characterize soil for disposal in the area where the stormwater treatment system vault will be installed.	• 10-foot bgs • Collect soil samples in the 0- to 2-foot bgs and 8- to 10-foot bgs depth intervals.	Not applicable.	• TPH-Dx, penta, metals, SVOCs, PCBs	Not applicable.
SB-02	• Evaluate presence of penta/Stoddard solvent in surface soils in the former wood drying area located in the northwest portion of the Site.	• Minimum of 5 feet bgs, dependent on field indicators. • Collect soil samples in the 0- to 2-foot bgs and 4- to 5-foot bgs depth intervals.	Not applicable.	• Penta/TPH-Dx in the surface sample depth interval 0 to 2 feet bgs. • If the concentration of either analyte is greater than its MTCA Industrial cleanup level, that chemical will be analyzed in the 4- to 5-foot bgs depth interval to delineate the vertical extent of contamination.	Not applicable.
SB-05 SB-08 SB-11	• Evaluate presence of other chemicals in surface soils throughout the site per Ecology's recommendation (Ecology 2014).	• Minimum of 5 feet bgs, dependent on field indicators. • Collect soil samples in the 0- to 2-foot bgs and 4- to 5-foot bgs depth intervals.	Not applicable.	• PCBs, SVOCs, and metals analyzed in the surface sample depth interval 0 to 2 feet bgs. • If concentrations of any chemicals are greater than their respective MTCA Industrial cleanup levels, those chemicals will be analyzed in the 4- to 5-foot bgs depth interval to delineate the vertical extent of contamination.	Not applicable.
SB-12	• Evaluate whether penta/Stoddard solvent is present in soil under the former wood platform that may have been used for drying treated wood.	• Minimum of 15 feet bgs, dependent on field indicators. • Collect soil samples if field observations indicate potential for contamination (i.e., odors, sheen, LNAPL, elevated PID readings). • Sample depths and intervals may include samples above, within, and below the groundwater table. • A minimum of one sample will be collected based on field indications. If there are no indications of contamination, the sample will be collected at the groundwater interface.	Not applicable	• TPH-Dx • Penta	Not applicable

Table 1.5
Proposed Sampling and Analytical Program

Boring/Well Designation	Rationale/Objective	Boring Depth/Soil Sampling	Well Screen Interval/ Groundwater Sampling	Soil Analysis	Groundwater Analysis
Groundwater					
Fox Avenue Monitoring Wells					
MW-7 MW-9 B-49	• Confirm current conditions associated with recently elevated penta/Stoddard solvent results in groundwater collected from well MW-7 and the previously elevated penta results in groundwater collected from wells MW-9 and B-49. • Better define the nature and extent of the plume (i.e., is it connected to the source area or associated with the Fox Avenue Site).	Not applicable.	• MW-7 installed to a depth of 14 feet bgs and screened from 4 to 14 feet bgs. • MW-9 installed to a depth of 13 feet bgs and screened from 8 to 13 feet bgs. • B-49 installed to a depth of 14.5 feet bgs and screened from 9.5 to 14.5 feet bgs.	Not applicable.	• TPH-Dx Penta
B-36	• Confirm that penta/Stoddard solvent have not migrated off-site toward the Lower Duwamish Waterway.	Not applicable.	• Installed to a depth of 13 feet bgs and screened from 6 to 11 feet bgs.	Not applicable.	• TPH-Dx • Penta
B-38	• Better define the extent of the penta/Stoddard solvent groundwater plume near the source area. • Evaluate if dioxins/furans are present in groundwater near the source area.	Not applicable.	• Installed to a depth of 19 feet bgs and screened from 6 to 16 feet bgs.	Not applicable.	• TPH-Dx • Penta • Dioxins/furans
Existing Monitoring Wells					
MW-01 to MW-07	• Confirm the elevated penta/Stoddard solvent results in groundwater collected from wells MW-01, MW-02, MW-04, MW-05, and MW-07. • Better define the nature and extent of the penta/Stoddard solvent groundwater plume near the source area. • Evaluate if dioxins/furans are present in groundwater near the source area.	Not applicable.	• Existing wells installed to a depth of 20 feet bgs and screened from 5 to 20 feet bgs.	Not applicable.	• TPH-Dx • Penta • Dioxins/furans to be analyzed in MW-04
MW-108 MW-109	• To better define the nature and extent of the penta/Stoddard solvent groundwater plume in the vicinity of existing wells MW-7 and MW-04 (i.e., is it connected to the source area or associated with the Fox Avenue Site).	• Advance boring to a minimum of 16 feet bgs, with final depth decided based on field indicators in soil and not to exceed 20 feet bgs.	• Install 10-foot well screen from 6 to 16 feet bgs.	Not applicable.	• TPH-Dx • Penta
MW-110	• Evaluate the nature and extent of TPH in groundwater surrounding existing soil boring GP-10.	• Advance boring to a minimum of 16 feet bgs, with final depth decided based on field indicators in soil and not to exceed 20 feet bgs.	• Install 10-foot well screen from 6 to 16 feet bgs.	Not applicable.	• TPH-Dx

Table 1.5
Proposed Sampling and Analytical Program

Boring/Well Designation	Rationale/Objective	Boring Depth/Soil Sampling	Well Screen Interval/ Groundwater Sampling	Soil Analysis	Groundwater Analysis
Groundwater (continued)					
Proposed Monitoring Wells					
MW-111	• Characterize extent of the penta/Stoddard solvent groundwater plume downgradient of MW-07. • Evaluate if dioxins/furans are present in groundwater downgradient of MW-07.	• Advance boring to a minimum of 16 feet bgs, with final depth decided based on field indicators in soil and not to exceed 20 feet bgs.	• Install 10-foot well screen from 6 to 16 feet bgs.	Not applicable.	• TPH-Dx • Penta • Dioxins/furans

Abbreviations:

bgs	Below ground surface
Ecology	Washington State Department of Ecology
LNAPL	Light non-aqueous phase liquid
MTCA	Model Toxics Control Act
PCB	Polychlorinated biphenyl
Penta	Pentachlorophenol
PID	Photoionization detector
SVOC	Semivolatile organic compound
TPH	Total petroleum hydrocarbon
TPH-Dx	Diesel-range total petroleum hydrocarbon
UST	Underground storage tank

Table 2.1
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Parameter	Method	Bottle Type	Preservative	Holding Time
Soil Samples				
Total Petroleum Hydrocarbons—diesel- and heavy oil-range	NWTPH-Dx	One 8-oz WMG	None, cool to <6 °C	14 days to extract, then 40 days to analyze (or freeze for 1 year)
Pentachlorophenol	USEPA Method 8151 or 8270	One 8-oz WMG	None, cool to <6 °C	14 days to extract, then 40 days to analyze (or freeze for 1 year)
Heavy Metals	USEPA Method 6020/7471	One 4-oz WMG	None, cool to <6 °C	Metals: 6 months (or freeze for 1 year) Mercury: 28 days
Semivolatile Organic Compounds (including cPAHs)	USEPA Method 8270D	One 16-oz WMG	None, cool to <6 °C	14 days to extract, then 40 days to analyze (or freeze for 1 year)
Aroclor Polychlorinated Biphenyls	USEPA Method 8082	One 16-oz WMG	None, cool to <6 °C	1 year
Dioxins/Furans	USEPA Method 1613B	One 8-oz WMG amber glass	None, cool to <6 °C	1 year
Groundwater Samples				
Total Petroleum Hydrocarbons—diesel- and heavy oil-range	NWTPH-Dx	Two 500-ml amber glass	None, cool to <6 °C	7 days to extract, then 40 days to analyze
Pentachlorophenol	USEPA Method 8151 or 8270	Two 500-ml amber glass	None, cool to <6 °C	7 days to extract, then 40 days to analyze

Table 2.1
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Parameter	Method	Bottle Type	Preservative	Holding Time
Groundwater Samples (continued)				
Heavy Metals	USEPA Method 200.8/245.1	One 500-ml HDPE	Laboratory filtered and preserved with HNO_3, cool to <6 °C	Metals: 6 months Mercury :28 days
Semivolatile Organic Compounds (including cPAHs)	USEPA Method 8270D	Two 500-ml amber glass	None, cool to <6 °C	7 days to extract, then 40 days to analyze
Aroclor Polychlorinated Biphenyls	USEPA Method 8082	Two 500-ml amber glass	None, cool to <6 °C	1 year
Dioxins/Furans	USEPA Method 1613B	Two 1-liter amber glass	None, cool to <6 °C	1 year

Abbreviations:

°C	Degrees Celsius
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
HDPE	High-density polyethylene
HNO_3	Nitric acid
ml	Milliliter
oz	Ounces
WMG	Wide-mouth glass jar

Table 3.1
Analytical Methods, Detection Limits, and Reporting Limits

Parameter	Analysis Method	Detection Limit	Reporting Limit[1] (PQL or LOQ)
Soil Samples			
Total Petroleum Hydrocarbons—diesel- and heavy oil-range	NWTPH-Dx	Diesel: 2.71 mg/kg Oil: 6.08 mg/kg	Diesel: 20 mg/kg Oil: 50 mg/kg
Pentachlorophenol	USEPA Method 8151	4.41 µg/kg	8.00 µg/kg
Pentachlorophenol	USEPA Method 8270SIM	1.3 µg/kg	20 µg/kg
Heavy Metals	USEPA Method 6020/7471	0.002 to 0.2 mg/kg	0.2 to 5.0 mg/kg
Semivolatile Organic Compounds (including cPAHs)	USEPA Method 8270D	1.7 to 60 µg/kg	80 to 500 µg/kg
Aroclor Polychlorinated Biphenyls	USEPA Method 8082	0.00159 mg/kg	0.1 mg/kg
Dioxins/Furans	USEPA Method 1613B	0.0184 to 0.136 pg/g	0.5 to 5.0 pg/g
Groundwater Samples			
Total Petroleum Hydrocarbons—diesel- and heavy oil-range	NWTPH-Dx	Diesel: 10.84 µg/L Oil: 24.33µg/L	Diesel: 50 µg/L Oil: 100 µg/L
Pentachlorophenol	USEPA Method 8151	0.0176µg/L	0.05 µg/L
Pentachlorophenol	USEPA Method 8270SIM	0.0344µg/L	0.1 µg/L
Heavy Metals	USEPA Method 200.8/245.1	0.0008to 2.0 µg/L	0.2 to 100 µg/L
Semivolatile Organic Compounds (including cPAHs)	USEPA Method 8270D	0.003to .127 µg/L	0.5 to 5 µg/L
Aroclor Polychlorinated Biphenyls	USEPA Method 8082	0.003µg /L	0.1 µg/L
Dioxins/Furans	USEPA Method 1613B	0.177 to 0.712pg/L	5.0 to 50 pg/L

Note:

1 All reporting limits shown are method PQLs or LOQs from Fremont Analytical, located in Seattle, Washington.

Abbreviations:

cPAH	Carcinogenic polycyclic aromatic hydrocarbon	mg/L	Milligrams per liter
LOQ	Limit of Quantitation	ng/kg	Nanograms per kilogram
µg/kg	Micrograms per kilogram	pg/L	Picograms per liter
µg/L	Micrograms per liter	PQL	Practical Quantitation Limit
mg/kg	Milligrams per kilogram		

Table 3.2
Data Quality Assurance and Quality Control Criteria

Parameter	Units	Reporting Limit	Precision	Accuracy	Completeness	Reference
Soil Samples						
Total Petroleum Hydrocarbons—diesel- and heavy oil-range	mg/kg	Diesel: 20.0 Oil: 50.0	± 30%	50–150%	95%	NWTPH-Dx
Pentachlorophenol	µg/kg	8.0	± 30%	21.4-135%	95%	USEPA Method 8151
Pentachlorophenol	µg/kg	20.00	± 30%	21.4-130%	95%	USEPA Method 8270SIM
Heavy Metals	mg/kg	0.1 to 5.0	± 20%	80–120%	95%	USEPA Method 6020/7471
Semivolatile Organic Compounds (including cPAHs)	µg/kg	80 to 200	± 30%	50–150%*	95%	USEPA Method 8270D
Aroclor Polychlorinated Biphenyls	mg/kg	0.1	± 30%	50–150%*	95%	USEPA Method 8082
Dioxins/Furans	pg/g	0.5 to 5.0 pg/g	± 30%	50–150%	95%	USEPA Method 1613B
Groundwater Samples						
Total Petroleum Hydrocarbons—diesel- and heavy oil-range	µg/L	Diesel: 50 Oil: 100	± 30%	50–150%	95%	NWTPH-Dx
Pentachlorophenol	µg/L	0.05	± 30%	15.3-126%	95%	USEPA Method 8151
Pentachlorophenol	µg/L	0.1	± 30%	20-137%	95%	USEPA Method 8270SIM
Heavy Metals	µg/L	0.00088 to 1.0	± 20%	85–115%	95%	USEPA Method 200.8/245.1

Table 3.2
Data Quality Assurance and Quality Control Criteria

Parameter	Units	Reporting Limit	Precision	Accuracy	Completeness	Reference
Groundwater Samples (continued)						
Semivolatile Organic Compounds (including cPAHs)	µg/L	0.5 to 5	± 30%	50−150%*	95%	USEPA Method 8270D
Aroclor Polychlorinated Biphenyls	µg/L	0.1	± 30%	50−150%*	95%	USEPA Method 8082
Dioxins/Furans	pg/L	5.0 to 50 pg/L	± 30%	50−150%	95%	USEPA Method 1613B

Note:

1 All reporting limits shown are method PQLs or LOQs from Fremont Analytical, located in Seattle, Washington.

* Depending on analyte.

Abbreviations:

cPAH	Carcinogenic polycyclic aromatic hydrocarbon
LOQ	Limit of Quantitation
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
ng/kg	Nanograms per kilogram
pg/L	Pictograms per liter
PQL	Practical Quantitation Limit

730 S. Myrtle Street

Current Situation Report and Subsurface Investigation Work Plan

Figures

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Note:
· Basemap provided by Esri, 2015

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730 S. Myrtle Street
Seattle, Washington

Figure 1.1
Vicinity Map

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11/13/2015

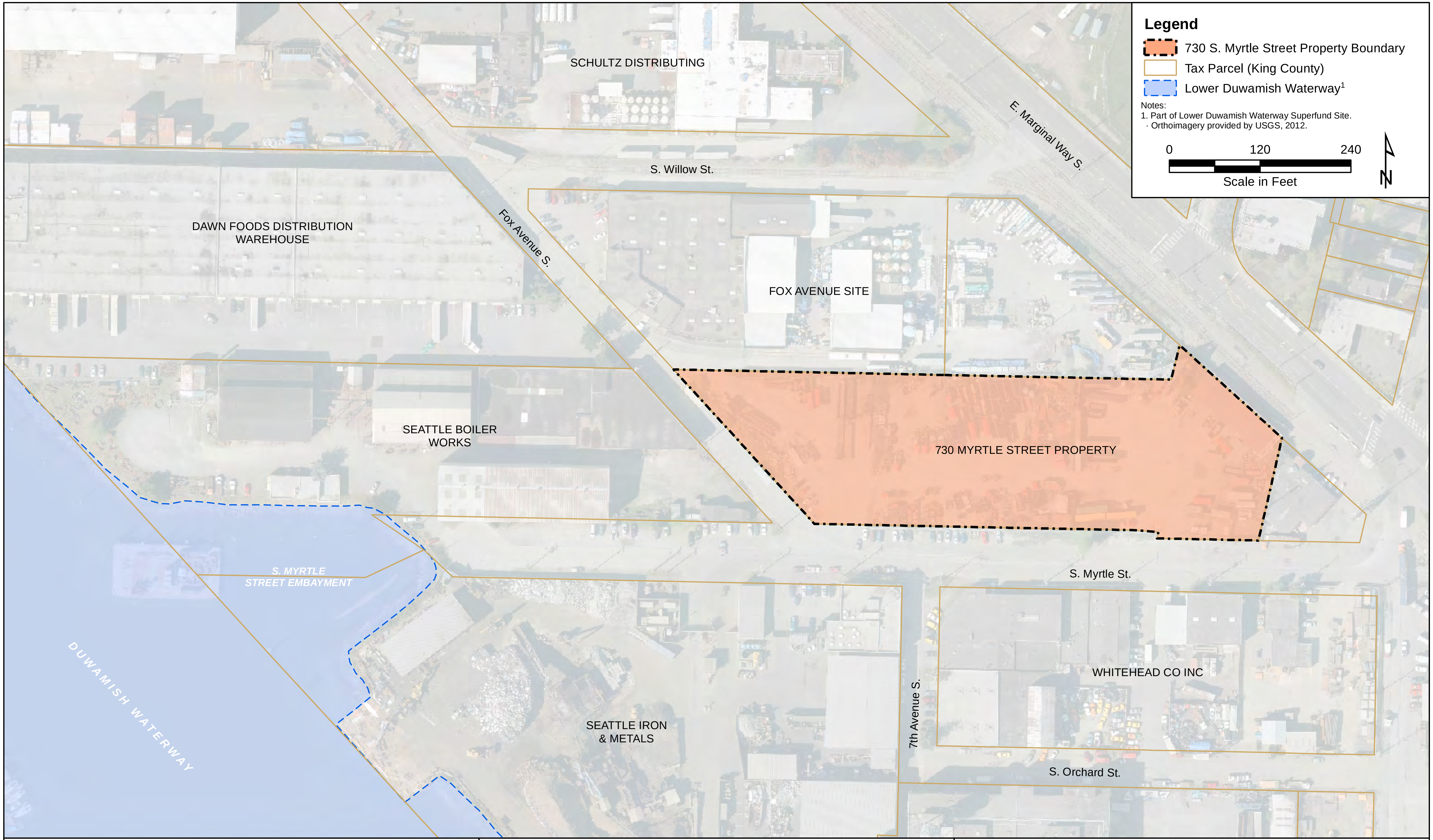

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Figure 1.2
Property Map

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11/30/2015

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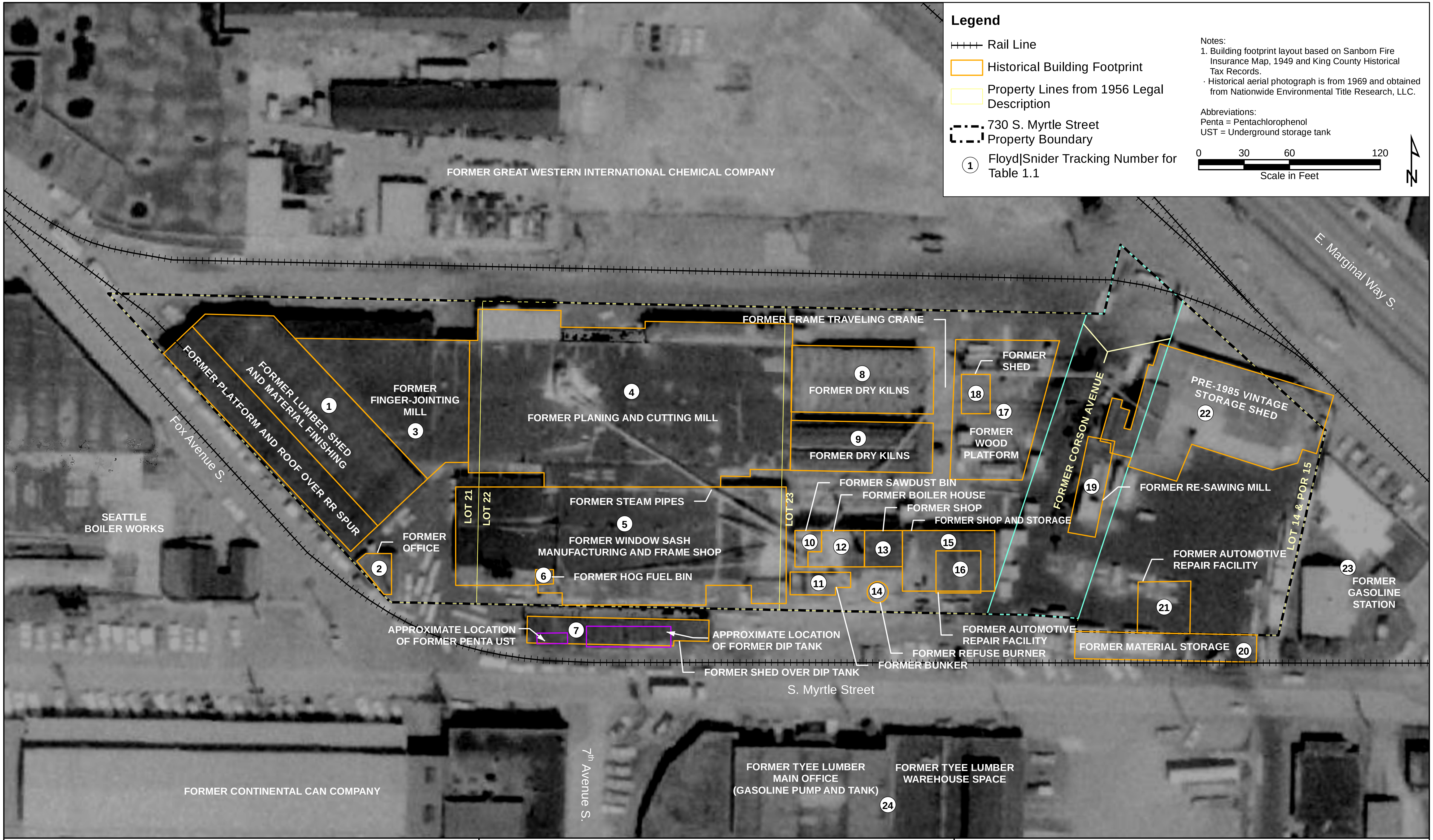

Notes:
1. Building footprint layout based on Sanborn Fire Insurance Map, 1949 and King County Historical Tax Records.
· Historical aerial photograph is from 1969 and obtained from Nationwide Environmental Title Research, LLC.

Abbreviations:
Penta = Pentachlorophenol
UST = Underground storage tank

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Figure 1.3
Historical Site Operations

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11/13/2015

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Notes:
1. CAA = Cleanup Action Area.
2. Figure soruced from the Washington Department of Ecology. 2012. *Fox Avenue Site FInal Cleanup Action Plan, Figure 2.3.*

Abbreviation:
CVOC = Chlorinated volatile organic compound

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Fox Avenue Site
Seattle, Washington

Figure 1.4
Fox Avenue Site Approximate CVOC
Groundwater Plume Extent

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11/13/2015

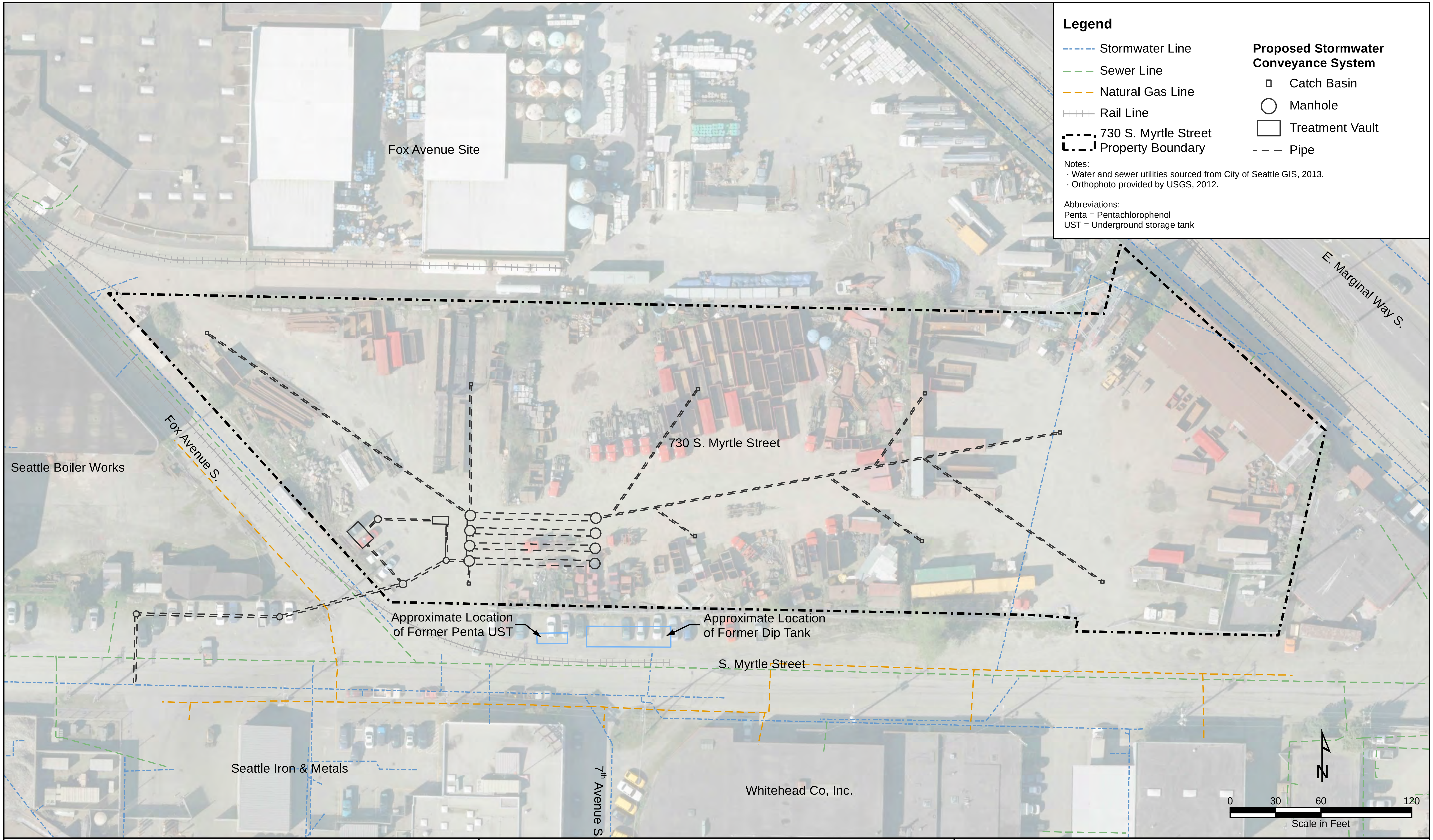

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Figure 1.5
Proposed Stormwater Conveyance System

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11/13/2015

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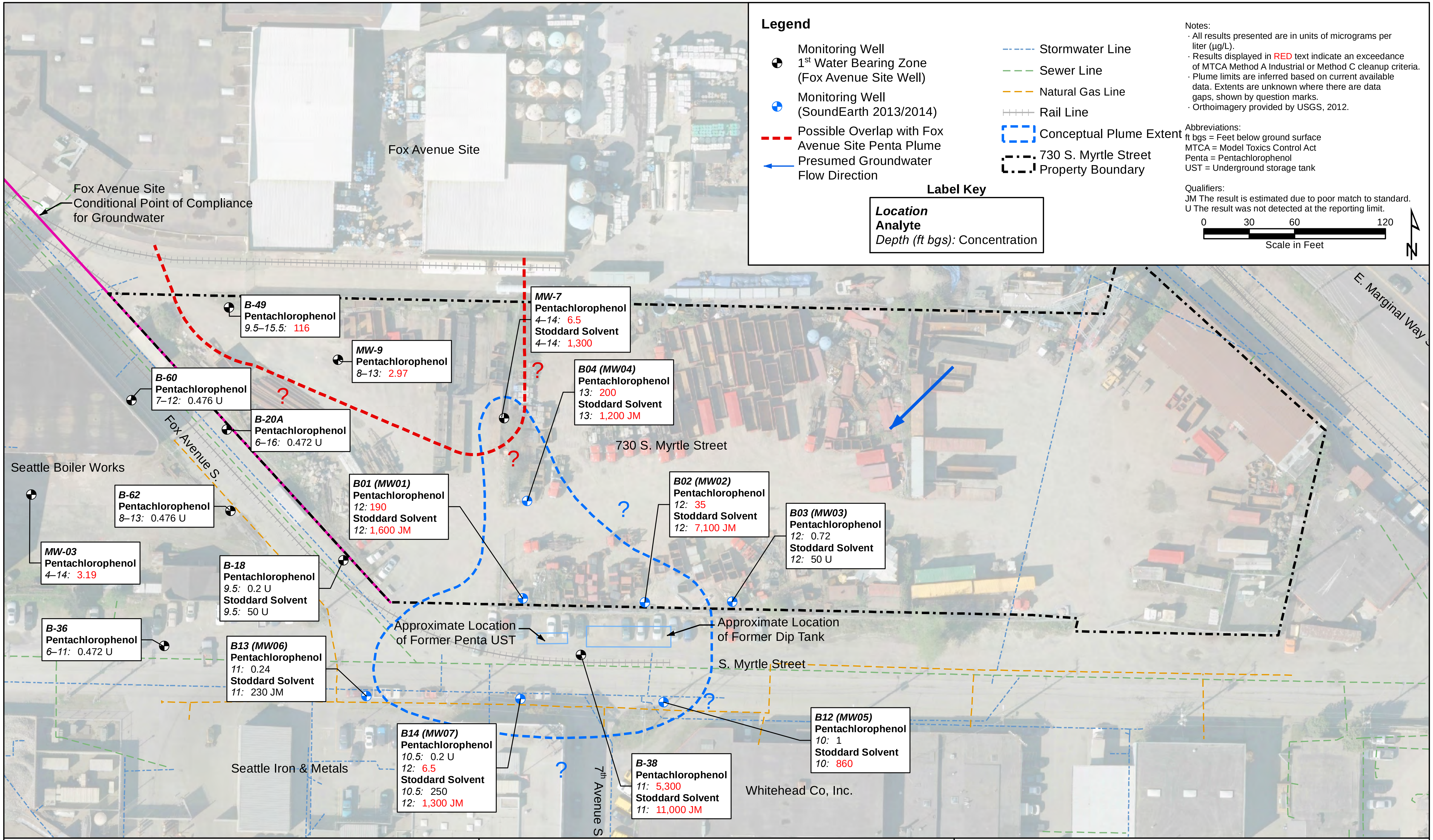

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Figure 1.6
Pentachlorophenol and Mineral Spirit (Stoddard Solvent)
Concentrations in Groundwater

I:\GIS\Projects\SIM-730EDR\MXD\SAP_QAPP\Figure 1.6 Penta and Mineral Spirit Stoddard Solvent Concentrations in Groundwater.mxd
11/19/2015

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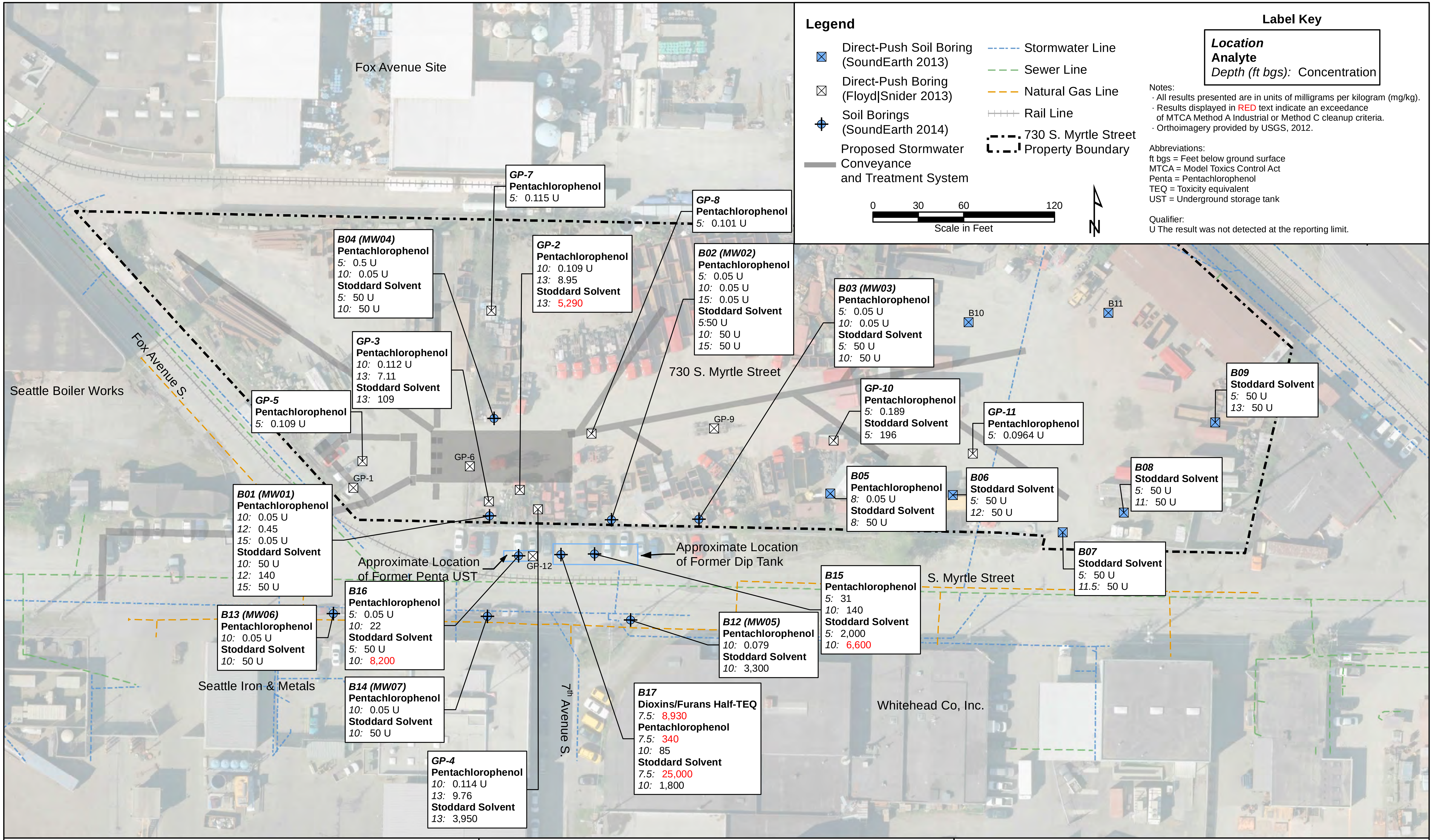

Notes:
- All results presented are in units of milligrams per kilogram (mg/kg).
- Results displayed in RED text indicate an exceedance of MTCA Method A Industrial or Method C cleanup criteria.
- Orthoimagery provided by USGS, 2012.

Abbreviations:
ft bgs = Feet below ground surface
MTCA = Model Toxics Control Act
Penta = Pentachlorophenol
TEQ = Toxicity equivalent
UST = Underground storage tank

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

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Figure 1.7
Pentachlorophenol and Mineral Spirit (Stoddard Solvent) and Dioxins/Furans Concentrations in Soil

I:\GIS\Projects\SIM-730EDR\MXD\SAP_QAPP\Figure 1.7 Existing Soil Contamination.mxd
11/25/2015

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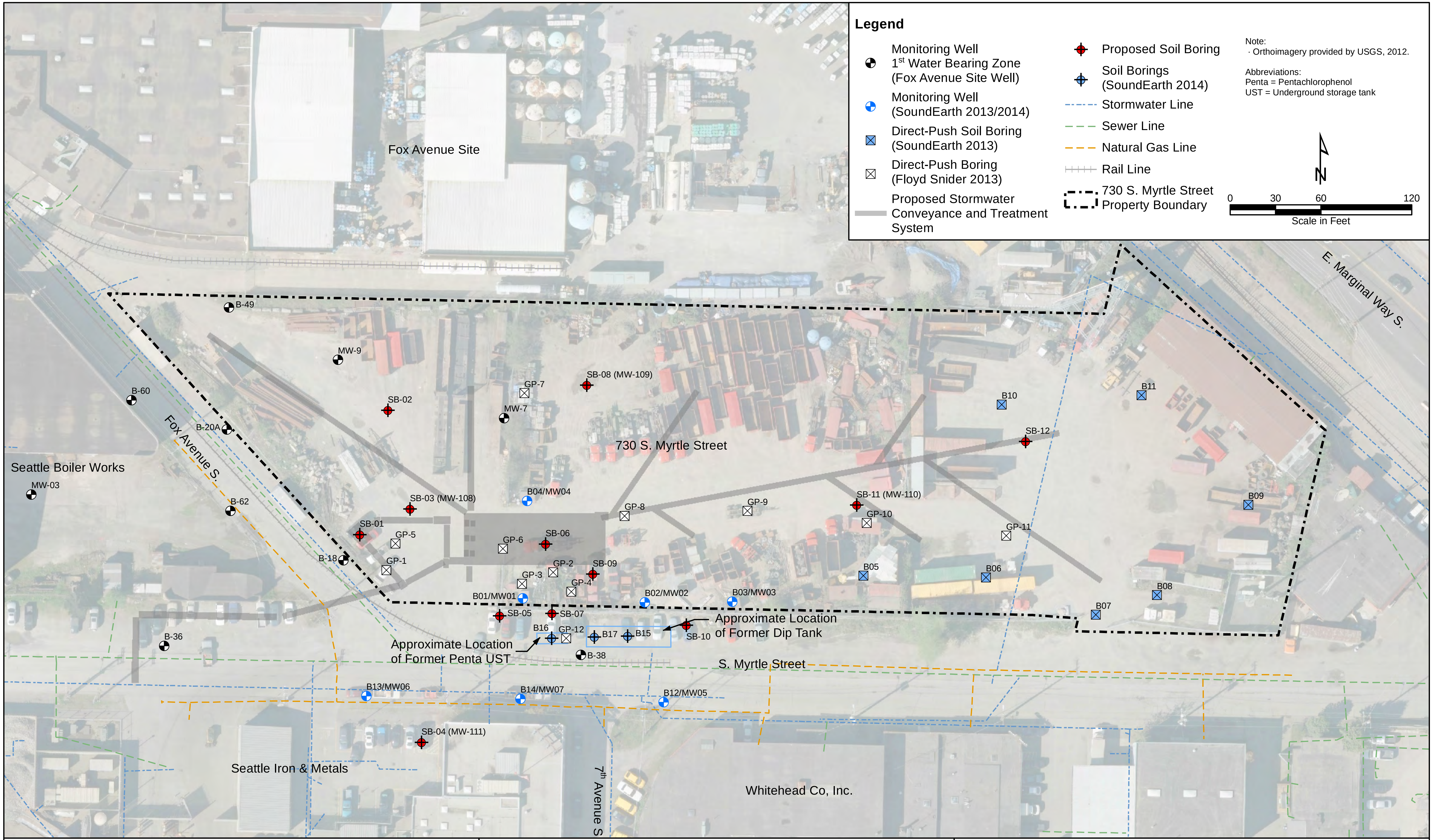

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Figure 1.8
Proposed Soil Boring Locations

I:\GIS\Projects\SIM-730EDR\MXD\SAP_QAPP\Figure 1.8 Proposed Soil Boring Locations.mxd
11/19/2015

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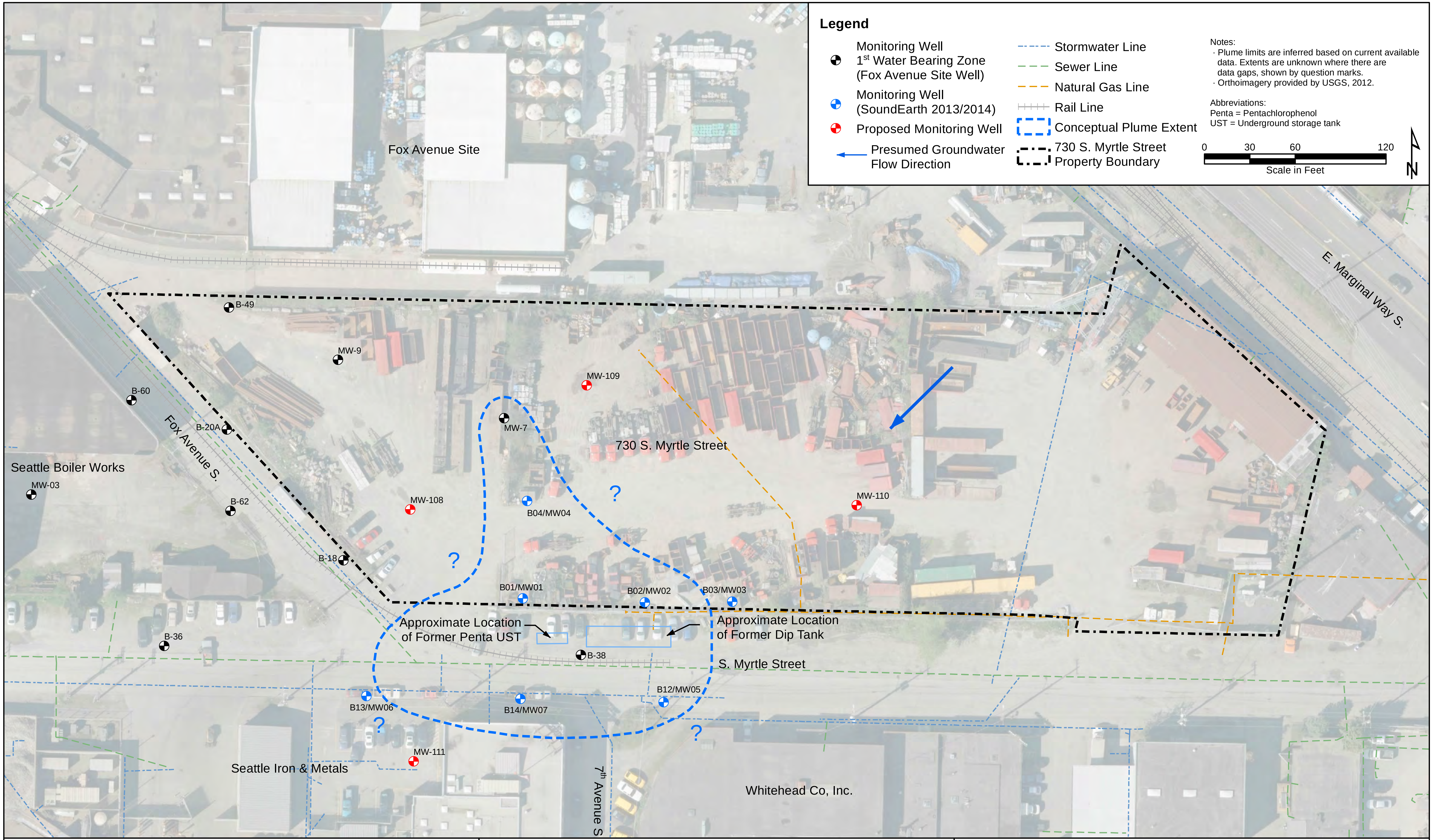

Notes:
- Plume limits are inferred based on current available data. Extents are unknown where there are data gaps, shown by question marks.
- Orthoimagery provided by USGS, 2012.

Abbreviations:
Penta = Pentachlorophenol
UST = Underground storage tank

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Figure 1.9
Proposed Monitoring Well Locations

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Current Situation Report and Subsurface Investigation Work Plan

Appendix A

Floyd|Snider Soil Sample Collection Standard Guideline and Field Form

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Two Union Square
601 Union Street, Suite 600
Seattle, WA 98101
tel: 206.292.2078 fax: 206.682.7867

F|S STANDARD GUIDELINE

Soil Sample Collection

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 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
- Graduated plunger and collection tubes for VOC samples (if needed)
- Trash bags
- Decontamination tools including:
    - Paper towels
    - Spray bottles of alconox (or similar) solution
    - Deionized or distilled water
- Adhesive drum labels, or 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; optional)
- Coolers, sample jars, labels, ice

Paperwork:

- Work Plan and/or Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP)
- Health and Safety Plan (HASP)
- Sample collection forms printed in Rite in the Rain paper, or Rite in the Rain field notebook

Personal Equipment:

- Steel-toed boots
- Safety vest
- Safety glasses
- Nitrile gloves
- Rain gear
- Work gloves

3.0 Standard Procedures

3.1 OFFICE PREPARATION

Prior to going into the field, review the SAP/QAPP tables to become familiar with the desired sample intervals, nomenclature, field Quality Assurance (QA) samples, 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 get coolers and appropriate sample containers. Familiarize yourself with the volume requirements and container types, preservation methods, and holding times for each class of analytes.

3.2 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. Note the soil type and any other observations or indications of contamination on a soil boring log, soil sample collection form or field notebook, as described in the Soil Logging Standard Guideline. Note the location and depth of the sample and take a photograph, if possible.
2. Refer to subsections 3.2.1 through 3.2.4 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 3.3 for specific sample collection procedures for this method. If composite soil sampling is recommended, refer to Section 3.4 for details.
3. Once soil has been collected from the desired depth or interval, mix thoroughly 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.
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 work plan and note the field duplicate name and sample time in the sample log. If extra volume for matrix spike/matrix spike duplicate (MS/MSD) analysis is being collected, 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. 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. Keep samples on ice to maintain temperatures of 4-6 degrees Celsius (°C) and transport to the laboratory under chain-of-custody procedures.

3.2.1 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. 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.

3.2.2 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 cleaned and 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 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 decontaminated stainless steel bowl. It may be necessary to empty the hand auger onto plastic sheeting or into a bowl in order 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.

3.2.3 Sample Collection from Test Pits or Limited Soil Excavations

These procedures should be used for collecting samples from test pit explorations excavated using a back hoe 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 from project to 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 beyond 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). 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 3.4.

3.2.4 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 of the pile for reference.
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 Ecology guidance for site remediation.
4. Samples for characterization of stockpiles of imported backfill or other presumed clean material should also be collected as described above. If not described in the work plan, the typical sample frequency for imported or clean material characterization is one sample per 500 CY.

3.3 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.

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. If multiple vials per sample are required, the same plunger may be re-used to fill the remaining vials.

3.4 COMPOSITE SAMPLE COLLECTION

For this guideline, composites are considered to be 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 3.2 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 in the event that 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 3.2. 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.

4.0 Decontamination

All reusable equipment that comes into contact with soil 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)/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 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 IDW that is containerized, such as waste soils, 55-gallon drums approved by WSDOT 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 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 that is placed into drums for temporary storage 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 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, 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.

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Boring ID:

Drill Date:
Logged By:
Drilled By:

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location:

Drill Type:
Sample Method:
Boring Diameter:
Boring Depth (ft bgs):
Groundwater ATD (ft bgs):

Client:
Project:
Task:
Address:

Remarks:

PID (ppm)	OIL INDICAT.	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20		

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:

Drill Date:
Logged By:
Drilled By:

Coordinate System:
Ground Surface Elevation:
Latitude/Northing:
Longitude/Easting:
Boring Location:

Drill Type:
Sample Method:
Boring Diameter:
Boring Depth (ft bgs):
Groundwater ATD (ft bgs):

Client:
Project:
Task:
Address:

Remarks:

PID (ppm)	OIL INDICAT.	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS
				20		
				21		
				22		
				23		
				24		
				25		
				26		
				27		
				28		
				29		
				30		
				31		
				32		
				33		
				34		
				35		
				36		
				37		
				38		
				39		
				40		

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

730 S. Myrtle Street

Current Situation Report and Subsurface Investigation Work Plan

Appendix B

Floyd|Snider Groundwater Well Construction Standard Guidelines and Field Forms

DRAFT

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.

Log of Soil Boring and Well Installation X

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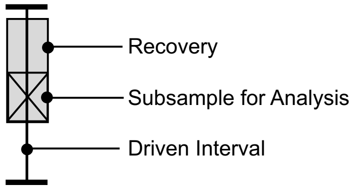
Floyd Snider
Boring ______ Date ______ Sheet ___ of ___
Job ______ Job No. ______
Logged By ______ Weather ______
Drilled By ______
Drill Type/Method ______
Sampling Method ______
Bottom of Boring ______ ATD Water Level Depth ______
Ground Surface Elevation ______

Obs. Well Install. ☒ Yes ☐ No

SAMPLE ID	Blow Count	DEPTH		SAMPLE RECOVERY (FT)			USCS Symbol	DESCRIPTION: color, texture, moisture MAJOR CONSTITUENT. NON-SOIL SUBSTANCES: Odor, staining, sheen, scrap, slag, etc.	
		From	To						
					0				
					1				
					2				
					3				
					4				
					5				
					6				
					7				
					8				
					9				
					10				
					11				
					12				
					13				
					14				
					15				
					16				
					17				
					18				
					19				
					20				



∇ Groundwater Observed At Time of Drilling

▨ Potentially Contaminated Soil

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

FLOYD | SNIDER

WELL DEVELOPMENT FIELD FORM

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:

730 S. Myrtle Street

Current Situation Report and Subsurface Investigation Work Plan

Appendix C

Floyd|Snider Low-flow Groundwater Collection Standard Guideline and Field Form

DRAFT

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strategy ▪ science ▪ engineering

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: August 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 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
- Poly tubing
- Silicone tubing
- Filters (if field filtering)
- Tools for opening wells (1/2-inch, 9/16-inch, and 5/8-inch sockets, ratchet, screwdriver)
- Well keys
- Tube cutters, razor blade, or scissors
- 5-gallon buckets and clamp
- Paper towels
- Bailer or pump to drain well box if full of stormwater
- Hammer
- Alconox (or similar decontamination solution), deionized water, spray bottles
- Tape measure
- 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
- Purge water plan
- Rite-in-the-Rain pens, paper, and permanent markers
- Site-Specific Health and Safety Plan (HASP)
- Sampling and Analysis Plan (SAP) and/or Quality Assurance Project Plan (QAPP) (including tables of analytes and bottle types)

Personal Protective Equipment (PPE):

- Boots/waders
- Safety vest
- Safety glasses
- Rain gear
- Nitrile gloves
- Work gloves

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 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.

3.2 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.

3.3 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 20 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.

- 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. If the depth of the well screen is not known, lower the 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. 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).
- 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)
- Purging will continue 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.
- 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. A minimum of 0.5 to 1 liter of groundwater must 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, samples will be placed in a cooler maintained at a temperature of approximately 4 to 6 degrees Celsius (°C) using ice. Chain-of-Custody Forms will be completed. 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 or more to sufficiently cover the pump of an Alconox (or similar)/clean water solution. 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 or more to sufficiently cover the pump of clean water. 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 or more to sufficiently cover the pump of distilled or deionized water. 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.

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.

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.

Disposable sampling materials and incidental trash such as paper towels and 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.

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.

7.0 References

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.

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: ______________________________ Date of Collection: ______________________________

Project Number: ______________________________ Field Personnel: ______________________________

Purge Data

Well ID: ______________________ Secure: ☐ Yes ☐ No Well Condition/Damage Description: ______________________

____

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No One Casing Volume (gal): ______________________

Depth of water (from top of well casing): ______________________ Well Casing Type/Diameter/Screened Interval: ______________________

After 5 minutes of purging (from top of casing): ______________________

Begin purge (time): ______________________

End purge (time): ______________________

Gallons 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	Vol. Purged	pH	DO	Conductivity	Turbidity	Temp	ORP	Comments

Sampling Data

Sample No: ______________________ Location and Depth: ______________________

Date Collected (mo/dy/yr): ______________ Time Collected: __________ ☐ AM ☐ PM Weather: ______________________

Type: ☐ Ground Water ☐ Surface Water Other: ______________ Sample: ☐ Filtered ☐ Unfiltered Other: ______________

Sample Collected with: ☐ Bailer ☐ Pump Other: ______________ Type: ______________________

Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☐ Horiba U-50 Other: ______________________

Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or dedicated silicon and poly tubing Other: __________

Sample Description (Color, Turbidity, Odor, Other): ______________________

Sample Analyses

TPH-D	(HCl)	☐	Chlor / Fluor	(unpres)	☐	COD / TOC	(H2SO4)	☐	Orthophos	(FILTER)	☐	Diss. Metals	(HNO3)	☐
TPH-G	(HCl)	☐	BTEX	(HCl)	☐	Total Metals	(HNO3)	☐	TKN/Phos	(N2SO4)	☐	VOCs	(HCl)	☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:

Signature: ______________________________ **Date:** ______________________