

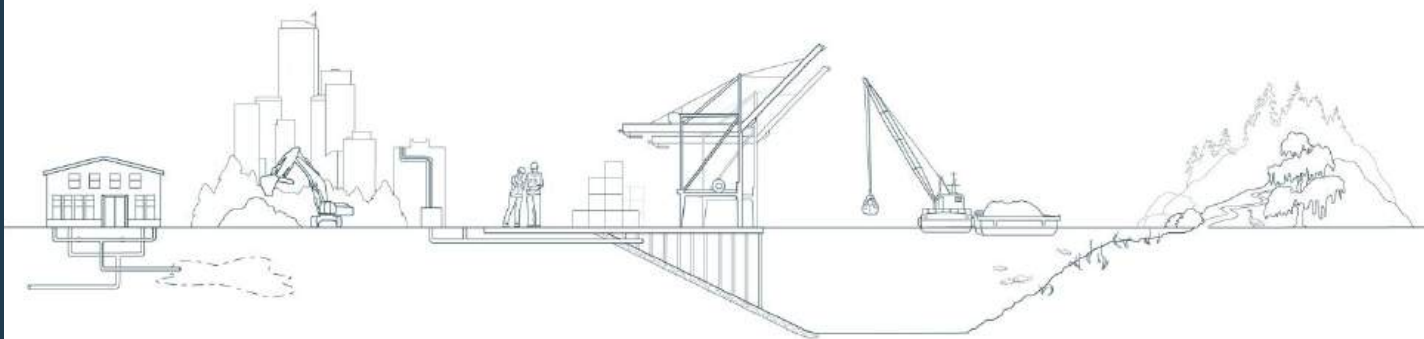
# Engineering Design Report

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## Riverside HVOC Site

**Prepared for**  
City of Bothell

November 2025



#### **LIMITATIONS**

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## Engineering Design Report

This document was prepared for  
City of Bothell  
under the supervision of:



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Date: 11/19/2025

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### List of Abbreviations

<b>Abbreviation</b>	<b>Definition</b>
AO	Agreed Order
ARAR	Applicable or Relevant and Appropriate Requirement
BDI Plus	Bio-Dechlor Inoculum Plus
bgs	Below ground surface
BMP	Best management practice
BSC Site	Bothell Service Center Simon & Son Site
CAP	Cleanup Action Plan
City	City of Bothell
cm/day	Centimeters per day
COC	Contaminants of concern
CSGP	Construction Stormwater General Permit
CUL	Cleanup level
DCE	Dichloroethene
DO	Dissolved oxygen
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
EIM	Environmental Information Management
Engineer	Engineer of Record
ERD	Enhanced reductive dechlorination
GSR	Green and sustainable remediation
HASP	Health and Safety Plan
HVOC	Halogenated volatile organic compound
HWA	HWA Geosciences
IC	Institutional control
IDP	Inadvertent Discovery Plan
LTCMP	Long-term compliance monitoring plan
µg/L	Micrograms per liter
µg/m <sup>2</sup> /day	Micrograms per square meter per day

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<b>Abbreviation</b>	<b>Definition</b>
mg/L	Milligrams per liter
mg-N/L	Milligrams of nitrogen per liter
Minimum Standards	Washington State Minimum Standards for Construction and Maintenance of Wells
MIP	Membrane interface probe
MNA	Monitored natural attenuation
MTCA	Model Toxics Control Act
NAVD 88	North American Vertical Datum of 1988
O&M	Operations and maintenance
ORP	Oxidation–reduction potential
OSHA	Occupational Safety and Health Act
PCE	Tetrachloroethene
PDI	Pre-engineering design investigation
PFM	Passive flux meter
POC	Point of compliance
QAPP	Quality Assurance Project Plan
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
ROW	Right-of-way
Site	Riverside HVOC Site
Site property	Eastern portion of King County Assessor’s parcel 082605-9120
S-mZVI	Sulfidated microscale zero-valent iron
SPECP	Spill Prevention and Emergency Countermeasure Plan
SR	State Route
TCE	Trichloroethene
TOC	Total organic carbon
UIC	Underground Injection Control
Ultra Site	Ultra Custom Care Cleaners Site
WAC	Washington Administrative Code
ZVI	Zero-valent iron

## 1.0 Introduction

This Engineering Design Report (EDR) was prepared per the requirements of Washington Administrative Code (WAC) 173-340-400(4)(a) and describes the engineering concepts and design criteria for the cleanup action selected by the Washington State Department of Ecology (Ecology) for the Riverside Halogenated Volatile Organic Compound (HVOC) Site (Site) located adjacent to the Sammamish River in the downtown corridor of Bothell, Washington, as described in the Cleanup Action Plan (CAP) Addendum (Floyd|Snider 2025a) for the Site. The Site is included on Ecology's Confirmed and Suspected Contaminated Sites List under Facility Site ID 93061 and Cleanup Site ID 14970. The Site location is shown on Figure 1.1.

### 1.1 SITE REGULATORY OVERVIEW

The Site is the location of a former machine shop where contamination resulting from releases of the solvents tetrachloroethene (PCE) and its degradation products have come to lie.

The City of Bothell (City) initially entered into Agreed Order (AO) No. DE 6295 with Ecology in March 2009 to perform a cleanup at the Site. Under an amendment to AO No. DE 6295 in April 2013, the City completed an interim action to install a system of extraction wells to pump HVOC-contaminated groundwater from the Site and discharge the contaminated water to the sanitary sewer under a King County Industrial Waste permit. In 2013, the groundwater extraction system consisting of four extraction wells was installed by HWA Geosciences (HWA). In 2016, HWA installed two more extraction wells in closer proximity to the river. The City continued to operate the groundwater extraction system in a modified capacity until September 24, 2025, in coordination with Ecology.

The City entered into a second AO (DE 16541) in 2019 to complete a Remedial Investigation/Feasibility Study (RI/FS) for the Site. The RI/FS was prepared for the Site in accordance with the AO in February 2022 (Kane 2022). The City entered into a third AO (DE 21531) in 2023 to design and implement a final cleanup action consistent with the Final CAP prepared in March 2023 (Ecology 2023a).

The City subsequently performed pre-engineering design investigation (PDI) under an Ecology-approved Pre-Remedial Design Investigation Work Plan (Floyd|Snider 2024a) to gather design data needed to implement the cleanup action specified in the Final CAP. The results of the PDI were summarized in a PDI Data Report (Floyd|Snider 2024b) and informed the selection of a revised cleanup action based on current Site conditions, which was developed to minimize the cost, treatment time, and impact to human health and the environment during the cleanup action. The selection of a revised cleanup action is described in the PDI Data Report and the CAP Addendum.

Ecology and the City signed First Amendment to AO No. DE 21531, incorporating the revised cleanup action, in August 2025. This EDR was developed in accordance with the requirements in the First Amendment to AO No. DE 21531.

## 1.2 PURPOSE AND OBJECTIVES

The purpose of the EDR is to satisfy Model Toxics Control Act (MTCA) requirements and provide the engineering design for cleanup action that will be used as the basis for developing the plans and specifications for the remedial construction phase of this project, as well as to provide sufficient detail to implement the post-construction activities.

The objectives of the cleanup action are to comply with applicable sections of WAC; MTCA (Chapter 70.105D Revised Code of Washington); and applicable state, federal, and local requirements.

## 1.3 ROLES AND RESPONSIBILITIES

This section defines roles and responsibilities for implementation of the cleanup, consistent with WAC 173-340-400(4)(a)(iii). The City is the owner and operator of the Site and is identified in the AO as the responsible party for implementation of the cleanup action. The City will direct the implementation of the cleanup action and obtain access to perform work on private properties where elements of the cleanup action will be constructed. The City will additionally perform post-construction operation, maintenance, and monitoring of the cleanup action.

Ecology will provide regulatory review and approval of this EDR; the cleanup action; and applicable post-construction operation, maintenance, and monitoring plans. Ecology may additionally conduct Site inspections.

The Engineer of Record (Engineer), a professional engineer registered in the state of Washington, is responsible for the preparation of this EDR and, on behalf of the City, will provide quality control oversight and monitoring during cleanup action implementation.

## 1.4 REPORT ORGANIZATION

The remainder of this EDR is organized as follows:

- **Section 2.0.** Presents a description of the Site and a brief summary of Site conditions and cleanup goals.
- **Section 3.0.** Presents the basis of design for the remedial action, incorporating Site data and data on the cleanup action components. Appendix A, which presents data regarding the historical progress of HVOC degradation at the Site; and Appendix B, which presents manufacturer-specific design basis for chemical products that will be applied to promote remediation, support this section.
- **Section 4.0.** Describes the required construction activities at the Site. This includes permitting, Site preparation, injection of in situ groundwater treatment materials, environmental media handling and disposal, decontamination procedures, and health and safety procedures. Appendix C, which presents boring logs for existing Site wells; Appendix D, which presents a Spill Prevention and Emergency Countermeasure

Plan (SPECIP); and Appendix E, which provides a site-specific Health and Safety Plan (HASP), support this section.

- **Section 5.0.** Describes the monitoring that will be conducted as part of the remedial construction, including confirmational sampling. Appendix G, which presents protocols for inadvertent discovery of cultural resources, supports this section.
- **Section 6.0.** Describes the required operation, monitoring, and maintenance that will be performed immediately after construction of the cleanup action. Appendix F, which presents a Quality Assurance Project Plan (QAPP); and Appendix H (presented as Appendix E in the Bothell Design and Construction Standards and Specifications), which presents documentation of protocols required by the City for construction in rights-of-way (ROWs) adjacent to contaminate sites, support this section.
- **Section 7.0.** Presents a discussion of the reporting that will be completed as part of the remedial action construction.
- **Section 8.0.** Presents the references relied upon in creation of this document.

Supporting tables and figures in this report, including Table 4.1 and Figure 3.4, 3.5, 3.6, 4.1, and 6.1, comprise the 90% Design Plans for construction of the cleanup action in accordance with Exhibit C of the First Amendment to the AO.

## 2.0 Site Description and Summary of Current Environmental Conditions

The Site is located on the eastern portion of King County Assessor's parcel 082605-9120 (Site property), which is owned by the City. The Site is located in the easternmost portion of the City's Park at Bothell Landing administered by the Parks and Recreation Department and is currently used as a public, unpaved parking lot. The City intends to continue operating the Site property as public park space after implementation of the cleanup action; further details regarding future Site use are provided in Section 4.10. The Site is bounded to the north by State Route (SR) 522 and to the south by the Sammamish River (refer to Figure 1.1). The Site property is intersected by NE 180<sup>th</sup> Street.

The Site is defined by the extents of soil and groundwater contamination likely resulting from releases of PCE to the ground at a former machine shop (Figure 1.1) that operated in the northeast portion of the current parking area from about 1944 until 1973.

### 2.1 SITE GEOLOGY AND HYDROGEOLOGY

The Site lies at a ground surface elevation of approximately 42 feet North American Vertical Datum of 1988 (NAVD 88) at its northern property boundary and slopes gently downward from north to south toward the bank of Sammamish River. The riverbank area of the Sammamish River is steeply sloped and thickly vegetated primarily with non-native Himalayan blackberry.

Soils encountered at the Site consist of an uppermost fill unit underlain by alluvium deposits. The fill is composed of varying amounts of well-graded sand, silty sand, and gravel and contains occasional anthropogenic debris. The contact between the fill and native alluvium is characterized by a peaty silt consistent with marsh deposits approximately 2 feet thick. Below the peaty deposit, soils consist of interbedded fine sand and silty sand. Alluvium was observed to the deepest depth of 40 feet below ground surface (bgs) explored during the PDI. Historical boring logs noted deeper occurrences of a stiff silt, which was interpreted to be a glacially deposited unit in prior reports.

Shallow groundwater occurs within the native alluvium sand and silty sand deposits. Overall shallow groundwater flow at the Site is to the south, toward the Sammamish River.

### 2.2 CONCEPTUAL SITE MODEL

The solvent PCE was released at the Site in the liquid phase at the historically unpaved ground surface in the vicinity of the former machine shop, where it was most likely used for degreasing. Smaller incidental PCE releases may also have occurred while moving containers of solvent or recently degreased parts at the Site property.

PCE migrated downward through permeable shallow soils into groundwater. Once in groundwater, contamination continues to migrate laterally in the direction of groundwater flow, which is generally southward toward the Sammamish River. Breakdown of PCE is occurring in groundwater in a limited capacity due to natural reductive dechlorination processes which

produce additional HVOCs including trichloroethene (TCE), *cis*-1,2-dichloroethene (DCE), and vinyl chloride.

## 2.3 CONTAMINANTS OF CONCERN, CLEANUP STANDARDS, AND REMEDIAL ACTION OBJECTIVES

Site contaminants of concern (COCs) comprise the chemicals that pose the greatest overall threat to human health and the environment due to toxicity, spatial distribution, and/or concentrations present. Cleanup standards for the COCs are protective of all active or potentially active exposure pathways at the Site, considering both current and future land use.

### 2.3.1 Contaminants of Concern

The Site COCs were determined in the Final CAP (Ecology 2023a) and include the following:

- **Groundwater.** PCE and toxic breakdown products of PCE (TCE, *cis*-1,2-DCE, and vinyl chloride)
- **Soil.** PCE, TCE, *cis*-1,2-DCE, and vinyl chloride

All of the groundwater COCs have been detected in Site groundwater at concentrations exceeding cleanup levels (CULs). PCE and TCE are the only soil COCs that have been detected in Site soil at concentrations exceeding CULs.

### 2.3.2 Cleanup Standards

The cleanup standards include a CUL combined with a point of compliance (POC) where the CUL applies. Cleanup standards for the COCs are protective of all active or potentially active exposure pathways at the Site.

#### 2.3.2.1 Groundwater Cleanup Standards

Groundwater cleanup standards include CULs to be achieved by remediation. The standard POC for groundwater, which applies to all groundwater COCs, is throughout the Site to the maximum depth where contamination from the Site is present. Compliance is determined for each groundwater monitoring well individually in accordance with WAC 173-340-720(9)(c)(iv).

CULs for groundwater were established to be protective of discharges to surface water of the adjacent Sammamish River, where applicable, per WAC 173-201A. CULs for each groundwater COC are summarized in Table 2.1

**Table 2.1**  
**Groundwater Cleanup Levels**

Contaminant	CAS No.	CUL (µg/L)	CUL Basis	Toxicity Basis <sup>(1)</sup>
PCE	127-18-4	4.9	Surface Water: Freshwater	Human Health: Consumption of Water and Organisms
TCE	79-01-6	0.38	Surface Water: Freshwater	Human Health: Consumption of Water and Organisms
<i>cis</i> -1,2-DCE	156-59-2	16	MTCA Method B	Noncarcinogenic
Vinyl chloride	75-01-4	0.020	Surface Water: Freshwater	Human Health: Consumption of Water and Organisms

Note:

- 1 In accordance with WAC 173-340-720(9)(c)(v), compliance with CULs will be determined using an upper percentile concentration for CULs based on short-term or acute toxic effects on human health or the environment, and the true mean concentration for CULs based on chronic or carcinogenic effects.

Abbreviations:

CAS Chemical Abstracts Service

µg/L Micrograms per liter

### 2.3.2.2 Soil Cleanup Standards

The CULs for HVOCs in soil are based on MTCA Method A, which is protective of all pathways for a simple site with a single contaminant source (e.g., PCE releases from former machine shop operations), or MTCA Method B where a Method A CUL has not been established. The POC for soil established in the Final CAP is the vadose zone throughout the Site (compliance with CULs in the saturated zone is demonstrated by achieving the groundwater CULs). CULs for soil are summarized in Table 2.2.

**Table 2.2**  
**Soil Cleanup Levels**

Contaminant	CAS No.	CUL (mg/kg)	CUL Basis
PCE	127-18-4	0.050	Protection of Groundwater
TCE	79-01-6	0.030	Protection of Groundwater
<i>cis</i> -1,2-DCE	156-59-2	160	MTCA Method B Noncarcinogenic
Vinyl chloride	75-01-4	0.67	MTCA Method B Carcinogenic

Abbreviation:

mg/kg Milligrams per kilogram

### 2.3.3 Areas of Concern

Areas of concern were defined in the PDI Data Report to facilitate evaluation and selection of remedial alternatives. These encompass Site soil and groundwater locations where recent results exceed CULs for COCs. Areas of concern for remediation are summarized as follows and described geographically relative to existing Site wells, which are shown on Figure 1.1.

**HVOC Source Area and Upgradient Plume.** This area includes the vicinity of the former machine shop where soils containing PCE and minor concentrations of TCE that may act as a continuing source of groundwater contamination are located. Soil contamination in the source area occurs in the saturated zone between approximately 13 and 30 feet bgs. This area also includes the most highly HVOC-contaminated groundwater at the Site, including wells RMW-12, BC-3, EW-2, and EW-3. The groundwater contamination in this area is primarily PCE with lesser amounts of the more-mobile degradation products at the outer edges of the source area (i.e., RMW-6 and RMW-8). The vertical extent of HVOCs in groundwater is presumed to extend from the water table to approximately 35 feet bgs or higher in this area, based on non-detect results at RMW-10D, which is screened 32 to 42 feet bgs.

**Western Plume.** An additional western lobe of the groundwater HVOC plume is represented by RMW-4, RMW-5, and GWB-08, which are farther outside the current extraction system and extents of the current soil source area. This area of the Site may have historically been impacted by incidental releases of PCE in soil; however, no soil source contamination remains. HVOC concentrations in this area are less elevated relative to the source area, with PCE concentrations less than the Site CUL and exceedances of CULs detected only for TCE and vinyl chloride.

**Downgradient Plume.** This area includes groundwater downgradient of the HVOC source area, where source soil is not present and contamination has migrated in the dissolved phase. In this area, PCE exceeds CULs and greater fractions of PCE degradation products are present relative to the source area. The vertical extent of HVOCs in groundwater in this area is presumed to extend from the water table to approximately 35 feet bgs based on non-detect results from 35 to 40 feet bgs and 40 to 45 feet bgs at GWB-07. The downgradient plume extends from the upgradient wells noted in the source area description above to the riverbank area of the adjacent Sammamish River.

### 2.3.4 Remedial Action Objectives

Remedial Action Objectives (RAOs) for the Site, established in the PDI Data Report, were developed to specifically identify goals that should be accomplished to meet the requirements of the MTCA Cleanup Regulations (WAC 173-340) and other objectives set forth by the City. The following RAOs are defined for the Site:

- Protect humans and the environment (ecological receptors) from exposure to Site contamination that exceeds applicable CULs.
  - Achieve CULs in groundwater to protect surface water quality of the adjacent Sammamish River.

- Achieve CULs in soil to protect groundwater or minimize leaching to the groundwater pathway.
- Comply with local, state, and federal laws and other applicable or relevant and appropriate requirements (ARARs; WAC 173-340-710) and Site-specific cleanup standards. ARARs are limited to applicable federal and state laws and those that Ecology determines are relevant and appropriate.
- Remediate contaminants in a manner that minimizes impacts to public use of park space at the Site.
- Provide compliance monitoring to evaluate the effectiveness of the preferred cleanup action and to evaluate when the cleanup standards are met.

### 2.3.5 Cleanup Action Components

The CAP Addendum identifies the following components for the cleanup action, which are shown on Figure 2.1.

**In Situ Groundwater Treatment.** In situ groundwater treatment will be conducted to achieve enhanced reductive dechlorination (ERD). Groundwater treatment materials were selected based on the current HVOC conditions.

- In the HVOC source area and upgradient plume, soluble organic carbon and *Dehalococcoides* cultures will be applied to achieve ERD. The treatment materials will be applied via direct-push injection, which will ensure treatment of the full thickness of the contaminated zone. The materials will additionally be supplemented with zero-valent iron (ZVI) to achieve rapid abiotic degradation of source PCE. A controlled-release source of organic carbon with a lifespan of up to 10 years will be used to ensure that sufficient donor electrons are present to sustain ongoing ERD as the remaining PCE sorbed to soil continues to dissolve as it is depleted in groundwater.
- In the western plume area, soluble organic carbon and *Dehalococcoides* cultures will be applied to achieve ERD. A lesser amount of supplemental ZVI will be added to promote reducing geochemical conditions favorable to ERD.
- In the downgradient plume area, soluble organic carbon and *Dehalococcoides* treatment will be supplemented with ZVI and colloidal activated carbon (such as PlumeStop) to form in situ treatment barriers designed to trap HVOCs, particularly more mobile vinyl chloride. This will allow increased contact time with the treatment materials to ensure more complete degradation of HVOCs prior to groundwater discharge to the river.

Institutional controls (ICs) are not anticipated to be required at the Site but may be revisited in the future. In situ treatment would address remaining soil that is a source of groundwater contamination, and HVOC concentrations do not exceed screening levels for worker protection in any Site soil.

Additionally, the City has implemented a ROW contamination protocol that is incorporated into the City parcel mapping system and triggered by applications for ROW work permits adjacent to contaminated sites. The ROW contamination protocol identifies requirements for design review and City consultation prior to construction, material handling, material disposal, recordkeeping, and worker safety (Appendix H). Although ICs are not anticipated to be required after completion of the cleanup action, future right-of-work will continue to be subject to design review in accordance with the current contamination protocol.

Together, the individual technologies reduce or remove contaminant mass in soil and groundwater through adsorption and degradation. The cleanup action is a comprehensive final remedy for the Site that is compliant with all the applicable remedy selection requirements under MTCA provided in WAC 173-340-360(3), as well as the RAOs for the Site, as described in Section 2.3.4.

### 3.0 Engineering Design

Design strategies have been developed as part of this EDR to ensure compliance with ARARs and other requirements consistent with MTCA. In accordance with WAC 173-340-400(4)(a)(viii), this section includes the design criteria and engineering justification for design and implementation parameters of the cleanup action. The cleanup action components were designed to comply with the Final CAP and to achieve the RAOs described in Section 2.3.4.

#### 3.1 IN SITU GROUNDWATER TREATMENT DESIGN BASIS

The design of the in situ groundwater treatment is informed by several types of data:

- **Hydrogeologic study data**, including measurements of groundwater horizontal gradients, hydraulic conductivity, and flow velocities. These data inform the placement of treatment injections and treatment component quantities. Groundwater elevation contours and flow velocity are presented on Figure 3.1.
- **Contaminant distribution and HVOC trend data**, including the most recent groundwater and saturated soil sample results for HVOCs, which inform the extents and vertical thickness of the groundwater treatment areas. HVOC results supporting this discussion are presented in Table 3.1 and summarized on Figure 3.2. Analysis of current HVOC degradation trends at the Site is presented in Appendix A.
- **Contaminant flux data**, including flux data collected by passive flux meters (PFMs), which inform the quantities of treatment components. Contaminant fluxes are presented in Table 3.2 and summarized on Figure 3.2.
- **Anaerobic dechlorination indicator data**, including contaminant concentration trends and measurements of laboratory and field geochemical parameters (such as dissolved oxygen [DO] and oxidation–reduction potential [ORP]). These data are used to identify areas of the plume that are more or less conducive to anaerobic dechlorination and to inform the quantities of electron donors or beneficial bacterial culture necessary to promote degradation. Geochemical parameter data supporting this discussion are presented in Table 3.3.
- **Treatment component dispersal potential data**, including soil grain size distribution data in the saturated zone. These data inform the assumed radius of influence for in situ injection points and the recommended horizontal spacing and injection screen length to achieve consistent and even application of the treatment materials. Soil grain size results supporting this discussion are presented in Table 3.4, and soil types are summarized in cross-section on Figure 3.3.

A summary of the key design details are presented in Figures 3.4, 3.5, and 3.6 and discussed in the following sections.

### 3.1.1 Hydrogeologic Study

Monitoring wells have been installed with screened intervals ranging from 15 to 42 feet bgs at the Site. Wells with top-of-screen depths below 30 feet bgs are designated with a “D” suffix appended to the monitoring well ID. The deeper zone wells were established for the purposes of groundwater characterization and do not represent a distinct hydrostratigraphic unit. A summary of well construction details and groundwater table elevation measurements is presented in Table 2.1 of the PDI Data Report (Floyd|Snider 2024b).

Depth to groundwater varies at the Site between approximately 9 and 21 feet bgs. The direction of groundwater flow at the Site is to the southeast toward the Sammamish River, consistent with Site topography. Groundwater elevations measured during the PDI ranged from approximately 26 to 19 feet NAVD 88 within the Site boundary, resulting in measured horizontal gradients of 0.06 to 0.07 feet per foot.

Hydraulic conductivity has been estimated at the Site by aquifer testing, including slug tests performed by Parametrix (Parametrix 2009) and pump tests performed by Kane (Kane 2022). Estimated hydraulic conductivity ranged from 7 to 26 feet per day during slug testing and from 0.3 to 2.8 feet per day during pump testing (Kane 2022). The estimated hydraulic conductivity obtained by slug testing is considered anomalously high for the predominantly fine-grained soils in the shallow saturated zone at the Site (refer to Section 3.1.5 for additional discussion of grain size analysis), whereas the estimated hydraulic conductivity data obtained from pump tests are generally consistent with literature values for fine-grained soils (Fetter 2001).

Groundwater velocity estimates collected by PFM samples during the PDI range from approximately 0.02 to 1.8 feet per day (8 to 646 feet per year). These velocity estimates are similar to those obtained by prior pump testing performed during the 2022 Supplemental RI/FS and significantly less than older slug testing data presented in Parametrix 2009.

The concurrence of the 2024 PFM and 2022 pump test data suggests that the initial radius of influence of injection points will be relatively small.

### 3.1.2 Contaminant Distribution and HVOC Degradation Trends

#### 3.1.2.1 HVOC Distribution

The nature and extent of HVOCs in groundwater were largely determined using historical sampling records and refined during PDI. HVOC results for the PDI sampling event (conducted in 2024) are presented in Table 3.1. Monitoring well locations and their corresponding PCE and vinyl chloride exceedance factors relative to their CULs are shown on Figure 3.2.

The HVOC groundwater contamination exceeding CULs at the Site originates in the vicinity of the former machine shop, where limited source soil with PCE exceeding CULs is also present. The shallow plume spreads laterally downgradient the south-southeast. HVOC contamination in groundwater is limited to the shallow saturated zone above approximately 35 feet bgs, whereas

the deep zone is unimpacted. The HVOC contaminants that drive the cleanup actions are PCE, TCE, and vinyl chloride, which are described in more detail below.

PCE concentrations at wells measured in 2024 ranged from not detected at a reporting limit of 0.20 µg/L to a maximum detection of 9.8 µg/L at downgradient well RMW-14, compared to an historical Site-wide maximum concentration in 2017 of 270 µg/L at EW-3. PCE exceedances of the CUL of 4.9 µg/L were detected at RMW-12 in the presumed source area, upgradient extraction well EW-2, and downgradient extraction well EW-6. PCE was also detected at reconnaissance borings GWB-05 and GWB-06 to the southeast of the current permanent well network.

TCE exceeding the CUL is generally collocated with elevated PCE concentrations in the source area and downgradient portions of the Site. Additionally, CUL exceedances of only TCE occur in the western plume area where PCE generally does not exceed CULs including at RMW-4, RMW-5, and RMW-6. TCE concentrations measured in 2024 in the western plume area exceeded the CUL of 0.38 µg/L at RMW-4 and RMW-5, with results of 0.96 and 0.55 µg/L, respectively.

Vinyl chloride concentrations at monitoring and extraction wells measured in 2024 ranged from not detected at a reporting limit of 0.020 µg/L to a maximum detection of 9.4 µg/L at RMW-7, compared to an historical Site-wide maximum concentration in 2014 of 47 µg/L at RMW-7. Vinyl chloride exceedances of the CUL of 0.020 µg/L were also detected at source area well RMW-12; upgradient extraction wells EW-3 and EW-4; downgradient wells RMW-13 and RMW-14; and cross-gradient wells RMW-5 and RMW-6 to the west-southwest. Vinyl chloride was additionally detected at downgradient reconnaissance borings GWB-04 and GWB-06 and at GWB-08 to the west. The most elevated concentrations of vinyl chloride remain at the farthest available downgradient monitoring point (RMW-7); however, a trend of declining vinyl chloride has been observed in this area since 2020.

The vertical extent of all HVOCs exceeding CULs is well-defined above 35 feet bgs by samples collected at RMW-10D (screened 32 to 42 feet bgs) and at GWB-07 (collected from 35 to 40 feet bgs and 40 to 45 feet bgs), which had results that were non-detect or less than CULs for all HVOCs.

### **3.1.2.2 HVOC Degradation Trends**

For the permanent monitoring and extraction wells, the progress of mass removal and contaminant degradation within each subarea of the HVOC plume discussed in Section 3.1.2.1 are further illustrated by analyzing changes in total HVOC molar concentrations and molar fractions of individual HVOCs over time. The molar composition of HVOCs at key wells are presented in detail in Appendix A and summarized as follows. Monitoring well locations are shown on Figure 3.2.

Within the source area and upgradient portions of the plume, the total molar concentration of HVOCs has declined since the start of groundwater extraction pumping. Data at most wells have experienced an approximately 10-fold decrease in HVOC concentrations since their first year of monitoring. The HVOC contamination within the source area (i.e., at RMW-12, BC-3, and

EW-1 through EW-4) prior to groundwater extraction was composed primarily of PCE, with lesser fractions of TCE and *cis*-1,2-DCE, and small amounts of vinyl chloride. At the nearby wells on the plume edges (i.e., RMW-6 and RMW-8), the more mobile degradation products TCE, *cis*-1,2-DCE, and vinyl chloride made up most of the HVOC mixture. The distribution of HVOCs in the source plume has remained largely consistent over the duration of groundwater extraction while the overall concentrations have decreased, indicating that removal by pumping has caused most of the reduction of HVOC mass. There is also some evidence of dechlorination, for example at RMW-13 where the HVOC molar mass is now primarily *cis*-1,2-DCE; however, this appears to be a lesser contribution to overall mass reduction. There is some observed fluctuation of total HVOC molar mass between wet and dry seasons at RMW-8 during more recent sampling events; however, these potential fluctuations are within the context of overall low and relatively stable HVOC mass.

Within the western plume area, which is generally outside the potential influence of extraction pumping, HVOC concentrations are less elevated relative to the main plume, and overall HVOC mass has been stable to slightly increasing. The HVOC distribution trend suggests that dechlorination has occurred, as illustrated by increases in *cis*-1,2-DCE fractions at both RMW-4 and RMW-5 and the vinyl chloride fraction at RMW-5; however, degradation appears to be slow and incomplete based on the relatively flat trends in HVOC concentrations during recent sampling events.

Within the downgradient portion of the plume, the total molar concentrations of HVOCs have declined at a rate similar to the upgradient areas. The initial distribution of HVOCs in the downgradient plume was more variable prior to pumping, with fractions of more highly mobile degradation products (i.e., *cis*-1,2-DCE and vinyl chloride) increasing with distance downgradient from the source area. Similar to the source area and upgradient portions of the plume, the distribution of HVOCs has remained relatively consistent while overall concentrations have decreased, indicating that pumping has caused most of the mass reductions. However, farthest downgradient at RMW-7, remaining HVOCs are primarily *cis*-1,2-DCE and vinyl chloride, suggesting that partial dechlorination has also occurred.

An additional trend that is demonstrated on Table 3.1 is a positive correlation between mobile HVOC concentrations at the farthest downgradient well RMW-7 and groundwater extraction at EW-5 and EW-6. During upgradient-only groundwater extraction between 2013 and 2017, vinyl chloride was highly variable at RMW-7, but evidence of a decreasing trend began to emerge in late 2016/early 2017. After downgradient extraction began in 2017, vinyl chloride was consistently elevated at concentrations between 25 and 27 µg/L. Declining pump performance at EW-5 and EW-6 ultimately resulted in pump failure in both wells between approximately 2020 and 2023; during the same period, vinyl chloride decreased to less than 10 µg/L. This trend suggests that steeper horizontal gradients created by groundwater extraction downgradient facilitated downgradient migration of mobile HVOCs. There is some fluctuation observed in overall HVOC mass at RMW-7 during more recent sampling events; however, these fluctuations do not appear to have any seasonality and likely reflect the overall heterogeneity of HVOC concentrations in Site groundwater.

### 3.1.3 Contaminant Flux

Additional HVOC flux data collected during the PDI inform the quantity of treatment materials needed to achieve dechlorination of HVOCs at the Site. The average ambient groundwater flux, or Darcy velocity, ranged from 3.0 to 5.4 centimeters per day (cm/day) at RMW-12 and 0.7 to 4.0 cm/day at RMW-7. Darcy velocity was generally uniform across the screened intervals and between the wells except in the water table interval at RMW-7, where the minimum value of 0.7 cm/day was observed.

Total PCE flux measurements (refer to Figure 3.2 and Table 3.2) were greatest in the shallowest sample interval from 15 to 17 feet represented by RMW-07 and RMW-12, where peak flux was 80 micrograms per square meter per day ( $\mu\text{g}/\text{m}^2/\text{day}$ ) at RMW-12. Peak PCE flux was the least in the deepest intervals represented by RMW-07, with a maximum of  $10 \mu\text{g}/\text{m}^2/\text{day}$ .

Total TCE flux measurements were greatest in the shallowest sample interval from 15 to 17 feet represented at RMW-07 and RMW-12 and at 19 to 21 feet in RMW-12, where peak flux was  $30 \mu\text{g}/\text{m}^2/\text{day}$  in both intervals at RMW-12. Peak TCE flux was the least in the 19- to 21-foot interval represented by RMW-07, where no TCE flux was detected.

Total *cis*-1,2-DCE flux measurements were greatest in the 19- to 21-foot interval represented by RMW-07, where peak flux was  $3,600 \mu\text{g}/\text{m}^2/\text{day}$ . *cis*-1,2-DCE flux was minimal throughout all intervals of RMW-12, which did not exceed  $100 \mu\text{g}/\text{m}^2/\text{day}$ .

Total vinyl chloride flux measurements were greatest in the 17- to 19-foot interval represented by RMW-07, where peak flux was  $2,500 \mu\text{g}/\text{m}^2/\text{day}$ . VC flux was minimal throughout all intervals of RMW-12, where there was no detected flux in any interval except 19 to 21 feet.

The flux data suggest that treatment should focus on rapid degradation of PCE and TCE in the source area and upgradient plume. In the downgradient area, treatment should focus on slowing the flux and achieving full dechlorination of the PCE degradation products (particularly vinyl chloride), and it should additionally consider the longevity of the treatment products to ensure continual dechlorination as the remaining contaminants move downgradient.

### 3.1.4 Anaerobic Dechlorination Indicators

Geochemical data suggest that current conditions at the Site (aside from wells pumped for groundwater extraction) are favorable for anaerobic biodegradation of HVOCs by reductive dechlorination. Key geochemical parameters supporting this assessment are described as follows. Data for these parameters are summarized in Table 3.3.

**DO:** DO measures the amount of oxygen, an electron acceptor, is available in groundwater. DO was generally low within the plume, with values of 0.5 milligrams per liter (mg/L) or less. Typical target DO concentrations for anaerobic biodegradation are less than 1.0 mg/L (Arcadis 2002). DO concentrations greater than 1 mg/L were measured in the upgradient and deep wells that are not impacted by HVOCs (RMW-9R and RMW-10D). Greater DO was also measured at EW-6, which

is attributed to localized perturbations caused by frequent on/off cycles with the pump inlet set near the groundwater table during the sampling period, because DO was significantly lower at adjacent non-pumping well EW-5. These results suggest that the treatment design should aim to maintain the existing low DO conditions in Site groundwater and additionally minimize disturbances that might introduce DO into groundwater (i.e., no operation of the existing groundwater extraction system).

**ORP:** ORP measures the capacity for electron transfer in groundwater in millivolts; positive ORP indicates that conditions are oxidizing (i.e., groundwater has a tendency to lose electrons), whereas negative ORP indicates that conditions are reducing (i.e., groundwater has a tendency to accept electrons). At Site wells, ORP values were generally near zero or negative within the HVOC plume, indicating that baseline conditions are reducing and conducive to anaerobic biodegradation. More strongly positive ORP values were measured at RMW-9R, RMW-10D, and EW-1, consistent with greater DO at these locations. More strongly positive ORP was also measured at RMW-12, indicating that this well is likely near the upgradient edge of the HVOC plume. These results suggest that treatment design should aim to enhance the existing reducing conditions in Site groundwater.

**pH:** pH in wells across the Site ranged from 5.95 to 7.10. Most biological activity in groundwater, including biodegradation, is most effective in near-neutral pH conditions consistent with those observed at the Site. Limited pH buffering should be included in the groundwater treatment.

**Nitrate and sulfate:** Nitrate and sulfate ions are electron acceptors that, along with DO, may compete with HVOCs for electrons and inhibit reducing processes that degrade HVOCs. Nitrate concentrations in Site groundwater ranged from 0.052 to 2.6 milligrams of nitrogen per liter (mg-N/L), and sulfate concentrations in Site groundwater ranged from not detected, at a reporting limit of 5.0 mg/L, to 34 mg/L. These values are generally low; an example study of the effects of competitor electron acceptors in reductive dechlorination (Xu et al. 2018) determined that a statistically significant effect on the progress of dechlorination occurred at electron acceptor millimolar concentrations of 1 to 2.5 millimolar (equivalent to 14 to 35 milligrams of nitrogen per liter or 96 to 240 milligrams of sulfate per liter).

**Total organic carbon (TOC):** Organic carbon acts as an electron donor that can facilitate anaerobic biodegradation by the process of reductive dechlorination. TOC concentrations in Site groundwater were relatively low, ranging from not detected at a reporting limit of 1 mg/L, to 11 mg/L. TOC concentrations of approximately 50 mg/L are required to sustain biodegradation and initial TOC concentrations up to 500 mg/L are generally targeted when soluble organic carbon is added as a treatment material to facilitate biodegradation (Arcadis 2002). These results indicate that a lack of TOC at the Site is a key factor that currently limits the rate of dechlorination at the Site. The treatment design should include addition of TOC throughout the HVOC plume.

**Dissolved gases (ethene, ethane, and methane):** Dissolved gases are the end products of anaerobic biodegradation. Of the dissolved gases, ethene and ethane are relatively short-lived in the environment and detection of these gases indicates that more rapid biodegradation is occurring, whereas methane is relatively long-lived and indicates slower rates of biodegradation.

At the Site, ethene and ethane were not detected at reporting limits of 0.56 and 0.58 µg/L, respectively, but methane ranged between 1,300 µg/L and 2,200 µg/L at western plume wells RMW-5 and RMW-6; and 580 µg/L and 820 µg/L at downgradient wells RMW-7 and RMW-14. These methane detections indicate that anaerobic biodegradation, likely at slow rates, is occurring in the western and downgradient portions of the HVOC plume. Target dissolved gas concentrations for anaerobic biodegradation are generally greater than 1,000 µg/L (USEPA 2023a). These results indicate that treatment should aim to create more rapid dechlorination of HVOCs and supplemental bacterial cultures of *Dehalococcoides* may additionally be beneficial for treatment.

**Calcium, iron, and magnesium:** The presence of metals including calcium, iron, and magnesium is an indicator of hardness in groundwater. Hardness inhibits the migration of some treatment materials such as activated carbon and ZVI, and therefore, calcium is often added to in situ treatment barriers to ensure their accurate placement. Total calcium concentrations in Site groundwater ranged from 38,000 to 64,000 µg/L (38 to 64 mg/L), total iron concentrations ranged from not detected to 31,000 µg/L (31 mg/L), and total magnesium concentrations ranged from 11,000 to 19,000 µg/L (11 to 19 mg/L). Similar values were observed for dissolved metals. Combined, the detected metals in Site water classify it as moderately hard (USGS 2018). These results indicate that other treatment materials, if needed, could be injected with accuracy at the Site.

Other parameters such as alkalinity, chloride, nitrite, and sulfide provide useful baseline measurements for comparison during future groundwater treatment. Increases in concentrations of these parameters are indicators of the occurrence of biodegradation by reductive dechlorination (ITRC and RTDF 1999).

### 3.1.5 Treatment Component Dispersal Potential

Grain size data collected during the PDI are the primary indicator with respect to whether treatment components will disperse adequately in the saturated zone. As shown in Table 3.4, saturated zone soil at the Site is relatively consistent across the vertical thickness of the targeted treatment zones. The results of qualitative grain size analysis conducted during the PDI showed that saturated soils consisted of approximately 30% fines and 70% coarse grain material. Refer to Table 3.4 for additional grain size information by depth. The relatively small but uniform grain size at the Site indicates that in situ injection using direct push technology, which is implemented over small (generally 2 feet) targeted intervals, would achieve the most even distribution of treatment materials and be preferable to injection via permanent wells with longer well screens.

### 3.1.6 Conclusions for Engineering Design

The key considerations for design of in situ groundwater treatment at the Site include the following:

- Adding sufficient donor electrons from organic carbon to increase the rate of reductive dechlorination, which currently appears to be limited Site-wide by low TOC concentrations in groundwater

- Achieving rapid and full degradation of remaining source PCE in the upgradient portion of the Site, which may be achieved by biotic and abiotic degradation (i.e., with ZVI)
- Achieving rapid removal and biodegradation of vinyl chloride in the downgradient portion of the Site, including establishment of an activated carbon treatment barrier (i.e., PlumeStop) to adsorb vinyl chloride prior to groundwater discharge to the Sannamish River
- Promoting reducing conditions Site-wide by addition of organic carbon and/or ZVI
- Supplementing the existing bacterial population to promote biodegradation of HVOCs site-wide via addition of *Dehalococcoides* culture
- Utilizing direct push injection to achieve targeted treatment in relatively fine-grained soils

## 3.2 ENGINEERING JUSTIFICATION AND DESIGN CRITERIA

The remedial technologies that will be used in the cleanup were selected for their implementability and expected efficiencies in reducing contaminant mass to achieve Site cleanup standards. The Site data presented in Section 3.0 provide the basis of design for the remedial technologies. Further discussion of the expected efficiencies and effectiveness of the cleanup action components, and expectations of how these technologies will allow for achieving the cleanup standards, is presented in the following sections.

### 3.2.1 Expected Efficiencies and Degree of Effectiveness

The remedial technology of in situ groundwater treatment is a proven and effective method of removal/reduction of HVOCs and will be accomplished using a mixture of controlled-release soluble organic carbon, *Dehalococcoides* bacterial culture (Bio-Dechlor Inoculum Plus [BDI Plus]) and sulfidated microscale ZVI (S-mZVI) to biotically and abiotically degrade HVOCs, with a supplemental colloidal activated carbon (PlumeStop) treatment barrier to capture HVOC groundwater flows across the downgradient portion of the Site. The materials selected are colloidal compounds that disperse minimally upon application (generally within 6 to 10 feet) in the saturated zone to form a stationary treatment area. The treatment area relies on passive groundwater flow to achieve continued treatment and create upgradient reducing conditions, as well as dispersal of organic carbon farther downgradient as it is released into the dissolved phase. The selected components of the in situ treatment are all proven and effective methods of groundwater treatment and are further designed to work together to effectively reduce the extents and concentration of HVOCs in groundwater in an accelerated manner. The effectiveness of the treatment components is supported by review of several case studies conducted at sites with similar or more contaminated HVOC conditions in groundwater.

The dechlorination process, using a mixture of soluble organic carbon and *Dehalococcoides* bacteria applied in targeted areas, will allow for bioremediation within the footprint of the HVOC plume. *Dehalococcoides* are the only known bacteria able to fully break down PCE to

nonhazardous ethene and ethane. The soluble organic carbon source product proposed for treatment releases electrons, which are used by *Dehalococcoides* bacteria in anaerobic biodegradation via fermentation reactions. Electron release is designed to occur in two phases, with an initial rapid release to stimulate the initial bioremediation reaction and growth of the bacteria, followed by slow release to facilitate full anaerobic biodegradation of HVOCs. The organic carbon source is designed to remain in place; however, the soluble donor electrons produced by fermentation are able to migrate downgradient and bacteria are expected to grow and multiply, thus providing ongoing remediation of HVOCs in the target treatment areas as well as downgradient of the areas of application.

The addition of S-mZVI causes degradation of PCE and TCE through abiotic reductive dechlorination. ZVI is a fast-acting electron donor, which replaces chlorine atoms with hydrogen atoms to transform HVOCs directly to nonhazardous ethene and ethane. Sulfidation of ZVI increases the efficiency of the electron donor by decreasing competition for electrons in the environment. The expected dechlorination efficiency of S-mZVI is approximately 4 millimole TCE per gram of ZVI (Gong et al. 2021). S-mZVI additionally ensures that reducing conditions conducive to anaerobic biodegradation are present in the saturated zone.

The synergistic biotic and abiotic processes described above work in combination to achieve degradation of HVOCs, resulting in complete degradation via dechlorination to produce nonhazardous ethene, ethane, and chloride anions.

Preliminary treatment approaches similar to those described above have also been used successfully to treat groundwater at the upgradient-adjacent Ultra Custom Care Cleaners Site (Ultra Site) and Bothell Service Center Simon & Son Site (BSC Site). At the Ultra Site, injection of organic carbon in the form of edible oil, supplemented with ZVI, was effective in achieving localized remediation of shallow groundwater HVOC contamination and creating a reducing environment downgradient of the injection points. These injections were conducted as interim measures and covered only portions of the approximate three-city-block extent of the Ultra Site; however, within the radius of influence of the interim measure injections, the approach was effective. Natural dechlorination processes have also been observed in portions of the HVOC plume at the Riverside HVOC Site (as evidenced by the presence of vinyl chloride in portions of the HVOC plume), so the enhanced bioremediation would also likely be effective in accelerating the existing dechlorination mechanisms in HVOC-contaminated groundwater at this Site. Subsequent source treatment of the Ultra Site source property using ZVI soil mixing in the saturated zone caused rapid abiotic degradation of groundwater PCE within that source area from more than 100 µg/L prior to treatment to 1.8 µg/L less than 1 year after treatment, indicating that ZVI is effective at primary treatment in addition to promoting reducing conditions.

At the BSC Site, injection and recirculation of organic carbon in the form of CarBstrate™ is being conducted with the goal of remediating shallow and intermediate groundwater HVOC contamination. Application of organic carbon has generally been effective in creating reducing conditions and enhancing PCE degradation in the vicinity of the injection wells. For example, after targeted CarBstrate™ injections at one well location at the BSC Site, groundwater PCE

concentrations rapidly reduced from more than 1,000 µg/L prior to system modifications to 2.2 µg/L in approximately 6 months (Floyd|Snider 2025b). The efficacy of organic carbon recirculation has been limited at the BSC Site by the extent of the injection and extraction well network and radius of influence of the individual wells; however, where sufficient doses of CarbStrate have been delivered, it has generally been effective at achieving bioremediation. The performance data at the BSC Site suggest that organic carbon would achieve bioremediation more effectively with a means to deliver the product more uniformly in the saturated zone.

The addition of a downgradient in situ treatment barrier is designed to capture organic contaminants in groundwater by colloidal activated carbon. Activated carbon is a porous adsorption medium with extremely high internal surface area. It is a proven technology with high removal efficiencies (up to 99.9%) for many volatile organic compounds and HVOCs, including PCE and TCE (USEPA 2023b). At the Site, where PCE is present at the greatest concentrations in groundwater, activated carbon is expected to reduce these concentrations to 1 µg/L or less (USEPA 2023b). This expected post-treatment concentration meets the PCE CUL. Activated carbon is also capable of achieving CULs rapidly for TCE. The sorption capacity of carbon is less for *cis*-1,2-DCE and vinyl chloride relative to PCE and TCE, which can be mitigated by increasing the dosage in the downgradient treatment barrier to ensure concentrations remain less than CULs as the source cleanup progresses. Adsorption by activated carbon also consolidates HVOC contaminants within the barriers and provides a substrate for bioremediation reactions for more efficient treatment by *Dehalococcoides* bacteria. The degradation of HVOCs creates vacant sorption sites on the activated carbon, prolonging the life of the barrier and ensuring that back-diffusion from saturated soil to groundwater does not cause rebound of HVOC concentrations.

### 3.2.2 Design Summary

The following sections describe the selection of treatment materials for each area of concern at the Site. Additional details regarding treatment zone depths and dosage of the treatment materials are presented in Section 4.6. Documentation of the in situ treatment design basis is presented in Appendix B.

#### 3.2.2.1 HVOC Source Area and Upgradient Plume Treatment Zone Design

PCE source contamination in groundwater in the upgradient portion of the Site will have soluble organic carbon (3-D Microemulsion) and *Dehalococcoides* (BDI Plus) treatment applied via direct-push injection, which is supplemented with ZVI to achieve prompt abiotic degradation of PCE and TCE and ensure ongoing reducing conditions to promote anaerobic biodegradation. A gridded approach to injection will ensure even coverage of the soluble treatment materials selected for this area (Figure 3.4).

#### 3.2.2.2 Western Plume Treatment Zone Design

The HVOC contamination plume in groundwater, which extends to the western portion of the Site (Figure 2.1), will have soluble organic carbon (3-D Microemulsion) and *Dehalococcoides* treatment applied via direct-push injection, which is supplemented with ZVI to achieve prompt

abiotic degradation of PCE and TCE and ensure ongoing reducing conditions to promote anaerobic biodegradation. A gridded approach to injection will ensure even coverage of the soluble treatment materials selected for this area (Figure 3.5).

### **3.2.2.3 Downgradient Plume Area In Situ Treatment Barrier Design**

The in situ treatment barrier, which is a stationary treatment zone, is designed to be placed at the downgradient edge of the plume to capture and degrade source contamination as groundwater flows through the barrier prior to discharging to the river (Figure 3.6). The addition of colloidal activated carbon (PlumeStop) downgradient is designed to adsorb HVOCs and allow longer contact time with the treatment materials, which will allow for more rapid cleanup of downgradient groundwater. A triple row of injections is planned, which is expected to form a highly effective barrier. Unlike the source and western plume grid treatments where 3-D Microemulsion is preferred, AquiFix is the preferred organic carbon technology in the downgradient plume area because it has been designed to be compatible with PlumeStop. Furthermore, because PlumeStop's pH is basic, it will provide a buffer to maintain ideal pH for bioremediation when adding the AquiFix solution, which is slightly acidic. The treatment barrier will also include S-mZVI and be supplemented with BDI Plus.

## **3.3 COMPLIANCE WITH CLEANUP REQUIREMENTS**

The requirements for cleanup actions are specified in MTCA (WAC 173-340-360(3)). The mandatory MTCA general requirements for cleanup action include the following:

- Protect human health and the environment
- Comply with cleanup standards
- Comply with applicable state and federal laws
- Prevent or minimize present and future releases of hazardous substances in the environment
- Provide resilience to climate change impacts
- Provide for compliance monitoring
- Not rely primarily on ICs or dilution and dispersion
- Provide for a reasonable restoration time frame
- Use permanent solutions to the maximum extent practicable

The cleanup action is designed to achieve cleanup standards in soil and groundwater Site-wide. The cleanup standards are protective of exposures to all human and environmental receptors per the requirements of state and federal law. The cleanup standards will be met for saturated soil and groundwater within a restoration time frame of approximately 3 years, as described in the CAP Addendum and PDI Data Report. Compliance with additional applicable laws related to worker safety, environmental media management and disposal, in situ injection, and protection of archaeological resources are ensured by the provisions of this EDR. Proposed compliance

monitoring, which is a key remedy component to assess progress toward cleanup standards, is additionally described in this EDR.

### 3.3.1 Green and Sustainable Remediation Components

Green and sustainable cleanup considerations are increasingly being integrated into cleanup programs, including under MTCA in Washington. Sustainable Remediation: Climate Change Resiliency and Green Remediation (Ecology 2023b) is a Washington-specific resource to incorporate resiliency into the selected cleanup remedy. In accordance with green and sustainable remediation (GSR) principles, the five core elements of energy, air, water, land/ecosystems, and materials/waste should be considered to reduce the project's net environmental footprint in ways that are consistent with applicable statutes and regulations. Common GSR elements that may be incorporated into design of a cleanup action include the reduction of waste generation, optimization of material use or reuse, minimization of impacts to resources, minimization of air pollutants, and positive economic impact to the local community.

Environmental remediation is intrinsically a green process, as the environment is improved and risk to the community and human health is reduced or diminished. The environmental "footprint" associated with Site remediation has been reduced by incorporating the following GSR elements into the design:

- Choosing a cleanup method that reduces soil disturbance to minimize worker contact with contamination
- Using in situ treatment, which relies on the natural flow of groundwater through treatment barriers, rather than energy-intensive ex situ treatment technologies

Additional measures will be incorporated into the construction specifications to minimize environmental and community impacts, including the following:

- A no-idling policy will be implemented for all construction equipment and support vehicles when not in use.
- Local remediation contractors and vendors will be utilized when available.
- The truck haul route will be limited to arterial streets (designated as principal, minor, or feeder arterial roadways by the City) to minimize traffic, noise, and economic neighborhood impacts. Based on the selected remedial technologies, there will be limited truck trips necessary as part of cleanup. Truck trips are expected to be limited to product delivery and waste drum disposal.
- No further operations and maintenance (O&M) of the existing system will be required, nor will any additional long-term treatment system O&M be required as part of the selected remedial technologies. This reduces power usage at the Site relative to current baseline conditions.

Finally, during post-construction monitoring, field sampling activities will be performed in accordance with Floyd|Snider's GSR practices, which include minimizing vehicle trips and using dedicated sampling equipment.

## 4.0 Remedial Action Construction Planning and Implementation

This section provides details for implementation of the cleanup action. The City is responsible for planning and implementation of the cleanup action.

### 4.1 CONSTRUCTION SCHEDULE

Construction of the Cleanup Action will be implemented by the City's Public Works department, using a publicly advertised bid process to select a qualified contractor to perform the construction activities. Construction plans and specifications will be developed following Ecology approval of this EDR and will be provided to all bidders. Upon conclusion of the public bid period, the City will select a winning bidder and begin the public works contracting procedures that will result in contractor Notice to Proceed (NTP). Following NTP and field mobilization, the scope of the construction work is expected to be completed within 30 to 40 business days.

### 4.2 SITE ACCESS

The Site consists of a combination of travel lanes, sidewalks, and unpaved City-owned property as shown on Figure 2.1. Where possible, existing driveways will be used to access work areas. Appropriate traffic control measures will be implemented in accordance with an approved Traffic Control Plan whenever working in City-owned ROWs including roadways and sidewalks.

There is currently one access driveway along the south side of the gravel paved parking area. This driveway will be the access point to the parking area and north-adjacent sidewalk ROW.

### 4.3 PERMITS AND EXEMPT PERMITS

Anticipated permits and other approvals to fulfill state requirements for the cleanup action include an Ecology-issued Underground Injection Control (UIC) permit for injection of the in situ treatment materials.

The UIC program is administered by Ecology to protect groundwater by regulating the discharge of fluids from underground injection wells. Registration under UIC is required for injection of reagents for groundwater treatment. The temporary injection points will be registered with Ecology as Class V UIC wells for cleanup sites. A copy of the UIC registration will be provided to the remediation contractor(s) prior to construction.

Additional local permits applicable to the cleanup action will be acquired as needed. Under MTCA, Ecology-led cleanups are exempt from these local permits but must comply with the substantive requirements of the permits. Because the City is both the Site owner/operator and the entity responsible for review and approval of permits, the City may request that the remediation contractor(s) prepare permit applications or prepare equivalent submittals demonstrating substantive compliance with the permit requirements to fulfill the terms of contracts for the cleanup action. Applicable local permits are anticipated to include ROW permits and mechanical permits for utility decommissioning.

Disposal of drummed waste soil and water generated during the cleanup action is not subject to permitting requirements; however, a disposal authorization is required from each licensed landfill facility before hauling waste soil or water to that facility.

#### **4.4 SITE PREPARATIONS**

Site preparation for the cleanup action will include establishing site controls and protecting or decommissioning underground structures as described in the following sections.

##### **4.4.1 Site Controls**

The Site is located in the easternmost portion of the City's Park at Bothell Landing administered by the Parks and Recreation Department and is currently utilized as a public, unpaved parking lot. The Site is bounded to the north by SR 522 and to the south by the Sammamish River (Figure 2.1). During construction, temporary fencing will be used around the designated work zone to control access by members of the public. The City may additionally opt to enclose a portion of the unpaved parking lot with temporary fencing during construction for the purposes of creating a secured equipment and material storage area.

##### **4.4.2 Utilities and Monitoring Wells**

Several underground structures, including utility lines and monitoring wells, are present in areas that may be disturbed by cleanup action construction. Limited surface utilities (including light poles/lampposts and the remediation system shed associated with the groundwater extraction system) are also present in some work areas. The locations of utilities and wells in the vicinity of the cleanup action are shown on Figure 4.1.

City-owned subsurface utilities in the vicinity of the cleanup action include sewer, stormwater water main lines and lateral service lines. Other utilities in the area include buried electrical main lines and gas lines owned by Puget Sound Energy, buried electrical service lines connected to streetlights and signals owned by the City, the buried electrical service line to the remediation shed, and buried electrical service and effluent water pipe connecting individual extraction wells to the remediation shed.

###### **4.4.2.1 Public Utilities**

All public utilities, including those owned by the City and Puget Sound Energy, will be protected during construction. The buried utility main lines are relatively new and expected to be equipped with metallic tracer wires; therefore, the general remediation contractor(s) will be responsible for locating underground utilities within 10 feet of ground-disturbing activities using electromagnetic methodology. If lateral sewer lines are not locatable with electromagnetic methods, a camera survey may be performed to trace the alignment at the ground surface by equipping the camera equipment with a Global Positioning System transmitter or tracer wire. A 3-foot buffer will be maintained between buried utilities and any ground-disturbing activities.

#### **4.4.2.2 Remediation System**

The remediation system components, including the electrical service lines, effluent pipes, and shed structure, will be decommissioned after completion of the cleanup action. Decommissioning of the remediation system is anticipated to be performed during grading activities for redevelopment of the Park at Bothell Landing, which is discussed in further detail in Section 4.11.

#### **4.4.2.3 Wells**

Site monitoring and extraction wells are located on the Site property and in the surrounding ROWs. Wells are designated for decommissioning or protection as shown on Figure 4.1. Well decommissioning will be performed by a licensed driller in accordance with the Washington State Minimum Standards for Construction and Maintenance of Wells (Minimum Standards; WAC 173-160). Well boring logs are provided in Appendix C.

The two downgradient extraction wells (EW-5 and EW-6) require decommissioning by over-drilling due to stuck pumps within the well casings. Because the well casings cannot be fully sealed due to the obstructions, the wells will be over-drilled using roto-sonic or hollow-stem auger tooling of larger diameter than the annular space of the well. The remaining extraction system components will be decommissioned as described below.

The remaining extraction wells will either be converted to monitoring wells or decommissioned in place. For conversion to monitoring wells, the casing will be extended to approximately 6 inches below the surrounding ground surface and protected with a flush-mounted monument set in concrete to create a continuous seal extending to the land surface. The remaining space inside the vault will be backfilled with crushed gravel to match the surrounding ground surface. For decommissioning, the well casing will be sealed according to the Minimum Standards and the vault will be backfilled to match the surrounding ground surface. Backfilling of the vaults for decommissioned wells will be performed during park redevelopment activities (refer to Section 4.11). Extraction wells to be converted to monitoring include EW-2 and EW-3. EW-1 and EW-4 will be decommissioned in place because they are located adjacent to existing monitoring wells.

Additional monitoring wells to be decommissioned include RMW-8, which is located more than 70 feet cross-gradient to the current plume extents and may conflict with future park redevelopment (refer to Section 4.10), and RMW-10D, which is screened below the depth of HVOC contamination and target HVOC treatment zone. The remaining monitoring wells will be protected during construction.

#### **4.4.3 Stormwater, Erosion, and Sediment Controls**

Cleanup action construction work is expected to begin in late spring to early summer of 2026, which is defined as dry season work in Ecology's Stormwater Management Manual for Western Washington (Ecology 2024). The scope of work of primary concern for stormwater

erosion and sediment control is construction equipment disturbing the ground on the source property. The total potential disturbed area of ground surface on the source property is less than 1 acre; therefore, a Construction Stormwater General Permit (CSGP) is not required for construction. However, work will implement best management practices (BMPs) consistent with CSGP requirements and Bothell Design and Construction Standards (City of Bothell 2023) to protect stormwater quality. The total disturbed area when installing a direct-push injection point is approximately 2 inches in diameter and therefore of minimal concern for stormwater run-on and run-off during injection activities. Well boring diameters are also relatively small, generally measuring 12 inches or less. Utility decommissioning may include limited pothole excavation or trenching and is expected to be the main source of ground disturbance at the Site.

Prior to beginning utility decommissioning, BMPs will be installed by the contractor as needed to control run-on and run-off of surface water within the planned work zones and to prevent commingling of stormwater with potentially disturbed soil or treatment materials. BMPs to prevent run-on into disturbed areas (such as berming or placement of a silt fence, straw wattle, coir log, or compost sock) will be installed during construction, if applicable. Additional protections will be implemented by the contractor to prevent leaks or drips from escaping from the injection products during transportation and storage and to prevent run-off from the injection points due to leaks or surfacing during in situ treatment injection. All stormwater will be allowed to infiltrate through the unpaved parking lot within the work area and not allowed to flow into downgradient catch basins at the west end of the Site. Although the overall traffic volumes are expected to be less during construction than during general parking lot use, the catch basins located in close vicinity to the construction activities will be protected with filter inserts as a precautionary measure to protect general stormwater quality.

#### **4.4.4 Spill Controls**

Potential releases of hazardous or potentially dangerous substances may occur during cleanup action construction. The hazardous substances of primary concern are HVOCs, which are the COCs present in Site media that will be targeted during the cleanup action. BMPs to limit the spread of waste waters potentially contaminated with HVOCs are presented in Appendix D.

The chemical components of the in situ treatment, consisting of organic carbon, colloidal activated carbon, and S-mZVI are not considered hazardous to human health or the environment; S-mZVI is however considered an irritant and can present a risk of damage to mucus membranes. The treatment components may create nuisance conditions or cause public concern if spills or accidental discharges occur.

Additional hazardous or potentially dangerous substances that may be released during the course of the cleanup action include fuels and hydraulic oils used in construction and drilling equipment.

An SPECIP to address spills of fuels and other chemicals used during the cleanup action is presented in Appendix D. Prior to beginning cleanup action construction, spill control devices and countermeasures will be mobilized to the Site in accordance with the SPECIP.

#### 4.5 ENGINEERING OVERSIGHT

Oversight of the cleanup action construction will be performed on behalf of the City to ensure that all aspects of the work are performed in accordance with the EDR. Engineering oversight will be performed by a qualified technician under the direct supervision of the Engineer.

The technician performing oversight will maintain a daily log of work performed under the EDR, including but not limited to the following information:

- Construction techniques and equipment used
- Roles and qualifications of personnel present on-site
- Types and quantities of materials imported
- Design verification measurements and test results
- Samples of environmental media collected
- Health and safety protocols and monitoring results
- Corrective actions performed to address work not meeting the standards of the EDR
- Site visits or inspections performed by the City or Ecology

#### 4.6 HEALTH AND SAFETY

The cleanup action construction work described will comply with the health and safety standards prescribed by the Occupational Safety and Health Act (OSHA) and the Washington Industrial Safety and Health Act. A project-specific HASP is attached as Appendix E. This plan includes emergency contacts and response, chemical and physical risk analysis, site controls, and monitoring. Copies of the HASPs will always be on-site, and visitors entering the work area will be required to review and sign the project-specific HASP. All work will be performed by remediation contractors with active Hazardous Waste Operations and Emergency Response (HAZWOPER) certifications, First Aid/cardiopulmonary resuscitation, and all applicable task training for the work required.

As the work will have high public interest and will likely impact the community while being conducted, appropriate site control measures will be maintained in all work areas to limit access during and after work hours. Site control measures include the site perimeter fence, sidewalk/access closures, and informational signage. Informational signage will be placed in the safest accessible location during the project work to discourage congregation near the perimeter of excavation areas or in the vicinity of operating equipment.

Site perimeter noise and dust monitoring will be conducted to ensure that populated areas adjacent to the Site are not negatively affected by work involving contaminated soil and heavy machinery. Refer to Section 5.1 for relevant monitoring and action levels.

## 4.7 IN SITU GROUNDWATER TREATMENT INJECTION

The following sections describe the alignment and injection details for installation of downgradient in situ groundwater treatment. In situ groundwater treatment will consist of the following applications:

- **HVOC Source Area and Upgradient Plume Treatment Zone.** Targeted upgradient treatment zone remediation will be implemented by installation of a total of nine injection points at 10-foot intervals in the source area, targeting a treatment zone between 12 and 35 feet bgs, as shown on Figure 3.4.
- **Western Plume Treatment Zone.** A supplemental treatment zone will be implemented by installation of a total of 15 injection points at 30-foot intervals in the western plume, targeting a treatment zone between 12 and 30 feet bgs, as shown on Figure 3.5.
- **Downgradient Plume In Situ Treatment Barrier.** In situ groundwater treatment will be implemented in shallow groundwater by installation of a treatment barrier perpendicular to the direction of groundwater migration at the downgradient edge of the HVOC plume, as shown on Figure 3.6. The proposed in situ treatment includes a total of 48 injection points installed at 5.5-foot intervals in three offset rows such that the spacing between adjacent points is 3.25 feet. The target treatment zone of the in situ treatment barrier is between 15 and 35 feet bgs.

Prior to beginning in situ injection, the remediation contractor(s) will be required to survey the injection points and control points defining each barrier to the nearest 0.1 horizontal feet. Survey of each barrier injection point is not required; however, the remediation contractor(s) will field-mark the locations of injection points consistent with the requirements specified in this section to the Engineer's satisfaction prior to beginning injection. Additionally, the remediation contractor(s) will communicate any points modified due to the presence of utilities or other obstructions to the Engineer.

### 4.7.1 Injection Methodology

Treatment fluids will be injected into the subsurface through a series of direct-push borings to create a passive treatment zone of chemical reduction and bioremediation. Fluids will be injected at each location under low pressure (generally less than 80 pounds per square inch) using a direct-push drill rig to provide even distribution of treatment media within the target treatment zone. Injection depths are designed to treat the most contaminated portions of the saturated zone, as described in Section 4.6.1.1, with targeted treatment depths ranging from 12 to 35 feet bgs within the shallow zone of contamination. Typical injection cross sections for the barriers are shown on Figures 3.4 through 3.6. The injection details are presented in Table 4.1.

#### 4.7.1.1 Treatment Components

Treatment components will be batch-mixed in aqueous solution to achieve the manufacturer-recommended dosages at an injection rate of 35 to 100 gallons per foot, depending on the product being applied. The recommended dosages vary according to the current contaminant concentration and geochemical conditions and contaminant flux rates. Refer to Table 4.1 for a summary of injection details in each treatment zone and the downgradient barrier.

At the source area and upgradient plume, geochemical conditions are reducing and PCE source contamination remains in saturated soil and groundwater between approximately 12 and 35 feet bgs. Treatment in this area will consist of S-mZVI to abiotically and completely degrade source PCE and ensure reducing conditions with supplemental organic carbon to promote complete biodegradation of the PCE breakdown products. Recommended treatment media dosage rates are as follows:

- 3-D Microemulsion dosing of 19.3 pounds per vertical foot
- S-mZVI dosing of 9.7 pounds per vertical foot
- BDI Plus dosing of 0.130 liters per vertical foot

In the western plume, lower levels of PCE and its breakdown products are present in groundwater between 12 and 30 feet bgs. In this area, treatment to enhance anaerobic biodegradation will consist of soluble organic carbon to ensure reducing conditions and provide donor electrons for the complete breakdown of the mixture of HVOCs using the following dosage rates:

- 3-D Microemulsion dosing of 37.0 pounds per vertical foot
- Supplemental S-mZVI dosing of 11.6 pounds per vertical foot (for additional pH buffering)
- BDI Plus dosing of 0.50 liters per vertical foot

In the downgradient plume area, some source PCE as well as elevated vinyl chloride are present in groundwater between 15 and 35 feet bgs. The downgradient edge of the HVOC plume in this area is presumed to discharge to the adjacent surface water of the Sammamish River. Treatment will consist of an in situ treatment barrier composed of PlumeStop, Aquifix, S-mZVI, and BDI-Plus, which will work in coordination to sorb HVOCs, abiotically degrade PCE, and promote anaerobic biodegradation of the HVOC breakdown products. Recommended dosing rates are as follows:

- PlumeStop colloidal carbon dosing of 20 pounds per vertical foot
- Aquifix dosing of 3.9 pounds per vertical foot
- S-mZVI dosing of 3.9 pounds per vertical foot
- BDI Plus dosing of 0.024 liters per vertical foot

#### **4.8 DECONTAMINATION**

Decontamination procedures will be strictly followed to prevent the spread of contamination. All drilling equipment will be decontaminated before it leaves the Site. Decontamination procedures will additionally be implemented for equipment when moving between the areas of concern.

Equipment decontamination will include decontamination of all drilling tooling that contacts subsurface soil and groundwater. Decontamination will consist of dry sweeping to achieve a visually debris-free surface, then pressure washing with detergent solution followed by a potable water rinse or steam cleaning.

Equipment decontamination wash water will be captured and not allowed to run onto the ground surface. Decontamination wash water will be managed according to the procedures for wastewater management, as described in Section 4.8.

#### **4.9 ENVIRONMENTAL MEDIA MANAGEMENT**

Waste soil and water anticipated to be generated during construction of the cleanup action includes soil cuttings from drilling, decontamination wash water, and purge water produced during injection implementation and monitoring. Waste soil and water have the potential to contain HVOC contamination.

Waste soil and water will be containerized in U.S. Department of Transportation-approved drums, labeled with their contents, and temporarily stored on City-owned property pending profiling. Waste water and soil will be disposed of off-site at a licensed facility.

#### **4.10 SITE RESTORATION AND DEMOBILIZATION**

Site restoration will consist of backfilling injection points, backfilling decommissioned utilities, and demobilization of equipment and temporary materials and structures.

Direct push injection points will be sealed with bentonite, bentonite slurry, neat cement grout, or neat cement in accordance with the Minimum Standards for decommissioning of direct push borings (WAC 173-160-460(2)(d)) after injection is completed and the drill rods are removed. After sealing the injection point, the small, disturbed area will be restored consistent with the surrounding ground surface (i.e., gravel, asphalt, or concrete). Utilities will be backfilled by crushed surface base course or top course material obtained from a quarry source.

Following completion of construction activities, all equipment will be demobilized and temporary structures, including constructed ramps or other ground surface protection, will be removed. Gravel used to construct curb crossings may be reused to restore gravel-paved surfaces on City-owned property. It is assumed that any temporary fencing will be removed; however, the City may retain or remove site access controls at its discretion after the other restoration activities are completed. Any vegetated areas damaged by construction activities will be re-seeded and/or stabilized with mulch at the City's direction.

#### **4.11 PARK REDEVELOPMENT**

The City's Parks and Recreation Department is currently in the planning stages for redevelopment of an improved Park at Bothell Landing, which encompasses the Riverside HVOC Site. The current redevelopment concept, which is shown on Figure 4.2, includes construction of a skate park, park entrance plaza, and walking trails in the vicinity of the Site. Construction of this park redevelopment is currently anticipated to begin in either 2027 or 2028, after completion of the cleanup action construction at the Site.

The conceptual park redevelopment design may include grading, paving, and/or planting in the vicinity of the Site monitoring wells. If grading occurs in the vicinity of the wells, the City will ensure that the well casings are protected, surface monuments are preserved or replaced as appropriate, and access is maintained to allow for continued groundwater monitoring as discussed in Section 6.0.

## 5.0 Construction Compliance Monitoring

This section presents the Compliance Monitoring Plan to be implemented during construction, consisting of protection monitoring for health and safety, performance monitoring to ensure quality control during implementation of the remedial technologies, and confirmation monitoring to ensure cleanup standards are met.

### 5.1 PROTECTION MONITORING

The primary concerns for protection monitoring for both community and worker exposures are high noise levels and exposure to HVOC compounds during soil disturbing activities.

Noise levels will be monitored continuously at the source, in addition to the engineering and administrative controls outlined in the HASP (Appendix E), to ensure they remain under the OSHA permissible exposure limits for those working in proximity. The noise monitoring will align with the maximum permissible exposure levels of WAC 173-60-050. Refer to Section 5.7 of the HASP (Appendix E) for action levels. If action levels are exceeded, additional work site and/or work practice controls will be implemented in accordance with the HASP.

Dust monitoring will include visual inspection to ensure that no dust leaves the work area. If fugitive dust is observed, the contractor will pause work to implement dust control measures.

### 5.2 PERFORMANCE MONITORING

Performance monitoring during construction will include testing, measuring, and documentation to ensure that the implementation of the remedial technologies and actions were effectively applied.

During in situ treatment barrier injection, the weights/volumes of each component when batch-mixing the aqueous injection solution, as well as the volume of solution injected in each interval of the treatment zone, will be recorded. Periodic verification testing of soil and groundwater within the injection zone will also be performed as directed by the Engineer. Verification testing will be performed on groundwater and soil samples to verify the in situ placement of the treatment materials.

Groundwater verification samples will be collected using a pump when injecting within 10 feet of a well screened within the treatment zone, or via temporary piezometers when nearby wells are not available. At least two groundwater verification samples will be collected from within each area of concern during injection for field measurement of organic carbon. Other geochemical indicators of successful in situ treatment barrier injection (such as DO, conductivity, and ORP) may not be immediately apparent during injection, but will be collected as field parameters during subsequent performance monitoring that will be completed after injection, as described in Section 6.1.

Soil verification testing may be performed for the in situ treatment barrier by advancing a direct-push boring within the barrier after completion of the injection. Adequate dispersion of the treatment barrier in soil and groundwater in the target treatment zone is visually assessed by noting color change to dark gray/black caused by colloidal activated carbon and S-mZVI.

The injection spacing may be field adjusted to be more closely or widely spaced if indicated by the findings of visual and field testing assessments, with corresponding adjustment made to the quantities of treatment components injected per depth interval at each point, to ensure consistent and even application of the specified quantities of treatment materials.

Lastly, a key component of in situ groundwater treatment is short-term groundwater performance monitoring, which is described in Section 6.1.

### **5.3 CULTURAL RESOURCE MONITORING**

The Washington State Department of Archaeology and Historic Preservation's predictive model on the Washington Information System for Architectural and Archaeological Records Data characterizes the project area for the Site as high to very high risk for containing buried archaeological materials including historical and prehistoric or pre-contact features and artifacts. No archaeological resources have been identified in any of the work areas for the cleanup action; however, there are eight previously recorded archaeological sites within a 1-mile radius of the project area. The majority of these sites are historical in nature.

During all ground-disturbing activities, the field technician will monitor for cultural resources in accordance with the Inadvertent Discovery Plan (IDP) provided in Appendix G. In the event that cultural resources are encountered, the field technician will stop work in the area as required by the IDP and notify the City and the Engineer. The City will comply with the IDP to perform additional evaluation and notifications appropriate to the type of resources encountered.

## 6.0 Short-Term Performance Monitoring, Operation, and Maintenance

The following sections describe the short-term operation, monitoring, and maintenance activities that will be performed for the first year after initial construction of the cleanup action, including the in situ groundwater treatment injection, as described in Section 4.6.

### 6.1 GROUNDWATER PERFORMANCE MONITORING

This section presents short-term performance monitoring that will be implemented for the first year after installation of the in situ treatment components to assess the performance of the barriers in removing and degrading HVOCs and to determine whether any additional treatment will be implemented as part of the cleanup action.

#### 6.1.1 Monitoring Well Locations

A monitoring well network of existing and new wells will be established to assess performance of the cleanup action and compliance with CULs for HVOCs. This network will include monitoring wells within the groundwater HVOC plume, including wells placed both upgradient and downgradient of the in situ treatment barrier, and a sentinel well upgradient of the Site to provide information on background geochemical conditions. Site topography at the southern plume boundary prevents the installation of a downgradient sentinel well because a steep embankment descending directly into the Sammamish River makes drilling infeasible. Compliance will be measured at the top of the embankment with the assumption that meeting the CULs at this point ensures HVOC concentrations remain at or less than CULs in the downgradient groundwater.

The existing network of monitoring wells will be used for groundwater monitoring to the extent possible; however, several wells are proposed for decommissioning prior to construction, and four additional wells are needed to complete the performance monitoring well network after construction, as described in Section 6.1.2. An additional well not designated for performance monitoring will be maintained as a sentinel well and may be sampled as needed to further investigate remedy performance.

#### 6.1.2 Well Installation

New monitoring wells will be installed to fill in key monitoring areas to complete the monitoring well network. The well screens will be situated to monitor HVOC conditions in groundwater within the most highly contaminated pre-remediation intervals and to evaluate the performance of the in situ injections. The well screens may be adjusted in the field to target more transmissive units, if encountered, within the in situ treatment zone. The new performance monitoring wells to be installed are shown on Figure 6.1 and include the following:

- One well (RMW-15) downgradient of the PlumeStop along the eastern edge of the plume. This monitoring well is designed to monitor HVOCs and degradation byproducts moving through the PlumeStop barrier, and the target well screen is approximately 15 to 25 feet bgs.

- One well (RMW-16) cross-gradient and to the west of the source area. The treatment zone monitored by this location is 12 to 30 feet bgs, and the target well screen is approximately 15 to 25 feet bgs.
- One well (RMW-17) along the southwestern edge of the plume. The treatment zone monitored by this location is 12 to 30 feet bgs, and the target well screen is approximately 15 to 25 feet bgs.
- One well (RMW-18S) within the source area and collocated with RMW-12 but screened across the groundwater table to better track the upper portion of the plume. This monitoring well is designed to monitor HVOCs in the uppermost portion of the treatment zone, and the target well screen is approximately 12 to 22 feet bgs.

The new wells will be installed, developed, and surveyed in accordance with the procedures in the QAPP (refer to Appendix F).

### 6.1.3 Groundwater Sampling and Analysis

Groundwater monitoring will be conducted in accordance with the procedures included in Attachment F.1 and will involve collecting groundwater samples and/or groundwater elevation measurements at the locations shown on Figure 6.2.

Samples will be analyzed for all or a subset of the following chemicals as specified in Table 6.1:

- HVOCs: PCE, TCE, *cis*-1,2-DCE, *trans*-1,2-DCE, and vinyl chloride
- Secondary geochemical parameters for assessment of natural attenuation (also known as monitored natural attenuation [MNA] parameters): anions (nitrate, nitrite, and sulfate), sulfide, TOC, ferrous iron, and dissolved gases (ethene, ethane, and methane)

HVOCs will be analyzed at all designated performance well locations (refer to Figure 6.2) to assess degradation performance Site-wide as well as cross- and within-barrier contaminant removal at the downgradient in situ treatment barrier. MNA parameters will be additionally analyzed to determine whether the treatment components are achieving the desired geochemical conditions for anaerobic dechlorination. MNA parameters may additionally be analyzed at designated sentinel wells if needed to diagnose issues with cleanup progress. Field water quality parameters including ORP, DO, pH, temperature, and turbidity will additionally be collected during sampling at all locations and will provide additional information for assessment of MNA. The plan for performance well sampling is summarized in Table 6.1.

Groundwater monitoring will be conducted quarterly during the first 1 year and a long-term compliance monitoring plan (LTCMP) will be developed for any further necessary groundwater monitoring. The scope of monitoring may also be adjusted as needed to meet the goals of performance assessment, which include the following:

- Upgradient performance of gridded organic carbon and S-mZVI treatment (RMW-4, RMW-5, RMW-6, RMW-12, RMW-14, RMW-16, RMW-18S, EW-2, and EW-3).

- Downgradient performance at monitoring wells (RMW-7, RMW-13, RMW-15, and RMW-17) to evaluate performance of the in situ treatment barrier.

Groundwater elevation measurements will be collected from each performance well designated for chemical analysis, in addition to plume boundary wells that may not be designated for chemical analysis to refine groundwater flow direction and measure the magnitude of hydraulic gradients at the Site.

## 6.2 ADDITIONAL ASSESSMENT OR TREATMENT EVALUATION

The need for additional groundwater treatment will be determined annually after the completion of the first year of quarterly groundwater monitoring. When making determinations for additional assessment or treatment, the following sources of performance data may be evaluated:

- Overall rates of HVOCs source mass reduction in Site groundwater based on statistical metrics (such as median and upper confidence limits) calculated Site-wide and at each monitoring well for successive quarterly monitoring datasets
- Trend analysis at individual wells in accordance with Ecology's statistical guidance (Ecology 1992) to determine the potential presence and slope of downward trends in HVOC concentrations
- Concentration trends of PCE breakdown products relative to PCE Site-wide and at individual wells
- Geochemical indicators of the occurrence of natural attenuation
- Geochemical conditions conducive to anaerobic dechlorination
- Cross-barrier removal efficiencies for HVOCs calculated for paired wells at the treatment barrier

If additional assessment or treatment is determined to be needed, the additional work will be proposed in coordination with Ecology.

## 7.0 Reporting

Reports will be prepared to document the implementation of the cleanup action and progress toward achieving the cleanup standards, as described in the following sections.

### 7.1 CONSTRUCTION COMPLETION REPORTS

An interim Cleanup Action Report (or as-built report) will be prepared and submitted to Ecology within 120 days after completion of in situ injection, as described in this EDR.

Information provided in the interim Cleanup Action Report will include an opinion from the Engineer, based on testing results and inspections, as to whether the cleanup action has been constructed in substantial compliance with the plans and specifications and related documents (WAC 173-340-400(6)(b)(ii)) providing the following, as appropriate:

- Description of remedial activities, including deviations from this EDR
- Photographic documentation of construction activities and the finished construction
- Documentation of in situ treatment component injection, including locations, depths and quantities injected
- Detailed sampling and analysis information, including location, matrix, analytical methods, and data quality review findings for the performance monitoring
- Well decommissioning and installation logs
- Copies of weekly construction reports

A Performance Monitoring Report will be prepared following the first year of initial performance monitoring conducted in accordance with Section 6.1 of this EDR. The Performance Monitoring Report will present groundwater monitoring results relative to CULs, analysis of contaminant concentration and geochemical trends, and recommendations for continued monitoring and/or additional treatment. Construction completion will be determined after 3 years of post-injection monitoring and any additional treatment implemented for the cleanup action, if required.

If no additional treatment is recommended after year 1 monitoring, the Performance Monitoring Report will additionally serve the purpose of documenting construction completion.

If additional treatment is required, the proposed scope will be presented in an addendum to this EDR. The additional treatment will be documented in a final Construction Completion Report in accordance with the requirements described above.

Additionally, all analytical data collected for the Site during construction of the cleanup action must be submitted to Ecology's Environmental Information Management (EIM) system within 30 days of receipt of validated data. EIM will also be updated after excavation to flag existing samples that were removed by excavation.

## **7.2 LONG-TERM MONITORING REPORTS**

An LTCMP will be prepared as part of, or concurrently with, the final Performance Monitoring Report or Construction Completion Report and submitted within 120 days following construction completion. The LTCMP will outline additional groundwater confirmation monitoring to be implemented immediately following construction completion. Data collected during groundwater confirmation monitoring will be reported in annual compliance monitoring reports. These annual compliance monitoring results will include results of groundwater monitoring when compared to CULs, an assessment of COC concentration trends, and recommendations for monitoring or contingency actions to be implemented in coordination with Ecology.

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# Engineering Design Report

Riverside HVOC Site

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## Tables

**Table 3.1  
Groundwater HVOC Results**

Analyte		Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	
CAS No.		127-18-4	79-01-6	156-59-2	156-60-5	75-01-4	
CUL <sup>(1)</sup>		4.9	0.38	16	--	0.020	
Unit		µg/L	µg/L	µg/L	µg/L	µg/L	
Sample Name	Sample Date	Sample Depth/ Screen Interval (feet bgs)					
<b>BC-3</b>							
BC-3D-092008	9/5/2008	15-25	110	120	46	1.0 U	1.0 U
BC-3D-092009	9/15/2009		130	120	49	1.0 U	1.0 U
BC-3D-122009	12/16/2009		170	130	48	1.0 U	1.0 U
BC-3-052013	5/24/2013		25	11	4.0		0.20 U
BC-3-062014	6/24/2014		11	4.0	0.75		0.20 U
BC-3D-122014	12/19/2014		7.7	2.1	0.44	0.20 U	0.20 U
BC-3D-062015	6/23/2015		3.8	0.90	0.20 U	0.20 U	0.20 U
BC-3D-122015	12/8/2015		5.3	1.3	0.29	0.20 U	0.20 U
BC-3D-062016	6/29/2016		3.7	0.93	0.20 U	0.20 U	0.20 U
BC-3D-122016	12/21/2016		5.9	1.5	0.57	0.20 U	0.20 U
BC-3-062017	6/28/2017		6.8	1.9	0.80		0.20 U
BC-3-092019	9/27/2019		4.3	1.0	0.34	0.20 U	0.20 U
BC-3-022020	2/4/2020		5.2	1.3	0.43	0.20 U	0.020 U
BC-3-052020	5/6/2020		6.7	1.7	0.52	0.20 U	0.020 U
<b>EW-1</b>							
EW-1-042014	4/4/2014	12.5-32.5	17	3.0	1.2		0.20 U
EW-1-062014	6/25/2014		27	8.1	6.5		0.20 U
EW-1-122014	12/19/2014		21	2.6	0.82	0.20 U	0.20 U
EW-1-032015	3/18/2015		2.8	0.27	0.20 U	0.20 U	0.20 U
EW-1-062015	6/23/2015		22	2.0	0.95	0.20 U	0.20 U
EW-1-092015	9/11/2015		41	2.2	0.79	0.20 U	0.20 U
EW-1-032016	3/31/2016		22	2.8	2.5	0.20 U	0.20 U
EW-1-062016	6/29/2016		24	4.2	4.5	0.20 U	0.20 U
EW-1-092016	9/30/2016		20	2.0	2.3	0.20 U	0.20 U
EW-1-012017	1/5/2017		1.1	0.20 U	0.20 U	0.20 U	0.20 U
EW-1-042017	4/5/2017		13	1.2	0.85		0.20 U
EW-1-062017	6/29/2017		8.9	0.77	0.70		0.20 U
EW-1-102017	10/10/2017		15	0.81	0.50		0.20 U
EW-1-082324	8/23/2024		3.2	0.20 U	0.20 U	0.20 U	0.020 U
<b>EW-2</b>							
EW-2-042014	4/4/2014	15-35	13	2.8	1.5		
EW-2-062014	6/25/2014		28	3.8	1.5		0.20 U
EW-2-092014	9/22/2014		66	16	12		0.40 U
EW-2-122014	12/19/2014		44	12	12	0.40 U	0.40 U
EW-2-032015	3/18/2015		22	6.5	4.3	0.20 U	0.20 U
EW-2-062015	6/23/2015		8.6	2.4	1.8	0.20 U	0.20 U
EW-2-092015	9/11/2015		6.5	0.62	0.40	0.20 U	0.20 U
EW-2-122015	12/8/2015		16	2.6	2.4	0.20 U	0.20 U
EW-2-032016	3/31/2016		16	4.0	3.7	0.20 U	0.20 U
EW-2-062016	6/29/2016		17	4.1	3.2	0.20 U	0.20 U
EW-2-092016	9/30/2016		21	6.2	5.6	0.20 U	0.20 U
EW-2-012017	1/5/2017		24	3.6	1.7	0.20 U	0.20 U
EW-2-042017	4/5/2017		11	3.2	2.2		0.20 U
EW-2-062017	6/29/2017		16	4.8	3.6		0.20 U
EW-2-102017	10/10/2017		3.0	0.45	0.23		0.20 U
EW-2-092019	9/27/2019		16	4.7	3.2	0.20 U	0.20 U
EW-2-022020	2/5/2020	26	7.9	6.2	0.20 U	0.39	
EW-2-082324	8/23/2024	7.8	0.27	0.20 U	0.20 U	0.020 U	
<b>EW-3</b>							
EW-3-042014	4/4/2014	14-34	49	14	7.2		0.61
EW-3-062014	6/25/2014		41	14	12		0.40 U
EW-3-092014	9/22/2014		190	59	33		1.1
EW-3-122014	12/19/2014		21	6.4	6.0	0.20 U	0.20 U
EW-3-032015	3/18/2015		140	46	29	1.0 U	1.0 U
EW-3-062015	6/23/2015		87	24	9.0	0.40 U	0.40 U
EW-3-092015	9/11/2015		81	28	14	0.40 U	0.40 U
EW-3-122015	12/8/2015		33	11	7.8	0.20 U	0.38
EW-3-032016	3/31/2016		72	21	16	0.40 U	0.64
EW-3-062016	6/29/2016		79	24	14	0.40 U	0.43
EW-3-092016	9/30/2016		50	18	10	0.20 U	0.63
EW-3-012017	1/5/2017		95	30	20	0.40 U	0.46
EW-3-042017	4/5/2017		150	57	30		1.3
EW-3-062017	6/29/2017		270	79	59		1.4
EW-3-102017	10/10/2017		69	25	16		0.41
EW-3-052020	5/7/2020		25	23	11	0.20 U	0.023
EW-3-082224	8/22/2024	3.7	3.4	12	0.21	0.42	

**Table 3.1**  
**Groundwater HVOC Results**

		Analyte	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride
		CAS No.	127-18-4	79-01-6	156-59-2	156-60-5	75-01-4
		CUL <sup>(1)</sup>	4.9	0.38	16	--	0.020
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L
Sample Name	Sample Date	Sample Depth/ Screen Interval (feet bgs)					
<b>EW-4</b>							
EW-4-062014	6/25/2014	11-31	1.7	1.8	1.1		0.38
EW-4-092014	9/22/2014		45	10	7.4		0.87
EW-4-122014	12/19/2014		1.2	1.6	1.1	0.20 U	0.27
EW-4-032015	3/18/2015		15	4.8	3.2	0.20 U	0.20 U
EW-4-062015	6/23/2015		0.85	2.8	1.7	0.20 U	0.37
EW-4-092015	9/11/2015		1.8	2.1	0.92	0.20 U	0.28
EW-4-122015	12/8/2015		0.20 U	1.6	2.9	0.20 U	0.85
EW-4-032016	3/31/2016		0.20 U	2.5	2.0	0.20 U	0.31
EW-4-062016	6/29/2016		0.20 U	1.2	3.5	0.20 U	0.61
EW-4-092016	9/30/2016		0.20 U	0.88	4.0	0.20 U	0.75
EW-4-012017	1/5/2017		0.33	3.2	1.8	0.20 U	0.29
EW-4-042017	4/5/2017		0.20	3.0	1.7		0.25
EW-4-062017	6/29/2017		0.20	0.90	2.6		0.24
EW-4-082324	8/23/2024		0.20 U	0.20 U	1.3	0.20 U	0.34
<b>EW-5</b>							
EW-5D-012017	1/5/2017	15-35	5.0	4.0	9.4	0.20 U	2.5
EW-5D-042017	4/5/2017		6.9	5.2	15		3.8
EW-5D-062017	6/29/2017		8.6	3.8	10		0.49
EW-5D-102017	10/10/2017		0.36	0.94	8.6		1.8
EW-5-072524	7/25/2024		0.26	0.20 U	0.20 U	0.20 U	0.20 U
EW-5-073124	7/31/2024		0.25	0.20 U	0.20 U	0.20 U	0.20 U
EW-5-082324	8/23/2024		0.20 U	0.20 U	0.20 U	0.20 U	0.020 U
<b>EW-6</b>							
EW-6D-012017	1/5/2017	15-35	2.4	0.54	0.20 U	0.20 U	0.20 U
EW-6D-042017	4/5/2017		2.1	0.94	1.2		0.20 U
EW-6D-062017	6/29/2017		0.56	0.63	2.0		0.31
EW-6D-102017	10/10/2017		20	7.2	18		0.46
EW-6D-092019	9/27/2019		4.7	1.4	4.2	0.20 U	0.20 U
EW-6D-022020	2/5/2020		3.1	1.0	4.0	0.20 U	0.16
EW-6D-052020	5/7/2020		12	5.3	7.6	0.20 U	0.36
EW-6-072524	7/25/2024		0.27	0.20 U	0.20 U	0.20 U	0.20 U
EW-6-073124	7/31/2024		1.5	0.20 U	0.20 U	0.20 U	0.20 U
EW-6-082324	8/23/2024		8.8	0.23	0.20 U	0.20 U	0.020 U
<b>RMW-4</b>							
RMW-4D-122014	12/19/2014	15-25	0.79	0.33	0.20 U	0.20 U	0.20 U
RMW-4D-062015	6/23/2015		0.52	0.72	0.20 U	0.20 U	0.20 U
RMW-4D-122015	12/8/2015		2.2	0.56	0.20 U	0.20 U	0.20 U
RMW-4D-062016	6/29/2016		3.6	0.46	0.20 U	0.20 U	0.20 U
RMW-4D-122016	12/21/2016		4.3	0.51	0.20 U	0.20 U	0.20 U
RMW-4-062017	6/28/2017		3.9	0.49	0.20 U		0.20 U
RMW-4-092019	9/26/2019		2.5	0.45	0.20 U	0.20 U	0.20 U
RMW-4-012020	1/31/2020		3.7	0.54	0.20 U	0.20 U	0.020 U
RMW-4-052020	5/4/2020		3.2	0.82	0.20 U	0.20 U	0.020 U
RMW-4-082324	8/23/2024		3.3	0.96	0.33	0.20 U	0.020 U
<b>RMW-5</b>							
RMW-5-052013	5/24/2013	12-22	1.7	0.20 U	0.20 U		0.20 U
RMW-5-062014	6/24/2014		1.4	0.40	0.20 U		0.20 U
RMW-5D-122014	12/19/2014		1.3	0.32	0.22	0.20 U	0.20 U
RMW-5D-062015	6/23/2015		0.66	0.36	0.20 U	0.20 U	0.20 U
RMW-5D-122015	12/8/2015		1.6	0.20 U	0.20 U	0.20 U	0.20 U
RMW-5D-062016	6/29/2016		1.1	0.31	0.20 U	0.20 U	0.20 U
RMW-5D-122016	12/22/2016		1.0	0.20 U	0.23	0.20 U	0.20 U
RMW-5-062017	6/29/2017		2.0	0.20 U	0.20 U		0.20 U
RMW-5-092019	9/26/2019		2.1	0.39	0.22	0.20 U	0.20 U
RMW-5-012020	1/31/2020		2.5	0.21	0.20 U	0.20 U	0.024
RMW-5-052020	5/4/2020		2.3	0.20 U	0.20 U	0.20 U	0.020 U
RMW-5-082224	8/22/2024		3.5	0.55	0.43	0.20 U	0.036
<b>RMW-6</b>							
RMW-6D-092009	9/14/2009	15-25	0.20 U	0.27	3.6	0.20 U	5.3
RMW-6-052013	5/24/2013		0.20 U	0.20 U	2.7		3.4
RMW-6-062014	6/24/2014		0.34	0.60	0.42		0.20 U
RMW-6D-122014	12/19/2014		0.47	0.20 U	0.20 U	0.20 U	0.20 U
RMW-6D-062015	6/23/2015		0.20 U	1.4	0.88	0.20 U	0.20 U
RMW-6D-122015	12/8/2015		0.20 U	2.7	1.0	0.20 U	0.20 U
RMW-6D-062016	6/29/2016		0.20 U	2.5	1.3	0.20 U	0.20 U
RMW-6D-122016	12/21/2016		0.20 U	0.39	0.50	0.20 U	0.20 U
RMW-6-062017	6/29/2017		0.20 U	0.41	0.30		0.20 U
RMW-6-092019	9/26/2019		0.20 U	1.7	3.8	0.20 U	0.57
RMW-6-012020	1/31/2020		0.20 U	0.52	2.5	0.20 U	0.70
RMW-6-052020	5/4/2020		0.20 U	0.45	1.5	0.20 U	0.21
RMW-6-082224	8/22/2024		0.20 U	0.20 U	0.77	0.20 U	0.79

**Table 3.1  
Groundwater HVOC Results**

		Analyte	Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride
		CAS No.	127-18-4	79-01-6	156-59-2	156-60-5	75-01-4
		CUL <sup>(1)</sup>	4.9	0.38	16	--	0.020
		Unit	µg/L	µg/L	µg/L	µg/L	µg/L
Sample Name	Sample Date	Sample Depth/ Screen Interval (feet bgs)					
<b>RMW-7</b>							
RMW-7D-092009	9/15/2009	15-25	50	120	190	2.0	22
RMW-7-052013	5/24/2013		9.0	33	65		9.3
RMW-7-042014	4/4/2014		0.75	3.8	35		8.3
RMW-7-062014	6/25/2014		5.2	24	80		9.9
RMW-7-092014	9/22/2014		1.0 U	3.2	170		47
RMW-7D-122014	12/19/2014		2.9	8.9	150	1.4	34
RMW-7D-032015	3/18/2015		0.40 U	1.5	57	0.64	20
RMW-7D-062015	6/23/2015		0.40 U	3.1	95	1.2	9.6
RMW-7D-092015	9/11/2015		4.2	23	110	1.4	14
RMW-7D-122015	12/8/2015		3.5	8.7	85	0.87	9.0
RMW-7D-032016	3/31/2016		1.5	6.8	84	0.91	35
RMW-7D-062016	6/29/2016		2.3	14	65	0.68	12
RMW-7D-092016	9/30/2016		2.4	7.8	89	1.0 U	13
RMW-7D-122016	12/22/2016		1.1	4.1	88	0.93	24
RMW-7-042017	4/5/2017		1.2	2.4	12		0.86
RMW-7-062017	6/28/2017		1.3	1.9	33		1.9
RMW-7-102017	10/10/2017		1.0	2.3	47		25
RMW-7-092019	9/27/2019		0.51	4.1	33	0.39	27
RMW-7-022020	2/3/2020		0.20 U	0.22	16	0.28	26
RMW-7-052020	5/5/2020		0.32	0.88	20	0.31	28
RMW-7-072524	7/25/2024	0.45	0.46	26	0.22	6.4	
RMW-7-073124	7/31/2024	0.38	0.41	31	0.29	9.4	
RMW-7-082224	8/22/2024	0.48	0.64	27	0.28	6.2	
<b>RMW-8</b>							
RMW-8D-092009	9/15/2009	20-30	0.46	2.6	1.3	0.36	0.20 U
RMW-8D-Dup-092009	9/15/2009		0.48	2.6	1.3	0.36	0.20 U
RMW-8D-122009	12/16/2009		0.91	3.0	1.4	0.40	0.20 U
RMW-8D-052013	5/24/2013		0.50	0.85	0.44		0.20 U
RMW-8D-062014	6/24/2014		0.20 U	0.20 U	0.20 U		0.20 U
RMW-8D-122014	12/19/2014		0.70	0.20 U	0.20 U	0.20 U	0.20 U
RMW-8D-062015	6/23/2015		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-8D-122015	12/8/2015		0.20 U	0.39	0.47	0.20 U	0.20 U
RMW-8D-062016	6/29/2016		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-8D-122016	12/22/2016		0.31	0.66	0.37	0.20 U	0.20 U
RMW-8D-062017	6/28/2017		0.20 U	0.20 U	0.20 U		0.20 U
RMW-8D-092019	9/27/2019		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-8D-022020	2/3/2020		0.20 U	0.40	0.28	0.20 U	0.020 U
RMW-8D-052020	5/6/2020		0.20 U	0.20 U	0.20 U	0.20 U	0.020 U
RMW-8-082324	8/23/2024		0.20 U	0.20 U	0.81	0.20 U	0.020 U
<b>RMW-9</b>							
RMW-9D-092009	9/15/2009	20-30	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-9D-122009	12/16/2009		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-9D-052013	5/24/2013		0.20 U	0.20 U	0.20 U		0.20 U
<b>RMW-9R</b>							
RMW-9RD-122014	12/19/2014	20-30	0.79	0.20 U	0.20 U	0.20 U	0.20 U
RMW-9D-062015	6/23/2015		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-9D-122015	12/8/2015		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-9D-062016	6/29/2016		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-9D-122016	12/22/2016		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-9RD-062017	6/29/2017		0.20 U	0.20 U	0.20 U		0.20 U
RMW-9RD-092019	9/27/2019		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-9RD-022020	2/4/2020		0.20 U	0.20 U	0.20 U	0.20 U	0.020 U
RMW-9RD-052020	5/7/2020		0.20 U	0.20 U	0.20 U	0.20 U	0.020 U
RMW-9R-082224	8/22/2024		0.20 U	0.20 U	0.20 U	0.20 U	0.020 U
<b>RMW-10D</b>							
RMW-10D-092009	9/15/2009	32-42	0.24	0.20 U	0.20 U	0.20 U	0.20 U
RMW-10D-122009	12/16/2009		0.35	0.27	0.20 U	0.20 U	0.20 U
RMW-10D-Dup-122009	12/16/2009		0.28	0.23	0.20 U	0.20 U	0.20 U
RMW-10D-052013	5/24/2013		0.20 U	0.20 U	0.20 U		0.20 U
RMW-10D-062014	6/24/2014		0.20 U	0.20 U	0.20 U		0.20 U
RMW-10D-122014	12/19/2014		0.69	0.20 U	0.20 U	0.20 U	0.20 U
RMW-10D-062015	6/23/2015		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-10D-122015	12/8/2015		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-10D-062016	6/29/2016		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-10D-122016	12/21/2016		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-10D-062017	6/28/2017		0.20 U	0.20 U	0.20 U		0.20 U
RMW-10D-092019	9/27/2019		0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
RMW-10D-022020	2/4/2020		0.20 U	0.20 U	0.20 U	0.20 U	0.020 U
RMW-10D-052020	5/5/2020		0.20 U	0.20 U	0.20 U	0.20 U	0.020 U
RMW-10D-082324	8/23/2024		0.20 U	0.20 U	0.20 U	0.20 U	0.020 U

**Table 3.1  
Groundwater HVOC Results**

Analyte			Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride
CAS No.			127-18-4	79-01-6	156-59-2	156-60-5	75-01-4
CUL <sup>(1)</sup>			4.9	0.38	16	--	0.020
Unit			µg/L	µg/L	µg/L	µg/L	µg/L
Sample Name	Sample Date	Sample Depth/ Screen Interval (feet bgs)					
<b>RMW-12</b>							
RMW-12D-072016	7/25/2016	15-25	120	19	14	1.0 U	1.0 U
RMW-12D-122016	12/21/2016		61	14	21	0.34	1.6
RMW-12D-062017	6/28/2017		130	27	29		1.0 U
RMW-12D-092019	9/27/2019		15	3.1	6.5	0.20 U	0.87
RMW-12D-022020	2/4/2020		13	3.7	6.1	0.20 U	2.8
RMW-12D-052020	5/6/2020		19	4.6	5.4	0.20 U	0.50
RMW-12-072524	7/25/2024		9.6	1.7	1.2	0.20 U	0.20 U
RMW-12-073124	7/31/2024		8.2	1.7	1.5	0.20 U	0.22
RMW-12-082224	8/22/2024		8.8	1.8	1.4	0.20 U	0.19
RMW-112-082224	8/22/2024		9.2	1.9	1.4	0.20 U	0.21
<b>RMW-13</b>							
RMW-13D-072016	7/25/2016	15-25	0.20 U	0.20 U	1.8	0.20 U	0.24
RMW-13D-122016	12/22/2016		0.20 U	0.20 U	1.2	0.20 U	0.20 U
RMW-13D-062017	6/28/2017		0.20 U	0.20 U	0.50		0.20 U
RMW-13D-092019	9/27/2019		0.20 U	0.20 U	0.97	0.20 U	0.20 U
RMW-13D-022020	2/3/2020		0.20 U	0.20 U	0.31	0.20 U	0.095
RMW-13D-052020	5/5/2020		0.20 U	0.20 U	0.30	0.20 U	0.060
RMW-13-082224	8/22/2024		0.20 U	0.20 U	0.48	0.20 U	0.16
<b>RMW-14</b>							
RMW-14D-052020	5/5/2020	15-25	15	5.6	4.0	0.20 U	0.15
RMW-14-082224	8/22/2024		9.8	2.7	0.58	0.20 U	0.032
<b>CDM-B14</b>							
CDM-B14-W	4/3/2009	9-9	5.9	0.54	0.33	0.20 U	0.20 U
<b>CDM-B15</b>							
CDM-B15-W	4/3/2009	10-10	3.9	1.8	1.4	0.20 U	0.20 U
<b>CDM-B16</b>							
CDM-B16-W	4/3/2009	13-13	0.21	0.20 U	0.20 U	0.20 U	0.20 U
<b>CDM-B17</b>							
CDM-B17-W	4/2/2009	11-11	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
<b>GWB-03</b>							
GWB-03-15-20	9/4/2024	15-20	0.20 U	0.20 U	0.68	0.20 U	0.20 U
GWB-03-20-25	9/4/2024	20-25	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
GWB-03-25-30	9/4/2024	25-30	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
<b>GWB-04</b>							
GWB-04-15-20	9/4/2024	15-20	0.20 U	0.50	3.6	0.20 U	1.4
GWB-04-20-25	9/4/2024	20-25	0.63	0.61	7.1	0.20 U	0.20 U
GWB-04-25-30	9/5/2024	25-30	0.20 U	0.20 U	0.32	0.20 U	0.20 U
<b>GWB-05</b>							
GWB-05-20-25	9/5/2024	20-25	1.2	1.5	12	0.20 U	0.20 U
GWB-05-25-30	9/5/2024	25-30	8.6	21	2.6	0.20 U	0.20 U
<b>GWB-06</b>							
GWB-06-20-25	9/5/2024	20-25	11	18	21	0.47	0.43
GWB-06-25-30	9/5/2024	25-30	18	18	11	0.29	0.20 U
<b>GWB-07</b>							
GWB-07-35-40	9/6/2024	35-40	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
GWB-07-40-45	9/6/2024	40-45	0.26	0.20 U	0.20 U	0.20 U	0.20 U
<b>GWB-08</b>							
GWB-08-15-25	9/5/2024	15-25	0.20 U	0.20 U	0.20 U	0.20 U	0.29
<b>RB-25</b>							
RB-25-102018	10/24/2018	15-25	200	88	92		1.0
<b>RB-26</b>							
RB-26-102018	10/24/2018	15-25	2.4	1.6	3.5		0.020 U
<b>RB-27</b>							
RB-27-102018	10/24/2018	15-25	29	19	7.1		1.0
<b>RB-28</b>							
RB-28-102018	10/24/2018	10-20	15	6.4	4.7		0.34
<b>RB-29</b>							
RB-29-102018	10/24/2018	15-25	2.6	1.0	1.4		0.020 U
<b>RB-30</b>							
RB-30-102018	10/24/2018	15-25	0.56	1.3	8.1		0.28
<b>RB-31</b>							
RB-31-102018	10/25/2018	15-25	63	11	43		13
<b>RB-32</b>							
RB-32-102018	10/25/2018	15-25	110	44	76		0.020 U
<b>UCCB-5</b>							
UCCB5-15-GW	3/22/2017	10-20	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
UCCB5-32-GW	3/22/2017	29-34	4.2	0.20 U	0.20 U	0.20 U	0.20 U
UCCB5-43-GW	3/22/2017	40-45	1.5	0.20 U	0.20 U	0.20 U	0.20 U

**Table 3.1  
Groundwater HVOC Results**

Analyte			Tetrachloroethene	Trichloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride
CAS No.			127-18-4	79-01-6	156-59-2	156-60-5	75-01-4
CUL <sup>(1)</sup>			4.9	0.38	16	--	0.020
Unit			µg/L	µg/L	µg/L	µg/L	µg/L
Sample Name	Sample Date	Sample Depth/ Screen Interval (feet bgs)					
<b>UCCB-6</b>							
UCCB6-9-GW	3/23/2017	7-12	0.20 U	0.20 U	0.20 U	0.20 U	<i>0.20 U</i>
UCCB6-22-GW	3/23/2017	20-25	0.20 U	0.20 U	0.20 U	0.20 U	<i>0.20 U</i>
UCCB6-36-GW	3/23/2017	33-38	0.20 U	0.20 U	0.20 U	0.20 U	<i>0.20 U</i>
<b>UCCB-7</b>							
UCCB7-17-GW	3/23/2017	14-19	0.20 U	0.20 U	0.20 U	0.20 U	<i>0.20 U</i>
UCCB7-28-GW	3/23/2017	25-30	0.20 U	0.20 U	0.20 U	0.20 U	<i>0.20 U</i>
UCCB7-38-GW	3/23/2017	35-40	0.20 U	0.20 U	0.20 U	0.20 U	<i>0.20 U</i>
<b>UCCB-9</b>							
UCCB9-18-GW	3/22/2017	15-20	0.20 U	0.20 U	0.20 U	0.20 U	<i>0.20 U</i>
UCCB9-31-GW	3/22/2017	28-33	0.61	0.20 U	0.20 U	0.20 U	<i>0.20 U</i>
UCCB9-41-GW	3/23/2017	39-44	0.20 U	0.20 U	0.20 U	0.20 U	<i>0.20 U</i>

Notes:

All results are rounded to two significant figures.

Blank cells are intentional.

-- Not established.

*Italic* Analyte was not detected at a reporting limit greater than the CUL.

**RED/BOLD** Analyte was detected at a concentration greater than the CUL.

1 CULs are established in the Final Cleanup Action Plan (Ecology 2023a).

Abbreviations:

bgs Below ground surface

CAS Chemical Abstracts Service

CUL Cleanup level

HVOC Halogenated volatile organic compound

µg/L Micrograms per liter

Qualifier:

U Analyte was not detected at the associate reporting limit.

**Table 3.2**  
**Passive Flux Meter Pre-Design Sample Results**

Well ID	RMW-07					RMW-12				
Sample Name	RMW-07-15-17	RMW-07-17-19	RMW-07-19-21	RMW-07-21-23	RMW-07-23-25	RMW-12-15-17	RMW-12-17-19	RMW-12-19-21	RMW-12-21-23	RMW-12-23-25
Depth Interval (feet bgs)	15-17	17-19	19-21	21-23	23-25	15-17	17-19	19-21	21-23	23-25
<b>Summary of Darcy Flux Values</b>										
Darcy Velocity (cm/day)	0.7	1.3	4.0	4.0	3.6	3.8	4.0	5.4	4.2	3.0
Average Darcy Velocity (cm/day)	2.72					4.1				
<b>Summary of Contaminant Concentration</b>										
cis-1,2-DCE (µg/L)	3.0	96	90	56	42	3.4	1.8	2.2	1.5	0.9
Average cis-1,2-DCE (µg/L)	57.4					1.96				
TCE (µg/L)	2.9	1.1	0.1	0.2	0.2	0.9	0.5	0.5	0.5	0.3
Average TCE (µg/L)	1.1					2.1				
PCE (µg/L)	6.2	1.0	0.1	0.2	0.3	2.1	1.1	0.6	0.5	0.5
Average PCE (µg/L)	0.2					1.2				
VC (µg/L)	29	186	45	16	27	0.0	0.0	2.1	0.0	0.0
Average VC (µg/L)	60.6					0.42				
<b>Summary of Mass Flux Values</b>										
cis-1,2-DCE (µg/m <sup>2</sup> /day)	0.0	1,300	3,600	2,200	1,500	100	100	100	100	0.0
Average cis-1,2-DCE (µg/m <sup>2</sup> /day)	1,720					80				
TCE (µg/m <sup>2</sup> /day)	20	10	0.0	10	10	30	20	30	20	10
Average TCE (µg/m <sup>2</sup> /day)	10					22				
PCE (µg/m <sup>2</sup> /day)	40	10	10	10	10	80	40	30	20	20
Average PCE (µg/m <sup>2</sup> /day)	16					38				
VC (µg/m <sup>2</sup> /day)	200	2500	1,800	600	900	0.0	0.0	100	0.0	0.0
Average VC (µg/m <sup>2</sup> /day)	1,200					20				
<b>Estimated Groundwater Velocity <sup>(1)</sup></b>										
Groundwater Velocity (ft/year)	626					394				
<b>Average Mass Discharge Per Unit Width</b>										
Darcy Velocity (cm/day)	2.7					4.1				
cis-1,2-DCE (mg/m/day)	5.2					0.2				
TCE (mg/m/day)	0.30					0.07				
PCE (mg/m/day)	0.05					0.12				
VC (mg/m/day)	3.66					0.06				

Note:

1 Regenesi estimated groundwater velocities by interpretation of PFM results.

Abbreviations:

- bgs Below ground surface
- cm/day Centimeters per day
- DCE Dichloroethene
- ft/year Feet per year
- µg/L Micrograms per liter
- µg/m<sup>2</sup>/day Micrograms per square meter per day
- mg/m/day Milligrams per meter per day
- PCE Tetrachloroethene
- PFM Passive flux meter
- TCE Trichloroethene

**Table 3.3**  
**Groundwater Geochemical Parameter Results**

Analyte		Dissolved Oxygen	ORP	pH	Specific Conductance	Temperature	Turbidity	Alkalinity, Total	Chloride	Nitrate	Nitrite	Sulfate	Sulfide
CAS No.		--	--	--	--	--	--	--	16887-00-6	14797-55-8	14797-65-0	14808-79-8	18496-25-8
Unit		mg/L	mV	pH	µS/cm	°C	NTU	mg-CaCO <sub>3</sub> /L	mg/L	mg-N/L	mg-N/L	mg/L	mg/L
Sample Location	Sample Date												
<b>Extraction Wells</b>													
EW-1	8/23/2024	0.36	168.3	6.43	240.0	14.9	1.10						
EW-2	8/23/2024	0.68	23.1	6.47	246.5	14.4	7.45						
EW-3	8/22/2024	0.22	-6.8	6.36	437.8	14.7	2.90	220 J	31 J	0.16	0.020 U	12	0.080
EW-4	8/23/2024	0.25	-31.6	6.57	377.7	14.7	16.10						
EW-5	7/25/2024	0.24	81.5	6.92	262.3	16.1	1.99						
	7/31/2024	0.26	114.3	7.10	260.1	16.8	0.87						
	8/23/2024	0.41	-47.5	6.89	252.5	16.1	0.81						
EW-6	7/25/2024	2.12	88.1	6.43	212.0	15.8	2.64						
	7/31/2024	2.15	88.6	6.52	207.2	16.3	2.37						
	8/23/2024	1.18	126.8	6.35	224.0	16.7	1.40						
<b>Monitoring Wells</b>													
RMW-4	8/23/2024	0.37	-78.1	6.27	394.2	14.8	0.97						
RMW-5	8/22/2024	0.22	-80.8	6.50	540.0	15.6	1.24	210 J	14 J	0.21	0.020 U	18	0.050 U
RMW-6	8/22/2024	0.56	-98.7	6.68	510.0	14.8	3.43	280 J	28 J	0.13	0.020 U	5.0 U	0.050 U
RMW-7	7/25/2024	0.24	-3.6	6.66	418.7	16.7	1.86						
	7/31/2024	0.27	4.6	6.69	440.9	17.6	1.25						
	8/22/2024	0.22	13.7	6.38	400.8	17.7	0.97	190 J	15 J	0.19	0.020 U	14	0.050 U
RMW-8	8/23/2024	0.40	-83.1	6.22	659.0	15.1	2.12						
RMW-9R	8/22/2024	5.00	166.4	5.95	506.0	16.6	0.60	40 J	140 J	2.6	0.020 U	23	0.050 U
RMW-10D	8/23/2024	2.39	161.8	6.24	217.9	15.2	1.13						
RMW-12	7/25/2024	0.48	113.0	6.16	380.0	15.1	1.77						
	7/31/2024	0.36	140.4	6.11	385.0	16.2	7.64						
	8/22/2024	0.36	125.0	6.00	420.8	16.3	1.26	190 J	34 J	0.052	0.020 U	16	0.050 U
RMW-13	8/22/2024	0.31	-7.6	6.32	399.7	17.9	1.35	200 J	14 J	0.21	0.020 U	34	0.050 U
RMW-14	8/22/2024	0.34	-6.9	6.34	339.1	15.8	1.50	160 J	12 J	0.97	0.020 U	20	0.050 U
<b>Reconnaissance Samples</b>													
GWB-03-15-20	9/4/2024	3.95	-41.7	6.70	294.3	19.7	80.30						
GWB-03-20-25	9/4/2024	4.58	-72.8	7.10	314.2	20.1	454.00						
GWB-03-25-30	9/4/2024	0.46	-207.4	7.99	301.9	19.1	368.00						
GWB-04-15-20	9/4/2024	3.12	-34.6	6.55	545.0	24.6	7.15						
GWB-04-20-25	9/4/2024	5.04	-49.9	7.25	322.8	23.8	47.30						
GWB-04-25-30	9/5/2024	2.54	-54.0	6.99	303.3	24.8	49.30						
GWB-05-20-25	9/5/2024	3.53	-27.4	6.69	280.6	21.9	40.00						
GWB-05-25-30	9/5/2024	2.74	-48.1	6.87	284.5	23.1	41.80						
GWB-06-20-25	9/5/2024	3.74	4.1	6.70	303.4	24.2	47.40						
GWB-06-25-30	9/5/2024	3.96	-35.3	6.83	302.4	23.7	61.70						
GWB-07-35-40	9/6/2024	2.64	-99.4	8.24	256.1	24.7	181.00						
GWB-08-15-25	9/5/2024	2.70	-67.4	6.84	497.2	24.1	48.00						

Notes:

- All chemistry results are rounded to two significant figures. Field parameters are reported as displayed by the instrument.
- Blank cells are intentional.
- Not established.

Abbreviations:

- °C Degrees Celsius
- CAS Chemical Abstracts Service
- µg/L Micrograms per liter
- µS/cm Microsiemens per centimeter
- mg-CaCO<sub>3</sub>/L Milligrams of calcium carbonate per liter
- mg-N/L Milligrams of nitrogen per liter
- mg/L Milligrams per liter
- mV Millivolts
- NTU Nephelometric turbidity units
- ORP Oxidation-reduction potential

Qualifiers:

- J Analyte was detected; concentration is an estimate.
- U Analyte was not detected at the associate reporting limit.
- UJ Analyte was not detected at the associate reporting limit, which is an estimate.

**Table 3.3**  
**Groundwater Geochemical Parameter Results**

Analyte	Total Organic Carbon	Ethane	Ethene	Methane	Calcium, Dissolved	Iron, Dissolved	Magnesium, Dissolved	Calcium, Total	Iron, Total	Magnesium, Total
CAS No.	TOC	74-84-0	74-85-1	74-82-8	7440-70-2	7439-89-6	7439-95-4	7440-70-2	7439-89-6	7439-95-4
Unit	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Sample Location	Sample Date									
<b>Extraction Wells</b>										
EW-1	8/23/2024									
EW-2	8/23/2024									
EW-3	8/22/2024	5.8	0.56 UJ	0.58 UJ	410	50,000	13,000	20,000	45,000	14,000
EW-4	8/23/2024									
EW-5	7/25/2024									
	7/31/2024									
	8/23/2024									
EW-6	7/25/2024									
	7/31/2024									
	8/23/2024									
<b>Monitoring Wells</b>										
RMW-4	8/23/2024									
RMW-5	8/22/2024	11	0.56 UJ	0.58 UJ	1,300	37,000	18,000	15,000	39,000	24,000
RMW-6	8/22/2024	11	0.56 UJ	0.58 UJ	2,200	54,000	31,000	19,000	53,000	31,000
RMW-7	7/25/2024									
	7/31/2024									
	8/22/2024	3.9	0.56 UJ	0.58 UJ	580	49,000	3,900	11,000	49,000	4,100
RMW-8	8/23/2024									
RMW-9R	8/22/2024	1.0 U	0.56 UJ	0.58 UJ	0.55 U	40,000	56 U	17,000	38,000	50 U
RMW-10D	8/23/2024									
RMW-12	7/25/2024									
	7/31/2024									
	8/22/2024	4.4	0.56 UJ	0.58 UJ	76	52,000	94	15,000	51,000	220
RMW-13	8/22/2024	4.9	0.56 UJ	0.58 UJ	26	65,000	1,900	14,000	64,000	1,900
RMW-14	8/22/2024	2.4	0.56 UJ	0.58 UJ	820	44,000	2,200	14,000	38,000	2,400
<b>Reconnaissance Samples</b>										
GWB-03-15-20	9/4/2024									
GWB-03-20-25	9/4/2024									
GWB-03-25-30	9/4/2024									
GWB-04-15-20	9/4/2024									
GWB-04-20-25	9/4/2024									
GWB-04-25-30	9/5/2024									
GWB-05-20-25	9/5/2024									
GWB-05-25-30	9/5/2024									
GWB-06-20-25	9/5/2024									
GWB-06-25-30	9/5/2024									
GWB-07-35-40	9/6/2024									
GWB-08-15-25	9/5/2024									

Notes:  
 All chemistry results are rounded to two significant figures. Field parameters are reported as displayed by the instrument.  
 Blank cells are intentional.  
 -- Not established.

Abbreviations:  
 °C Degrees Celsius  
 CAS Chemical Abstracts Service  
 µg/L Micrograms per liter  
 µS/cm Microsiemens per centimeter  
 mg-CaCO<sub>3</sub>/L Milligrams of calcium carbonate per liter  
 mg-N/L Milligrams of nitrogen per liter  
 mg/L Milligrams per liter  
 mV Millivolts  
 NTU Nephelometric turbidity units  
 ORP Oxidation–reduction potential

Qualifiers:  
 J Analyte was detected; concentration is an estimate.  
 U Analyte was not detected at the associate reporting limit.  
 UJ Analyte was not detected at the associate reporting limit, which is an estimate.

**Table 3.4**  
**Grain Size Pre-Design Sample Results**

Sample Name	SB-06-08.5-10		SB-06-13-14.5		SB-06-14-16		SB-06-16-18		SB-06-18-20		SB-06-20-22		SB-06-22-24		SB-06-24-26		SB-06-26-28		SB-06-28-30		SB-06-30-32		SB-06-32-34		SB-06-34-36		SB-06-36-38		SB-06-38-40	
Qualitative	Fraction		Fraction		Fraction		Fraction		Fraction		Fraction		Fraction		Fraction		Fraction		Fraction		Fraction		Fraction		Fraction		Fraction		Fraction	
Grain Size	Fines	35%	Fines	77%	Fines	35%	Fines	28%	Fines	35%	Fines	20%	Fines	23%	Fines	16%	Fines	26%	Fines	26%	Fines	20%	Fines	36%	Fines	30%	Fines	17%	Fines	20%
Analysis	Coarse	65%	Coarse	23%	Coarse	65%	Coarse	72%	Coarse	65%	Coarse	80%	Coarse	77%	Coarse	84%	Coarse	74%	Coarse	74%	Coarse	80%	Coarse	64%	Coarse	70%	Coarse	83%	Coarse	80%
Total	100%		100%		100%		100%		100%		100%		100%		100%		100%		100%		100%		100%		100%		100%		100%	

Note:  
Fine to very fine sand is considered coarse grain per U.S. Geological Survey guidance.

**Table 4.1  
Injection Details**

Application Type	Treatment Location			Treatment Components <sup>(1)</sup>											
	Size	Injection Points	Treatment Interval (feet bgs)	Volume (gal)		PlumeStop (lb)		3DME (lb)		S-mZVI (lb)		AquiFix (lb)		BDI Plus (L)	
				Total	Per Foot	Total	Per Foot	Total	Per Foot	Total	Per Foot	Total	Per Foot		
<b>Source Area</b>															
Grid	13,500 SF	9	12 to 35	10,125	45	--	--	4,000	19.3	2,000	9.7	--	--	27	0.130
<b>Western Plume</b>															
Grid	1,512 SF	15	12 to 30	27,000	100	--	--	10,000	37.0	4,000	11.6	--	--	173	0.50
<b>Downgradient Plume</b>															
Barrier	105 feet	48	15 to 35	39,900	35	22,500	23	--	--	4,500	4.7	4,500	4.7	27	0.028

Notes:

-- Not recommended

1 PlumeStop, S-mZVI, AquiFix, and BDI Plus are all registered or pending trademarked products created by Regenesis.

Abbreviations:

3DME 3-D Microemulsion

BDI Plus Bio-Dechlor Inoculum Plus

bgs Below ground surface

gal Gallons

L Liters

lb Pounds

S-mZVI Sulfidated microscale zero-valent iron

SF Square feet

**Table 6.1  
Groundwater Performance Monitoring Details**

Location Information		Data Collection <sup>(1)</sup>		
Well ID	Screen Interval (feet bgs)	Water Level	HVOC	MNA
<b>Upgradient Performance Wells</b>				
EW-2	15–35	X	X	
EW-3	14–34	X	X	
RMW-4	15–25	X	X	X
RMW-5	12–22	X	X	
RMW-6	15–25	X	X	
RMW-12	15–25	X	X	X
RMW-14	15–25	X	X	X
RMW-16	15–25 <sup>(2)</sup>	X	X	X
RMW-18S	12–22 <sup>(2)</sup>	X	X	X
<b>Upgradient Sentinel</b>				
RMW-9R	20–30	X		X <sup>(3)</sup>
BC-3	15–25	X		
<b>Downgradient Performance Wells</b>				
RMW-7	15–25	X	X	X
RMW-13	15–25	X	X	
RMW-15	15–25 <sup>(2)</sup>	X	X	
RMW-17	15–25 <sup>(2)</sup>	X	X	

Notes:

- 1 Data will be collected quarterly. HVOC analysis includes PCE, TCE, cis- and trans-1,2-DCE, and vinyl chloride. MNA parameter analysis includes anions (nitrate, nitrite, and sulfate), sulfide, total organic carbon, ferrous iron and dissolved gases (ethene, ethane, methane).
- 2 New well to be installed during construction; screened interval is approximate.
- 3 Background MNA parameters will be collected from the upgradient sentinel well during the first quarter only.

Abbreviations:

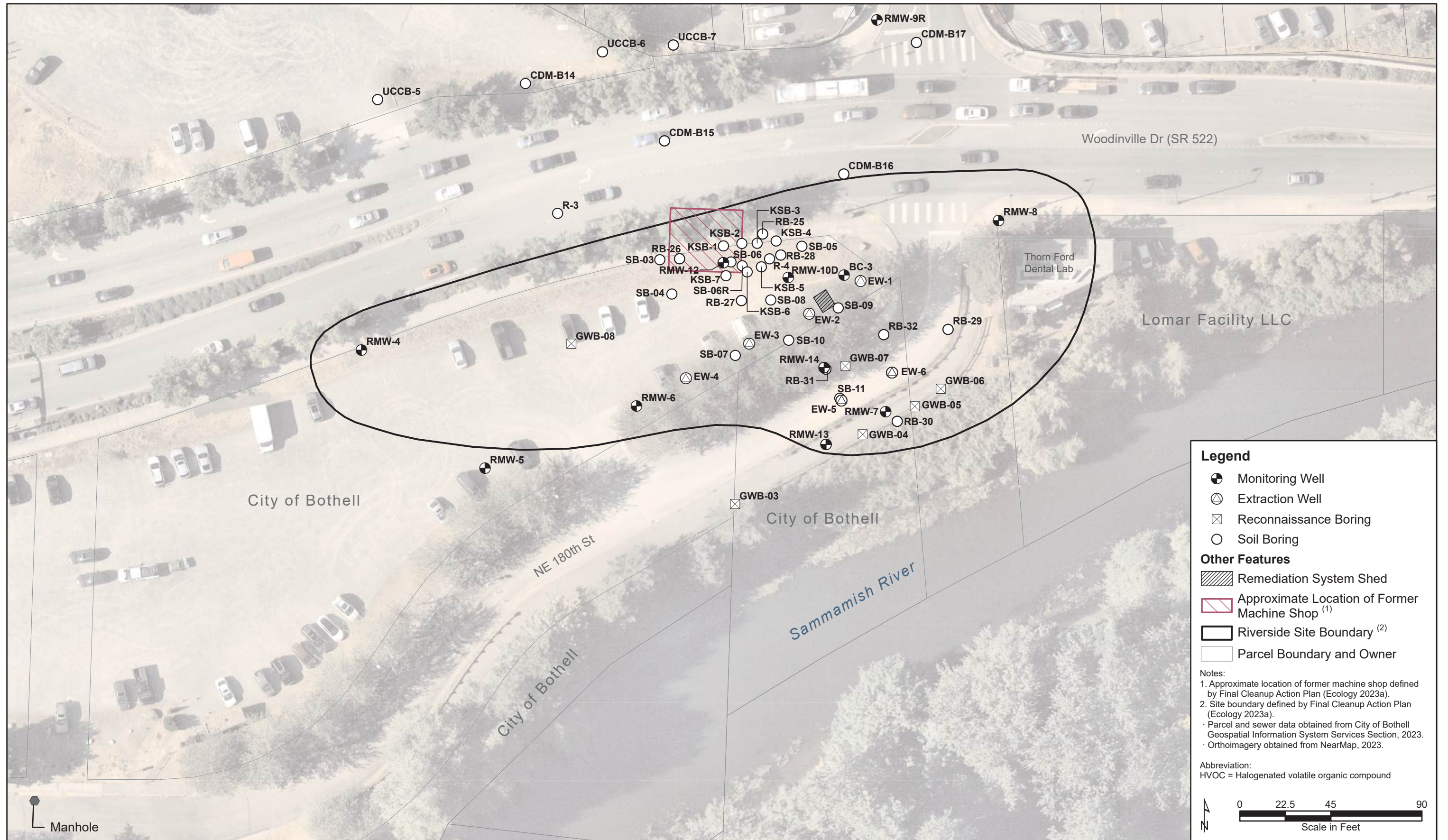
- bgs Below ground surface
- HVOC Halogenated volatile organic compound
- DCE Dichloroethene
- MNA Monitored natural attenuation
- PCE Tetrachloroethene
- TCE Trichloroethene

# Engineering Design Report

Riverside HVOC Site

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## Figures



**Legend**

- ⊕ Monitoring Well
- ⊖ Extraction Well
- ⊗ Reconnaissance Boring
- Soil Boring

**Other Features**

- ▨ Remediation System Shed
- ▧ Approximate Location of Former Machine Shop <sup>(1)</sup>
- ▭ Riverside Site Boundary <sup>(2)</sup>
- ▭ Parcel Boundary and Owner

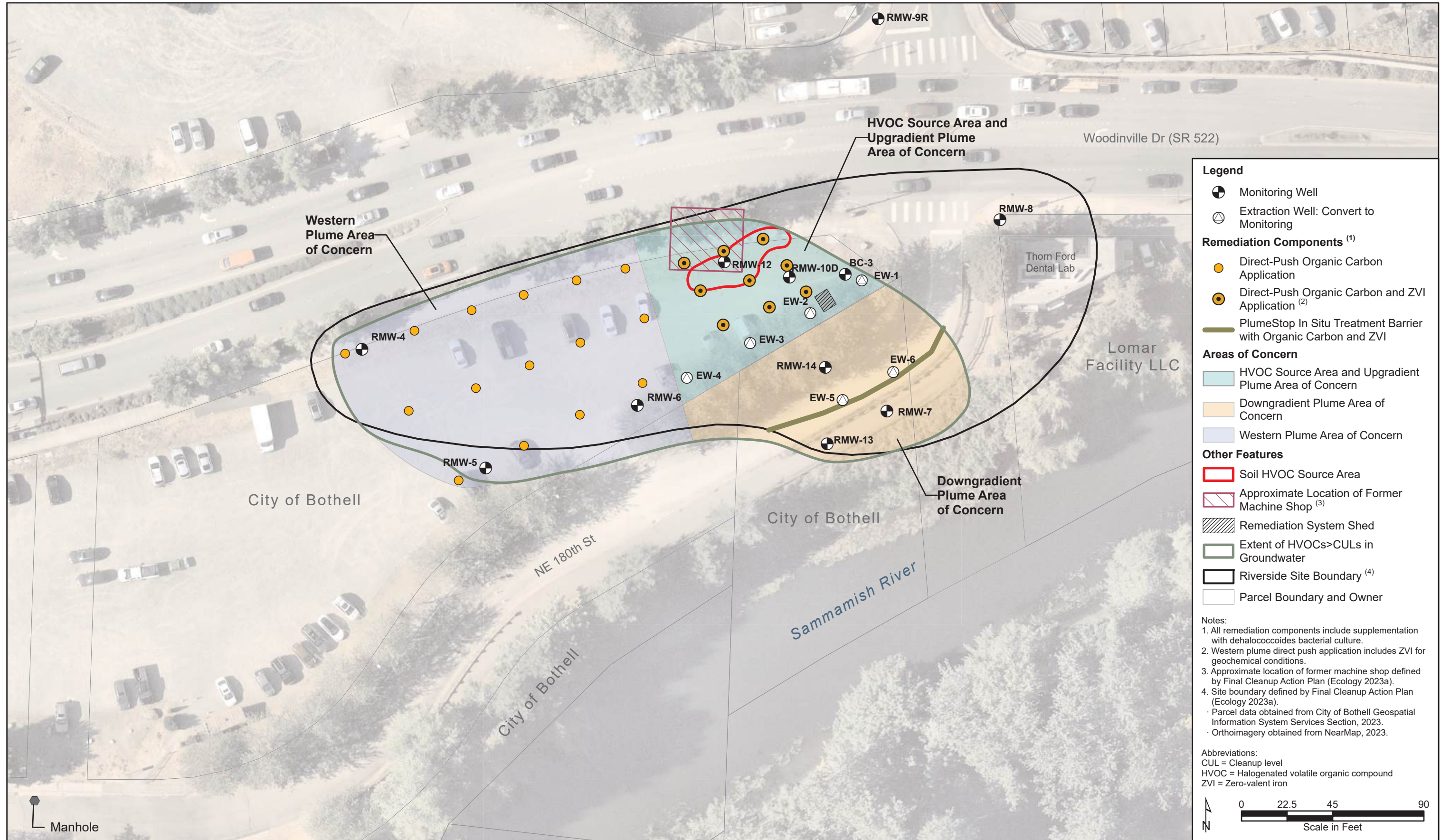
**Notes:**

1. Approximate location of former machine shop defined by Final Cleanup Action Plan (Ecology 2023a).
2. Site boundary defined by Final Cleanup Action Plan (Ecology 2023a).

- Parcel and sewer data obtained from City of Bothell Geospatial Information System Services Section, 2023.
- Orthoimagery obtained from NearMap, 2023.

**Abbreviation:**  
 HVOC = Halogenated volatile organic compound

0 22.5 45 90  
 Scale in Feet



**Legend**

- ⊕ Monitoring Well
- ⊖ Extraction Well: Convert to Monitoring

**Remediation Components <sup>(1)</sup>**

- Direct-Push Organic Carbon Application
- Direct-Push Organic Carbon and ZVI Application <sup>(2)</sup>
- PlumeStop In Situ Treatment Barrier with Organic Carbon and ZVI

**Areas of Concern**

- HVOC Source Area and Upgradient Plume Area of Concern
- Downgradient Plume Area of Concern
- Western Plume Area of Concern

**Other Features**

- ▨ Soil HVOC Source Area
- ▨ Approximate Location of Former Machine Shop <sup>(3)</sup>
- ▨ Remediation System Shed
- Extent of HVOCs > CULs in Groundwater
- ▭ Riverside Site Boundary <sup>(4)</sup>
- ▭ Parcel Boundary and Owner

**Notes:**

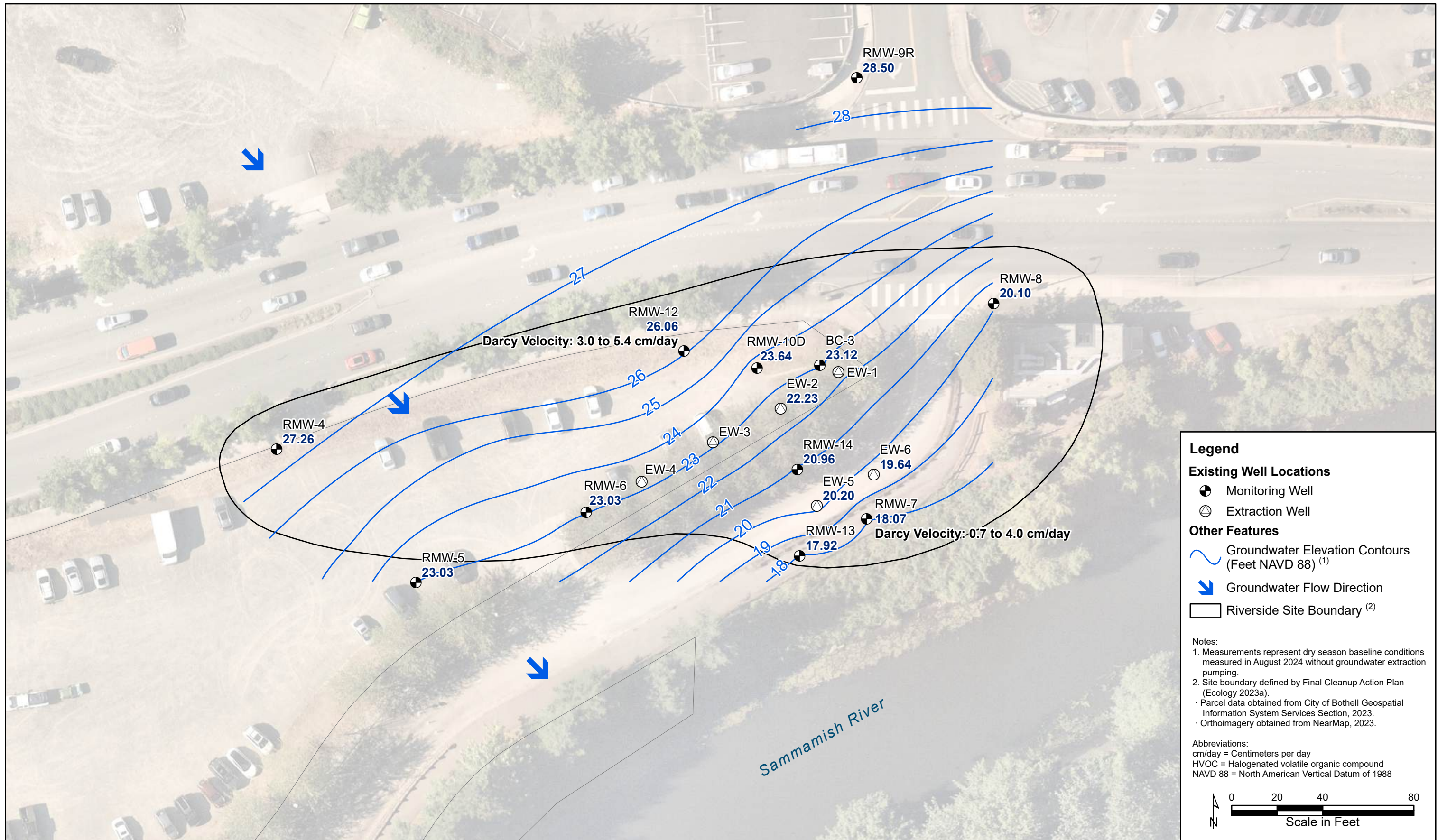
1. All remediation components include supplementation with dehalococoides bacterial culture.
2. Western plume direct push application includes ZVI for geochemical conditions.
3. Approximate location of former machine shop defined by Final Cleanup Action Plan (Ecology 2023a).
4. Site boundary defined by Final Cleanup Action Plan (Ecology 2023a).

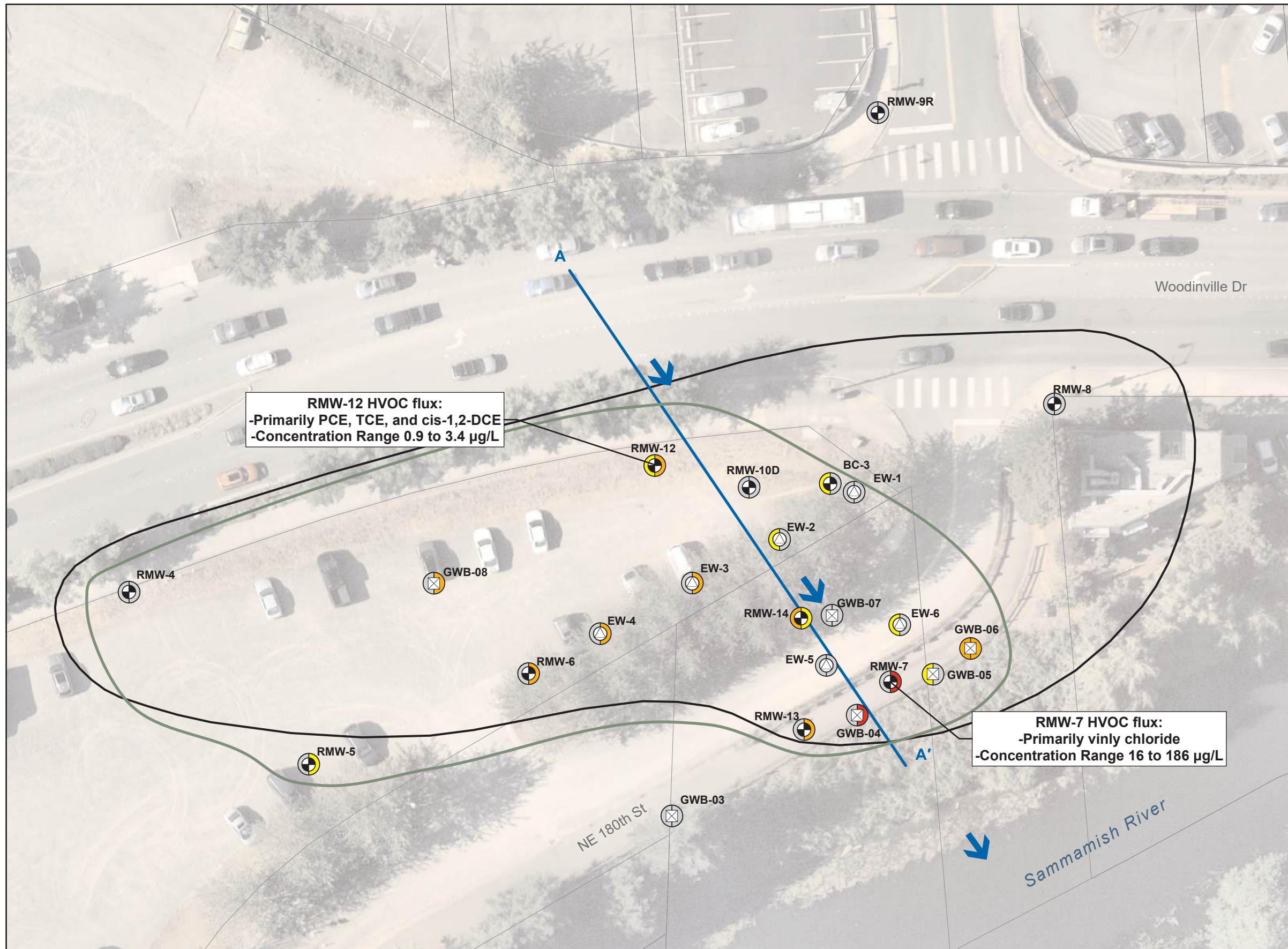
- Parcel data obtained from City of Bothell Geospatial Information System Services Section, 2023.
- Orthoimagery obtained from NearMap, 2023.

**Abbreviations:**

- CUL = Cleanup level
- HVOC = Halogenated volatile organic compound
- ZVI = Zero-valent iron

0 22.5 45 90  
Scale in Feet





**Legend**

**Groundwater Sample Result <sup>(1)</sup>**

<b>PCE Result</b>	⊕	<b>Vinyl Chloride Result</b>	⊕
ND or ≤CUL	⊖	ND or ≤CUL	⊖
>CUL – <2x CUL	⊙	>CUL – <5x CUL	⊙
≥2x CUL – <10x CUL	⊗	≥5x CUL – <50x CUL	⊗
≥10x CUL	⊘	≥50x CUL	⊘

**Sample Location**

- ⊕ Monitoring Well
- ⊗ Reconnaissance Boring
- ⊖ Extraction Well

**Other Features**

- ➔ Groundwater Flow Direction
- Cross-Section Transect
- ▭ Riverside Site Boundary <sup>(2)</sup>
- ▭ Extent of HVOCs > CULs in Groundwater
- ▭ Parcel Boundary

**Cleanup Levels**  
 PCE = 4.9 µg/L  
 Vinyl chloride = 0.02 µg/L

Notes:

- For reconnaissance boring samples with multiple sample depths, the maximum result is shown. HVOC results shown are the maximum detection in samples collected from July to September 2024, except at BC-3 where the most recent result collected in May 2020 is shown.
- Site boundary defined by Final Cleanup Action Plan (Ecology 2023a).

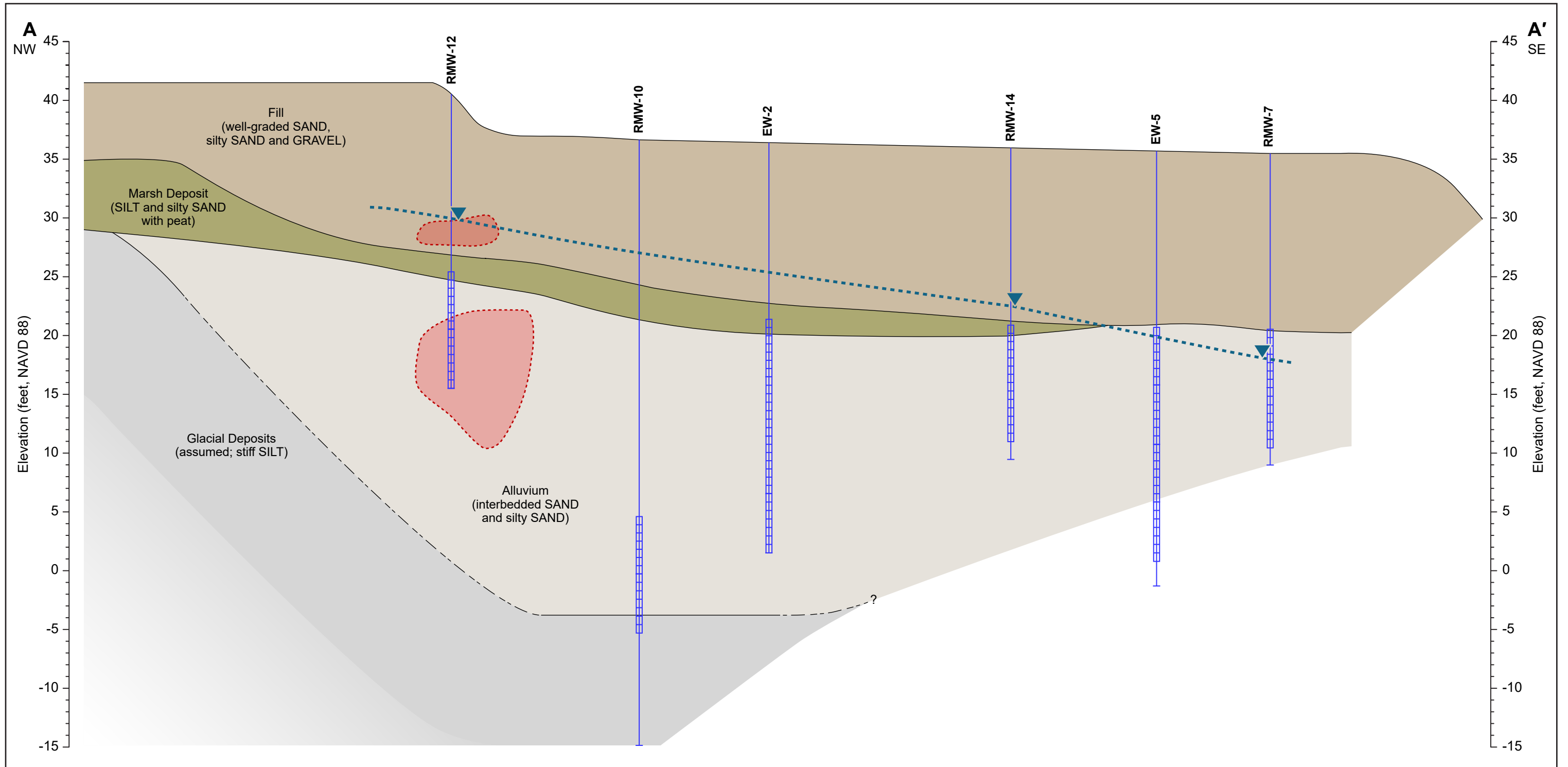
- Parcel data obtained from City of Bothell Geospatial Information System Services Section, 2023.
- Orthoimagery obtained from NearMap, 2023.

Abbreviations:

- CUL = Cleanup level
- DCE = Dichloroethene
- HVOC = Halogenated volatile organic compound
- µg/L = Micrograms per liter
- ND = Non-detect
- PCE = Tetrachloroethene
- TCE = Trichloroethene

Scale in Feet: 0, 17.5, 35, 70

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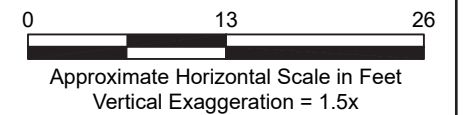


**Legend**

- RMW-12** Identifier
- Well Screen Interval on Well Casing
- Groundwater Elevation, July-Sep 2024
- Groundwater Table, July-Sep 2024

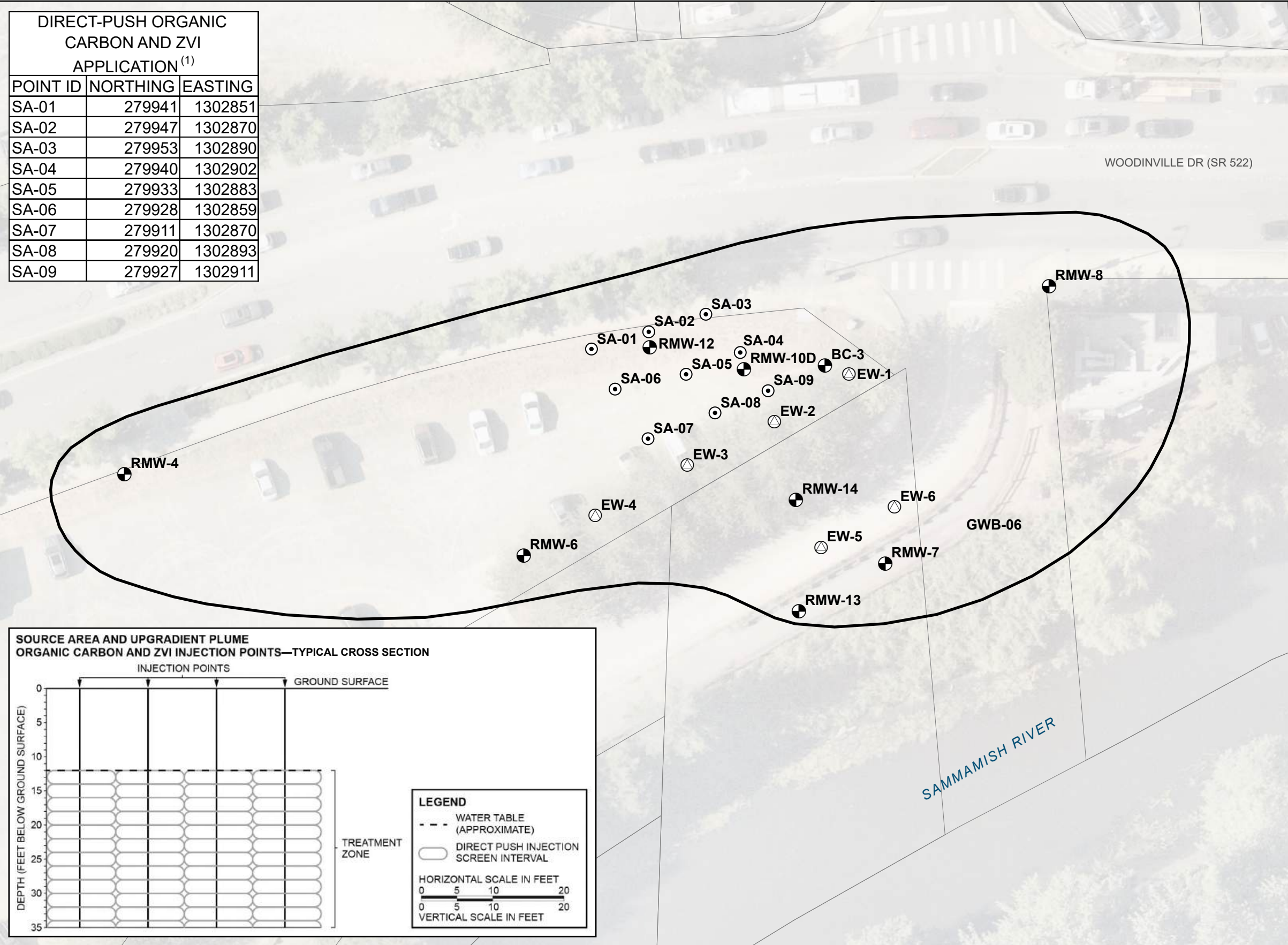
- Contact Boundary Between Lithologies (dashed where inferred)
- Approximate Extent of Soil Tetrachloroethene Source Area

Abbreviations:  
 HVOC = Halogenated volatile organic compound  
 NAVD 88 = North American Vertical Datum of 1988



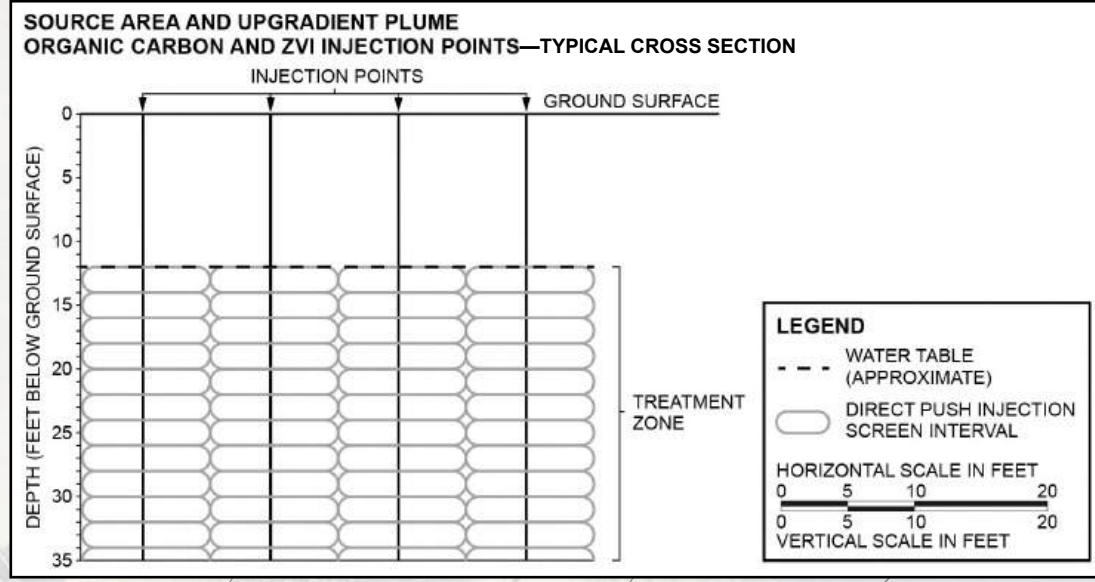
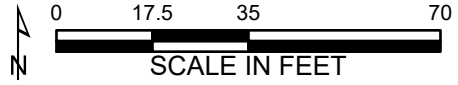
DIRECT-PUSH ORGANIC CARBON AND ZVI APPLICATION <sup>(1)</sup>		
POINT ID	NORTHING	EASTING
SA-01	279941	1302851
SA-02	279947	1302870
SA-03	279953	1302890
SA-04	279940	1302902
SA-05	279933	1302883
SA-06	279928	1302859
SA-07	279911	1302870
SA-08	279920	1302893
SA-09	279927	1302911

- LEGEND**
- ⊙ DIRECT-PUSH ORGANIC CARBON AND ZVI APPLICATION (3-D MICROEMULSION, S-MZVI, AND BDI PLUS)
  - ⊕ EXISTING MONITORING WELL
  - ⊖ EXTRACTION WELL
  - ▭ PARCEL BOUNDARY
  - ▭ RIVERSIDE SITE BOUNDARY <sup>(2)</sup>



- NOTES:**
- DIRECT-PUSH ORGANIC CARBON AND ZVI APPLICATION POINT COORDINATES ARE PRESENTED IN FEET NAD 83 WASHINGTON STATEPLANE NORTH.
  - SITE BOUNDARY DEFINED BY FINAL CLEANUP ACTION PLAN (ECOLOGY 2023A).
- SPACING BETWEEN INJECTION POINTS PER TYPICAL INJECTION DETAIL IS SHOWN. INJECTION ALIGNMENT MAY BE FIELD MODIFIED AT ENGINEER'S DIRECTION.
  - PARCEL DATA OBTAINED FROM CITY OF BOTHELL GEOSPATIAL INFORMATION SYSTEM SERVICES SECTION, 2023.
  - ORTHOIMAGERY OBTAINED FROM NEARMAP, 2023.

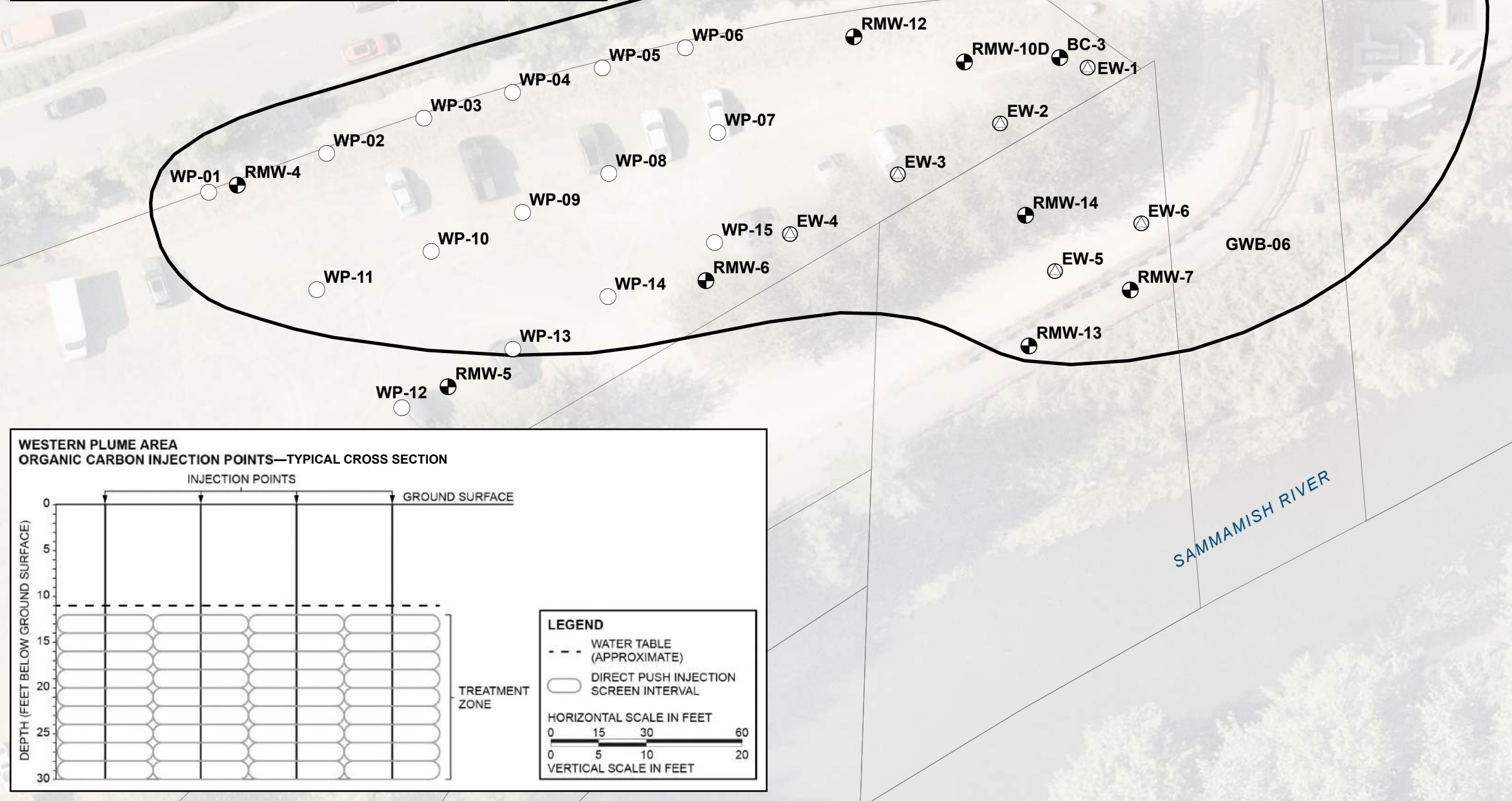
- ABBREVIATIONS:**
- ENGINEER = ENGINEER OF RECORD
  - HVOC = HALOGENATED VOLATILE ORGANIC COMPOUND
  - NAD 83 = NORTH AMERICAN DATUM OF 1983
  - S-MZVI = SULFIDATED MICROSCALE ZERO-VALENT IRON
  - ZVI = ZERO-VALENT IRON



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DIRECT-PUSH ORGANIC CARBON AND ZVI APPLICATION <sup>(1)</sup>			DIRECT-PUSH ORGANIC CARBON AND ZVI APPLICATION <sup>(1)</sup>		
POINT ID	NORTHING	EASTING	POINT ID	NORTHING	EASTING
WP-01	279897	1302684	WP-09	279891	1302775
WP-02	279908	1302718	WP-10	279880	1302748
WP-03	279918	1302746	WP-11	279868	1302715
WP-04	279926	1302772	WP-12	279834	1302740
WP-05	279933	1302798	WP-13	279851	1302772
WP-06	279939	1302822	WP-14	279867	1302799
WP-07	279914	1302831	WP-15	279882	1302830
WP-08	279902	1302800			

- LEGEND**
- DIRECT-PUSH ORGANIC CARBON APPLICATION (3-D MICROEMULSION, S-MZVI, AND BDI PLUS)
  - ⊕ EXISTING MONITORING WELL
  - ⊖ EXTRACTION WELL
  - ▭ PARCEL BOUNDARY
  - ▭ RIVERSIDE SITE BOUNDARY<sup>(2)</sup>



- NOTES:**
1. DIRECT-PUSH ORGANIC CARBON APPLICATION POINT COORDINATES ARE PRESENTED IN FEET NAD 83 WASHINGTON STATEPLANE NORTH.
  2. SITE BOUNDARY DEFINED BY FINAL CLEANUP ACTION PLAN (ECOLOGY 2023A).
- SPACING BETWEEN INJECTION POINTS PER TYPICAL INJECTION DETAIL IS SHOWN. INJECTION ALIGNMENT MAY BE FIELD MODIFIED AT ENGINEER'S DIRECTION.
  - PARCEL DATA OBTAINED FROM CITY OF BOTHELL GEOSPATIAL INFORMATION SYSTEM SERVICES SECTION, 2023.
  - ORTHOIMAGERY OBTAINED FROM NEARMAP, 2023.

- ABBREVIATIONS:**
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  - NAD 83 = NORTH AMERICAN DATUM OF 1983
  - S-MVZI = SULFIDATED MICROSCALE ZERO-VALENT IRON
  - ZVI = ZERO-VALENT IRON
- 0 17.5 35 70  
SCALE IN FEET

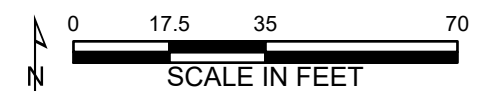
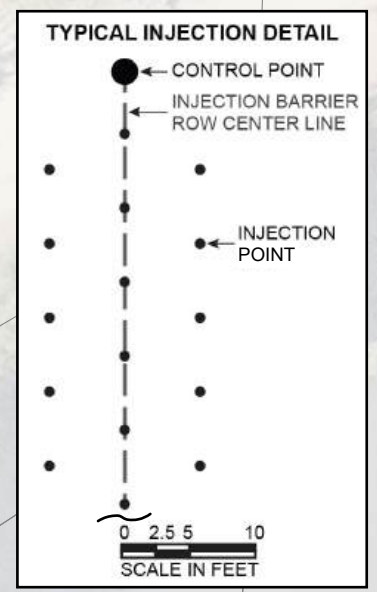
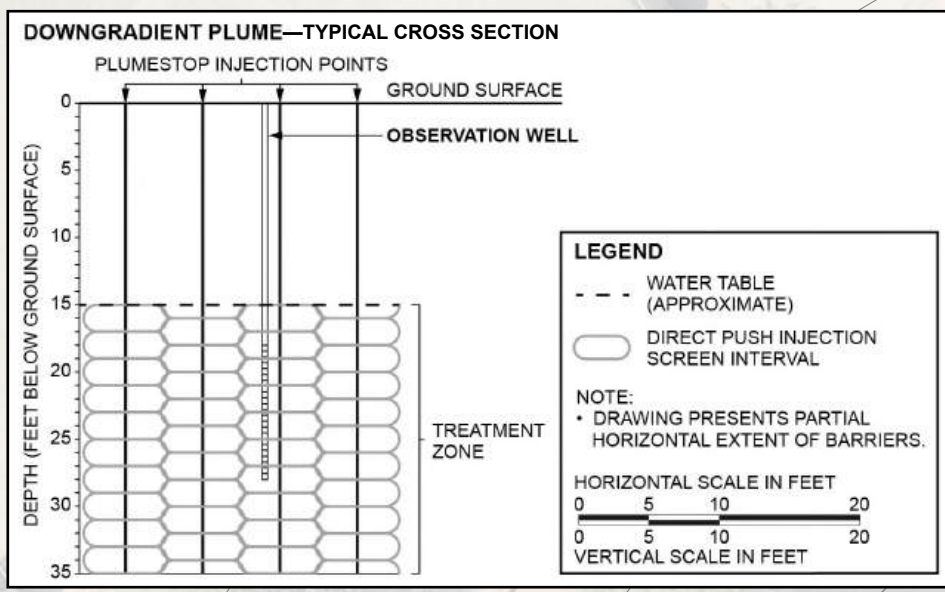
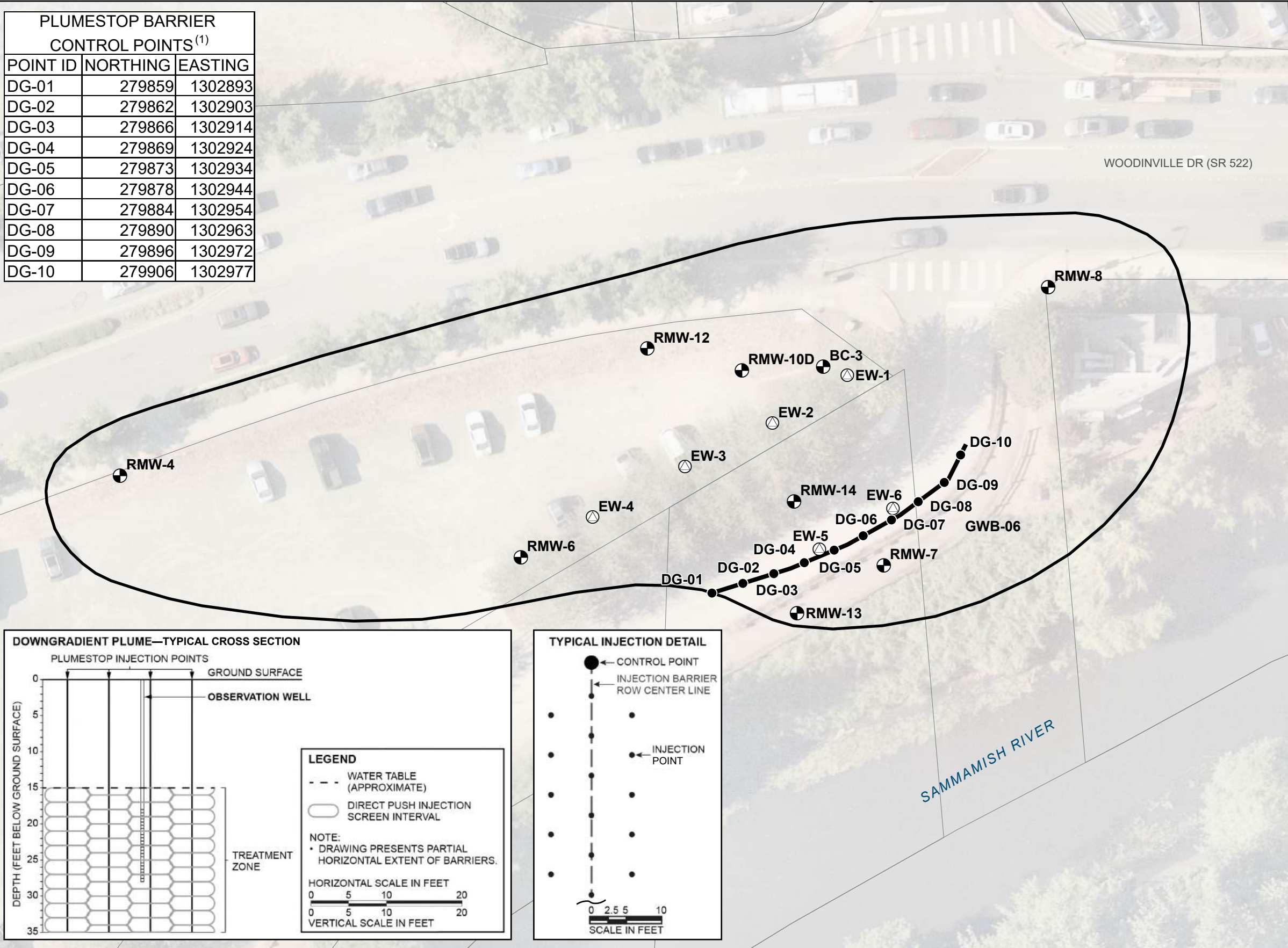
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PLUMESTOP BARRIER CONTROL POINTS <sup>(1)</sup>		
POINT ID	NORTHING	EASTING
DG-01	279859	1302893
DG-02	279862	1302903
DG-03	279866	1302914
DG-04	279869	1302924
DG-05	279873	1302934
DG-06	279878	1302944
DG-07	279884	1302954
DG-08	279890	1302963
DG-09	279896	1302972
DG-10	279906	1302977

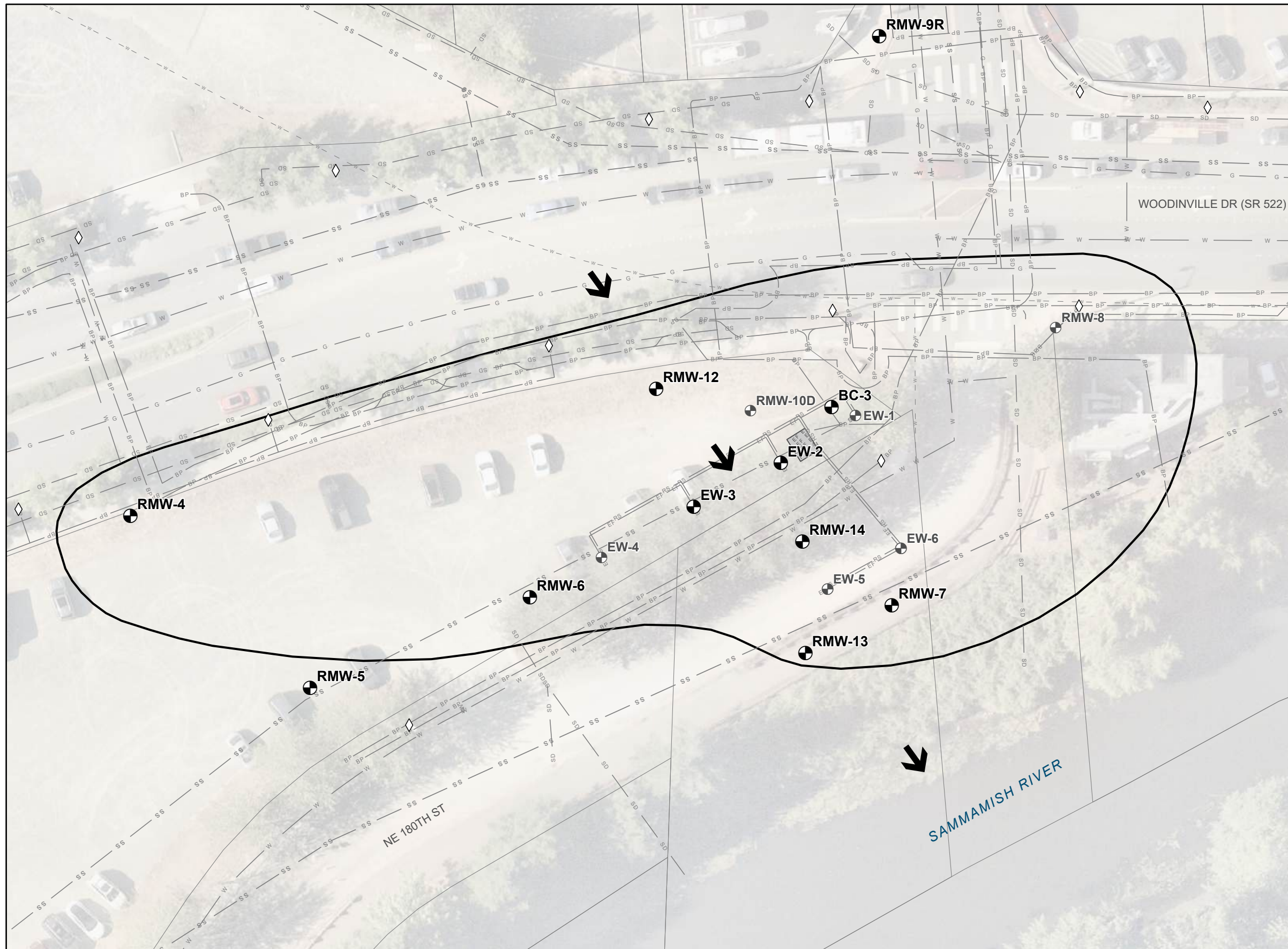
- LEGEND**
- EXISTING MONITORING WELL
  - ⊙ EXTRACTION WELL
  - PLUMESTOP IN SITU TREATMENT BARRIER WITH ORGANIC CARBON AND ZVI (PLUMESTOP, AQUIFIX, S-MZVI, AND BDI PLUS)
  - ▭ PARCEL BOUNDARY
  - ▭ RIVERSIDE SITE BOUNDARY<sup>(2)</sup>

- NOTES:**
- PLUMESTOP INJECTION APPLICATION POINT COORDINATES ARE PRESENTED IN FEET NAD 83 WASHINGTON STATEPLANE NORTH.
  - SITE BOUNDARY DEFINED BY FINAL CLEANUP ACTION PLAN (ECOLOGY 2023A).
  - SPACING BETWEEN INJECTION POINTS PER TYPICAL INJECTION DETAIL IS SHOWN. INJECTION ALIGNMENT MAY BE FIELD MODIFIED AT ENGINEER'S DIRECTION.
  - PARCEL DATA OBTAINED FROM CITY OF BOTHELL GEOSPATIAL INFORMATION SYSTEM SERVICES SECTION, 2023.
  - ORTHOIMAGERY OBTAINED FROM NEARMAP, 2023.

**ABBREVIATIONS:**  
 ENGINEER = ENGINEER OF RECORD  
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**LEGEND**

**WELLS**

- EXISTING MONITORING WELL - PROTECT
- ⊕ WELL TO BE DECOMMISSIONED

**UTILITIES - PROTECT**

- SS — SANITARY SEWER LINE
- SD — STORMWATER LINE
- W — WATER LINE
- G — GAS LINE
- BP — BURIED POWER
- ◇ STREET LIGHT

**PREVIOUSLY DECOMMISSIONED UTILITIES**

- - - ABANDONED WATER LINE

**GROUNDWATER REMEDIATION SYSTEM <sup>(1)</sup>**

- RS — BURIED POWER
- EF — EFFLUENT PIPE
- REMEDATION SYSTEM SHED

**OTHER FEATURES**

- ➔ GROUNDWATER FLOW DIRECTION
- ▭ RIVERSIDE SITE BOUNDARY <sup>(2)</sup>
- ▭ PARCEL BOUNDARY

**NOTES:**

1. CONTRACTOR SHALL REMOVE GROUNDWATER EXTRACTION PUMPS AND DOWN-WELL POWER AND PIPING LINES. FOR EXTRACTION WELLS DESIGNATED FOR PROTECTION (INCLUDES EW-2 AND EW-3), CONTRACTOR SHALL COVERT SURFACE COMPLETION TO FLUSH-MOUNT MONUMENT. REMAINING GROUNDWATER REMEDIATION SYSTEM COMPONENTS TO BE DECOMMISSIONED BY OTHERS.
2. SITE BOUNDARY DEFINED BY FINAL CLEANUP ACTION PLAN (ECOLOGY 2023A).

- EXISTING WELL LOCATIONS WERE SURVEYED BY FLOYD|SNIDER IN 2024.
- PARCEL DATA OBTAINED FROM CITY OF BOTHELL GEOSPATIAL INFORMATION SYSTEM SERVICES SECTION, 2023.
- ORTHOIMAGERY OBTAINED FROM NEARMAP, 2023.

**ABBREVIATION:**  
 HVOC = HALOGENATED VOLATILE ORGANIC COMPOUND

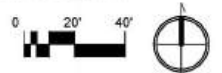
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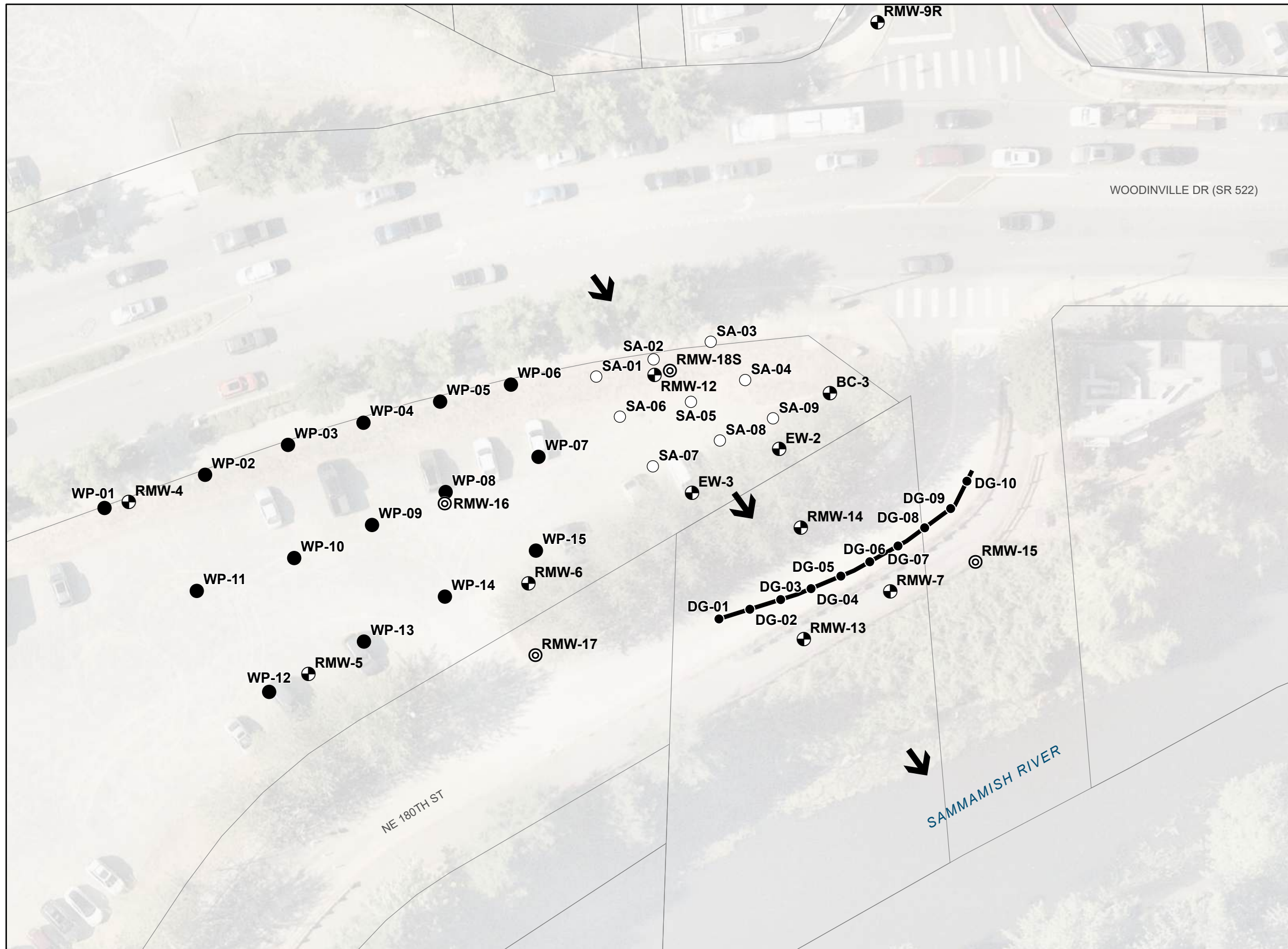
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1 Graphic Site Plan  
1" = 40'-0"

Note: Original drawing obtained from SiteWorkshop LLC.





**LEGEND**

**SAMPLE LOCATION**

- EXISTING MONITORING WELL
- ⊙ WELL TO BE INSTALLED <sup>(1)</sup>
- DIRECT-PUSH ORGANIC CARBON APPLICATION
- DIRECT-PUSH ORGANIC CARBON AND ZVI APPLICATION
- PLUMESTOP INJECTION POINTS
- PLUMESTOP IN SITU TREATMENT BARRIER WITH ORGANIC CARBON AND ZVI

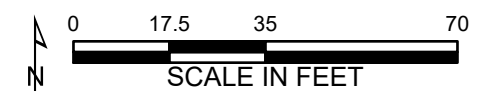
**OTHER FEATURES**

- ➔ GROUNDWATER FLOW DIRECTION
- ▭ PARCEL BOUNDARY

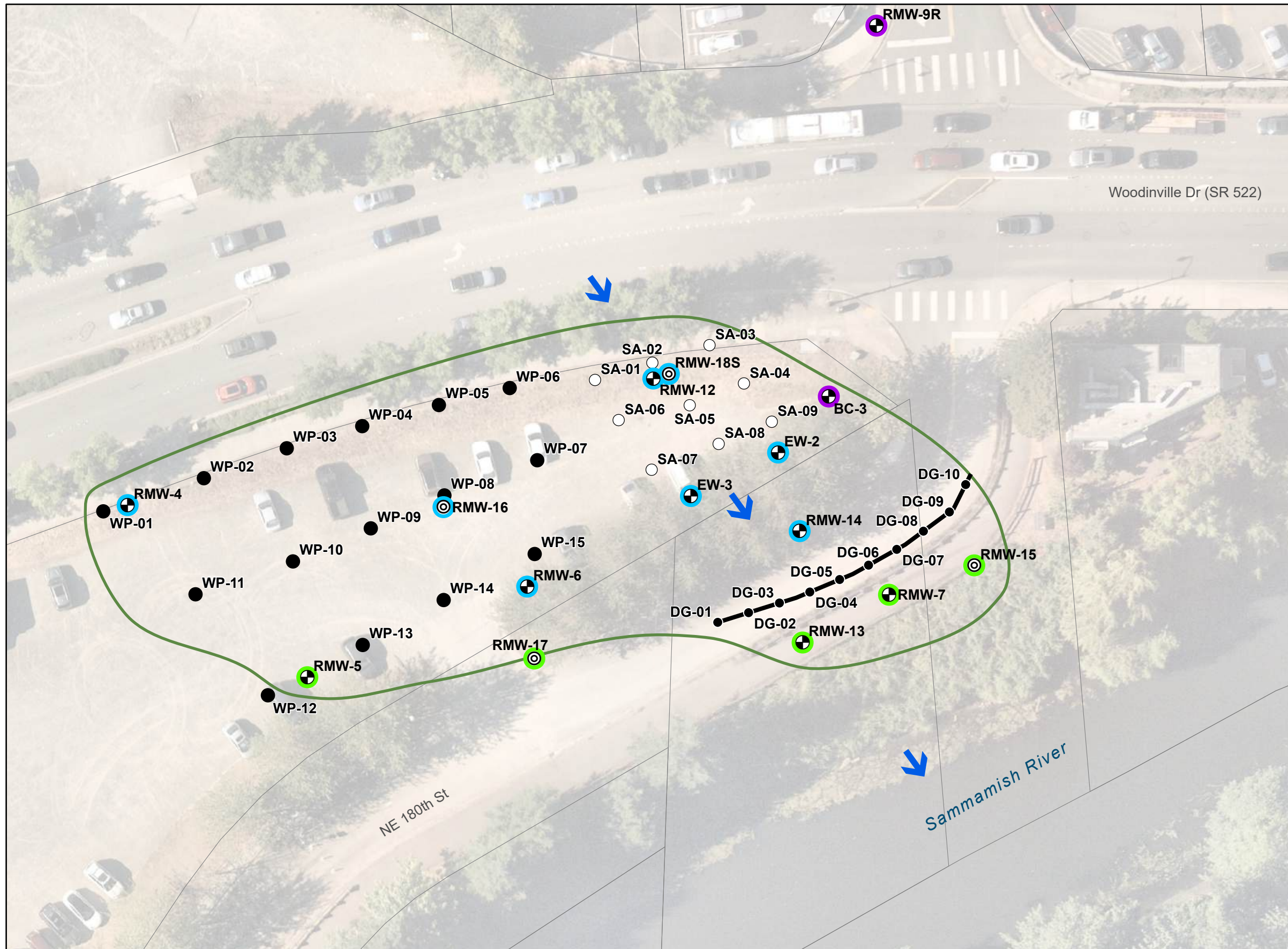
**NOTES:**

1. WELL LOCATION PLACEMENT AND WELL SCREEN INTERVALS WILL BE DIRECTED BY THE FIELD TECHNICIAN. SCREEN INTERVALS WILL BE SET TO MEASURE GROUNDWATER QUALITY IN THE APPROXIMATE VERTICAL TREATMENT ZONE OF THE IN SITU INJECTION.
- EXISTING WELL LOCATIONS WERE SURVEYED BY FLOYD|SNIDER IN 2024.
- PARCEL DATA OBTAINED FROM CITY OF BOTHELL GEOSPATIAL INFORMATION SYSTEM SERVICES SECTION, 2023.
- ORTHOIMAGERY OBTAINED FROM NEARMAP, 2023.

**ABBREVIATIONS:**  
 HVOC = HALOGENATED VOLATILE ORGANIC COMPOUND  
 ZVI = ZERO-VALENT IRON



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**Legend**

**Groundwater Monitoring Plan**

- ⊕ Upgradient Sentinel
- ⊕ Upgradient Performance
- ⊕ Downgradient Performance

**Sample Location**

- ⊕ Existing Monitoring Well
- ⊕ Well to Be Installed <sup>(1)</sup>
- Direct-Push Organic Carbon Application
- Direct-Push Organic Carbon and ZVI Application
- PlumeStop Injection Points
- PlumeStop In Situ Treatment
- Barrier with Organic Carbon and ZVI

**Other Features**

- ➔ Groundwater Flow Direction
- Extent of HVOCs > CULs in Groundwater
- Parcel Boundary

Notes:

1. Well location placement and well screen intervals will be directed by the field technician. Screen intervals will be set to measure groundwater quality in the approximate vertical treatment zone of the in situ injection.

- Existing well locations were surveyed by Floyd|Snider in 2024.
- Parcel data obtained from City of Bothell Geospatial Information System Services Section, 2023.
- Orthoimagery obtained from NearMap, 2023.

Abbreviations:

- CUL = Cleanup level
- HVOC = Halogenated volatile organic compound
- ZVI = Zero-valent iron

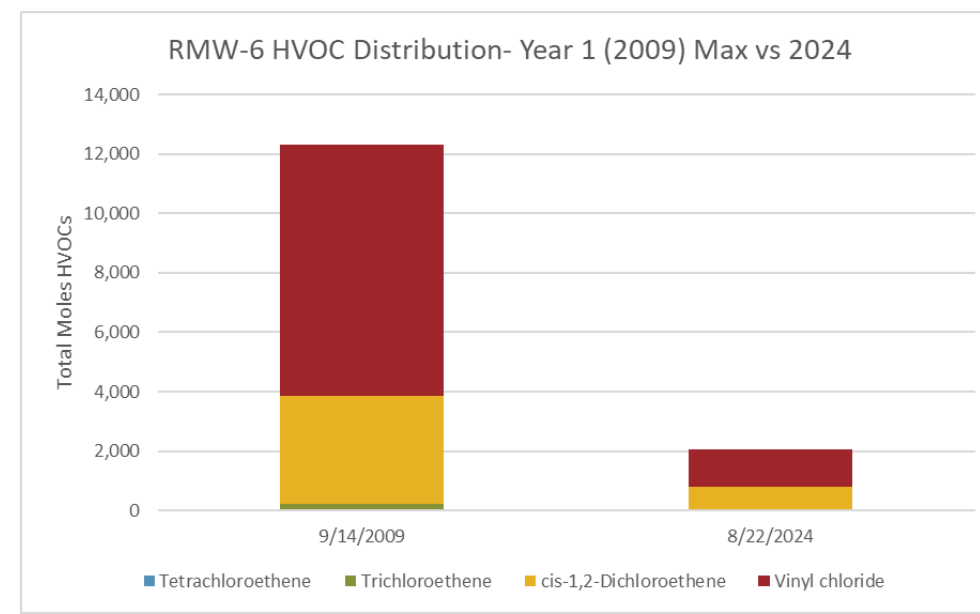
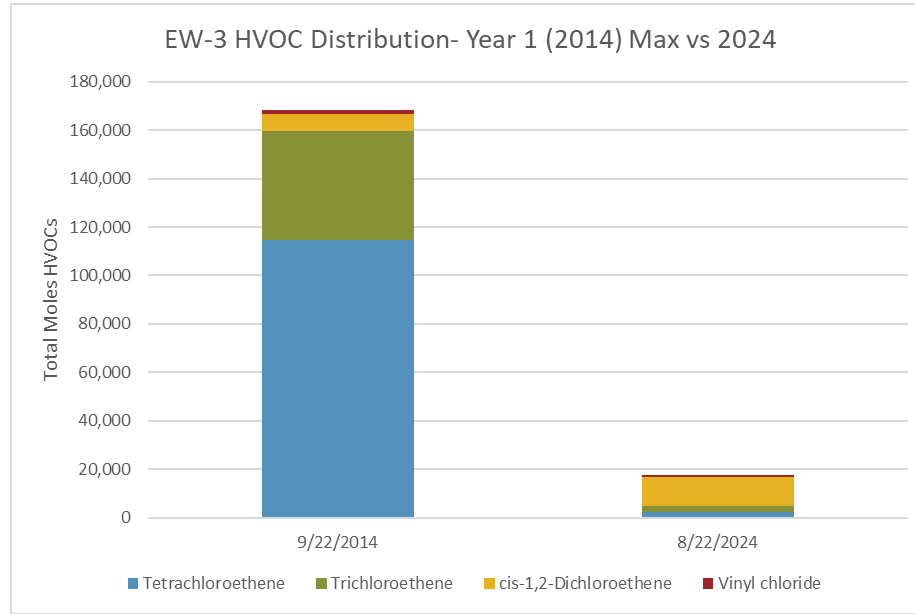
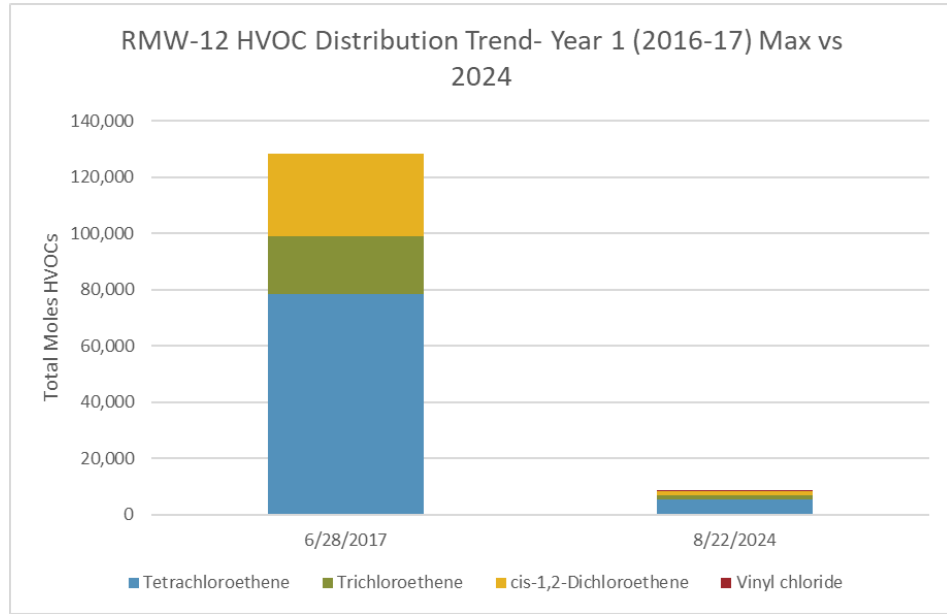
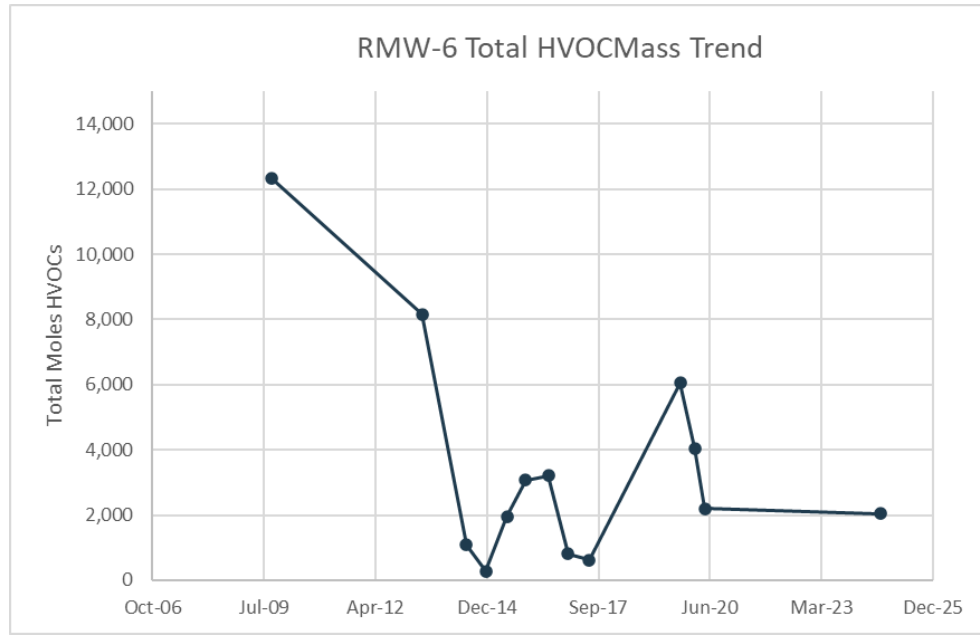
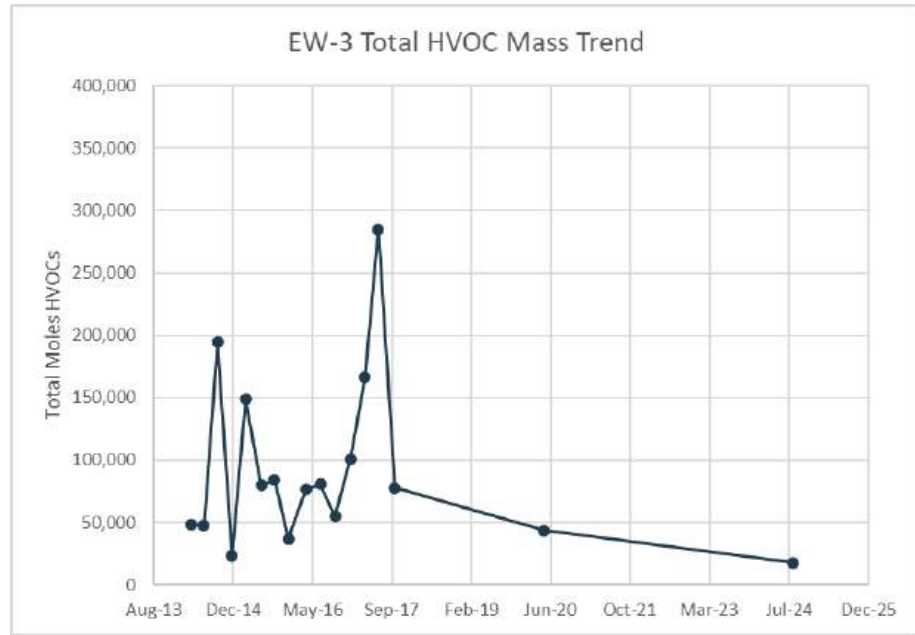
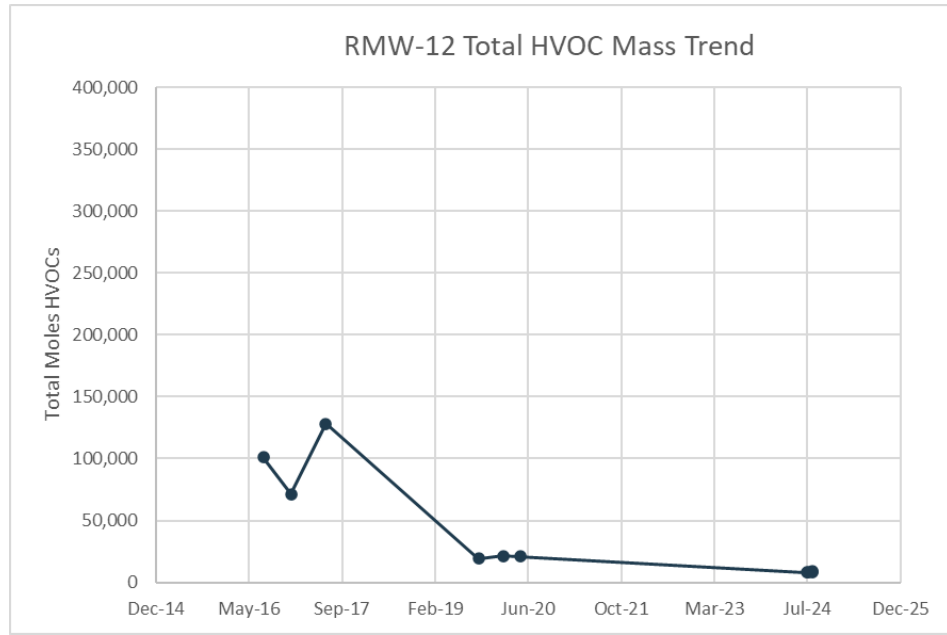
Scale in Feet

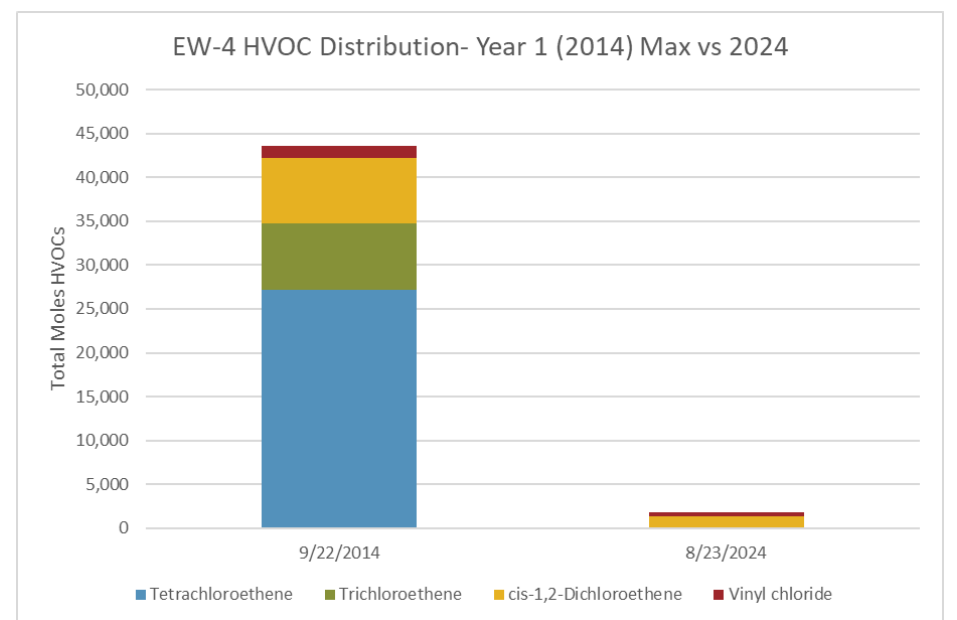
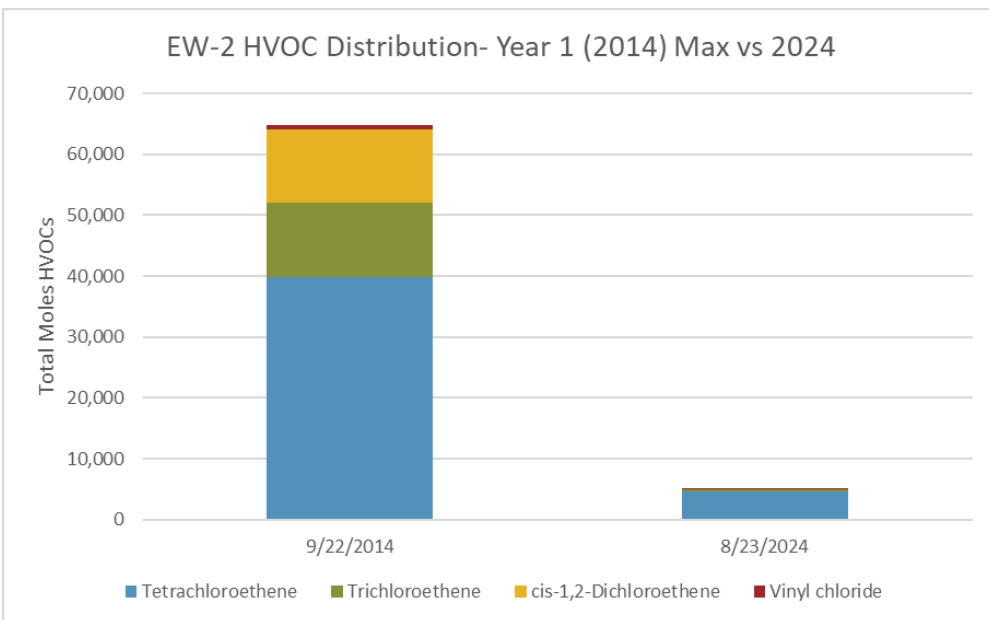
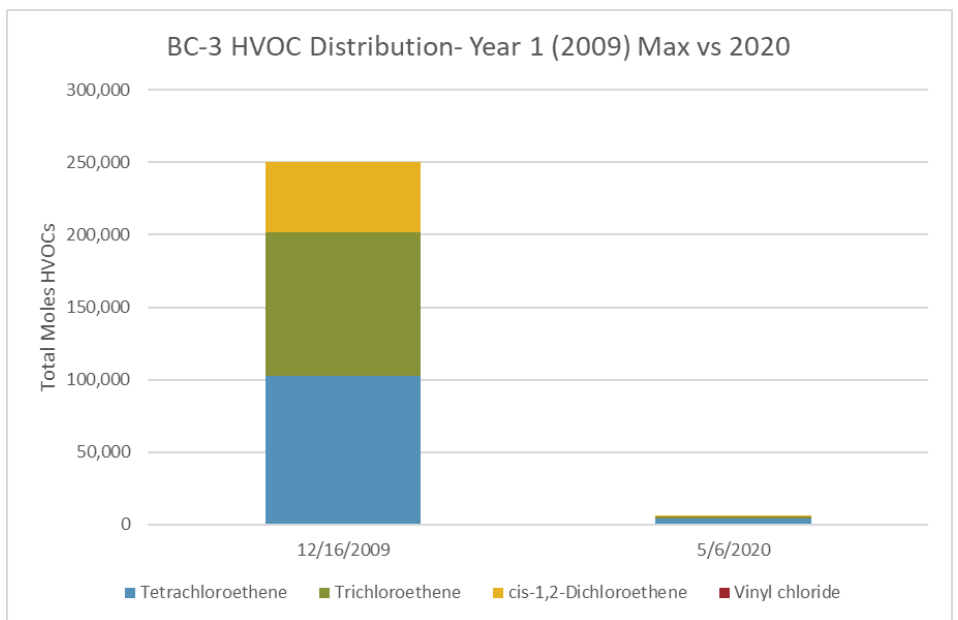
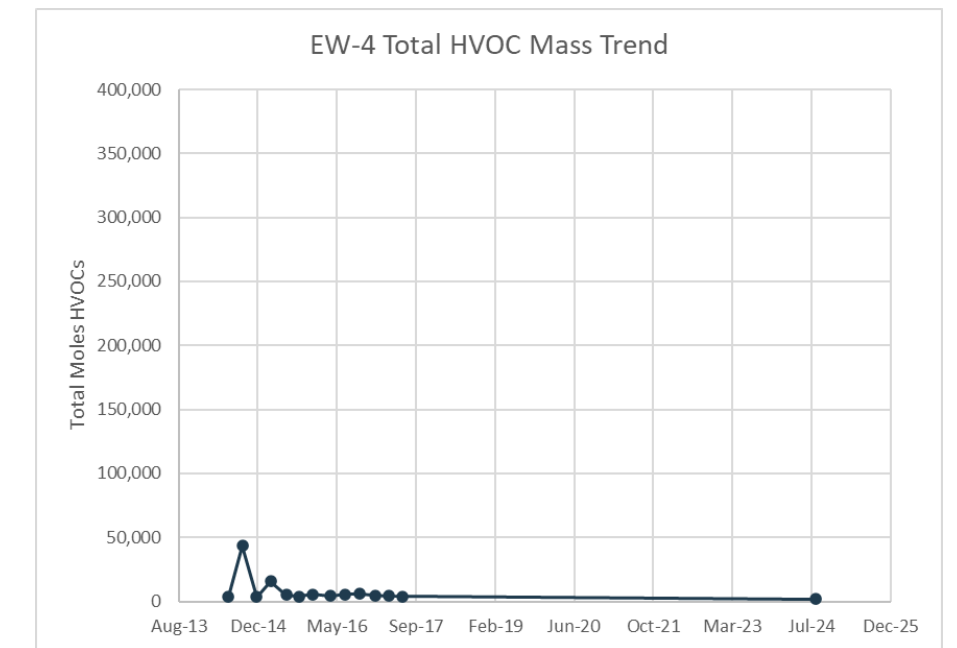
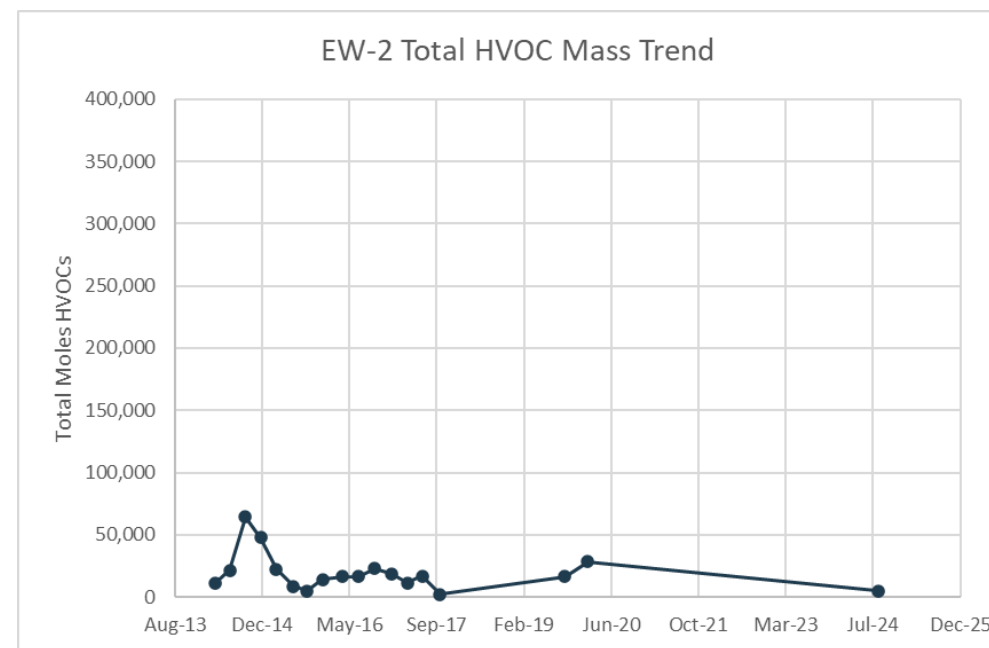
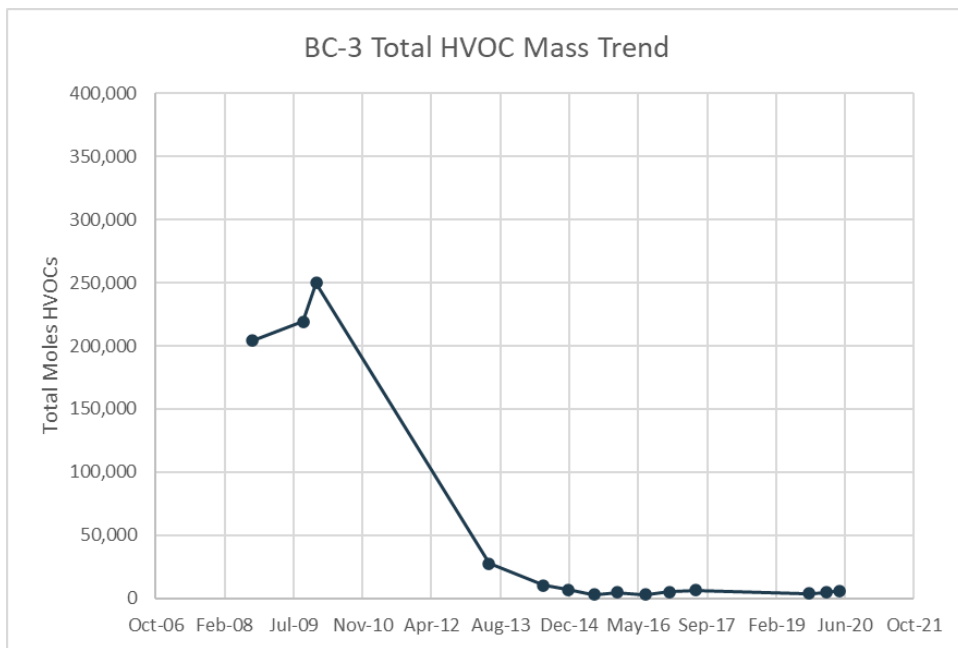
# Engineering Design Report

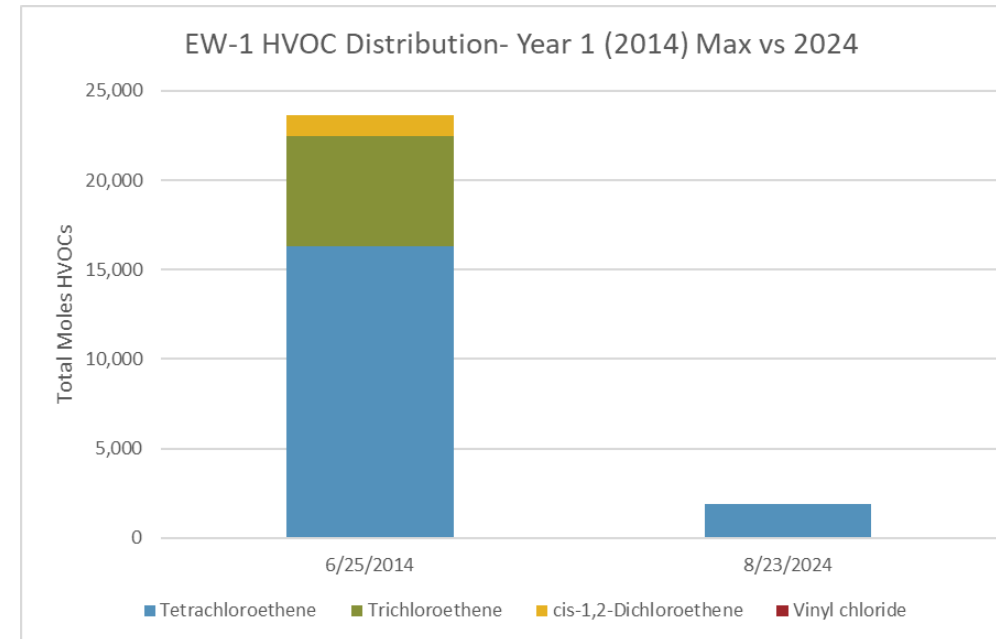
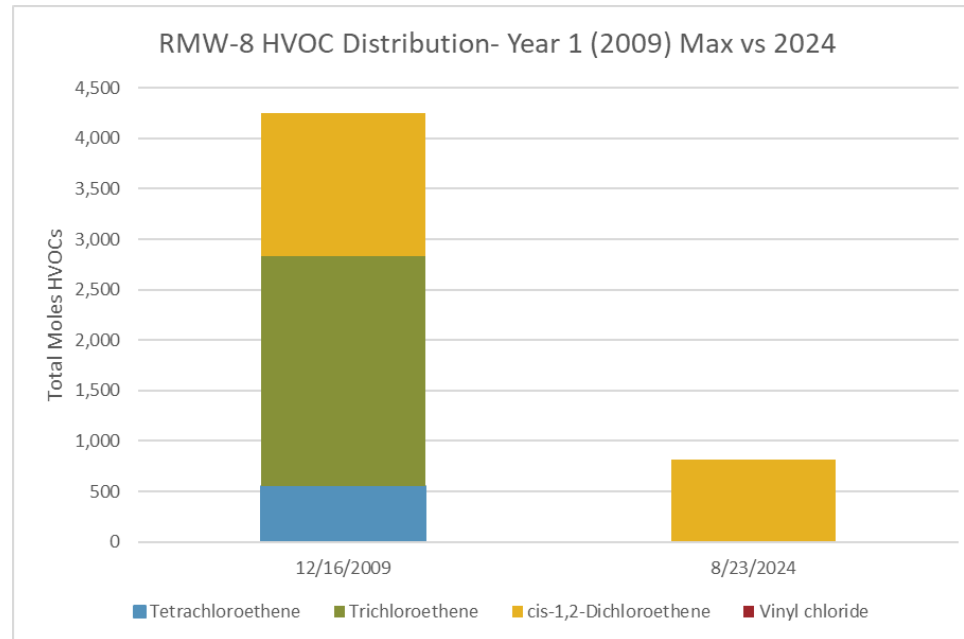
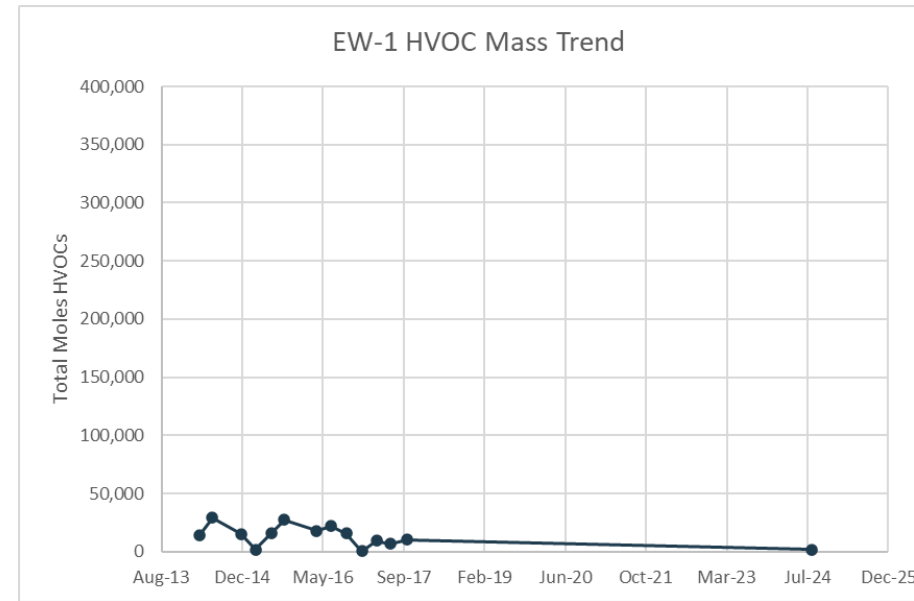
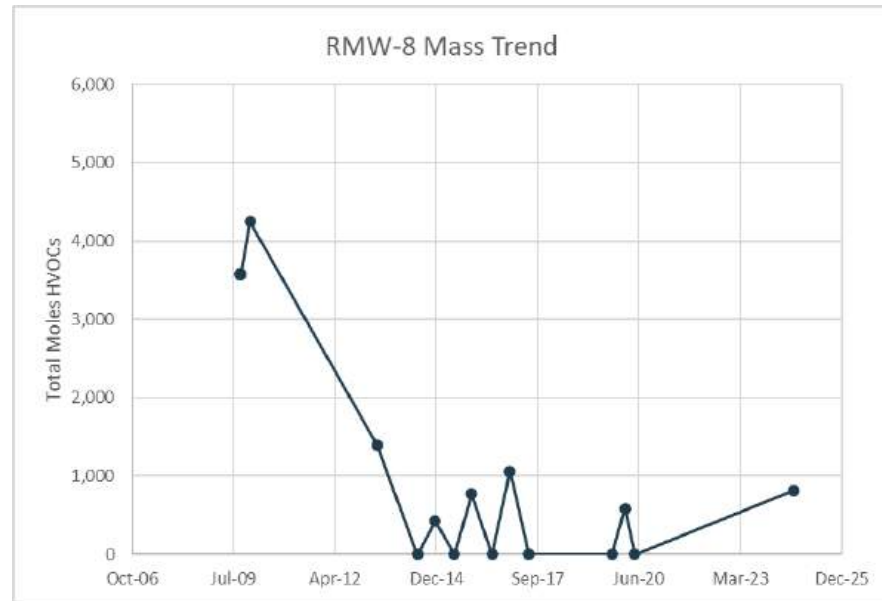
Riverside HVOC Site

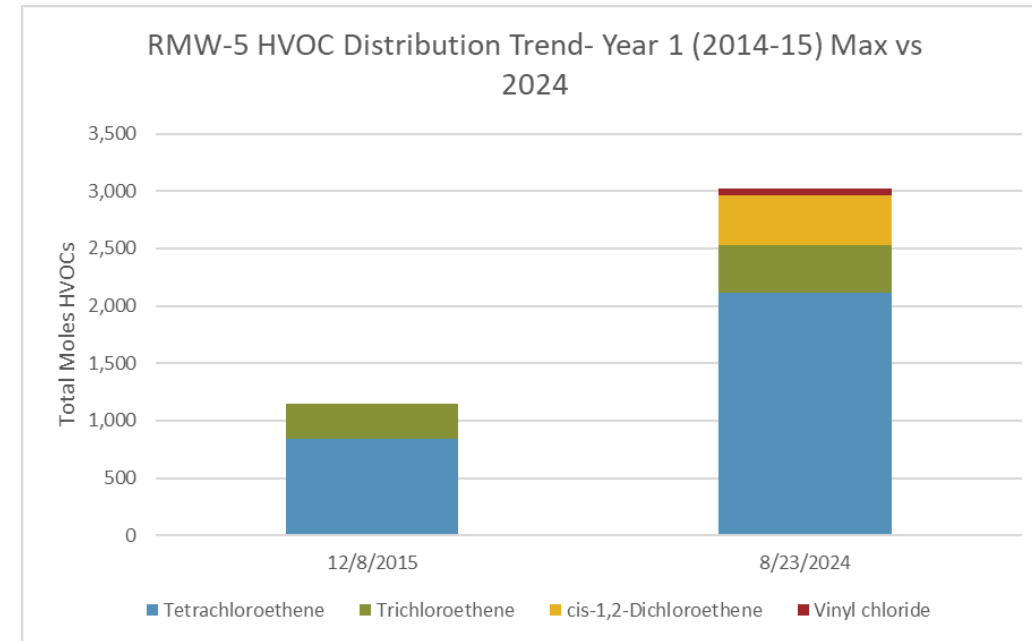
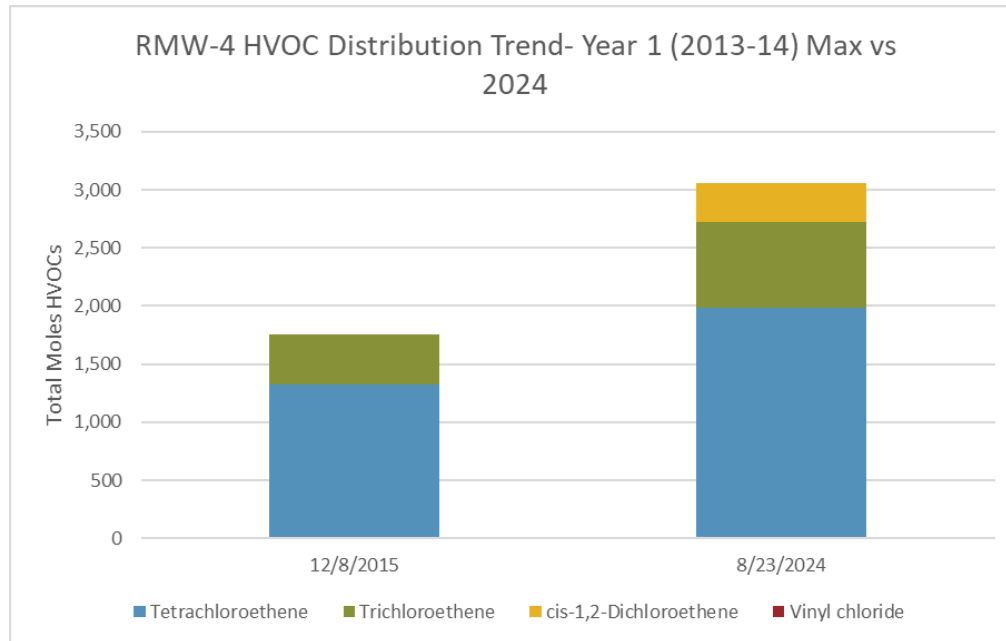
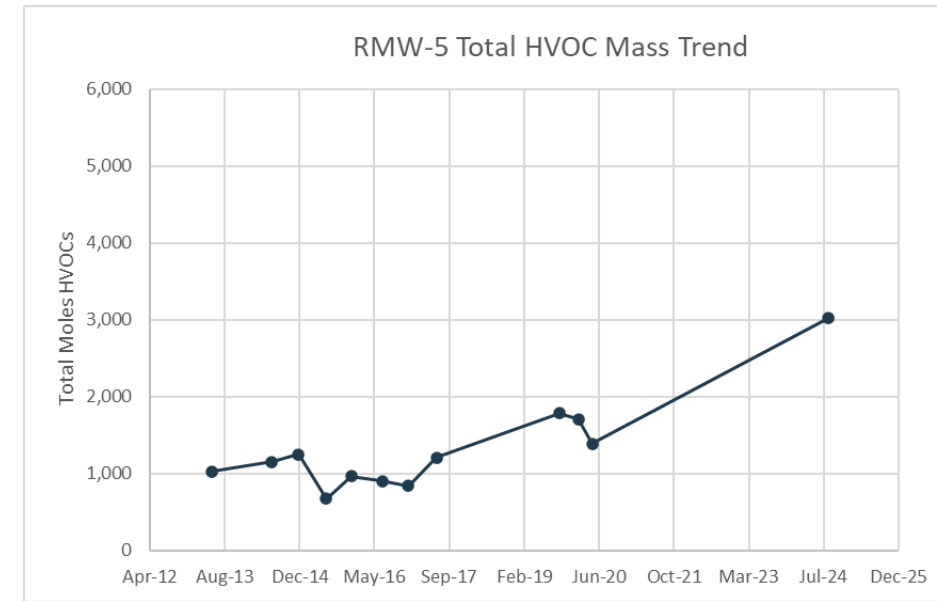
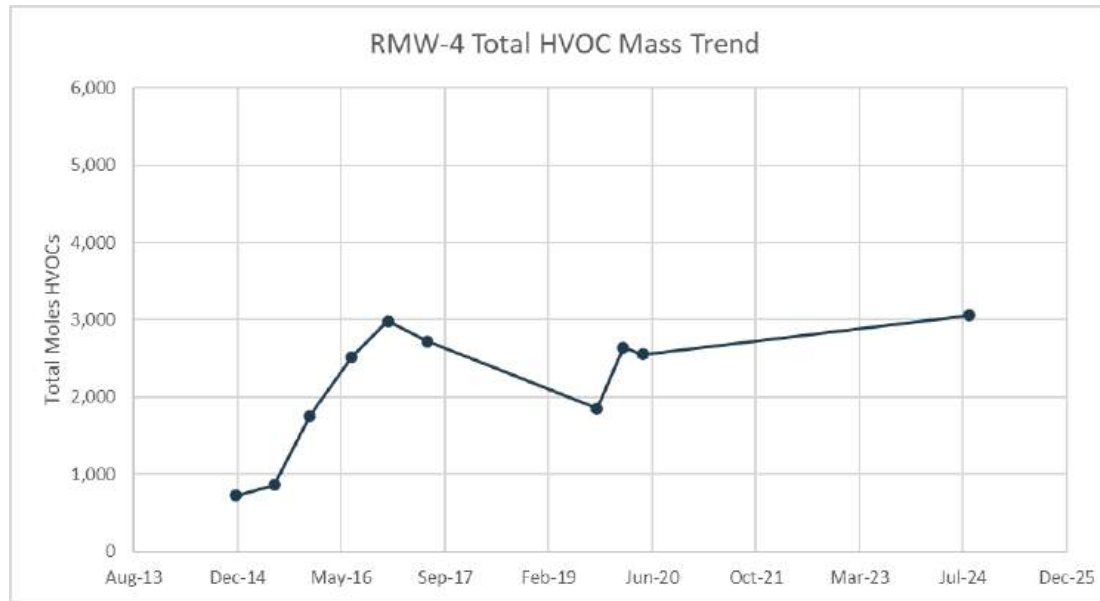
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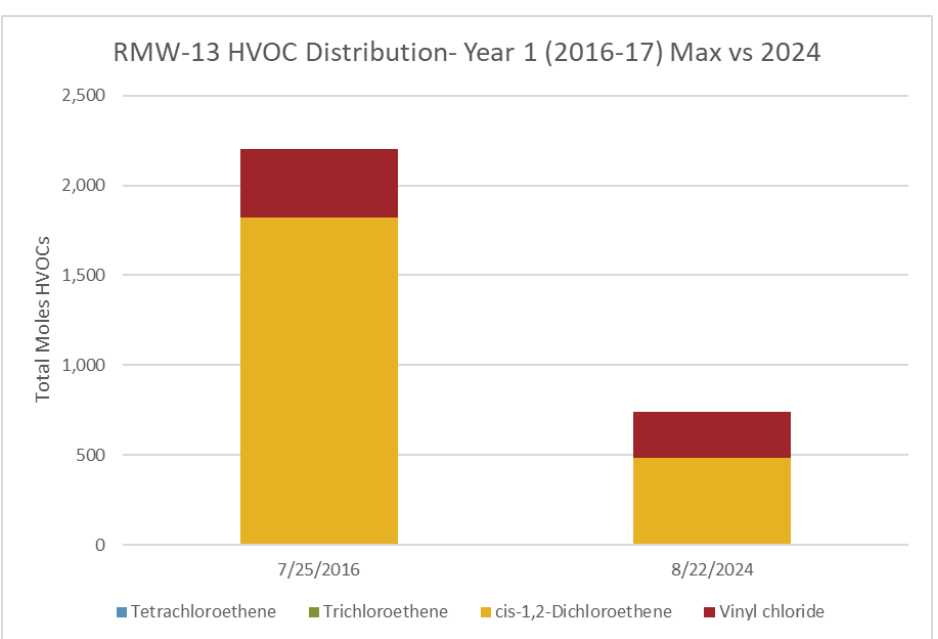
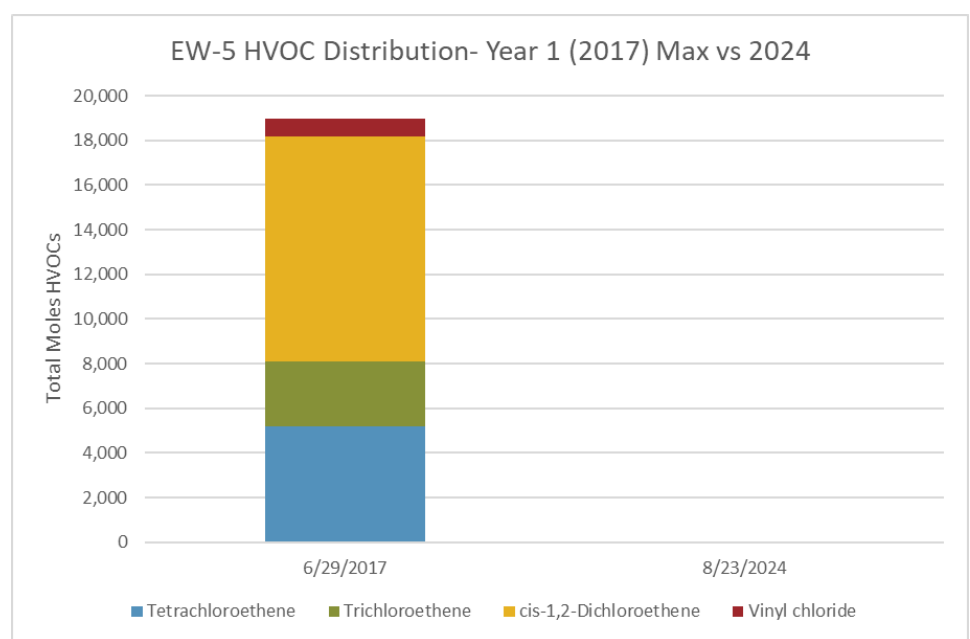
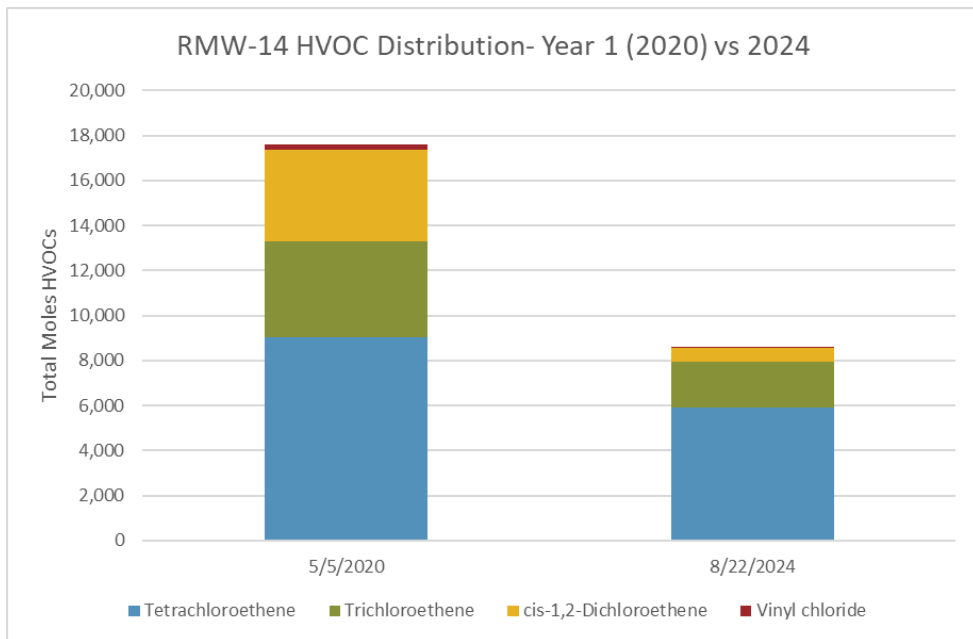
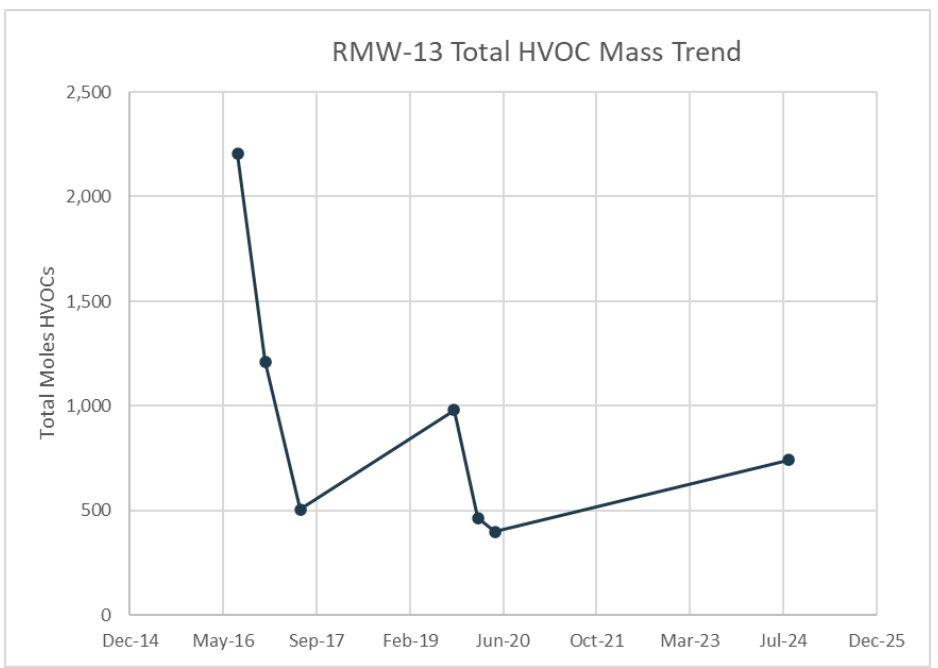
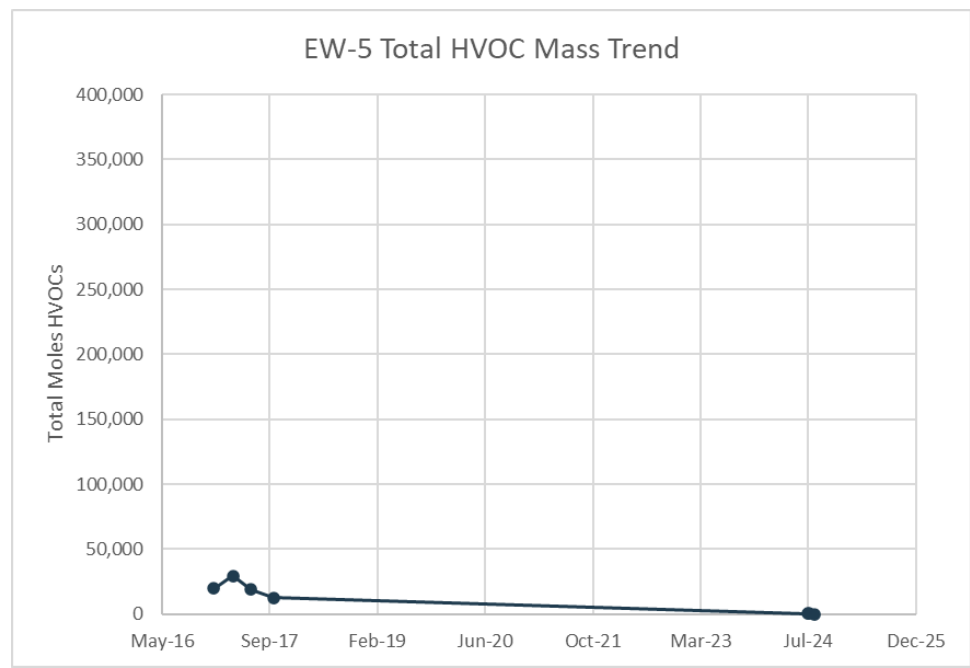
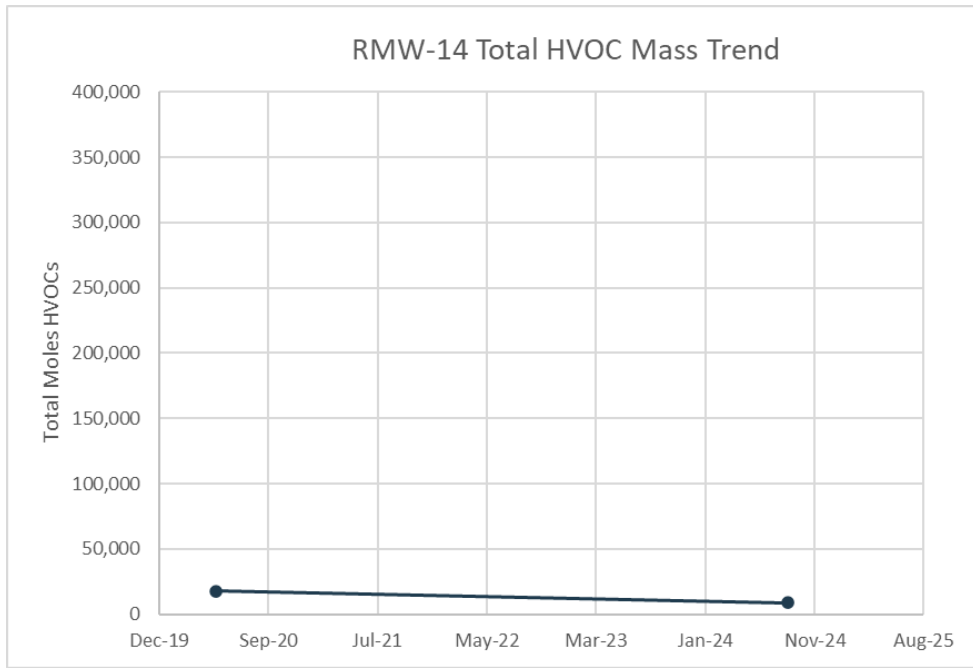
## Appendix A HVOC Molar Trend Analysis

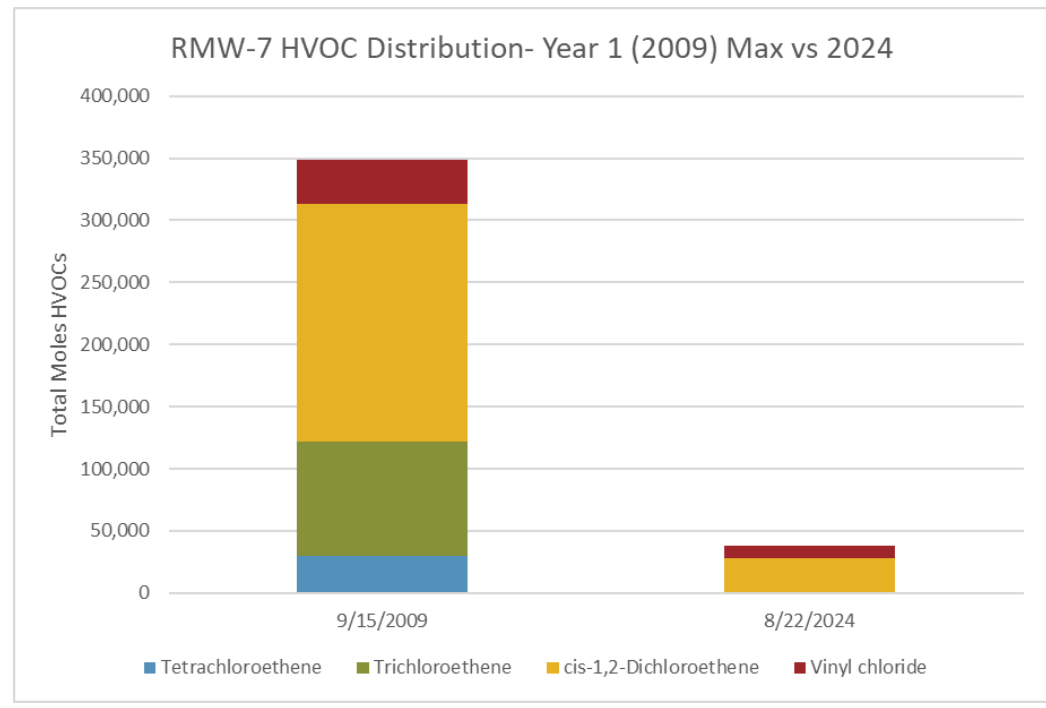
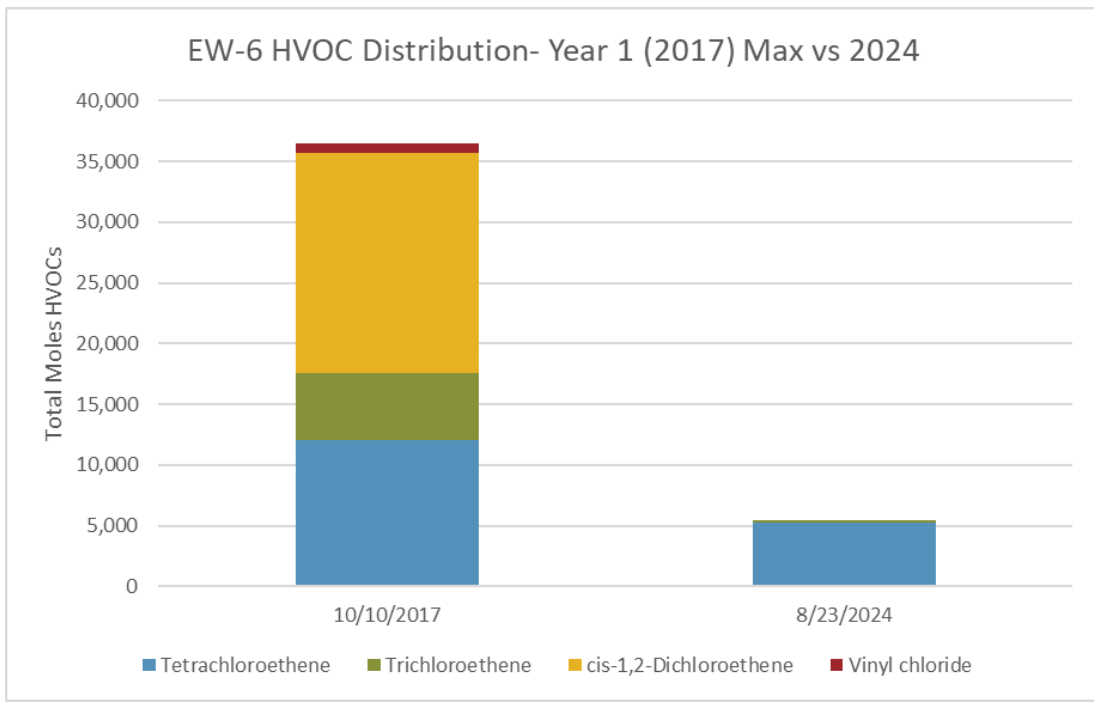
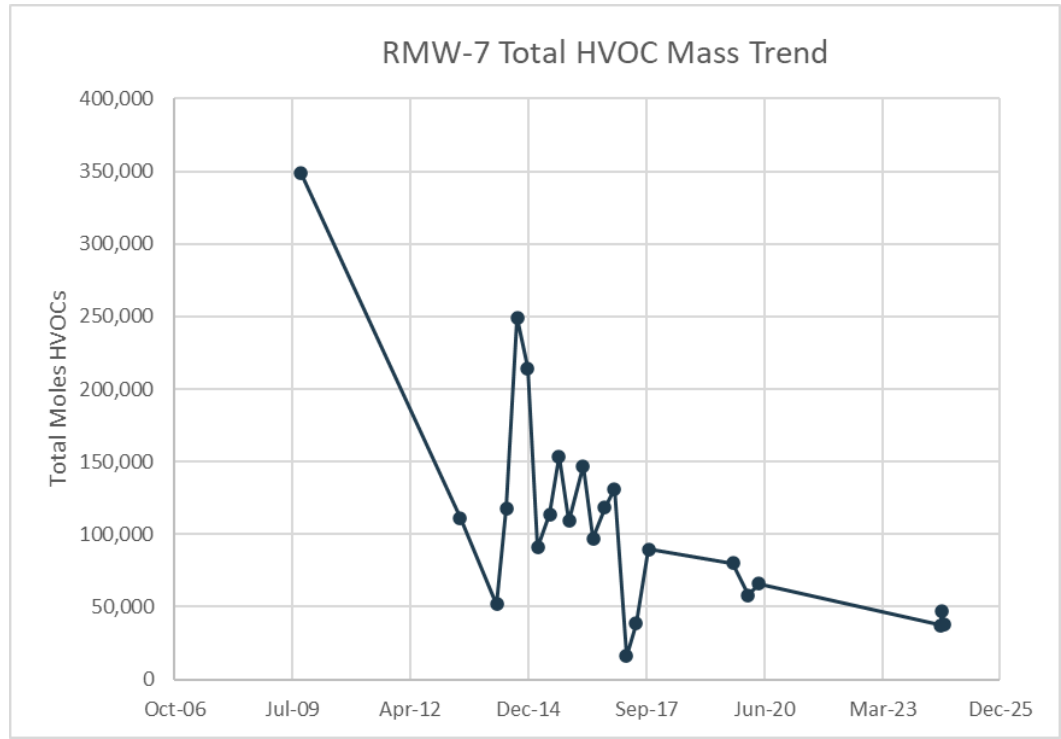
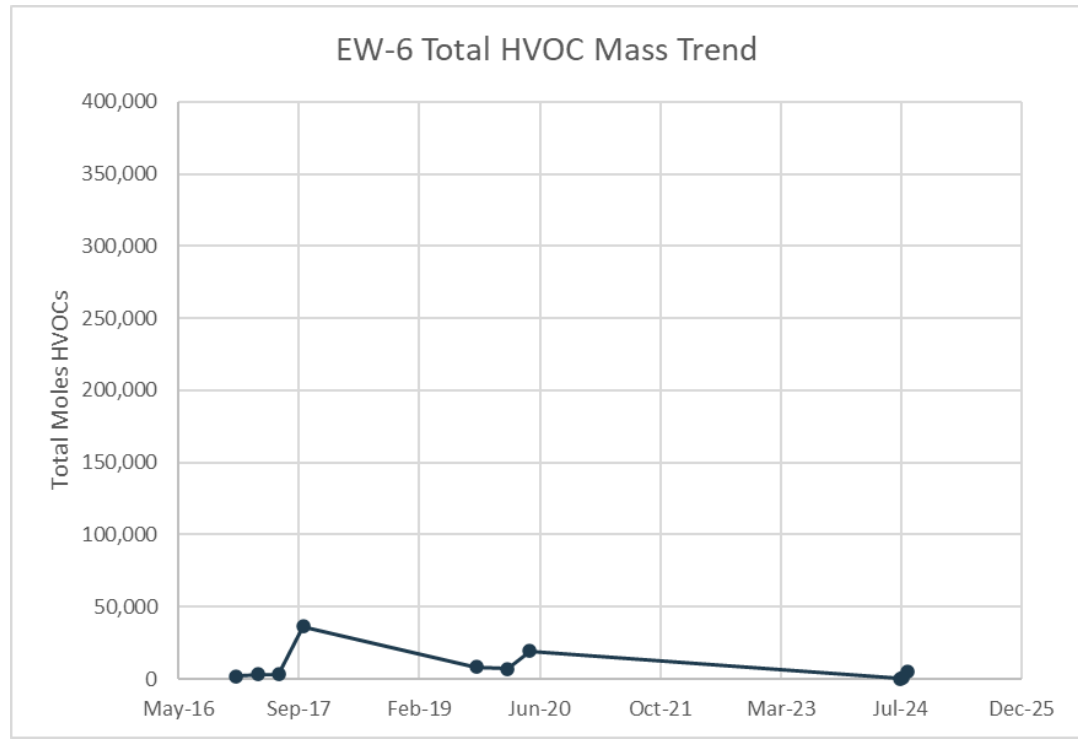












# Engineering Design Report

Riverside HVOC Site

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## Appendix B Remediation Product Basis of Design



# REGENESIS

Technology-Based Solutions for the Environment

PROJECT NAME

## Bothell Riverside

### Preliminary Cost Proposal

### Revision I

PREPARED FOR

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PREPARED BY

REGENESIS

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September 30, 2025

# Project Summary

REGENESIS appreciates the opportunity to provide Floyd Snider our remedial design and cost estimate for the Bothell Riverside project. This proposal has been revised pursuant to information provided by Floyd Snider during September 2025. This proposal includes an overview of our proposed solution, the project goals, technologies proposed, application design summary table and a treatment area map. Costs are presented as a preliminary range in this proposal. If you and your client concur with the proposed approach and preliminary budget, please let us know and we can provide a final budget and proposal.

## Proposed Solution

We propose a source grid treatment along with side gradient and down gradient treatments utilizing combinations of Regenesis products. The proposed product combinations were based upon the contaminant types, concentrations, remedial goals, site specific geochemistry, target longevity while also considering what is the most cost-effective solution as well. Each of the design summaries for each treatment are presented starting on page 2. The proposed treatments are presented in map view on Figure 1 on page 6. Each of the proposed technologies are engineered to be 4 microns or less in size which make them easily injectable with excellent distribution and reactivity in the subsurface. Links at the bottom of the page provide additional information on each of the proposed technologies. Additional information on the function of the proposed technologies is presented in the Technical Approach section on page 7.

Source Grid Treatment - For the source we propose using an ISCR-ERD approach using 3-D Microemulsion, S-MicroZVI and BDI Plus. This approach is consistent with our previous discussions as Floyd Snider indicated they did not want to use activated carbon in the source area. An ISCR-ERD approach is ideal for the source treatment of cVOCs as it will provide fast acting and a long-lasting seven year estimated performance. In addition, there is synergy between these products as they enhance performance dramatically when working together. Although Aquifix has the potential to last longer than 3-D Microemulsion, Aquifix was not selected for the source treatment because the background pH is around 6 or less, which is too low to use with Aquifix which is slightly acidic.

Side Gradient Grid Treatment- For the side gradient treatment we propose using an ISCR-ERD approach using 3-D Microemulsion, S-MicroZVI and BDI Plus. This approach is consistent with our previous discussions as Floyd Snider indicated they wanted a bio approach that could be injected on a wide spacing and allowed to distribute to treat a wider area. Similar to the source treatment approach, the side gradient treatment is estimated to provide 7 years of performance. In addition, Aquifix was not selected for the side gradient treatment because of the background groundwater chemistry.

Down Gradient Barrier - For the down gradient barriers we propose using sorption along with ISCR-ERD. Consistent with our previous discussions, the reactive barrier will provide at least 10 years of plume cleanup longevity. The addition of PlumeStop technology will offer a higher level of performance and longevity using sorption to trap the passing contaminants and creating a greater barrier residence time for the contaminants to be treated by S-MicroZVI, Aquifix and BDI. Unlike the source and side gradient grid treatments where 3-D Microemulsion is preferred, Aquifix is the preferred technology because it has been designed to be compatible with PlumeStop. Furthermore, PlumeStop which is basic, will buffer the Aquifix solution making it the best choice for the PRB design.

## Technical Resources

- [PlumeStop® Case Study: PlumeStop Application Paves The Way For Redevelopment](#)
- [PlumeStop® Case Study: Site Goals Achieved Within 2 Months at Manufacturing Facility](#)
- [Technical Bulletin - Biodegradation of Contaminants From Colloidal Activated Carbon](#)
- [S-MicroZVI® Technical Bulletin: Benefits of Sulfidation](#)

## Technologies Proposed

- [PlumeStop®](#)
- [S-MicroZVI®](#)
- [Aquifix™](#)
- [3-D Microemulsion®](#)
- [Bio-Dechlor INOCULUM® Plus \(BDI Plus\)](#)
- *Click above to access product specification sheets*

## Design Summary

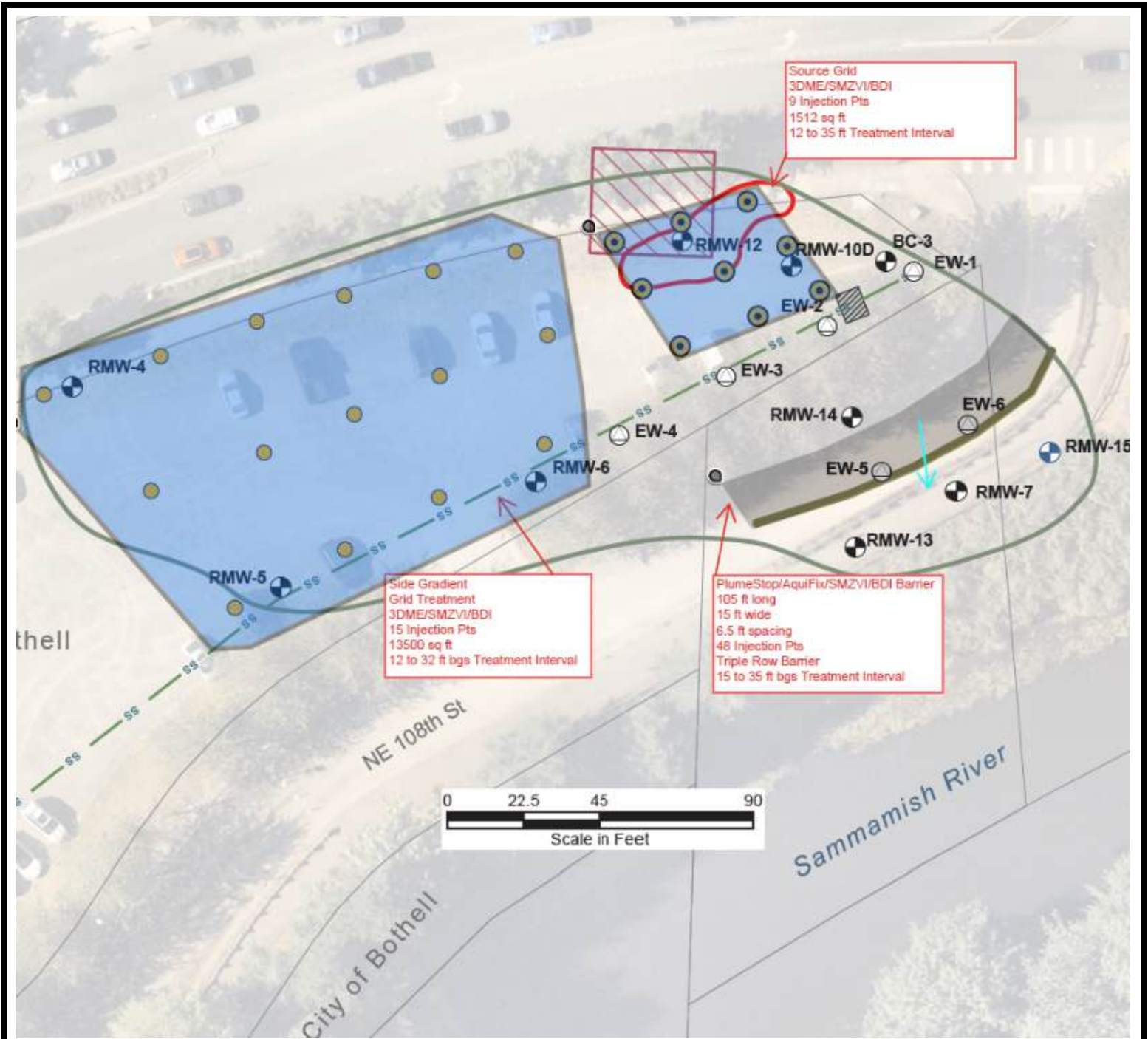
Project Information		
Riverside HVOC Site		
Bothell, WA		
Source Area Treatment		
Prepared For:		
Floyd Snider		
Target Treatment Zone (TTZ) Info	Unit	Value
Areal Extent	sq ft	1,512
Top Treat Depth	ft	12.0
Bot Treat Depth	ft	35.0
Vertical Treatment Interval	ft	23.0
Treatment Zone Volume	ft <sup>3</sup>	34,776
Treatment Zone Volume	cy	1,288
Soil Type	---	sand
Porosity	cm <sup>3</sup> /cm <sup>3</sup>	0.33
Effective Porosity	cm <sup>3</sup> /cm <sup>3</sup>	0.25
Treatment Zone Pore Volume	gals	85,847
Treatment Zone Effective Pore Volume	gals	65,036
Soil Density	g/cm <sup>3</sup>	1.7
Soil Density	lb/ft <sup>3</sup>	108
Soil Weight	lbs	3.8E+06
Soil Weight	kgs	1.7E+06
Hydraulic Conductivity	ft/day	3.0
Hydraulic Conductivity	cm/sec	1.06E-03
Hydraulic Gradient	ft/ft	0.090
GW Velocity	ft/yr	394
Application Design Summary		
<b>Treatment Type</b>		<b>Grid</b>
Treatment Areal Extent (sq ft)		1,512
Spacing Within Rows (ft)		10.0
Spacing Between Rows (ft)		16
<b>DPT Injection Points</b>		<b>9</b>
<b>3DME to be Applied (lbs)</b>		<b>4,000</b>
3DME to be Applied (gals)		479
3DME Mix %		5.2%
<b>Volume Water (gals)</b>		<b>8,703</b>
3DME Mix Volume (gals)		9,183
<b>S-MZVI to be Applied (lbs)</b>		<b>2,000</b>
S-MZVI Volume (gals)		132
<b>BDI Plus to be Applied (L)</b>		<b>25</b>
<b>Total Application Volume (gals)</b>		<b>9,315</b>
Technical Notes		
Gallons per foot		45.0
BDI is to be slip stream injected with 3DME/SMZVI Mixture using compressed nitrogen.		
Application Dosing		
3-D Microemulsion to be Applied	lbs	4,000
S-MZVI to be Applied	lbs	2,000
BDI Plus to be Applied	liters	25

## Design Summary

Project Information		
Riverside HVOC Site		
Bothell, WA		
Side Gradient Treatment		
Prepared For:		
<b>Floyd Snider</b>		
Target Treatment Zone (TTZ) Info	Unit	Value
Areal Extent	sq ft	13,500
Top Treat Depth	ft	12.0
Bot Treat Depth	ft	30.0
Vertical Treatment Interval	ft	18.0
Treatment Zone Volume	ft <sup>3</sup>	243,000
Treatment Zone Volume	cy	9,000
Soil Type	---	sand
Porosity	cm <sup>3</sup> /cm <sup>3</sup>	0.33
Effective Porosity	cm <sup>3</sup> /cm <sup>3</sup>	0.25
Treatment Zone Pore Volume	gals	599,863
Treatment Zone Effective Pore Volume	gals	454,442
Soil Density	g/cm <sup>3</sup>	1.7
Soil Density	lb/ft <sup>3</sup>	108
Soil Weight	lbs	2.6E+07
Soil Weight	kgs	1.2E+07
Hydraulic Conductivity	ft/day	3.0
Hydraulic Conductivity	cm/sec	1.06E-03
Hydraulic Gradient	ft/ft	0.090
GW Velocity	ft/yr	394
Application Design Summary		
<b>Treatment Type</b>		<b>Grid</b>
Treatment Areal Extent (sq ft)		13,500
Spacing Within Rows (ft)		30.0
Spacing Between Rows (ft)		30
<b>DPT Injection Points</b>		<b>15</b>
<b>3DME to be Applied (lbs)</b>		<b>10,000</b>
3DME to be Applied (gals)		1,198
3DME Mix %		4.5%
<b>Volume Water (gals)</b>		<b>25,537</b>
3DME Mix Volume (gals)		26,735
<b>S-MZVI to be Applied (lbs)</b>		<b>4,000</b>
S-MZVI Volume (gals)		265
<b>BDI Plus to be Applied (L)</b>		<b>173</b>
<b>Total Application Volume (gals)</b>		<b>27,000</b>
Technical Notes		
Gallons per foot		100.0
BDI is to be slip stream injected with 3DME/SMZVI Mixture using compressed nitrogen.		
Application Dosing		
<b>3-D Microemulsion to be Applied</b>	<b>lbs</b>	<b>10,000</b>
<b>S-MZVI to be Applied</b>	<b>lbs</b>	<b>4,000</b>
<b>BDI Plus to be Applied</b>	<b>liters</b>	<b>173</b>

## Design Summary

Project Info		
<b>Riverside HVOC Site</b>		
<b>Bothell, WA</b>		
<b>Down Gradient Barrier</b>		
Prepared For:		
<b>Floyd Snider</b>		
Target Treatment Zone (TTZ) Info	Unit	Value
Barrier Length	ft	105
Top Treat Depth	ft	15.0
Bot Treat Depth	ft	35.0
Vertical Treatment Interval	ft	20.0
Treatment Zone Volume	cy	1,167
Soil Type	---	sand
Porosity	cm <sup>3</sup> /cm <sup>3</sup>	0.33
Effective Porosity	cm <sup>3</sup> /cm <sup>3</sup>	0.21
Treatment Zone Pore Volume	gals	77,760
Treatment Zone Effective Pore Volume	gals	49,484
Soil Density	g/cm <sup>3</sup>	1.7
Hydraulic Conductivity	ft/day	3.5
Hydraulic Conductivity	cm/sec	1.24E-03
Hydraulic Gradient	ft/ft	0.090
GW Velocity	ft/yr	550
Application Design Summary		
<b>Treatment Type</b>		<b>Barrier</b>
Distance Perpendicular to Flow (ft)		105
Spacing Within Rows (ft)		6.5
Number of Rows		3
<b>DPT Injection Points</b>		<b>48</b>
<b>PlumeStop to be Applied (lbs)</b>		<b>20,000</b>
PlumeStop to be Applied (gals)		2,220
<b>Volume Water (gals)</b>		<b>29,544</b>
<b>S-MZVI to be Applied (lbs)</b>		<b>6,000</b>
S-MZVI Volume (gals)		397
<b>AquiFix to be Applied (lbs)</b>		<b>12,000</b>
AquiFix Volume (gals)		1,439
<b>BDI Plus to be Applied (L)</b>		<b>19</b>
<b>Total Application Volume (gals)</b>		<b>33,600</b>
Technical Notes		
Gallons per ft		35.0
Gallons per point		700.0
BDI to be slip stream injected with PlumeStop/AquiFix/SMZVI mixture using compressed nitrogen.		
Application Dosing	Unit	Value
PlumeStop to be Applied	lbs	20,000
S-MZVI to be Applied	lbs	6,000
AquiFix to be Applied	lbs	12,000
BDI Plus to be Applied	Liters	19



Bothell Riverside

Floyd Snider

September 30, 2025

Figure 1-Treatment Area Map

# Technical Approach

## Source & Side Gradient Treatment

This approach combines both biological enhanced reductive dechlorination (ERD) and abiotic in situ chemical reduction (ISCR) degradation pathways for rapid reduction of chlorinated solvents while maintaining a healthy aquifer pH for optimal bioremediation rates. The self-distributing features of 3-D Microemulsion® combined with its longevity (several years) allow for sufficient coverage with minimal pore volume displacement thereby minimizing application costs. Our colloidal zero-valent iron (ZVI) product, Sulfidated-MicroZVI (S-MZVI®), will provide a source of iron, creating conditions for abiotic reduction via the formation of iron sulfides, oxides and hydroxides, while also maintaining strongly reducing conditions in the treatment area for an extended timeframe. This will foster rapid abiotic reduction of chlorinated solvents while reducing the potential for daughter product formation compared to a standard in situ bioremediation approach. The release of iron will also provide a mild buffering of the aquifer pH, which will help improve groundwater conditions for bioremediation at the site. Bio-Dechlor INOCULUM® Plus is added to provide a live microbial culture that is known to fully degrade these compounds.

## Down Gradient Barrier Treatment

REGENESIS proposes a comprehensive and innovative approach to treat residual chlorinated solvents in groundwater. Our solution involves the strategic application of cutting-edge technologies, including PlumeStop® Liquid Activated Carbon™ (PlumeStop), Sulfidated-Micro Zero Valent Iron (S-MicroZVI®), AQUIFIX™, and Bio-Dechlor INOCULUM Plus (BDI PLUS®). These solutions, which are fully compatible and can be injected as a single mixture, work synergistically to foster rapid concentration reductions and provide sustainable long-term treatment through sorption, abiotic, and biological degradation pathways while minimizing the potential for daughter product formation.

PlumeStop, the platform technology in this approach, is a colloidal form of activated carbon. PlumeStop is designed to readily disperse the activated carbon particles from the injection point without the use of high pressures and leaves a thin coating of particles on the soil matrix throughout the targeted treatment zone. This process creates a substantial sorption surface, immediately reducing contaminant concentrations in groundwater, thus halting further migration and facilitating efficient and controlled remediation.

To promote rapid contaminant reduction via abiotic degradation pathways, we propose S-MicroZVI. S-MicroZVI is a concentrated suspension of sulfidated, colloidal zero-valent iron, designed for enhanced and long-lasting reactivity. Upon application to the subsurface, it employs an in-situ chemical reduction (ISCR) mechanism, directly destroying chlorinated ethenes (e.g., TCE) through abiotic degradation pathways, minimizing the formation of harmful daughter products, such as vinyl chloride. Furthermore, S-MicroZVI contributes to the enhancement of biological degradation by creating and sustaining a reduced environment conducive to the activity of dechlorinating bacteria.

For enhancing the biotic degradation pathways, we integrate AQUIFIX™, an innovative electron donor compatible and co-injectable with PlumeStop. AQUIFIX is formulated with both fast and slow-releasing electron donor materials, driving the biodegradation of chlorinated solvents present in groundwater for up to 10 years. Its unique design incorporates an easily injected, solid-phase source of fatty acids and beneficial nutrients, which disperses widely within aquifer flux zones and actively supports dechlorinating microbe populations. It swiftly establishes a reducing environment and provides a crucial hydrogen source to dechlorinating bacteria through an initial rapid release of organic carbon.

Subsequently, AquiFix offers slow-release fatty acids, promoting and sustaining the reductive dechlorination of cVOCs. This slow-release feature decreases the frequency of re-application while enhancing its efficiency. Moreover, AquiFix's compatibility with PlumeStop allows for safe co-application with no interference to contaminant sorption by the Liquid Activated Carbon.

Additionally, we recommend incorporating Bio-Dechlor INOCULUM Plus (BDI PLUS®) into the treatment approach. BDI PLUS is an enriched natural consortium containing species of Dehalococcoides sp. (DHC). This culture rapidly and completely dechlorinates chlorinated solvents to non-toxic end products, including ethene, carbon dioxide, and water. Furthermore, it is capable of dehalogenating halomethanes and haloethanes, as well as mixtures of these contaminants.

By leveraging the combined power of PlumeStop, AquiFix, S-MicroZVI, and BDI PLUS, REGENESIS is confident in our ability to achieve exceptional results in the treatment of residual chlorinated solvents. This forward-thinking and sustainable approach ensures both immediate reduction and long-term control of the target compounds while minimizing the generation of harmful by-products. Our innovative technologies offer an effective solution for your remediation needs.

## Performance Monitoring

To measure performance at your site, we recommend sampling at one month, three months and then continued quarterly monitoring following the application. Monitoring wells should be sampled for cVOCs, geochemical parameters, nitrates, sulfate and dissolved gases. Results should be provided to Regenesi promptly so we can assist with data interpretation and barrier performance interpretation.

## Design Verification Testing (DVT)

Design Verification Testing (DVT) describes a suite of field sampling/testing activities carried out before an *in-situ* injection program is implemented. The purpose is to verify that the conditions in the treatment zone match those used in the design. Performing the DVT step provides critical data input to the design team allowing to adjust the necessary elements in the design. Regenesi has reviewed the DVT information collected by Floyd Snider. No additional DVT data collection is needed for the site.

# RRS Statement of Qualifications

RRS provides turn-key remediation planning, design, and application services. RRS field scientists are college degreed professionals that understand the details of each remediation design, the site conceptual site model, the remediation chemistry being applied, the significance of the designed amendment dosing and achieving subsurface distribution, and how a breakdown of any one of these and other factors can result in poor remediation performance. They have the unique background and experience to understand the significance of modifications made in the field.

RRS' direct management of the injection program optimizes the design and ultimately, the overall remedy performance. No one has more professional experience handling and applying *in situ* remediation products than RRS personnel.

RRS has been offering industry-leading application services combined with excellence in field activity management for over a decade. We succeed by meeting the cleanup objectives established by the environmental engineering firms who contract our services. To produce this outcome, we employ field-experienced, disciplined, and dedicated project teams who work with our clients to address the unique requirements of each project site. Astute technical insight and timely, direct, and honest communication are hallmarks of RRS. Our reputation for meeting or exceeding clients' objectives has been proven in project successes throughout North America.

Further information on what sets RRS apart is provided in the following technical resources:

- [RRS: Performance Driven, Results Based](#)
- [The RRS Difference](#)
- [RRS Project Experience](#)

With decades of application experience, RRS is strategically located across the country to mobilize and assist on a wide range of sites throughout the US.

Over 100 Projects Completed Annually Across the US



# RRS Scope of Services

RRS, as part of its role, will operate under the guidance of Floyd Snider to execute the remedial actions in the field, employing the chosen remediation methodologies. The collaboration between RRS and Floyd Snider will entail joint responsibilities in carrying out this scope of work.

Prior to and during the injection, **Placement Validation (PV) testing** will be conducted. PV serves as a standard in-field methodology involving temporary wells and the observation of water samples to assess the dispersion of amendments during the remedial application. RRS will execute PV at the outset of the application and periodically thereafter. In-field adaptations may be implemented during the application if PV testing suggests adjustments are required to ensure the distribution of remedial amendments aligns with the design.

The distribution of responsibilities is elaborated upon in this section as well as under the Assumptions/Qualification segment. At the outset of each day, RRS will convene a safety tailgate meeting to discuss the day's objectives, procedures, assigned roles, and review health and safety concerns.

RRS will be outfitted with various injection tool alternatives compatible with 1.5-inch diameter Direct Push Technology (DPT) rods. The injection tool configuration will be advanced either to the upper or lower extent of the target treatment zone, and injections will be conducted utilizing either a bottom-up or top-down technique based on the subsurface lithology.

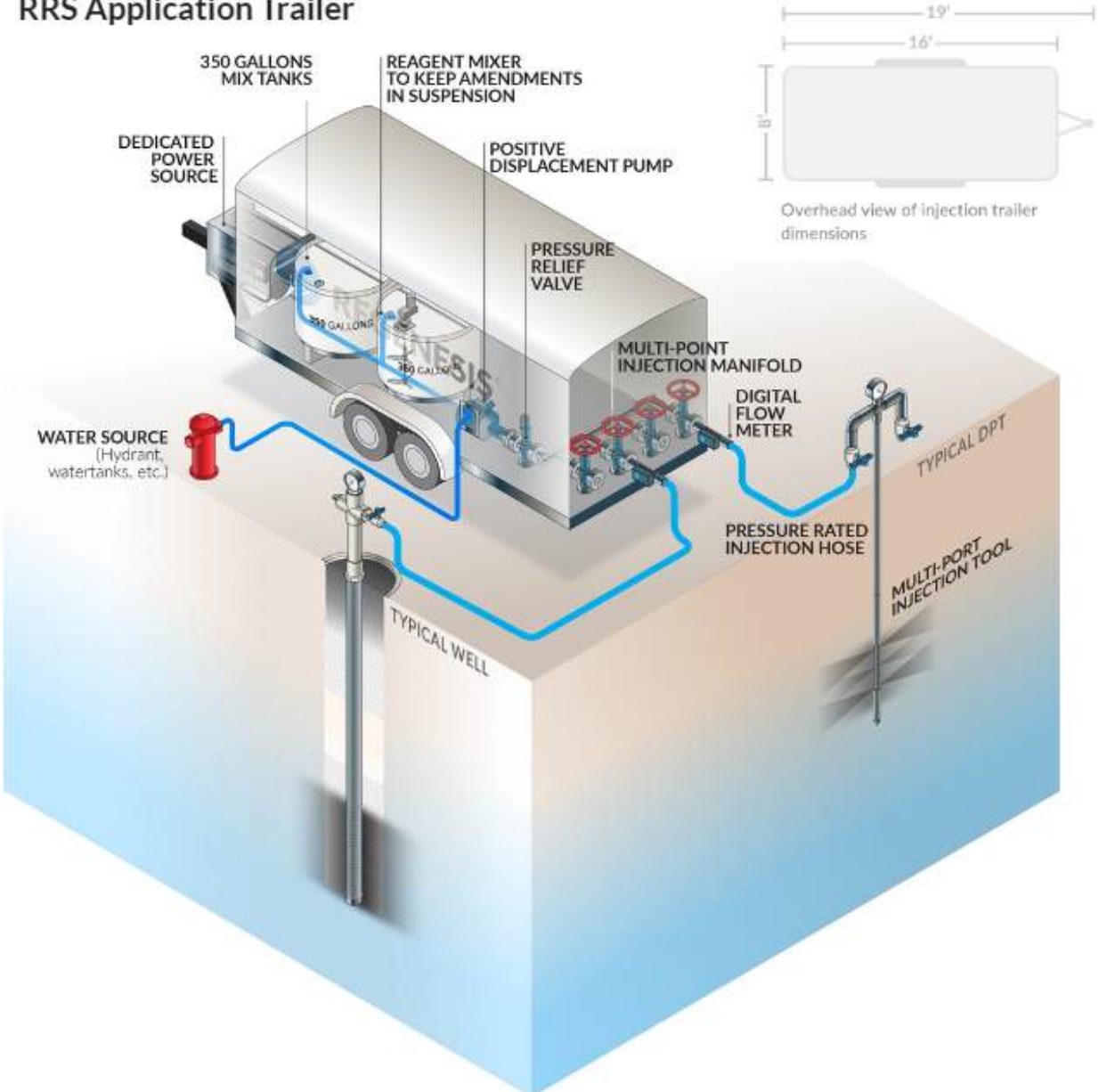
Remediation technologies will be mixed with water utilizing a custom-built injection system (see below), adhering to the specified solution concentration. This mixture will be consistently agitated during the injection process. Parameters such as pressures, flow rates, and overall volume will be closely monitored and digitally recorded for each injection interval. To enhance efficiency on-site, simultaneous injections at multiple locations may be performed. RRS will vigilantly monitor the injection points and their surroundings for any indications of surfacing, and a spill response kit will remain on standby.

Throughout the application, real-time data will be collected and analyzed to corroborate design assumptions and the dispersion of reagents in the subsurface. Depending on the remedial agent applied, the gathered and analyzed data may encompass groundwater quality parameters (e.g., pH, conductivity, Dissolved Oxygen (DO), Oxidation-Reduction Potential (ORP), etc.), measurements of water table depth, visual indicators observed via groundwater or soil samples, and in-field concentration tests of injected substances. This data collection is typically conducted during the application process when operating within 10 feet of appropriately screened monitoring wells.

Guided by the collected information, the project team may introduce adjustments to the remediation design to enhance the injection application's efficacy. These adjustments might involve alterations in injection concentrations and volume per location.

Upon the conclusion of the injection operation, RRS will demobilize all equipment and personnel from the site. A comprehensive injection summary report, encompassing details of injection points (interval depths, injection pressure/flow rates, reagent volume, time elapsed, and surfacing occurrences), on-site observations, and any notable information, will be prepared and submitted to Floyd Snider.

# RRS Application Trailer



# Health and Safety Plan

RRS is committed to providing a safe and healthy working environment for all on-site employees, including Floyd Sniders and contractors on-site. Before mobilization, RRS will develop a site-specific Health and Safety Plan (HASP) and designate an on-site safety officer. All personnel on-site are required to participate in daily safety tailgate meetings to proactively identify potential hazards and mitigate risks to the full extent possible.

In addition to the hours of rigorous safety training courses all personnel are required to complete, RRS also incorporates a behavior-based safety program by utilizing our DoneSafe mobile application (app) interface on every site. This app encourages our personnel to actively search for potential on-site risks and document mitigation actions. The effectiveness of our safety program can be seen in our industry-leading Experience Modification Rating (EMR) listed in table below.

Year	Total Hours	EMR
2023	193,433	0.67
2022	189,458	0.73
2021	125,592	0.71
2020	162,037	0.64

RRS safety tailgate meetings and HASP will include the following:

- Site map .
- List of personnel and contact information for employees on-site and supporting the project.
- Route to the nearest occupational treatment facility and hospital along with contact information.
- Job Hazard Analysis (JHA) detailing each job task on-site with its potential hazards and best practices to avoid those hazards.
- Description and hazards of the contaminants of concern (COC) with appropriate Personal Protection Equipment (PPE) requirements.
- List and description of REGENESIS chemicals on-site including a Safety Data Sheet (SDS) for each chemical.
- Checklist of site safety equipment including fire extinguishers, eyewash station, first aid kit, spill prevention kit and any site-specific equipment needed.
- Daily tailgate safety meeting sheet with identified hazards and risks associated with the site and job tasks for that day, along with shared learning observations from the previous day.



# Pricing

Below is the cost estimate to provide the remediation technologies and execute the design provided in this proposal. Please also see the assumptions and qualifications section. Note that costs are an approximate range at this time. RRS will need to discuss the proposed application in detail with Floyd Snider to be sure that all permitting, fees and resources are included.

Item	Side Gradient Grid - 3DME/SMZVI		Source Grid - 3DME/SMZVI		Down Gradient Barrier - PlumeStop/AquiFix (Triple Row Design)		Totals
PlumeStop					20,000	lbs	20,000
AquiFix					12,000	lbs	12,000
S-MZVI	4,000	lbs	2,000	lbs	6,000	lbs	12,000
BDI	173	liters	25	liters	19	liters	217
3-D Microemulsion	10,000	lbs	4,000	lbs	0	lbs	14,000
Area or Length	13500	sq ft	1512	sq ft	105	ft long	
Target Interval (ft bgs)	12 to 32	ft	12 to 35	ft	15 to 35	ft	
Number of Injection Pts	15	points	9	points	48	points	72
Volume Injected	27,000	gallons	9,315	gallons	33,600	gallons	69,915
Volume Per Ft	100	gallons	45	gallons	35	gallons	
Product Cost	\$ 143,254.00		\$ 52,750.00		\$ 297,622.00		\$ 493,626.00
Tax and Shipping	\$ 21,488.10		\$ 7,912.50		\$ 53,571.96		\$ 82,972.56
Application Cost	\$ 47,621.00		\$ 21,819.00		\$ 59,752.22		\$ 129,192.22
Drilling Costs	\$ 31,339.00		\$ 9,429.00		\$ 51,522.27		\$ 92,290.27
Total Cost without Driller	\$ 212,363.10		\$ 82,481.50		\$ 410,946.18		\$ 705,790.78
Total Cost with Driller	\$ 243,702.10		\$ 91,910.50		\$ 462,468.44		\$ 798,081.04

**Approximately \$700K to \$750K Cost Range (Without Driller)**

**OR, Approximately \$800K to \$850K Cost Range (Turnkey With Driller)**

**Costs do not include water supply, permitting, fork lift or acceptance of the product delivery onsite**

**COST ESTIMATE DISCLAIMER:** The cost listed assumes conditions set forth within the proposed scope of work and assumptions and qualifications. Changes to either could impact the final cost of the project. This may include final shipping arrangements, sales tax, or application-related tasks such as product storage and handling, access to water, etc. If items listed need to be modified, please contact REGENESIS for further evaluation.

**REGENESIS** developed this Scope of Work in reliance upon the data and professional judgments provided by those who completed the earlier environmental site assessment(s), and in reliance upon REGENESIS' prior experience on similar project sites. The fees and charges associated with the Scope of Work were generated through REGENESIS' proprietary formulas and thus may not conform to billing guidelines, constraints, or other limits on fees. REGENESIS does not seek reimbursement directly from any government agency or any governmental reimbursement fund (the "Government"). In any circumstance where REGENESIS may serve as a supplier or subcontractor to an entity that seeks reimbursement from the Government for all or part of the services performed or products provided by REGENESIS, it is the sole responsibility of the entity seeking reimbursement to ensure the Scope of Work and associated charges are in compliance with and acceptable to the Government prior to submission. When serving as a supplier or subcontractor to an entity that seeks reimbursement from Government, REGENESIS does not knowingly present or cause to be presented any claim for payment to the government.

**PROFESSIONAL JUDGEMENT:** In generating this estimate, REGENESIS relied upon professional judgment and site-specific information provided by others. Using this information as input, we performed calculations based upon the known chemical and geologic relationships to generate an estimate of the mass of product and subsurface placement required to affect the remediation of the site.



# Acknowledgement

This scope and associated costs are budgetary and should not be considered final. Listed below are the next steps to secure a final design and cost estimate from REGENESIS.

## Steps to Final Design and Scope of Work

1. Signature notifying REGENESIS to proceed with final design.
2. REGENESIS technical team contacts Floyd Snider to review final scope of work and provide detailed design and cost estimate
3. Provide Detailed Remediation Services Scope of Work, if applicable.
4. Confirm Implementation Schedule
5. Submit Detailed Design and Cost Estimate to Floyd Snider for review and final approval

Signature below confirms signee accepts this preliminary scope of work and would like REGENESIS to proceed with a detailed design and cost estimate.

 SIGNATURE  
Kristin Anderson

Not yet accepted

---

Floyd Snider | Kristin Anderson, Senior Geologist

# Terms & Conditions

1. **PAYMENT TERMS.** Net 30 Days. Accounts outstanding after 30 days will be assessed 1.5% monthly interest. Volume discount pricing will be rescinded on all accounts outstanding over 90 days. An early payment discount of 1.5% Net 10 is available for cash or check payments only. We accept Master Card, Visa and American Express.
2. **RETURN POLICY.** A 15% re-stocking fee will be charged for all returned goods. All requests to return product must be pre-approved by seller. Returned product must be in original condition and no product will be accepted for return after a period of 90 days.
3. **FORCE MAJEURE.** Seller shall not be liable for delays in delivery or services or failure to manufacture or deliver due to causes beyond its reasonable control, including but not limited to acts of God, acts of buyer, acts of military or civil authorities, fires, strikes, flood, epidemic, war, riot, delays in transportation or car shortages, or inability to obtain necessary labor, materials, components or services through seller's usual and regular sources at usual and regular prices. In any such event Seller may, without notice to buyer, at any time and from time to time, postpone the delivery or service dates under this contract or make partial delivery or performance or cancel all or any portion of this and any other contract with buyer without further liability to buyer. Cancellation of any part of this order shall not affect Seller's right to payment for any product delivered or service performed hereunder.
4. **LIMITED WARRANTY.** Seller warrants the product(s) sold and services provided as specified on face of invoice, solely to buyer. Seller makes no other warranty of any kind respecting the product and services, and expressly DISCLAIMS ALL OTHER WARRANTIES OF WHATEVER KIND RESPECTING THE PRODUCT AND SERVICES, INCLUDING ALL WARRANTIES OF MERCHANTABILITY, FITNESS FOR PARTICULAR PURPOSE AND NON-INFRINGEMENT.
5. **DISCLAIMER.** Where warranties to a person other than buyer may not be disclaimed under law, seller extends to such a person the same warranty seller makes to buyer as set forth herein, subject to all disclaimers, exclusions and limitations of warranties, all limitations of liability and all other provisions set forth in the Terms and Conditions herein. Buyer agrees to transmit a copy of the Terms and Conditions set forth herein to any and all persons to whom buyer sells, or otherwise furnishes the products and/or services provided buyer by seller and buyer agrees to indemnify seller for any liability, loss, costs and attorneys' fees which seller may incur by reason, in whole or in part, of failure by buyer to transmit the Terms and Conditions as provided herein.
6. **LIMITATION OF SELLER'S LIABILITY AND LIMITATION OF BUYER'S REMEDY.** Seller's liability on any claim of any kind, including negligence, for any loss or damage arising out of, connected with, or resulting from the manufacture, sale, delivery, resale, repair or use of any goods or performance of any services covered by or furnished hereunder, shall in no case exceed the lesser of (1) the cost of repairing or replacing goods and repeating the services failing to conform to the foregoing warranty or the price of the goods and/or services or part thereof which gives rise to the claim. IN NO EVENT SHALL SELLER BE LIABLE FOR SPECIAL INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING LOST PROFITS, OR FOR DAMAGES IN THE NATURE OF PENALTIES.
7. **INDEMNIFICATION.** Buyer agrees to defend and indemnify seller of and from any and all claims or liabilities asserted against seller in connection with the manufacture, sale, delivery, resale or repair or use of any goods, and performance of any services, covered by or furnished hereunder arising in whole or in part out of or by reason of the failure of buyer, its agents, servants, employees or customers to follow instructions, warnings or recommendations furnished by seller in connection with such goods and services, by reason of the failure of buyer, its agents, servants, employees or customers to comply with all federal, state and local laws applicable to such goods and services, or the use thereof, including the Occupational Safety and Health Act of 1970, or by reason of the negligence or misconduct of buyer, its agents, servants, employees or customers.

8. **EXPENSES OF ENFORCEMENT.** In the event seller undertakes any action to collect amounts due from buyer, or otherwise enforce its rights hereunder, Buyer agrees to pay and reimburse Seller for all such expenses, including, without limitation, all attorneys and collection fees.
9. **TAXES.** Liability for all taxes and import or export duties, imposed by any city, state, federal or other governmental authority, shall be assumed and paid by buyer. Buyer further agrees to defend and indemnify seller against any and all liabilities for such taxes or duties and legal fees or costs incurred by seller in connection therewith.
10. **ASSISTANCE AND ADVICE.** Upon request, seller in its discretion will furnish as an accommodation to buyer such technical advice or assistance as is available in reference to the goods and services. Seller assumes no obligation or liability for the advice or assistance given or results obtained, all such advice or assistance being given and accepted at buyer's risk.
11. **SITE SAFETY.** Buyer shall provide a safe working environment at the site of services and shall comply with all applicable provisions of federal, state, provincial and municipal safety laws, building codes, and safety regulations to prevent accidents or injuries to persons on, about or adjacent to the site.
12. **INDEPENDENT CONTRACTOR.** Seller and Buyer are independent contractors and nothing shall be construed to place them in the relationship of partners, principal and agent, employer/employee or joint ventures. Neither party will have the power or right to bind or obligate the other party except as may be expressly agreed and delegated by other party, nor will it hold itself out as having such authority.
13. **REIMBURSEMENT.** Seller shall provide the products and services in reliance upon the data and professional judgments provided by or on behalf of buyer. The fees and charges associated with the products and services thus may not conform to billing guidelines, constraints or other limits on fees. Seller does not seek reimbursement directly from any government agency or any governmental reimbursement fund (the "Government"). In any circumstance where seller may serve as a supplier or subcontractor to an entity that seeks reimbursement from the Government for all or part of the services performed or products provided by seller, it is the sole responsibility of the buyer or other entity seeking reimbursement to ensure the products and services and associated charges are in compliance with and acceptable to the Government prior to submission. When serving as a supplier or subcontractor to an entity that seeks reimbursement from the Government, seller does not knowingly present or cause to be presented any claim for payment to the Government.
14. **APPLICABLE LAW/JURISDICTION AND VENUE.** The rights and duties of the parties shall be governed by, construed, and enforced in accordance with the laws of the State of California (excluding its conflict of laws rules which would refer to and apply the substantive laws of another jurisdiction). Any suit or proceeding hereunder shall be brought exclusively in state or federal courts located in Orange County, California. Each party consents to the personal jurisdiction of said state and federal courts and waives any objection that such courts are an inconvenient forum.
15. **ENTIRE AGREEMENT.** This agreement constitutes the entire contract between buyer and seller relating to the goods or services identified herein. No modifications hereof shall be binding upon the seller unless in writing and signed by seller's duly authorized representative, and no modification shall be effected by seller's acknowledgment or acceptance of buyer's purchase order forms containing different provisions. Trade usage shall neither be applicable nor relevant to this agreement, nor be used in any manner whatsoever to explain, qualify or supplement any of the provisions hereof. No waiver by either party of default shall be deemed a waiver of any subsequent default.

# Engineering Design Report

Riverside HVOC Site

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## Appendix C Well Logs

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-03**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
W of Former Machine Shop

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
10

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/3/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
0		Brown, well graded <b>SAND</b> with silt.			
2				0.4	
4				0.3	
6		Gravel present.		0.2	
8	SW-SM			0.9	
10				0.9	
12				0.4	
14	GW-GM	Brown, well graded <b>GRAVEL</b> with silt and trace fines, saturated.			

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-03**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
W of Former Machine Shop

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
10

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/3/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
16	ML	Black, medium plasticity <b>SILT</b> , with organic woody material from 15 to 16 ft., saturated, no odor.		0.5	
18	SP-SM	Brown, poorly garded <b>SAND</b> with silt and gravel, saturated. Iron oxide present.		0.5	SB-03-16-19
20		Brown, well graded <b>SAND</b> with silt, saturated, iron oxide present, no odor.		0.2	SB-03-19-22
22		Transitions to gray.		0.3	SB-03-22-25
24	SW-SM			0.5	
26				0.2	SB-03-25-28
28				0.2	
30		Bottom of Boring = 30 ft bgs		0.2	

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-04**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
SW of Former Machine Shop

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
8

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/4/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
0		Brown, well graded <b>SAND</b> with silt and trace gravel, no odor.			
2				0.2	
4		Becomes moist.		0.3	
	SW-SM				
6				0.4	
8				0.5	
		Organic woody debris (about 4") present.		0.2	
10	SP	Gray, poorly graded medium <b>SAND</b> , trace fines, wet, no odor.			
		Brown <b>silty SAND</b> no odor, wet.		0.4	
12		Trace gravel present.		0.4	
	SM				
14		Organic woody debris present.		0.5	
					SB-04-13-16

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-04**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
SW of Former Machine Shop

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
8

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/4/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
16	GW-GM	Dark brown well graded sub angular <b>GRAVEL</b> , with silt and medium to coarse sand, wet, no odor.	[Drive/Recovery Data]	0.3	SB-04-16-19
		Pocket of silty sand present.		0.3	
18		Iron oxide present.		0.3	
20	SW-SM	Dark brown well graded <b>SAND</b> with silt, medium to dense, wet, no odor.	[Drive/Recovery Data]	0.4	SB-04-19-22
22		Trace cobbles present.		0.3	
24		Transitions to light brown with high dilatancy.		0.3	
26				0.3	
28				0.2	
30		Bottom of Boring = 30 ft bgs		0.3	SB-04-25-28

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-05**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
E of Former Machine Shop

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
13

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/3/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
0		Brown, well graded medium to coarse <b>SAND</b> with silt, organics at surface, wet, no odor,			
				0.5	
2					
				0.4	
4					
				0.4	
6		Trace gravel at 6.25 ft.			
	SW-SM				
8					
		Cobbles present.			
		Red brick present.			
10					
				0.3	
12					
				0.3	
14		Iron oxide present.			
				0.5	
					SB-05-13-16

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-05**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
E of Former Machine Shop

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
13

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/3/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
16	SW-SM	Brown/orange well graded <b>SAND</b> with silt, trace gravel 0.1 to 0.3", wet, no odor, dilatancy		0.4	SB-05-16-19
18		Light brown, poorly graded <b>SAND</b> with silt, wet, dilatancy.		0.4	
20				0.4	SB-05-19-22
22	SP-SM	Pockets of coarse <b>SAND</b> present.		0.6	
24				0.3	SB-05-22-25
26		Brown <b>silty SAND</b> , wet, iron-oxidized layers present, dilatancy		0.5	SB-05-25-28
28	SM			0.5	
30		Bottom of Boring = 30 ft bgs		0.5	

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-06**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
Former Machine Shop

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
40

**DEPTH TO WATER (ft bgs):**  
10

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/3/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
0		Brown well graded <b>SAND</b> with silt and gravel, sand medium to coarse, gravel sub-angular 0.5" to 1", dry, no odor. grass and at surface.			
2				0.3	
4		Becomes moist.			
	SW-SM				
6				0.3	
8					
10		Gray, poorly graded sub-angular <b>GRAVEL</b> ~ 0.5 to 1.25", wet, no odor.		0.5	SB-06-8.5-10.5
	CGP				
12		Brown-black, <b>SILTY SAND</b> , trace gravel, orange iron-oxide patches, wet, no odor.		0.4	
	SM				
14		Brown, well graded medium to coarse <b>SAND</b> with silt, trace fine gravel, wet, no odor.			SB-06-13-14.5
	SW-SM				

**ABBREVIATIONS:**

ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

PROJECT:  
COB-Riverside

SITE ADDRESS:  
Bothell, WA 98011

BORING ID:  
**SB-06**

LOGGED BY:  
Ryne Adams

BORING LOCATION:  
Former Machine Shop

DRILLED BY:  
Holocene

NORTHING:

EASTING:

DRILLING EQUIPMENT:  
Geoprobe LAR

GROUND SURFACE  
ELEVATION:

COORDINATE SYSTEM:

DRILLING METHOD:  
Direct push

TOTAL DEPTH (ft bgs):  
40

DEPTH TO WATER (ft bgs):  
10

SAMPLING METHOD/SAMPLER LENGTH:  
5' x 2" disposable poly liner

BORING DIAMETER:  
2"

DRILL DATE:  
9/3/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
16	SP-SM	Brown, poorly graded fine <b>SAND</b> with silt, iron-oxide streaks, wet, no odor.		0.5	
18				0.5	SB-06-16-18
20	SW-SM	Brown/orange well graded fine to coarse <b>SAND</b> with silt, iron oxide present, wet, no odor.		0.5	SB-06-18-20
22		Brown silty <b>SAND</b> , fine <b>SAND</b> , iron oxide present, loose, wet, high dilatancy, no odor		0.3	SB-06-20-22
24	SM	Becomes gray with lower dilatancy, medium stiff.		0.3	SB-06-22-24
26		Brown and light brown, <b>silty SAND</b> , medium stiff, wet, high dilatancy, no odor.		0.3	SB-06-24-26
28				0.3	SB-06-26-28
30				0.3	SB-06-28-30

ABBREVIATIONS:  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

NOTES:

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-06**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
Former Machine Shop

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
40

**DEPTH TO WATER (ft bgs):**  
10

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/3/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
30	SP-SM	Brown, poorly graded fine to medium <b>SAND</b> with silt, medium dense iron oxide present, wet, high dilatancy, no odor..		0.2	SB-06-30-32
		Grain size begins to coarsen.		0.3	SB-06-32-34
		Iron oxide pocket present.		0.5	SB-06-34-36
		Iron oxide pocket present.		0.4	SB-06-36-38
		Bottom of Boring = 40 ft bgs		0.2	SB-06-38-40

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-07**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
Upgradient Extraction Well Row

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
12

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/6/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
0		Brown, silty <b>SAND</b> , loose, dry, no odor,			
2				0.2	
4				0.3	
5	SW-SM				
6					
8					
10		Brown, well graded fine to coarse <b>SAND</b> with trace silt. Cobble present.			
11	SW			0.3	
12		Brown <b>silty SAND</b> , medium dense, trace gravel ~0.5", wet, no odor.			
13				0.6	
14	SM			0.3	

**ABBREVIATIONS:**

ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-07**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
Upgradient Extraction Well Row

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
12

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/6/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
16		Dark brown well graded fine to coarse <b>SAND</b> with silt and trace gravel ~0.2 to 0.3", wet, no odor.		0.3	
18	SW-SM			0.3	SB-07-16-19
20		Gray, poorly graded fine <b>SAND</b> with silt, medium dense, wet, dilatancy.		0.3	SB-07-19-22
22				0.2	
24		Becomes brown.		0.2	SB-07-22-25
26	SP-SM			0.2	SB-07-25-28
28				0.2	
30		Bottom of Boring = 30 ft bgs		0.1	

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-08**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
S of Former Machine Shop

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
10.5

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/3/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
0		Light brown, fine <b>silty SAND</b> , trace sub-angular gravel ~0.25-0.5", very loose, dry, no odor.			
2	SM			0.1	
4		Trace organics present.		0.3	
6	SP-SM	Brown, poorly graded <b>SAND</b> with silt, no odor, moist.			
8					
10	SP	Brown, poorly graded <b>SAND</b> with trace siltmoist, no odor.,		0.1	
10		Dark brown, fine <b>silty SAND</b> with trace gravel ~0.5-1.5" and trace organics medium stiff.		0.1	
12	SM	Cement fiber board present.			
		Becomes black, peat present.		0.2	
14		Becomes stiff.			

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-08**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
S of Former Machine Shop

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
10.5

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/3/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
16		Brown, medium to coarse well graded <b>SAND</b> with silt and trace gravel 0.2-0.5", wet, no odor, iron oxide present.		0.1	SB-08-15-16.5
				0.2	
	SW-SM			0.3	
20	SP	Light brown, poorly graded fine <b>SAND</b> with trace silt, wet, no odor.		0.3	SB-08-19-22
22		Brown, poorly graded fine <b>SAND</b> with silt, wet, no odor, iron oxide streaks. Interspersed silt pockets present.		0.3	SB-08-22-25
				0.3	
				0.3	
26	SP-SM	Grain size coarsens and increased silt present, high dilatancy.		0.2	SB-08-25-28
				0.2	
				0.2	
30		Bottom of Boring = 30 ft bgs			

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-09**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
Upgradient Extraction Well Row

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
16

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/6/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
0		Brown, well graded <b>SAND</b> with silt, loose, dry, no odor.			
2				0.1	
4				0.1	
6				0.2	
8	SW-SM				
10		Cobble present.		0.1	
12				0.1	
14		Becomes moist and very loose.			

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

<b>PROJECT:</b> COB-Riverside	<b>SITE ADDRESS:</b> Bothell, WA 98011	<b>BORING ID:</b> <b>SB-09</b>
<b>LOGGED BY:</b> Ryne Adams	<b>BORING LOCATION:</b> Upgradient Extraction Well Row	
<b>DRILLED BY:</b> Holocene	<b>NORTHING:</b>	<b>EASTING:</b>
<b>DRILLING EQUIPMENT:</b> Geoprobe LAR	<b>GROUND SURFACE ELEVATION:</b>	<b>COORDINATE SYSTEM:</b>
<b>DRILLING METHOD:</b> Direct push	<b>TOTAL DEPTH (ft bgs):</b> 30	<b>DEPTH TO WATER (ft bgs):</b> 16
<b>SAMPLING METHOD/SAMPLER LENGTH:</b> 5' x 2" disposable poly liner	<b>BORING DIAMETER:</b> 2"	<b>DRILL DATE:</b> 9/6/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
16		Dark brown, fine <b>silty SAND</b> with peat, medium dense.		0.4	
18	SM			0.4	SB-09-16-19
		1" lense of gray poorly graded fine sand.		0.4	
20	SW	Brown, well graded fine to coarse <b>SAND</b> , wet, no odor.		0.2	SB-09-19-22
22	SM	Brown, fine <b>SILTY SAND</b> ], loose, wet, no odor.		0.3	SB-09-22-25
26		Brown, poorly graded fine <b>SAND</b> with silt, medium dense wet, high dilatancy no odor. ,		0.3	SB-09-25-28
28	SP-SM			0.3	
30		Bottom of Boring = 30 ft bgs		0.3	

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-10**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
Upgradient Extraction Well Row

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
30

**DEPTH TO WATER (ft bgs):**  
14.5

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/6/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
0		Brown, well graded medium to coarse <b>SAND</b> with silt, very loose, dry, no odor, , trace iron oxide			
2					
4					
6					
8	SW-SM				
10					
12					
14		Cobble present.			

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                ▼ = denotes groundwater table

**NOTES:**

<b>PROJECT:</b> COB-Riverside	<b>SITE ADDRESS:</b> Bothell, WA 98011	<b>BORING ID:</b> <b>SB-10</b>
<b>LOGGED BY:</b> Ryne Adams	<b>BORING LOCATION:</b> Upgradient Extraction Well Row	
<b>DRILLED BY:</b> Holocene	<b>NORTHING:</b>	<b>EASTING:</b>
<b>DRILLING EQUIPMENT:</b> Geoprobe LAR	<b>GROUND SURFACE ELEVATION:</b>	<b>COORDINATE SYSTEM:</b>
<b>DRILLING METHOD:</b> Direct push	<b>TOTAL DEPTH (ft bgs):</b> 30	<b>DEPTH TO WATER (ft bgs):</b> 14.5
<b>SAMPLING METHOD/SAMPLER LENGTH:</b> 5' x 2" disposable poly liner	<b>BORING DIAMETER:</b> 2"	<b>DRILL DATE:</b> 9/6/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
16	SM	Dark brown, <b>silty SAND</b> with organic matter, loose, saturated, no odor.			
18		Brown-gray, poorly graded fine <b>SAND</b> with silt, fine sand, wet, no odor, loose, iron oxide pockets at 19 ft			SB-10-16-19
20		Iron oxide pockets present			
20		Becomes light brown with high dilatancy.			SB-10-19-22
22					
24	SP-SM				SB-10-22-25
26					
26					SB-10-25-28
28					
30		Bottom of Boring = 30 ft bgs			

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

**PROJECT:**  
COB-Riverside

**SITE ADDRESS:**  
Bothell, WA 98011

**BORING ID:**  
**SB-11**

**LOGGED BY:**  
Ryne Adams

**BORING LOCATION:**  
Downgradient Extraction Well Row

**DRILLED BY:**  
Holocene

**NORTHING:**

**EASTING:**

**DRILLING EQUIPMENT:**  
Geoprobe LAR

**GROUND SURFACE ELEVATION:**

**COORDINATE SYSTEM:**

**DRILLING METHOD:**  
Direct push

**TOTAL DEPTH (ft bgs):**  
25

**DEPTH TO WATER (ft bgs):**  
8.5

**SAMPLING METHOD/SAMPLER LENGTH:**  
5' x 2" disposable poly liner

**BORING DIAMETER:**  
2"

**DRILL DATE:**  
9/4/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
0		Brown, well graded medium to coarse <b>SAND</b> with silt and fine gravel 0.2-0.5", loose, moist, no odor. Asphalt present at surface.		0.2	
2				0.2	
4				0.3	
5	SW-SM				
6				0.3	
8				0.3	
9		Black, well graded fine to medium <b>SAND</b> with silt and gravel 0.2-0.3", loose to medium dense, wet, no odor.		0.4	
10				0.3	
12		Gray, well graded <b>SAND</b> with silt, loose, wet, no odor.		0.3	
14	SW-SM			0.3	

**ABBREVIATIONS:**  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                    ▼ = denotes groundwater table

**NOTES:**

PROJECT:  
COB-Riverside

SITE ADDRESS:  
Bothell, WA 98011

BORING ID:  
**SB-11**

LOGGED BY:  
Ryne Adams

BORING LOCATION:  
Downgradient Extraction Well Row

DRILLED BY:  
Holocene

NORTHING:

EASTING:

DRILLING EQUIPMENT:  
Geoprobe LAR

GROUND SURFACE  
ELEVATION:

COORDINATE SYSTEM:

DRILLING METHOD:  
Direct push

TOTAL DEPTH (ft bgs):  
25

DEPTH TO WATER (ft bgs):  
8.5

SAMPLING METHOD/SAMPLER LENGTH:  
5' x 2" disposable poly liner

BORING DIAMETER:  
2"

DRILL DATE:  
9/4/2024

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, <b>MAJOR CONSTITUENT</b> , odor, staining, sheen, debris, etc.)	Drive/Recovery	PID (ppm)	Sample ID
16	SW-SM	Gray, well graded, fine to medium <b>SAND</b> with silt, saturated.		0.2	
18	SM	Brown, fine <b>silty SAND</b> , dense, wet, no odor		0.3	
20	SP	Gray, poorly graded <b>SAND</b> , trace fines, dense, wet, no odor		0.3	
22	CGP	Brown, poorly graded fine <b>GRAVEL</b> , no odor.		0.3	
24	SP-SM	Brown, poorly graded fine <b>SAND</b> with silt, medium dense, wet, high dilatency, , no odor.		0.2	SB-11-21-23
		Bottom of Boring = 25 ft bgs		0.2	
26					
28					
30					

ABBREVIATIONS:  
ft bgs = feet below ground surface    USCS = Unified Soil Classification System  
ppm = parts per million                ▼ = denotes groundwater table

NOTES:

# **Engineering Design Report**

Riverside HVOC Site

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## **Appendix D Spill Prevention and Emergency Countermeasure Plan**

**Riverside HVOC Site**

**Spill Prevention and Emergency  
Countermeasure Plan**

**Prepared for**

City of Bothell

18415 101st Avenue NE

Bothell, Washington 98011

**Prepared by**

**FLOYD | SNIDER**

601 Union Street

Suite 600

Seattle, Washington 98101

**November 2025**

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**List of Attachments**

Attachment D.1      Weekly Visual Inspection Checklist

Attachment D.2      Spill Response Procedures

Attachment D.3      Spill Notification Form

**List of Abbreviations**

<b>Abbreviation</b>	<b>Definition</b>
BMP	Best management practice
CFR	Code of Federal Regulations
EDR	Engineering Design Report
HAZWOPER	Hazardous Waste Operations and Emergency Response
HVOC	Halogenated Volatile Organic Compound
SPECP	Spill Prevention and Emergency Countermeasure Plan
Site	Riverside HVOC Site
S-mZVI	Sulfidated microscale zero-valent iron

**Contact Information**

**Responsible Personnel**

Contact Name	Work Phone	Cell Phone
Kristin Anderson, Project Manager	(206) 292-2078	(206) 552-4241
Emily Jones, Project Engineer	(206) 292-2078	(206) 719-6993
Lynn Grochala, Principal-in-Charge	(206) 292-2078	(603) 491-3952
Scott Adamek, City of Bothell Site Environmental Coordinator	(425) 806-6824	(425) 409-4278
Prime Contractor Field Superintendent	TBD	TBD
Danielle Gallaher, Field Lead	(206) 292-2078	(619) 302-6688

**Spill Reporting**

<b>Spills into waters of the State (including ponds, ditches, seasonally dry streams, and wetlands)</b>
Immediately call all of the following:
<b>The National Response Center: 1 (800) 424-8802</b>
<b>Washington State Department of Ecology (Ecology) Northwest Regional Office: 1 (206) 594-000</b>
<b>Spill to Soil (including encounters of pre-existing contamination)</b>
Report immediately if threatening to health or environment (i.e., explosive, flammable, toxic vapors, shallow groundwater, nearby creek), otherwise within 90 days
<b>Ecology Northwest Regional Office: 1 (206) 594-000</b>
Notify public works department if spill enters sanitary sewer; call the spill hotline if spills enter the stormwater system, streets, ditches, streams, and/or wetlands
<b>City of Bothell Public Works Spill Reporting: 1 (425) 806-6750</b>
<b>Underground Storage Tank</b>
Report within 24 hours if confirmed release of material
<b>Ecology Northwest Regional Office: 1 (206) 594-000</b> <b>Sunny Becker, Ecology Site Manager: 1 (425) 457-3842</b>
<b>Washington Emergency Management Division: 1 (800) 258-5990 or 1 (800) OILS-911</b>

## 1.0 Introduction

### 1.1 PURPOSE

This Spill Prevention and Emergency Countermeasure Plan (SPECP) has been prepared as an appendix to the Engineering Design Report (EDR) for the cleanup action selected by the Washington State Department of Ecology for the Riverside Halogenated Volatile Organic Compound (HVOC) Site (Site) located in between the Sammamish River and the downtown corridor of Bothell, Washington, as detailed in the Final Cleanup Action Plan for the Site. The purpose of the SPECP is to prevent spills from occurring during the cleanup action, and to perform safe, efficient, and timely response in the event of a spill or leak (both referred to as “spills” herein). Although the scope of the cleanup action does not meet the definition of a “facility” under 40 Code of Federal Regulations (CFR) 112.2 because there is no aboveground oil storage capacity of more than 1,320 U.S. gallons, the SPECP is prepared to be consistent with the substantive requirements of 40 CFR 112 but does not need certification.

This SPECP presents the minimum requirements for spill prevention, control, and countermeasures to be fulfilled by the selected contractor during the cleanup action. It may be amended or superseded entirely by a SPECP prepared by the contractor, so long as the contractor’s plan contains the basic elements included in this plan, or their equivalents.

The SPECP should be a working document to be used during the cleanup action and a copy of the plan, including any necessary updates as work progresses, should be maintained at the Site. The plan should be used frequently in the following ways:

- As a reference for oil storage and containment system information
- As a reference for contractors performing work at the Site
- As a guide for site inspections
- As a resource during an emergency response

Additionally, in the event that the project is extended beyond the estimated schedule, the SPECP must be reviewed at least once every month.

### 1.2 FACILITY DESCRIPTION

<b>Facility Name</b>	Riverside HVOC Site
<b>Facility Location</b>	NE 180 <sup>th</sup> Street and Woodinville Drive, Bothell, Washington, 98011
<b>Facility Type</b>	Environmental Cleanup Site (currently vacant)
<b>Date of Initial Operation</b>	June 2026 (anticipated)
<b>Designated Site Environmental Coordinator</b>	Scott Adamek, City of Bothell

### **1.2.1 General Facility Layout**

Site boundaries and cleanup areas are shown on Figure 1.1 and 2.1 of the EDR. Site features including utilities and access routes are shown on Figure 4.1 of the EDR.

### **1.2.2 Stormwater**

The scope of work of primary concern for stormwater erosion and sediment control is from fueling and use of drilling equipment during direct-push injection and well installation. Minor ground disturbances may also occur when decommissioning the existing groundwater extraction remediation system. The total potential disturbed area of ground surface on the source property is less than 1 acre; therefore, a Construction Stormwater General Permit is not required for construction. Best management practices (BMPs) are consistent with the permit requirements to protect stormwater quality, as described in the stormwater controls presented in Section 4.3.3 of the EDR. The total disturbed area when installing a direct-push injection point is approximately 2 inches in diameter and therefore of minimal concern for stormwater run-on and run-off during injection activities.

## 2.0 Potential Spill Sources and Spill Prevention Control and Countermeasure Features

The purpose of this SPEC is to present BMPs and response procedures for releases of chemicals used during implementation of the cleanup action. These substances primarily include fuels and hydraulic oils used in construction and drilling equipment. The chemical components of the in situ treatment barriers, consisting of liquid activated carbon, sulfidated microscale zero-valent iron (S-mZVI), organic carbon (including Aquifix and 3D Microemulsion), and *Dehalococcoides* bacterial cultures, are not considered hazardous to human health or the environment but may create nuisance conditions or cause public concern if spills or accidental discharges occur.

### 2.2 DISCHARGE PREVENTION

The potential use of petroleum products during the project will be gasoline or diesel fuel used to power machinery and hydraulic oil used in drilling and hauling equipment. While the procedures for equipment fueling will be specific to the selected contractor, it is anticipated that mobile fueling of equipment will occur. The total oil to be stored on-site is anticipated to be minimal.

Mixing of other reagents, including liquid activated carbon, S-mZVI, organic carbon, and bacterial cultures, will be conducted within an enclosed trailer. Discharges may be possible during injection if preferential pathways (such as utility corridors) in a given area allow injected materials to travel to the ground surface (also known as daylighting).

#### 2.2.1 Spill Prevention Control and Countermeasure Features and Operating Procedures

Employees will be trained to implement spill prevention practices. Personnel will use common sense and rely on spill prevention practices to minimize the potential for a release. Fueling and oil storage procedures will be determined by the contractor.

#### 2.2.2 Tests and Inspections

The contractor is responsible for performing maintenance of the equipment and equipment fueling systems to keep it performing in an efficient and environmentally sound manner. The equipment will be observed to ensure that no leaks are occurring.

Observation results will be recorded on a Weekly Visual Inspection Checklist; an example checklist is included in Attachment D.1. Spill response kits will be kept near all areas where equipment is being used, fueled, or stored, and will be restocked as necessary. Inspections include observations of the exterior of the equipment for signs of deterioration or spills (leaks), and inventory of spill response kit materials.

#### 2.2.3 Training

Personnel will be trained in Hazardous Waste Operations and Emergency Response (HAZWOPER) and will be knowledgeable in the operation and maintenance of oil pollution prevention

equipment and pollution control laws and regulations. The contractor will also be knowledgeable in the operation and maintenance of oil pollution spill/prevention equipment.

#### **2.2.4 Site Security**

The work area will be secured with a chain link fence, or by temporary barriers. Equipment will be stored securely and locked when workers are off-site.

### **2.3 SPILL RESPONSE PROCEDURES**

It is essential to prevent spills from spreading. Releases of petroleum products or toxic chemicals during the proposed cleanup will warrant immediate response and cleanup. It is expected that most spills will be minor spills of fuel or hydraulic oil that will occur primarily within unpaved zones, except for PlumeStop barrier being within the right of way, which will prevent them from contaminating the underlying ground surface.

Spill response and notification procedures for spills, leaks, or uncontrolled releases of hazardous materials during proposed construction are provided in Attachment D.2. Floyd|Snider personnel responsible for the handling, storage, and disposal of oil or chemicals are trained in these methods and procedures. A copy of the spill response and notification procedures is kept with each spill response kit.

Because the level of petroleum spill notification is dependent on the volume of the material released, spills are defined below.

For this project:

- All spills greater than approximately 1 gallon to land shall be reported.
- Spills of any quantity to water shall be reported.

The Project Manager, Field Lead, or designate is responsible for completing the Spill Notification Form (refer to Attachment D.3 for an example spill notification form) and notifying the relevant external agencies (refer to Contact Information on page D-ii of this appendix). Completed spill notification forms will be kept by the Site Environmental Coordinator.

If spills meet any of the following conditions, the U.S. Environmental Protection Agency Regional Administrator will be notified:

- Discharge from a single oil spill event exceeding 1,000 gallons.
- Discharge from two spill events within a 12-month period greater than 42 gallons.

If daylighting of the liquid activated carbon (PlumeStop) and S-mZVI mixture occurs during injection, procedures will be implemented to contain and absorb the material in accordance with this plan to prevent nuisance conditions. Reporting is not required for occurrences of daylighting.

## 2.4 SPILL RESPONSE KITS

Spill kits will be kept near all areas where equipment is used, fueled, or stored. This spill kit will contain the following, at minimum:

- Oil-absorbent pads, berms, blankets, or granules
- Oil-resistant gloves
- Detergent
- Compact first-aid kit

Spill kits can be used for initial control of spills from equipment reservoir failures, or incidental spill/leaks associated with the storing/handling of containerized fuel and lubricants.

In the event of a release from any storage tank or vehicle, the emphasis of initial spill response is isolation and containment with diking materials until fully cleaned up or a response contractor can be summoned.

## 2.5 FUELING PROCEDURES

Fueling procedures, whether on- or off-site, will be determined by the contractor. The contractor will maintain a spill kit wherever fueling occurs and will continually monitor fueling operations. In the event that a spill occurs, the contractor will follow the spill handling, cleanup, and reporting procedures, as outlined herein.

## 2.6 OPERATIONAL SPILL PROCEDURES

If a spill occurs during operational procedures associated with this project, the contractor will stop working and employ BMPs to stop the spill source, contain the spill, and proceed with cleanup and reporting protocols outlined in this SPEC. The contractor will maintain spill kits onsite and the materials identified herein will be used to stop, contain, and clean up leaks or spills.

# **Engineering Design Report**

Riverside HVOC Site

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## **Appendix D**

### **Attachment D.1 Weekly Visual Inspection Checklist**

**Attachment D.1  
Weekly Visual Inspection Checklist**

<b>Pollution Sources or Oil-Filled Operational Equipment</b>	<b>Structural Integrity</b> (Note visible cracks, holes, excessive rust, pitting in exterior surface or supports)	<b>Visible Leaks/ Spills/Petroleum Sheens</b> (Yes/No)

Spill Kit Location	Spill Kit Contents	Date Checked
	___ Oil-Absorbent Materials (pads, berms, blankets, or granules) ___ Detergent ___ Pair of Nitrile Gloves ___ First Aid Kit	
	___ Oil-Absorbent Materials (pads, berms, blankets, or granules) ___ Detergent ___ Pair of Nitrile Gloves ___ First Aid Kit	
	___ Oil-Absorbent Materials (pads, berms, blankets, or granules) ___ Detergent ___ Pair of Nitrile Gloves ___ First Aid Kit	
	___ Oil-Absorbent Materials (pads, berms, blankets, or granules) ___ Detergent ___ Pair of Nitrile Gloves ___ First Aid Kit	
	___ Oil-Absorbent Materials (pads, berms, blankets, or granules) ___ Detergent ___ Pair of Nitrile Gloves ___ First Aid Kit	

Additional Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Inspected By: \_\_\_\_\_ Date: \_\_\_\_\_ Time: \_\_\_\_\_

# **Engineering Design Report**

Riverside HVOC Site

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## **Appendix D**

### **Attachment D.2 Spill Response Procedures**

## Attachment D.2 Spill Response Procedures

### PERSONNEL SAFETY

When an uncontrolled release of a hazardous substances occurs (associated with proposed construction), address the safety of all personnel and the public. Until the spilled material has been identified and controlled, do the following:

- Ensure that no one is smoking in or near the area.
- Evacuate all nonessential personnel.
- If a fire is involved or appears imminent, call for fire department for assistance: 911.
- Wear the appropriate level of personal protective equipment (oil-resistant gloves, goggles, rubber boots, and/or Tyvek coveralls) when responding to spills.

### SPILLS

#### Aboveground Storage Tanks and Containerized Oil/Lubricant

- Quickly contain spilled fuel/oil as close to source as possible using absorbent booms and blankets provided in the spill kit located inside the loading/unloading area.
- Prevent the spilled fuel/oil from entering the stormwater catch basins by placing oil-absorbent booms around threatened inlets until all spilled fuel/oil can be cleaned up. If necessary, cover the threatened inlets with the rubber drain covers found in the spill kit.
- Place barricades, cones, or flagging a safe distance around the area. Post a watch (Floyd|Snider or contractor employee or construction flagger) at the scene (upwind) to prevent entry to the area.
- Contact the Site Environmental Coordinator or designate (refer below) to inform them of the situation within 15 minutes of any spill greater than 10 gallons.
- Once the spilled oil has been contained, quickly clean up the spilled liquid using the absorbent blankets or granules found in the spill kit.
- Collect spent absorbent material in sealed plastic garbage bags and place in nearby dumpster. Keep dumpster lid closed except when adding waste materials into the receptacle.
- In the event an oil spill enters one of the stormwater catch basins, remove the metal grate and insert absorbent boom and/or blankets and notify the Site Environmental Coordinator.
- The Site Environmental Coordinator or designate is responsible for making the required notifications (refer to Notification Procedures).

**NOTIFICATION PROCEDURES**

In case of either a minor spill (i.e., greater than 10 gallons and less than 42 gallons) or major spill (greater than 42 gallons) of oil or other hazardous substance, immediately contact one of the following (in preferred order):

<b>Contact Name</b>	<b>Work Phone</b>	<b>Cell Phone</b>
Kristin Anderson	(206) 292-2078	(206) 552-4241
Lynn Grochala	(206) 292-2078	(603) 491-3952
Scott Adamek	(425) 806-6824	(425) 409-4278
Ryan Roberts	(360) 417-3422	NA

One of these persons shall be available for spill emergencies at the facility either by being at the Site (during business hours) or available on an on-call basis (after business hours). These persons are responsible for coordinating all of the emergency response measures detailed in this plan. Contact information for additional Agencies required to be notified of spills to waters of the state or soils, or confirmed releases from underground storage tanks, are provided in the Contact Information section of this appendix (Spill Prevention, Control, and Countermeasure Plan).

**Site Environmental Coordinator/Designate**

<b>Regulatory Agency/Spill Response Contractor</b>	<b>Normal Business Hours Phone</b>
Sunny Becker, Ecology	(425) 457-3842

# Engineering Design Report

Riverside HVOC Site

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## Appendix D

### Attachment D.3 Spill Notification Form

### Attachment D.3 Spill Notification Form

<b>Part A: Basic Spill Data</b>		
Type of Spilled Substance:	Notification Person:	
Quantity Released:	Spill Date and Time:	
Location of Spill:	Discovery Date and Time:	
	Spill Duration:	
Facility Name and Location:	Release to: <input type="checkbox"/> Outdoor Pavement <input type="checkbox"/> Stormwater Catch Basin <input type="checkbox"/> Soil <input type="checkbox"/> Containment <input type="checkbox"/> Other: _____	
Nature of spill and any environmental or health effects: <input type="checkbox"/> Injuries <input type="checkbox"/> Fatalities		
<b>Part B: Notification Checklist</b>		
Spill Type:	Notification Date and Time:	Name of Person that Received Call:
All measurable spills		
Ecology:		
Additional contact if spill enters the sanitary sewer		
City of Bothell		
Additional contact if spill enters waters of the State		
National Response Center 1-800-424-8802		

# Engineering Design Report

Riverside HVOC Site

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## Appendix E Health and Safety Plan

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Attachment E.2	Daily Tailgate Safety Meeting Form
Attachment E.3	Good Catch and Incident Reporting Form

### List of Abbreviations

<b>Abbreviation</b>	<b>Definition</b>
ANSI	American National Standards Institute
APP	Accident Prevention Plan
BDI Plus	Bio-Dechlor Inoculum Plus
CAP	Cleanup Action Plan
City	City of Bothell
COC	Contaminant of concern
dba	Decibels "A" weighted for pitch
DCE	Dichloroethene
HASP	Health and Safety Plan
HSO/SS	Health and Safety Officer/Site Supervisor
HVOC	Halogenated volatile organic compound
NIOSH	National Institute for Occupational Safety and Health
O&M	Operations and maintenance
OSHA	Occupational Safety and Health Act
PCE	Tetrachloroethene
PEL	Permissible Exposure Limit
PID	Photoionization detector
PM	Project Manager
PPE	Personal protective equipment
ppm	Parts per million
REL	Recommended exposure limit
ROW	Right of way
Site	Riverside HVOC Site
S-mZVI	Sulfidated microscale zero-valent iron
SSO	Site Safety Officer
TCE	Trichloroethene

## 1.0 Plan Objectives and Applicability

This Health and Safety Plan (HASP) has been written to comply with the standards prescribed by the Occupational Safety and Health Act (OSHA) and the Washington Industrial Safety and Health Act.

The purpose of this HASP is to establish site-specific protection standards and mandatory safe practices and procedures for all personnel involved with operations and maintenance (O&M), investigation and remediation under the Agreed Order, Final Cleanup Action Plan (CAP), and CAP Addendum with the Washington State Department of Ecology at the City of Bothell (City) Riverside Halogenated Volatile Organic Compound (HVOC) Site (Site), in Bothell, Washington. It has been prepared as a supplement to Floyd|Snider's Accident Prevention Plan (APP; Attachment E.1).

This HASP establishes standard operating procedures and provides for contingencies that may be implemented during field work activities. This HASP consists of Site and facility descriptions, a summary of work activities, the identification and evaluation of chemical and physical hazards, monitoring procedures, a description of Site zones, decontamination and disposal practices, and emergency procedures.

The provisions and procedures outlined in this HASP apply to all Floyd|Snider personnel on-site. Contractors, subcontractors, other oversight personnel, and all other persons involved in the field work activities described herein are required to develop and comply with their own HASP or Job Safety Analysis but must also comply with the requirements of this HASP on job sites managed by Floyd|Snider. All Floyd|Snider staff conducting field activities are required to read this HASP and indicate that they understand its contents by signing the Health and Safety Officer/Site Supervisor's (HSO/SS's) copy of this plan prior to conducting field work activities. A copy of this plan must be maintained on-site at all times by the HSO/SS.

This HASP is based on information that was available as of the date indicated on the title page. Additional hazards not specifically addressed by this HASP may exist at the work site or may be created as a result of site activities. Should project personnel identify a site condition that is not addressed by this HASP and have any questions or concerns about site conditions, they should immediately notify the HSO/SS, and work shall be paused to assess any new hazards. If any new hazards identified can be mitigated or controlled, work can proceed and the HASP will be revised, if appropriate.

The HSO/SS has field responsibility for ensuring that the HASP adequately protects worker health and safety and is properly implemented. In this capacity, the HSO/SS will conduct regular site inspections and has the authority to make health and safety decisions that may not be specifically outlined in this HASP based on site conditions. If the HSO/SS leaves the Site while work is in progress, an alternate Site Safety Officer (SSO) will be designated. Personnel responsibilities are further described in the APP.

This HASP was reviewed by the Project Manager (PM) and the HSO/SS prior to commencement of work activities.

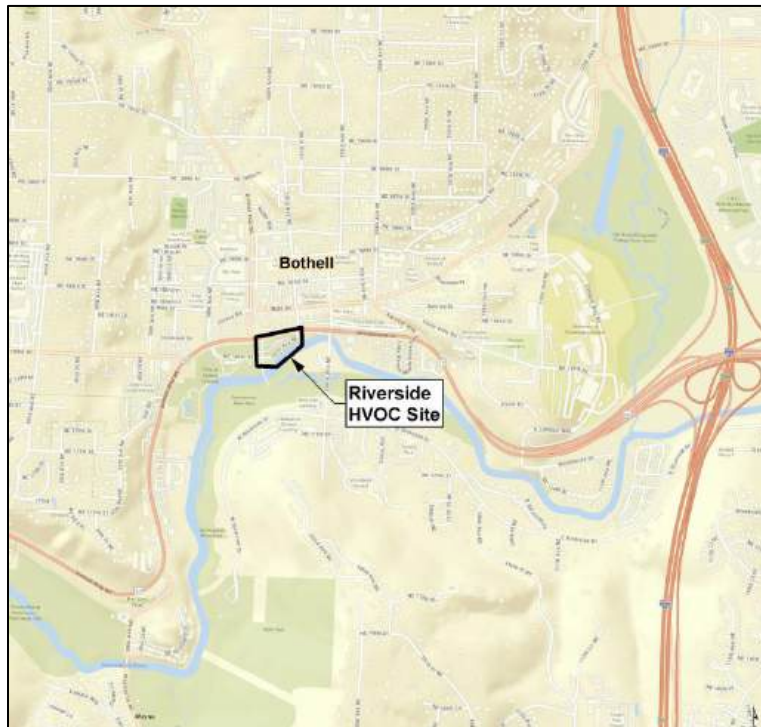
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## 2.0 Background Information

### 2.1 SITE BACKGROUND

The Site is located on the eastern end of the King County Assessor's parcel 082605-9120 in downtown Bothell as shown on Figure E.1. The parcel containing the Site is currently vacant and is utilized as a City park and a public gravel parking lot, accessed by public roadways.

**Figure E.1**  
**Riverside HVOC Site Vicinity Map**



The Site is the location of a former small machine shop where tetrachloroethene (PCE) was believed to be used for degreasing.

To the west of the Site are City-owned properties associated with the City's Park at Bothell Landing; south of the Site is the Sammamish River; east of the Site is a dental office; and north of the Site is State Route 522 (Woodinville Drive) with retail parking on the opposite side of the street. Roadways in the vicinity of the Site are the state highway with high traffic frequency and side streets that have a low traffic frequency.

The contaminants of concern (COCs) at the Site in both groundwater and soil include HVOC associated with dry cleaning activities, including PCE and its breakdown products trichloroethene (TCE), *cis*-1,2-dichloroethene (DCE), and vinyl chloride.

Floyd|Snider will be conducting investigation activities in the northeast portion of the property.

## 2.2 SCOPE OF WORK

The purpose of the investigation is to refine the extent of HVOC contamination and gather hydrogeologic data to support cleanup action design. The investigation will consist of the following:

- O&M of existing groundwater extraction system
- Water level monitoring and flow testing of existing well performance
- Installing additional monitoring wells
- Site-wide groundwater sampling
- Soil sampling via direct push drilling
- Direct push injection of bioremediation products
- Well/pipeline decommissioning

### 3.0 Emergency Contacts and Information

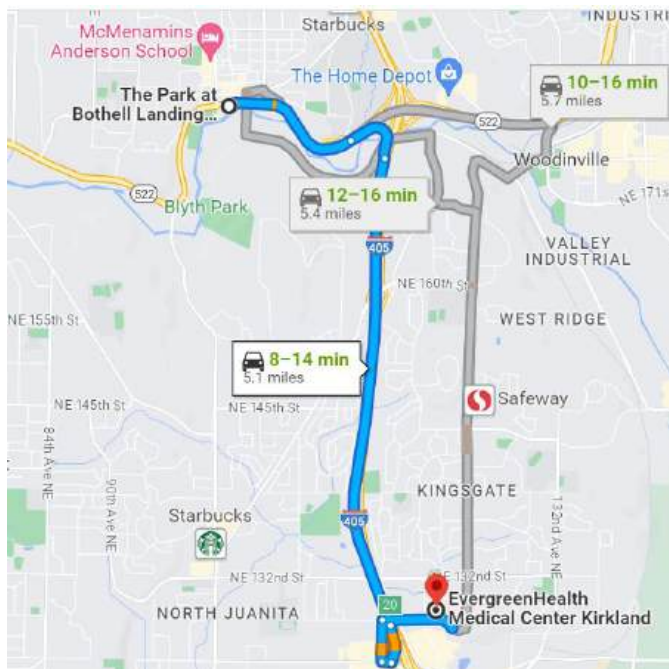
#### 3.1 DIAL 911

In the event of an emergency, dial 911 to reach fire, police, and first aid.

#### 3.2 HOSPITAL AND POISON CONTROL

<p><b>Nearest Hospital Location and Telephone:</b> (Refer to Figure E.2 for directions and map to the hospital.)</p>	<p>Evergreen Health Medical Center 12040 NE 128<sup>th</sup> St Kirkland, Washington (425) 899-1700</p>
<p><b>Washington Poison Control Center:</b></p>	<p>(800) 222-1222</p>

**Figure E.2  
Hospital Directions**



1. Head southeast toward NE 180<sup>th</sup> St
2. Turn left onto NE 180<sup>th</sup> St
3. Turn right at the 1<sup>st</sup> cross street onto WA-522 E/Woodinville Dr
4. Use the right two lanes to merge onto I-405 S via the ramp to Bellevue
5. Merge onto I-405 S
6. Take exit 20 for NE 124<sup>th</sup> St
7. Use the right lane to turn right onto NE 124<sup>th</sup> St
8. Turn right at the 1<sup>st</sup> cross street onto 116<sup>th</sup> Ave NE
9. Turn right onto NE 128<sup>th</sup> St to arrive at Evergreen Health Medical Center

**3.3 PROVIDE INFORMATION TO EMERGENCY PERSONNEL**

All Floyd|Snider project personnel should be prepared to give the following information:

Information to give to Emergency Personnel	
<b>Site Location:</b> (Refer to Figure E.1)	The Park at Bothell Landing Additional Parking Area NE 180 <sup>th</sup> Street and Woodinville Drive Bothell, Washington
<b>Number You Are Calling From:</b>	This information can be found on the phone you are calling from.
<b>Type of Accident or Type(s) of Injuries:</b>	Describe accident and/or incident and number of individuals needing assistance.

**3.4 UTILITY EMERGENCY CONTACTS**

Additional entities that may need to be contacted in the event of an emergency involving damage to a utility include the following:

PSE Electric or Gas Emergency Line:	(888) 225-5773
City of Bothell Sewer & Water Utility Contact	(425) 488-0118

**3.5 PROJECT CONTACTS**

After contacting emergency response crews as necessary, contact the Floyd|Snider PM, or a Principal, to report the emergency. The Floyd|Snider PM may then contact the City or direct the field staff to do so.

**Floyd|Snider Emergency Contacts:**

Contact	Office Phone Number	Cell Phone Number
Kristin Anderson, PM	(206) 292-2078	(206) 552-4241
Lynn Grochala, Associate Principal		(603) 491-3952
Danielle Gallaher, HSO/SS		(619) 302-6688

**City of Bothell Emergency Contacts:**

Contact	Office Phone Number	Cell Phone Number
Scott Adamek	(425) 806-6824	(425) 409-4278
Ryan Roberts	(425) 806-6823	(425) 471-1837

## 4.0 Hazard Evaluation and Risk Analysis

The typical fire, explosion, and physical hazards likely to be present on the job site, and procedures to control the mitigation of these hazards, are presented in the APP. This HASP presents additional information regarding site-specific hazards, including chemical exposure hazards associated with site COCs or the scope of field activities and analysis of the hazards associated with each site investigation task.

### 4.1 CHEMICAL EXPOSURE HAZARDS

This section describes potential chemical hazards associated with the field activities being conducted. Based on previous site data, elevated concentrations of the following chemicals may be encountered at the Site:

- HVOCs including PCE and its breakdown products TCE, *cis*-1,2-DCE, and vinyl chloride in soil and/or groundwater
- Laboratory preservatives encountered during sampling
- Petroleum products used for equipment
- Bioremediation products: PlumeStop, AquiFix, sulfidated microscale zero-valent iron (S-mZVI), Bio-Dechlor Inoculum Plus (BDI Plus), and 3-D Microemulsion

Human health hazards associated with these chemicals are presented in the following table. This information covers potential toxic effects that might occur in the event of relatively significant acute and/or chronic exposure. Potential routes of exposure include inhalation, dermal contact, ingestion, and eye contact. The primary exposure route of concern during site work is ingestion of contaminated water, soil, or sediment, though such exposure is considered unlikely and highly preventable.

The types of planned work activities and use of monitoring procedures and protective measures will limit potential exposures at this Site. The use of appropriate personal protective equipment (PPE) and decontamination practices will assist in controlling exposure by means of all pathways to the COCs listed in the following table.

Chemical Hazard	OSHA-Permissible Exposure Limits (8-hour TWA/STEL)	Highest Historical Concentration	Routes of Exposure	Potential Toxic Effects
<b>Groundwater/Sediment Operations</b>				
PCE	25 ppm / 100 ppm	1.5 mg/kg in soil, 6,270 µg/L in groundwater	Inhalation, skin absorption, ingestion, skin/eye contact	Eye irritation; allergic dermatitis; chloracne; GI distress; liver, kidney damage; breast and other cancers.
TCE	10 ppm / 25 ppm	0.30 mg/kg in soil, 130 µg/L in groundwater	Inhalation	Dermatitis; bronchitis; lung, skin, and stomach cancer.
<i>cis</i> -1,2-DCE	200 ppm / 250 ppm	0.50 mg/kg in soil; 190 µg/L in groundwater	Inhalation, skin absorption, ingestion, skin/eye contact	Ulceration of nasal septum; dermatitis; GI disturbance; respiratory irritation; hyperpigmentation of skin; skin and lung cancer.
Vinyl Chloride	1 ppm / 5 ppm	0.0048 mg/kg in soil; 47 µg/L in groundwater	Inhalation, skin/eye contact	Lassitude; abdominal pain, GI bleeding; enlarged liver; pallor or cyanosis of extremities; cancer
Laboratory Preservatives (hydrochloric acid, methanol, sodium bisulfate, nitric acid)	Not applicable	Not applicable	Dermal contact, eye contact	Irritation to skin or eyes. Avoid contact by proper use of PPE during sample handling and collection.

Chemical Hazard	OSHA-Permissible Exposure Limits (8-hour TWA/STEL)	Highest Historical Concentration	Routes of Exposure	Potential Toxic Effects
<b>Bioremediation Products</b>				
PlumeStop	Not applicable	Not applicable	Dermal contact, eye contact, inhalation, ingestion	Direct contact with eyes, skin, mouth, or respiratory system may cause temporary irritation
S-mZVI	Not applicable	Not applicable	Dermal contact, eye contact, inhalation, ingestion	Direct contact with eyes, skin, mouth, or respiratory system may cause temporary irritation
AquiFix	Not applicable	Not applicable	Dermal contact, eye contact, inhalation, ingestion	Skin corrosion/irritation, serious eye damage/irritation
3-D Microemulsion	Not applicable	Not applicable	Dermal contact, eye contact, inhalation, ingestion	Direct contact with eyes, skin, mouth, or respiratory system may cause temporary irritation
BDI Plus	Not applicable	Not applicable	Dermal contact, eye contact, inhalation, ingestion	Direct contact with eyes, skin, mouth, or respiratory system may cause temporary irritation
<b>Fueling Operations</b>				
Diesel-Range and Heavy Oil-Range Organics	None established	Not applicable	Inhalation, skin/eye contact	Irritation of eyes, reduction in pulmonary function, and effects to central nervous system.

Chemical Hazard	OSHA-Permissible Exposure Limits (8-hour TWA/STEL)	Highest Historical Concentration	Routes of Exposure	Potential Toxic Effects
<b>Fueling Operations (cont.)</b>				
Gasoline-Range Hydrocarbons	300 ppm / 500 ppm	Not applicable	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation of eyes, skin, mucus membranes; headache; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; liver, kidney damage.

Abbreviations:

- GI Gastrointestinal
- µg/L Micrograms per liter
- mg/kg Milligrams per kilogram
- ppm Parts per million
- STEL Short-term exposure limit
- TWA Time-weighted average

**4.2 JOB HAZARD ANALYSIS**

This section identifies potential hazards associated with each task listed in Section 2.2 of this HASP. Tasks have been grouped according to the types of potential hazards associated with them.

Work Task	Potential Hazards	Actions to Control Hazards
Load and Transport Equipment on Vehicles	Damage or injury from unsecured cargo	Ensure that all cargo is secured when packing equipment in or out. Prevent movement of equipment while vehicle is in operation.
	Injuries during the removal of work zone delineators	Verify that traffic is clear before removing work zone delineators and/or traffic control devices.
Lifting and manual transport of equipment	Improper lifting techniques, overreaching/overextending, lifting overly heavy objects	Use proper lifting techniques and mechanical devices where appropriate. Test the weight of the load prior to lifting. Do not attempt to lift a heavy load alone. Never try to lift more than you are accustomed to lifting. Avoid quick, jerky movements and twisting motions.
Working in populated/urban area	Third party impacts from noise, COCs	Perimeter controls of cones and barricades with controlled entry around the work area.

Work Task	Potential Hazards	Actions to Control Hazards
Traffic hazards	Vehicle traffic and hazards when working near active operations	<p>Personnel working are required to wear American National Standards Institute (ANSI) class 2 vests or garments within any right of way (ROW).</p> <p>Traffic control plans and permits from the City will be required for any lane closures, work in sidewalks and equipment or truck movement that is against established traffic signals.</p> <p>Washington State Department of Transportation required signage, protection devices, and flagging will be used by the Contractor if required during lane closures.</p> <p>Avoid working with your back to traffic whenever possible.</p>
Ground impacting tasks	Underground Utility damage	Utilities are to be surveyed with a public and private utility locate and marked prior to work
Accidents due to inadequate lighting	Improper illumination	Work will only proceed during daylight hours or under sufficient artificial light.
Soil Sampling characterization, direct push drilling, geo-probe sampling and well removal activities	Heavy equipment usage (drill rigs)	Ensure the use of competent operators, backup alarms, regular maintenance, daily mechanical checks, and proper guards. All project personnel will make eye contact with the operator and obtain a clear "OK" before approaching or working within the swing radius of heavy equipment, staying clear of the swing radius.
	Exposure to loud noise	Wear earplugs or protective ear covers when heavy equipment is operating and when a conversational level of speech is difficult to hear at a distance of 3 feet; when in doubt, a sound level meter may be used on-site to document noise exposure.
	Overhead hazards, falling and/or sharp objects, bumping hazards, construction equipment	All personnel will wear hard hats at all times when overhead hazards exist, such as during drilling activities and around heavy or large equipment. Workers will never work under overhead loads

Work Task	Potential Hazards	Actions to Control Hazards
Water level measurements, well surveying activities, well development, well decommissioning, and groundwater sampling from monitoring wells	Slip, trip, or fall hazards	Steel-toed boots must be worn on-site at all times while heavy equipment is present. Pay attention to footing on uneven or wet terrain and do not run. Keep work areas organized and free from unmarked trip hazards.
	Biological hazards, dermal or eye exposure to site contaminants in groundwater	Wear proper PPE including safety glasses at all times while on-site. If a pressure washer is used to decontaminate heavy equipment, a face shield will be worn over safety glasses or goggles. Care will be taken during decontamination procedures and groundwater sampling to avoid splashing or dropping equipment into decontamination water.
	Heat and cold exposure hazards	Refer to Section 5.3 in the APP.
	Pinch hazards	Ensure proper gloves are worn when removing well lids, use tools instead of fingers to move lid, and use care when dropping lid back into place.
In situ injections	Pressurized liquids direct push injection	All lines and connections with pressurized liquids are to be inspected for damage prior to use. Traffic controls will be implemented to prevent vehicles causing damage to lines, and pedestrian controls will be implemented to keep unnecessary personnel away from lines.

## 5.0 Site Controls and Monitoring

The following sections describe site controls and monitoring that will be implemented during site field activities. The HSO/SS, or a designated alternate (SSO), is responsible for inspecting the work area daily and identifying additional hazards. Personnel responsibilities are further described in the APP.

### 5.1 DAILY SAFETY MEETINGS

A safety meeting will be conducted by the HSO/SS or designated SSO daily prior to the start of work. Additional safety briefings or safety checks should also be performed when switching tasks or whenever new hazards are identified. Safety meetings topics and attendance will be recorded on the Daily Tailgate Safety Meeting and Debrief Form provided in Attachment 2.

Any near-misses or incidents that occur on the job site will be recorded on the Good Catch and Incident Reporting Form provided in Attachment 3.

### 5.2 EMERGENCY MUSTER POINT

The emergency muster point is the east parking lot of the dental building to the east of the Site.

The APP describes required emergency equipment and procedures to be followed in the case of medical emergency; release of a hazardous substance; or other emergencies such as a thunderstorm, vehicle collision, fire, or earthquake.

### 5.3 PERSONAL PROTECTIVE EQUIPMENT

Work will proceed in standard Level D as described in the APP. PPE should be inspected for defects before each use. Field staff will use clean, disposable nitrile gloves when handling sample material. ANSI class 2 high-visibility vests or garments are required for work within ROWs, working around heavy equipment and on road shoulders. During drilling work, staff will additionally wear hard hats and hearing protection.

### 5.4 WORK AREAS

An exclusion zone will be established when working with contaminated materials. The exclusion zone will be delineated with cones and barricades.

A contaminant reduction zone will be set up at the entry/exit point of the exclusion zone. The contaminant reduction zone will contain the necessary elements to perform personnel and equipment decontamination as described in Section 5.5. The contaminant reduction zone will be established approximately 5 feet from the exclusion zone in the downwind direction.

The support zone will consist of vehicles and public restroom facilities located near the side.

**5.5 DECONTAMINATION AND WASTE DISPOSAL**

Field staff should always follow the best practices for prevention of contamination detailed in the APP.

Large equipment and vehicle decontamination generally consists of scrubbing to remove visible debris followed by washing with a soap and water solution and rinsing with clean water. For drilling equipment, decontamination wash water will be captured in a watertight trailer and drummed at the end of the work day. Sampling equipment will be decontaminated by scrubbing to remove visible debris, washing with soap and water, and rinsing with distilled water. Personnel decontamination will include removal of disposal gloves/other disposable PPE followed by washing of hands.

Floyd|Snider and its subcontractors will use safe and prudent waste collection and housekeeping practices to minimize the spread of contamination beyond the work zone and the amount of investigation-derived waste. The Floyd|Snider HSO/SS will work with site personnel to ensure the proper collection, packaging, and identification of waste materials so that waste materials will be properly disposed of.

Disposable PPE and sampling equipment will be placed into trash bags and disposed of as municipal solid waste. Excess sample material will be containerized in drums approved by U.S. Department of Transportation. Equipment wash water will also be containerized in drums on-site.

**5.6 AIR MONITORING**

Air monitoring using a photoionization detector (PID) will be performed if personnel are likely to be exposed to volatile contaminants. Contaminant concentrations in soil and groundwater at the Site are present at concentrations that are not expected to result in vapor concentrations that exceed allowable OSHA levels. Potential volatile COCs include chlorinated solvents such as PCE, TCE, *cis*-1,2-DCE, and vinyl chloride in soil or groundwater.

Action levels for air monitoring are presented in the following table with PID calibrated to isobutylene with the correction factor for vinyl chloride for a 10.6 electron volt lamp.

Monitoring Equipment	VOC Concentration	Action
PID	Less than 1 ppm and less than 5 ppm for no longer than 15 minutes	Continue operations in Level D PPE. Work upwind of excavation area when possible.
	Greater than 1 ppm and less than 5ppm; intermittent	Leave work area and allow vapor to dissipate; use engineering controls if necessary. Monitor VOC concentration every 5 minutes; resume work once concentrations are less than 1 ppm for 15 minutes.
	Greater than 5 ppm	Stop operations and evacuate area. Do not resume work until engineering controls are able to maintain VOC concentrations less than 2 ppm in breathing space are in place.

**5.7 NOISE MONITORING**

Noise levels will be monitored with a dosimeter to ensure they are under the National Institute for Occupational Safety and Health (NIOSH)-recommended exposure limit (REL) for daily exposure. Noise levels will be measured at the closest working distance from the source during the working day for the TWA working dose. The following table shows the duration at maximum exposure level before reaching the Permissible Exposure Limit (PEL)/REL, respectively.

<b>NIOSH REL Maximum Exposure Level (dBA)</b>	<b>OSHA PEL Maximum Exposure Level (dBA)</b>	<b>Duration of Exposure</b>
82	85	16 hours
85	90	8 hours
88	95	4 hours
91	100	2 hours
94	105	1 hour
97	110	30 minutes
100	115	15 minutes
103	120	7.5 minutes
106	125	3.75 minutes
109	130	1.88 minutes

Abbreviation:  
 dBA Decibels "A" weighted for pitch

All noise-generating activities will be conducted during the allowable noise-generating hours as stated by the City. Construction Noise Hours for the City are between 7 a.m. and 10 p.m., Monday through Friday, unless a variance is granted in writing by the City where hours outside of the standard Construction Noise Hours will be prescribed.

The city municipal code has adopted the maximum permissible environmental noise levels set forth in WAC 173-60-050, which exempts temporary construction sites. The maximum noise level impacts under the municipal code are included in the following table for a Class C to Class B zoned building type in WAC 173-60-050.

<b>Sound at Source (dBA)</b>	<b>Sound at Adjacent Buildings (150 feet) (dBA)</b>	<b>Duration (minutes per hour)</b>
108.5	65	15
113.5	70	5
118.5	75	1.5

Action levels for noise monitoring are presented in the following table. Repeated TWA levels greater than 90 in an 8-hour day will require additional controls.

Monitoring Area	Noise Level	Actions and Controls
Immediate Work Area and Support Zones	Less than 85 dBA for 8 hours TWA; peak less than 100 dBA for no longer than 15 minutes.	Continue to monitor noise levels, hearing protection recommended; non-essential personnel should move away from the source.
	Greater than 85 dBA for 8 hours TWA but less than 90; peak greater than 100 dBA but less than 115 dBA for no longer than 15 minutes.	Hearing protection required; non-essential personnel should move away from the source. Rotate essential operators to reduce individual dosage.
	Greater than 90 dBA for 8 hours TWA.	Stop noisy operations until TWA drops below 90 dBA. Rotate essential operators to quieter areas/tasks to reduce individual dosage.
Work Perimeter and Adjacent Buildings	Less than 65 dBA at 150 feet; source peak less than 108 dBA for no longer than 15 minutes every hour.	Continue to monitor noise levels. Sidewalks/access paths closest to source noise shall be blocked off and information posted away from source to discourage public from increasing duration of exposure.
	Greater than 65 dBA but less than 70 dBA; source peak greater than 108 dBA but less than 113 dBA for no longer than 5 minutes per hour.	Along with all the above controls, ensure peaks under 15 minutes per hour and monitor for third parties' high potential exposures.
	Greater than 70 dBA; source peak greater than 113 dBA for more than 5 minutes per hour.	Stop noisy operations until TWA drops below 70 dBA at 150 feet. Rotate essential operators to quieter areas/tasks to reduce individual dosage

## 6.0 Approvals

\_\_\_\_\_  
Project Manager

\_\_\_\_\_  
Date

\_\_\_\_\_  
Project Health & Safety Officer

\_\_\_\_\_  
Date

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**Riverside HVOC Site**  
**Engineering Design Report**

**Appendix E**  
**Health and Safety Plan**

**Attachment E.1**  
**Accident Prevention Plan**

# Accident Prevention Plan

May 2025

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**List of Abbreviations**

<b>Abbreviation</b>	<b>Definition</b>
AED	Automated external defibrillator
APP	Accident Prevention Plan
AQI	Air quality index
COPD	Chronic obstructive pulmonary disease
CPR	Cardiopulmonary resuscitation
FFR	Filtering facepiece respirator
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSO/SS	Health and Safety Officer/Site Supervisor
JHA	Job Hazard Analysis
JSA	Job Safety Analysis
L&I	Washington State Department of Labor & Industries
MTCA	Model Toxics Control Act

<b>Acronym/ Abbreviation</b>	<b>Definition</b>
L&I	Washington State Department of Labor & Industries
MTCA	Model Toxics Control Act
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Act
PEL	Permissible exposure limit
PM	Project Manager
PPE	Personal protective equipment
RPP	Respiratory Protection Program
SDS	Safety Data Sheet
SSO	Site Safety Officer
USEPA	U.S. Environmental Protection Agency
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Act

## 1.0 Plan Objectives and Applicability

This Accident Prevention Plan (APP) describes the policies and best practices established by Floyd|Snider to ensure the safety of employees to the maximum extent possible when performing their work duties. Employee safety is Floyd|Snider's highest priority. Employees are encouraged to use the Health and Safety Department as a resource in identifying potential hazards and the appropriate precautions to address them. While additional safety precautions may impact project schedules and costs, Floyd|Snider will ultimately benefit as accidents are avoided.

This APP has been written to comply with the standards of the Occupational Safety and Health Act (OSHA) and Washington Industrial Safety and Health Act (WISHA) as they pertain to work activities performed by Floyd|Snider.

This APP applies to all employees of Floyd|Snider. It consists of the following components:

- A description of the roles and responsibilities of all Floyd |Snider personnel in ensuring worker safety,
- General safety policies for the office and the field job site,
- Procedures to follow in an emergency,
- Information on common hazards and steps that should be taken to mitigate these hazards,
- A description of the basic safety controls that should be implemented on all field job sites,
- Training requirements for field staff, and
- Safety record keeping and reporting requirements and procedures.

## **2.0 Roles and Responsibilities**

All staff members share responsibility for safety. The roles and responsibilities for Floyd|Snider staff in ensuring company safety are described in the following sections.

### **2.1 BOARD OF DIRECTORS**

The Floyd|Snider board of directors consists of the elected senior officers of Floyd|Snider who establish the company's culture of safety. These individuals set policy for the company, including safety policy. The Management Committee, which consists of the Board of Directors and additional shareholder representatives, is also responsible for enforcement of this APP.

### **2.2 HEALTH AND SAFETY COMMITTEE**

The Health and Safety Committee is composed of field and management staff, who meet on a quarterly basis or more frequently if needed to review and update the Floyd|Snider Health and Safety Program. The Health and Safety Committee is responsible for making updates to this APP as approved by the Management Committee. Health and Safety Committee meeting minutes are recorded and made accessible on Floyd|Snider's Health and Safety department page on SharePoint.

### **2.3 HEALTH AND SAFETY ADMINISTRATOR**

The Health and Safety Administrator receives, organizes, and reviews reports of near misses and incidents in the workplace. The Health and Safety Administrator is responsible for the administration of benefits, working with managers to identify OSHA-reportable incidents, and managing the OSHA reporting process. The Health and Safety Administrator is also responsible for documentation of Health and Safety Committee meeting minutes and employee training record keeping. The Health and Safety Administrator is supported by the Board of Directors and the Health and Safety Committee, who are responsible for taking corrective actions when near misses, incidents, and other safety issues identified in this plan occur.

### **2.4 PROJECT MANAGERS**

Project Managers (PMs) reinforce the Floyd|Snider safety culture. During all phases of projects, PMs review health and safety issues and will have authority to allocate resources and personnel to safely accomplish project work.

PMs direct the field personnel at a job site. PMs coordinate with the project Health and Safety Officer/Site Supervisor (HSO/SS) to ensure that the scope of the project and site conditions are accurately documented in all project safety materials and that all Floyd|Snider personnel on site have received the required safety training and understand the procedures to follow should an incident occur on site. PMs review safety documentation materials with the HSO/SS at intervals

determined prior to the start of field events and report near misses and incidents to the Health and Safety Administrator.

## **2.5 FIELD HEALTH AND SAFETY OFFICER AND SITE SUPERVISOR**

The HSO/SS prepares and/or approves the site Health and Safety Plan (HASP) and any amendments thereof and is responsible for full implementation of all elements of the HASP.

The HSO/SS will advise the PM and project personnel on all potential health and safety issues of the field investigation activities to be conducted at a site. The HSO/SS will specify required exposure monitoring to assess site health and safety conditions, modify the site HASP based on field assessment of health and safety accidents and/or incidents, and recommend corrective action if needed. The HSO/SS will report all accidents and/or incidents to the PM. If the HSO/SS observes unsafe working conditions by Floyd|Snider personnel or any contractor personnel, the HSO/SS will suspend all work until the hazard has been addressed.

The HSO/SS is responsible for conducting tailgate safety meetings daily before the start of field work. Tailgate safety meetings should identify the work to be completed, safety hazards likely to be encountered, and the appropriate work practices needed to minimize exposure to these hazards. Tailgate safety meeting forms are included in the HASP documents.

## **2.6 FIELD SITE SAFETY OFFICER**

The field Site Safety Officer (SSO) may be a person dedicated to this task, to assist the HSO/SS during field work activities. The SSO will ensure that all personnel have appropriate personal protective equipment (PPE) on site and that PPE is properly used. The SSO will assist the HSO/SS in field observation of Floyd|Snider personnel safety. If a health or safety hazard is observed, the SSO shall suspend all work activity. The SSO will conduct onsite safety meetings daily before work commences. All health and safety equipment will be calibrated daily and records kept in the daily field logbook. The SSO may perform exposure monitoring if needed and will ensure that equipment is properly maintained.

## **2.7 FLOOR WARDENS**

Floor Wardens are Floyd|Snider staff members who have volunteered to coordinate Floyd|Snider's response in case of an emergency at Union Square. Floor Wardens are responsible for ensuring that all staff have evacuated the building if an evacuation order is issued by building management and accounting for staff at the emergency muster point. Floor Wardens also post and update emergency evacuation routes and maintain maintenance records for fire extinguishers located at the office. The names of current Floor Wardens are posted in the office above fire extinguishers and on the Floyd|Snider SharePoint home page.

## **2.8 EQUIPMENT MANAGER**

The Equipment Manager is responsible for ensuring that all field equipment, including the company vehicle, is in safe working order and for keeping records of equipment maintenance. Employees must report any issues with the company vehicle or field equipment to the Equipment Manager. The Equipment Manager will designate an alternate for days when the manager will not be available to assist field staff with urgent equipment or vehicle issues.

## **2.9 FLOYD|SNIDER PERSONNEL**

All Floyd|Snider project personnel will take precautions to prevent accidents and/or incidents from occurring to themselves and others. Employees must read, understand, and sign this APP. Employees will report all incidents and near misses to their PM, HSO/SS, or SSO and inform of any physical conditions that could impact their ability to perform their work.

## **2.10 EMERGENCY CONTACTS**

All Floyd|Snider staff must designate a person outside of the company who may be contacted in case of an emergency in which a staff member requires medical care. Emergency contacts are responsible for making decisions regarding medical treatment in the event that the staff member is incapacitated, or for contacting the individual who has been designated authority by the staff person to make such decisions if they do not have that authority.

Emergency contact information will be provided to the Health and Safety Administrator and updated as needed, at a minimum frequency of once per year. The Health and Safety Administrator is responsible for maintaining emergency contact information in the Floyd|Snider firm contact database and making this information available on the Floyd|Snider SharePoint home page.

### 3.0 Safety Policies

The safety policies presented in this section have been developed to ensure the safety of all staff. They should be considered the minimum requirements to maintain a safe workplace; staff should be vigilant at all times and take the needed actions to identify and correct unsafe situations.

#### 3.1 GENERAL OFFICE SAFETY

This section describes the policies that have been developed to keep staff safe in all work scenarios, including at the office and on the job site.

##### 3.1.1 Injury Prevention

In office areas, trips and falls are the primary cause of acute injury, and they can be easily prevented. There are many different ways to prevent injury, including, but not limited to:

- Keep all work areas, aisles, and hallways clear at all times.
- Make sure all exits are accessible, clearly marked, and properly illuminated.
- Keep all work and storage areas in a sanitary condition; floors shall be clean and, as much as possible, kept in a dry condition. If floors are wet, they should be marked with signage to notify others.
- Pile or store materials in a stable manner, so that they will not be subject to falling.
- Keep walkways and work areas free of electrical cords.
- Never make repairs to light fixtures unless authorized to do so by a supervisor.
- Use a stepstool when reaching overhead objects.
- Do not lift equipment and materials weighing more than 20 pounds by yourself; ask for help and/or use a handtruck.
- When carrying loads, exercise care to avoid overexertion and strain. Use proper lifting and reaching techniques.
- Use adjustable desk chairs to reduce musculoskeletal injuries; ask for assistance if you are unfamiliar with proper ergonomic adjusts for your desk, computer, and chair.
- Report all unsafe conditions and symptoms of injury to the Health and Safety Administrator.
- Exercise caution in moving about the office.

##### 3.1.2 Administration of First Aid and Cardiopulmonary Resuscitation

First aid and cardiopulmonary resuscitation (CPR) should only be administered by individuals with the appropriate training. Floyd|Snider makes First Aid and CPR/automated external defibrillator (AED) training to available to all staff members and requires this training for all field staff members. At least one person on a field site must be trained and have current certification in

First Aid and CPR. First aid kits compliant with the ANSI Z308.1-2015 Class B standard will be available at the Floyd|Snider office and at all field sites. First aid kits for field sites additionally include basic medications (aspirin and diphenhydramine), tweezers, a clotting sponge, potable water, outdoor skin cleanser, super glue, adhesive moleskin pads, safety pins, sunblock, insect repellent, medical masks and a printed field staff emergency contact list.

### **3.1.3 New Employee Orientation**

All new employees receive an orientation to the Floyd|Snider Health and Safety Program from a member of the Health and Safety Committee. This orientation is arranged by the assigned mentor for the new employee and includes a review of the materials available on the Health and Safety department home page (APP, HASP templates, near miss and incident forms, training resources, etc.) as appropriate to the employee's role at Floyd|Snider, office and field safety policies, and training and documentation requirements for field and office safety.

### **3.1.4 Workplace Hostility**

Floyd|Snider intends to provide a work environment that is free from intimidation, hostility, or other offenses that are inappropriate. Harassment of any sort—verbal, physical, or visual—will not be tolerated.

Harassment can take many forms. It may be, but is not limited to, words, signs, jokes, pranks, physical or verbal intimidation, physical contact, or violence. Harassment is not necessarily sexual in nature, although these prohibitions against harassment specifically include all forms of sexual harassment.

It is the company's policy to regard sexual harassment and other forms of harassment, as well as the threat of such harassment, as very serious matters and to prohibit them in the workplace by any person and in any form. All staff are required to complete harassment training. Floyd|Snider also makes bystander intervention training available to all staff.

## **3.2 FIELD SAFETY**

This section describes the additional policies developed to keep field staff safe on the job site.

### **3.2.1 Stop Work Authority**

All staff members have Stop Work Authority. Stop Work could be a temporary pause in work for a few minutes or a full shutdown of work until unsafe work conditions can be addressed. If unsafe work conditions are encountered and cannot be immediately addressed by the staff on-site, the HSO/SS should report immediately to the PM. Safety hazards may include physical site conditions or dangerous work practices by subcontractors or other workers. The PM will help the field staff to make modifications to the work practices to mitigate the hazard if possible. If the unsafe conditions cannot be mitigated, field staff have the authority to stop all work until the conditions can be properly addressed.

## **3.2.2 Health and Safety Plan**

A site-specific HASP must be prepared and made available to field staff at job sites. A site-specific HASP is required for any activities where field staff may contact contaminated material; activities such as a site visit or oversight where no contact with contaminated material or physical hazards may occur can be completed without a HASP, if approved by the PM. The HASP should address both potential physical and chemical hazards on-site and steps taken to mitigate those hazards.

## **3.2.3 Tailgate Safety Meetings**

The HSO/SS is responsible for conducting tailgate safety meetings daily before the start of field work. Tailgate safety meetings should identify the work to be completed, safety hazards likely to be encountered, and the appropriate work practices needed to minimize exposure to these hazards. Tailgate safety meetings must always cover the site-specific procedures to follow in case of an emergency.

When performing field work, staff should maintain awareness of new or changing hazards at the job site. Staff should always assess then reassess the hazards when changing between tasks or changing the manner in which a task is performed and document meetings and assessments on the tailgate safety meeting form.

## **3.2.4 Buddy System**

Floyd|Snider employs the buddy system for work at job sites meaning employees are never alone in the field. The buddy system ensures that employees can get help in case of an emergency. Working in the field without another Floyd|Snider employee present may be permissible in the following scenarios:

- When the site is occupied, you are not performing an activity with high risk of injury (e.g., not working in traffic, not entering small spaces or lifting heavy objects), and you are in close proximity of other people capable of responding if you call for help.
- If you are accompanied by a teaming partner or subconsultant who may act as your buddy.
- IF FOR ANY REASON YOU ARE NOT COMFORTABLE WITH THE ASSIGNMENT OR THE CONDITIONS, DISCUSS IT WITH YOUR PM AND ASK FOR A BUDDY.

## **3.2.5 Check-in Procedure**

All employees in the field, whether in groups or alone, will follow the check-in procedure detailed below:

- Notify front desk or your PM when you are leaving for field work. Notification can be by email, phone, or in person.
- Provide an estimated completion time of when you think you will return to the office or head home.

- At the end of the field day, before leaving the site, call the office and let the front desk or your PM (the same person you notified at the beginning of the day) know you are returning to the office or heading home. Ask to be transferred to the PM to discuss how things went.
- If you will not be finished with field work by 5:00 p.m., call the office and let the front desk know you are still in the field and that you will check in with the PM when fieldwork is finished.
- Communicate with the PM when you are finished with work and leaving the site (after 5:00 p.m.).
- If you are in a group of Floyd|Snider employees doing this field work, one person can do this check-in process on behalf of the group.
- If you fail to check in and cannot be reached by cell phone, someone from the office may be sent to locate you, or local authorities may be notified.

### **3.2.6 Personal Protective Equipment**

Field staff must wear the appropriate PPE required in the site-specific HASP. Floyd|Snider provides employees with all required PPE such as steel-toed boots, reflective vest/jacket, hardhat, safety glasses, gloves, ear protection, and first aid kits. Field staff are responsible for wearing the appropriate PPE in accordance with the HASP, keeping their PPE in good condition, and replacing it as needed.

All work will proceed in Level D PPE, which shall include hard hat, protective footwear, hearing protection, eye protection, gloves, and sturdy outer work clothing. Protective footwear must be compliant with ASTM F2413 or the former ANSI Z41 (repealed) standard, with oil- and chemical-resistant soles, and must be securely laced without signs of excessive tread wear. For all work involving potential exposure to soil and groundwater, workers will wear nitrile gloves and Level D PPE. Personal floatation devices will be worn at all times during work in the vicinity of surface water. When working in a remote location, all teams must carry a field first aid kit. The contents of a field first aid kit include basic medications (aspirin and diphenhydramine), sterile dressings, adhesive bandages and tape, wound-cleansing towelettes, sting-relief wipes, antibiotic ointment, butterfly bandages, tweezers, safety pins, and a printed field staff emergency contact list.

All field personnel will be properly fitted for PPE and trained in the use of PPE during initial 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training (refer to Section 7.0 for additional training information). The level of protection will be upgraded by the HSO/SS whenever warranted by conditions present in the work area. The HSO/SS will ensure that field staff know how to properly use PPE and periodically inspect equipment such as gloves and hard hats for defects.

## 3.2.7 Confined Spaces

Floyd|Snider field staff are not trained in confined space entry and may not enter permit-required confined spaces. It is considered entry if your head/face breaks the plane of the confined space opening.

Confined spaces are defined as a spaces that have limited or restricted means for entry or exit and are not designed for continuous occupancy. Confined spaces commonly encountered at field sites may include vaults, manholes, pits, and tanks. OSHA designates confined spaces as “permit-required confined spaces” if they exhibit one or more of the following characteristics:

- Contains or has the potential to contain a hazardous atmosphere
- Contains material that has the potential to engulf an entrant
- Has walls that converge inward or floors that slope downward and taper into a smaller area that could trap or asphyxiate an entrant
- Contains any other recognized safety or health hazard (e.g., unguarded machinery, exposed wires, extreme heat)

In accordance with OSHA regulations, only personnel with specialized confined space training may enter a permit-required confined space under a confined space entry plan.

## 3.3 RESPIRATORY PROTECTION PROGRAM

The goals of the Respiratory Protection Program (RPP) are to protect employees from potential exposure to respiratory hazards and to ensure compliance with applicable occupational safety and health standards regarding respiratory hazards. Additionally, the RPP provides requirements for the proper selection and use of respiratory protection equipment.

On July 16, 2021, the Washington State Department of Labor & Industries (L&I) adopted an emergency rule to protect workers who are exposed to harmful levels of wildfire smoke (WAC 296-62-085). This RPP conforms to the Washington Administrative Code (WAC) standards for WAC 296-841 Airborne Contaminants and WAC 296-842 Respirators, as well as draft rule WAC 296-65-085 Wildfire Smoke.

### 3.3.1 Applicability

This RPP applies to respiratory protection used in the field due to impaired ambient air quality when respirator use is not required but may be preferred for comfort. This applies to impaired ambient air quality due to chemical hazards or wildfire smoke. Employees will not be required to perform site work when airborne substances (i.e., site contaminants) are present at concentrations exceeding their OSHA permissible exposure limits (PELs) or if air quality due to wildfire smoke exceeds the Stop Work action threshold and respiratory protection would be

required to safely complete the work. Employees may additionally elect to use respirators for comfort purposes to control non-hazardous substances such as nuisance odors.

If there is the potential to exceed a PEL or wildfire smoke action threshold at a site, engineering and administrative controls will be implemented to mitigate the hazard. Project work that cannot be altered by using engineering or administrative controls must be approved by the Management Committee in advance of the scheduled fieldwork.

The RPP is intended to help employees identify conditions that may warrant the voluntary use of a respirator and to support the selection and maintenance (if applicable) of an appropriate respirator. The RPP should be implemented when employees are working in conditions where respiratory hazards may be encountered, such as when working in conditions with wildfire smoke.

### **3.3.2 Administrator and Employee Responsibility**

The RPP administrator is the Health and Safety Committee chair. The RPP administrator oversees the development, execution, and evaluation of the RPP and will ensure procedures are followed, respirator use is monitored, and respirators provide adequate protection when job conditions change. The RPP administrator will ensure appropriate respirators and the associated supplies are provided to employees for voluntary use at no cost to the employee.

Employees voluntarily using respirators have the following responsibilities:

1. Participate in the Floyd|Snider medical monitoring program in accordance with Section 7.1.
2. Use the respirator only for the specific tasks that it was issued for.
3. Seek medical help if wearing a respirator creates negative health effects such as difficulty breathing, dizziness, or anxiety.
4. Care for and maintain respirators as instructed, including following the manufacturer's specific cartridge change-out or respirator replacement schedule.
5. Notify the supervisor of any problems associated with using a respirator. This includes a respiratory hazard that needs further evaluation, if the respirator is not providing adequate protection, and any concerns with the RPP.
6. Monitor air quality while wearing a respirator and calling Stop Work if PELs are exceeded or if the Stop Work action level for wildfire smoke is exceeded.

### **3.3.3 Use of Respirators**

Respirator use by Floyd|Snider employees is done on a voluntary basis and may be done at any time when the use of an approved respirator may increase comfort or provide additional

protection when air quality conditions are still within a level considered to be safe for work. Voluntary use of respirators applies only when it has been determined that:

- Such respirator use will not in itself create a hazard.
- Airborne occupational exposures to hazardous chemicals will not exceed applicable PELs.
- Exposure to fine particles called PM2.5 in wildfire smoke does not exceed the Stop Work action level (refer to Table 3.1).
- No airborne biological hazard is present.
- No specification standards require the mandatory use of respirators.

### **3.3.4 Wildfire Smoke Exposure Control Plan**

The Wildfire Smoke Exposure Control Plan is intended to address risks to employees working outside from potential exposure to wildfire smoke. This plan will be in effect whenever wildfires are present in the region (in Washington State, surrounding states, or British Columbia, Canada) and will continue to be implemented until such a time that wildfire smoke is no longer a health risk as determined by the air quality index (AQI). The greatest risk of wildfire coincides with the dry season from approximately mid-May through mid-October; however, fires can also occur outside of the typical dry season.

Smoke from wildfires contains chemicals, gases, and fine particles that can be harmful to human health. Breathing in smoke can cause immediate health effects such as coughing, trouble breathing, stinging eyes, a scratchy throat, runny nose, irritated sinuses, wheezing and shortness of breath, chest pain, headaches, an asthma attack, tiredness, and fast heartbeat (U.S. Centers for Disease Control and Prevention 2024). The smallest and most harmful particulate matter in wildfire smoke and other air pollutants are PM2.5. PM2.5 are particles that are 2.5 micrometers or less in width. Increases in daily PM2.5 exposure has been linked to premature death in people with heart or lung disease and nonfatal heart attacks (U.S. Environmental Protection Agency [USEPA] 2025). Long-term exposure to PM2.5 is associated with increased rates of lung cancer and heart disease.

Those at increased risk for adverse health effects from wildfire smoke include the following:

- People with lung diseases such as asthma or chronic obstructive pulmonary disease (COPD), including bronchitis and emphysema, and those who smoke
- People with respiratory infections, such as pneumonia, acute bronchitis, bronchiolitis, colds, or flu, or those with or recovering from COVID-19
- People with existing heart or circulatory problems, such as irregular heartbeat, congestive heart failure, coronary artery disease, or angina, and those who have had a heart attack or stroke

- Adults over age 65 and pregnant women
- People with diabetes
- People with other medical or health conditions that can be exacerbated by exposure to wildfire smoke as determined by a physician

Program elements and protocols for wildfire smoke have been developed in accordance with emergency rule WAC 196-62-085 and additionally consider Cal/OSHA Title 8 California Code of Regulations Section 5141.1 regarding Wildfire Smoke.

The Wildfire Smoke Program includes the following elements:

1. Identification of Harmful Exposures (WAC 296-62-08530):

When wildfire smoke is present, the site-specific HSO will monitor the AQI before each shift and periodically thereafter using USEPA's AirNow,<sup>1</sup> available at [www.airnow.gov](http://www.airnow.gov), or a similar state or federal AQI modeling service. The HSO can also monitor real-time air quality using an air quality detector capable of measuring PM<sub>2.5</sub>. The HSO will take actions consistent with the action levels presented in Table 3.1.

2. Hazard Communication (WAC 296-62-08540):

The HSO will communicate wildfire smoke hazards to employees during the tailgate safety meeting and will record the AQI or PM<sub>2.5</sub> concentration on the tailgate meeting form when wildfire smoke is present in the air. The HSO will communicate available measures for employees to mitigate wildfire smoke exposure and the symptoms of smoke exposure.

3. Information and Training (WAC 296-62-08550):

Employees will be trained in the information presented in this RPP (refer to Section 3.3.9), consistent with mandatory information presented in WAC 296-62-08590, prior to conducting work in the presence of wildfire smoke.

4. Exposure Symptom Response (WAC 296-62-08560):

Employees displaying adverse symptoms of wildfire smoke exposure must be monitored to determine whether medical attention is necessary and may not be penalized for seeking medical treatment. Symptoms of wildfire smoke exposure most often include persistent coughing, difficulty breathing, and aggravation of existing respiratory conditions such as asthma. Provisions for prompt medical treatment will be established for each job site and reviewed during the tailgate safety meetings.

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<sup>1</sup> AirNow reports air quality using the official U.S. AQI, a color-coded index designed to communicate whether air quality is healthy or unhealthy. AirNow is a partnership of USEPA; National Oceanic and Atmospheric Administration; National Park Service; National Aeronautics and Space Administration; U.S. Centers for Disease Control and Prevention; and Tribal, state, and local air quality agencies.

5. Exposure Controls (WAC 296-62-08560):

Floyd|Snider will reduce workers' exposure to wildfire smoke by using the hierarchy of controls. Controls are encouraged whenever the ambient air concentration of PM<sub>2.5</sub> is greater than 20.5 micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ; AQI 69) and required when the concentration of PM<sub>2.5</sub> is greater than 55.5  $\mu\text{g}/\text{m}^3$  (AQI 151).

- A. Engineering controls will be implemented where feasible. Such controls include providing enclosed buildings, structures, or vehicles where the air is adequately filtered.
- B. If engineering controls are not sufficient to reduce exposure, Floyd|Snider will implement administrative controls. Such controls include relocating work to a location with a lower ambient air concentration of PM 2.5, changing work schedules to a time where the ambient air concentration of PM 2.5 is less, reducing work intensity, and providing additional rest periods.
- C. In addition to the standards provided in the emergency regulation (WAC 296-62-085), Floyd|Snider has developed action levels for wildfire smoke exposure to be followed at job sites. Table 3.1 shows the AQI categories, equivalent PM<sub>2.5</sub> measurement in micrograms per cubic meter, the level of health concern, and the action required. The HSO will stop work if the AQI for PM<sub>2.5</sub> is greater than 301 or if it is not possible to conduct field activities safely due to discomfort or decreased visibility.
- D. Where overnight stays are required in areas that do not have filtered indoor air, additional Floyd|Snider policies apply. If the AQI is forecasted to be greater than 301 overnight, or if the AQI exceeds 500 for several hours, the HSO, Floyd|Snider PM, and client PM will coordinate and decide whether demobilization to an off-site location is necessary.

6. Respiratory Protection (WAC 296-62-08570):

Floyd|Snider will provide respirators at no cost to all employees for voluntary use in accordance with WAC 296-842 Safety Standards for Respirators. Employees are encouraged to use respirators any time the PM<sub>2.5</sub> concentration is greater than 20.2  $\mu\text{g}/\text{m}^3$  (AQI 69), and especially when the PM<sub>2.5</sub> concentration is 55.5  $\mu\text{g}/\text{m}^3$  (AQI 151) or greater.

**Table 3.1  
Action Levels for Wildfire Smoke**

AQI Categories for PM2.5	PM2.5 (µg/m <sup>3</sup> )	Levels of Health Concern	Action <sup>(1)</sup>
0 to 50	0 to 12.0	Good	<ul style="list-style-type: none"> <li>• Monitor air quality if wildfire smoke is present.</li> <li>• Stop work if employees have symptoms of smoke exposure.<sup>(2)</sup> All employees have Stop Work authority.</li> </ul>
51 to 68	12.1 to 20.1	Moderate	<ul style="list-style-type: none"> <li>• Monitor air quality.</li> <li>• Stop work if employees have symptoms of smoke exposure.<sup>(2)</sup> All employees have Stop Work authority.</li> <li>• Implement administrative and engineering controls.</li> </ul>
69 to 150	20.2 to 55.4	Unhealthy for Sensitive Groups	<ul style="list-style-type: none"> <li>• Monitor air quality.</li> <li>• Stop work if employees have symptoms of smoke exposure.<sup>(2)</sup> All employees have Stop Work authority.</li> <li>• Implement administrative and engineering controls.</li> <li>• Respirator provided for voluntary use; respirator use is strongly encouraged.</li> <li>• Take frequent breaks in an indoor space with filtered air.</li> </ul>
151 to 200	55.5 to 150.4	Unhealthy	<ul style="list-style-type: none"> <li>• Monitor air quality.</li> <li>• Stop work if employees have symptoms of smoke exposure.<sup>(2)</sup> All employees have Stop Work authority.</li> <li>• Implement administrative and engineering controls.</li> <li>• Respirator provided for voluntary use; respirator use is strongly encouraged.</li> <li>• Provide for frequent breaks—at least once per hour—in an indoor space with filtered air; stop work if an indoor space with filtered air is not available.</li> <li>• Accommodations must have filtered air for multi-day and overnight field events.</li> </ul>
201 to 300	150.5 to 250.4	Very Unhealthy	<ul style="list-style-type: none"> <li>• Monitor air quality.</li> <li>• Stop work if employees have symptoms of smoke exposure.<sup>(2)</sup> All employees have Stop Work authority.</li> <li>• Implement administrative and engineering controls.</li> <li>• Respirator provided for voluntary use; respirator use is strongly encouraged.</li> <li>• Take breaks at least once per hour in an indoor space with filtered air; stop work if an indoor space with filtered air is not available.</li> <li>• Accommodations must have filtered air for multi-day and overnight field events.</li> <li>• Reduce work hours; limit workday to no more than 8 hours on-site.</li> </ul>
301 to 500	250.5 to 500.4	Hazardous	<ul style="list-style-type: none"> <li>• Stop work.</li> <li>• Demobilize to an off-site work location if necessary.</li> </ul>

Notes:

- 1 Respirators can be worn at lower AQI levels based on personal preference. Respirators are provided at no cost to employees for use during any air quality conditions.
- 2 Symptoms of wildfire smoke exposure most often include persistent coughing, difficulty breathing, and aggravation of existing respiratory conditions such as asthma.

### **3.3.5 Selection of Respirators**

Employees can voluntarily use a respirator based on personal preference. Floyd|Snider will provide respirators at no cost to all employees for voluntary use in accordance with WAC 296-842 Safety Standards for Respirators. PPE is the last line of defense and should be considered after engineering and administrative controls are implemented.

The only approved respirator types to be used without fit testing are filtering facepiece respirators (FFRs), also known as N95 dust masks. Per WAC 296-842-10200, FFRs are any tight-fitting, half-facepiece, negative-pressure, particulate air purifying respirator with the facepiece composed mainly of filter material. These respirators do not use cartridges or canisters and may have sealing surfaces composed of rubber, silicone, or other plastic-like materials. Employees may elect to use respirators for other voluntary uses such as to control nuisance odors and may additionally elect to use respirators other than FFRs for protection from wildfire smoke if the respirator provides protection from PM2.5 equivalent to or greater than an FFR. Use of respirators other than FFRs is subject to fit testing requirements in accordance with the manufacturer specifications. Fit testing, if required for the selected respirator, is provided by Floyd|Snider at no cost to employees.

The National Institute for Occupational Safety and Health (NIOSH) of the U.S. Centers for Disease Control and Prevention certifies N95 respirators including FFRs. A label or statement of certification by NIOSH should appear on the respirator or respirator packaging. KN95 respirators, which are filtering facepiece respirators manufactured to the Chinese particulate filtration standard equivalent to N95, are approved for respiratory protection by the U.S. Food and Drug Administration and may also be used if an adequate supply of NIOSH-approved respirators is not available.

Any employee who experiences any difficulties while wearing a respirator must immediately inform their supervisor. If an employee requests to wear a respirator other than an FFR, they must contact their supervisor to ensure the respirator is appropriate and properly fitted for the user.

### **3.3.6 Medical Evaluations**

All Floyd|Snider field staff participate in a medical monitoring program and are evaluated biennially. This evaluation includes respiratory clearance and accomplishes the goal of medical clearance for this program on a voluntary use basis per WAC 296-842-11005. Workers with breathing problems such as asthma, COPD, or chronic heart and lung disease should communicate these conditions to their doctor to determine whether it is safe for them to voluntarily wear an FFR or other type of protection at work. Respirators restrict breathing and can put stress on the heart and lungs, which may worsen health symptoms.

### 3.3.7 Respirator Fit and Seal Check

Proper fit is necessary to get the most protection from a respirator. Fit testing is not required for FFRs, so employees are not required to participate in fit testing; however, fit testing can be provided at employee request. Note that facial hair, piercings, or facial abnormalities may disqualify an employee from using certain types of tight-fitting respirators. Shaving facial hair is recommended, but not required, for voluntary FFR use. Employees who choose to use a tight-fitting elastomeric respirator (half- or full-face respirators) will require fit testing and additional training, which Floyd|Snider will provide at no cost to employees.

FFRs should fit according to the manufacturer's instructions. Elastic straps, a moldable nosepiece, or adhesive may be used to aid in sealing. A seal check should be performed after fitting the respirator to the face, using the following procedure:

1. Cover the respirator with both hands and exhale. If air leaks where the respirator seals against the face, readjust the respirator and nosepiece and try again. When a proper fit is achieved, the respirator should bulge from the face and not leak around the seal.
2. Cover the respirator with both hands and inhale. If air leaks where the respirator seals against the face, readjust the respirator and nosepiece and try again. When a proper fit is achieved, the respirator should collapse slightly and not leak around the seal.

The following video provides additional demonstration of fitting the respirator to the face and performing a seal check: <https://www.youtube.com/watch?v=GmJxzGXelvo>.

### 3.3.8 Respirator Replacement, Maintenance, and Storage

FFRs are disposable and generally designed for single use (i.e., one 8-hour day); however, the total hours of use may vary by manufacturer. Employees will replace respirators according to the manufacturer-recommended schedule, or a minimum of once per work day if not specified. Disposable respirators should also be immediately discarded if, at any time during use, they become damaged, deformed, dirty, or difficult to breathe through. The number of times an FFR is doffed and donned should be limited whenever possible. Respirators other than FFRs will be maintained or replaced (in full or in part, such as in the case of respirators with detachable cartridges) according to the manufacturer specification. Respirators will be given to a specific employee and may not be shared among employees.

Before donning, respirators will be inspected by the user for damage, deterioration, or improper functioning before use. FFRs will also be checked for proper sealing using the seal check procedures described in Section 3.3.7.

Respirators will be stored in a clean, dry, and sealed area in the field room, field vehicle, or a designated clean area on the job site.

### 3.3.9 Training

Training will be provided to all employees who voluntarily wear respirators. At a minimum, the training will cover the following information:

- Identification of the hazard (i.e., wildfire smoke)
- Floyd|Snider's policy on hazard communication and how to obtain current information regarding the AQI
- Potential health affects as a result of exposure to the hazard
- Employee rights regarding medical treatment for exposures
- Mitigation measures for smoke exposure
- Employer requirements to provide respirators under the L&I emergency rule
- The respirator's capabilities and limitations
- Proper fit, use, and maintenance of respirators

### 3.3.10 Record Keeping

As per WAC 296-842-11010, voluntary use of respirators does not require record keeping; however, all employees are required to read and sign this APP, and Floyd|Snider will retain a copy of the signature page and any additional relevant training materials.

## 3.4 BUILDING SECURITY

For security purposes, Union Square is equipped with an access card system. Computerized proximity cards let you enter the building on your own, any time, but prevent unauthorized access to the building.

To help maintain the integrity of this system:

- Do not let others follow you into the building when exiting and entering when entrances to the building are locked.
- Notify Tenant Services of lost access cards.
- Notify the company when transferring ownership of access cards.

General regular building hours are defined as the time between 6:00 a.m. and 6:30 p.m. After-hours are defined as the time between 6:30 p.m. and 6:00 a.m. During this time period, One and Two Union Square are in after-hours mode and will require an after-hours access card for entry into the buildings.

There is a security guard desk in the main lobby where any security-related incidents should be reported. The security guards are also available to escort employees to their vehicles if they are

feeling unsafe for any reason or can provide access to the office (after verifying your employment status by calling a Principal) if you do not have your access card or keys with you.

## **3.5 VEHICLE SAFETY**

Floyd|Snider maintains a company vehicle for use during field work and to attend meetings. Personal vehicles and/or rental vehicles may be used if additional transportation is needed for a specific task. General vehicle safety and Floyd|Snider vehicle-specific procedures when driving for business purposes are described in the following sections.

### **3.5.1 General Vehicle Safety**

Before driving a vehicle, always perform a safety check:

- Walk around and look for damage such as broken reflectors, damaged mirrors, windshield cracks, missing wiper blades, obviously low tire pressure or damage to tires, new dents, or scratches. Report new damage to the Equipment Manager. Do not drive a vehicle with obvious tire damage or an unrepaired windshield crack. Also note collision hazards in the immediate area.
- Check the vehicle emergency kit for the following items: first aid kit, potable water, eye wash, fire extinguisher, Mylar blanket, road flares, and collapsible traffic cones.
- Ensure that all items stored inside the vehicle are secure and will not slide or tumble during transport. Do not drive with unsecured loads.
- Start the vehicle and check that safety systems are working: headlights, turn signals, emergency flashers, headlights, brake lights, and windshield wipers. Check for dashboard warning lights and address any critical safety warnings (low tire pressure, low oil pressure, high engine temperature, antilock brake system, battery) immediately.

When driving a vehicle for business purposes, all traffic laws must be obeyed. Obey speed limits and all posted signs. Minimize distractions and stay aware of your surroundings. In addition to your safety, you are also a representative of the company behind the wheel and should not conduct any behaviors that would put you or Floyd|Snider in a negative light.

The following safety violations will not be tolerated by Floyd|Snider and will cause revocation of your driving privileges for company business purposes (even if they occur after business hours):

- Texting/cell phone use while driving (hands-free device permitted)
- Citations for reckless driving
- Use of alcohol or drugs before or while driving
- Carrying more passengers than available seatbelts

In the event of an accident, call 911 and follow the procedures in Section 4.3. In the event of a breakdown, call roadside assistance if possible in the area where you are located. If roadside assistance is not available, staff may perform basic tasks (such as addressing a flat tire) in order to be able to return to the office safely only if they are trained and feel comfortable to do so. If you are stuck, call your PM to arrange for emergency assistance.

In the event of a multi-day field effort or a late-night finish, all field equipment (high-dollar-value items) must be stored in a locked garage or other locked storage area for the night and should not be left in the vehicle.

### **3.5.2 Floyd|Snider Vehicle Safety**

The Floyd|Snider vehicle is not equipped with 4-wheel drive, so no off-road driving should be attempted. If the project site is especially muddy or has limited access, an appropriate vehicle should be rented. No one other than Floyd|Snider employees (except for emergency personnel in case of emergency or qualified repair personnel) should be allowed to drive the company vehicle. Do not smoke in the company vehicle.

A first aid kit and fire extinguisher will be kept in the vehicle at all times. A checklist of supplies is kept in the vehicle bulkhead vertical file area and inside the door to the field room for reference. Additional safety supplies that are stocked in the vehicle include nitrile and work gloves, hearing protection, safety glasses, and basic decontamination equipment including Alconox solution, distilled water, disinfectant spray/wipes, and paper towels. If you have used these items, please notify the Health and Safety Committee so they can be replenished. The vehicle is also equipped with basic maintenance supplies including a jack, air pump, and spare tire. The gas tank should always be left at least half full before returning the company vehicle to the garage. The vehicle engine has a minimum octane rating and should be filled with premium gasoline.

Report vehicle warning lights immediately to the Equipment Manager or a designated alternate in the event that the Equipment Manager is not available. The Equipment Manager will work with you to determine a plan to safely address the warning light. If you cannot use the field vehicle safely, notify your PM to assist you with arranging an alternate vehicle. Tire pressure warning lights should be addressed immediately using the pump stored in the van or at a service station if a station is readily available—never drive a vehicle with insufficient tire pressure.

The Equipment Manager will be responsible for making sure the following routine maintenance is performed (but please notify them immediately if you notice any other problems):

- Oil changes and periodic routine maintenance per dealer schedule
- Monthly walk-around check (tires, lights, damage, etc.)
- Detailing when needed

### 3.6 CONTROLLED SUBSTANCE ABUSE

Floyd|Snider has a strong commitment to provide a safe and drug-free workplace for its employees.

Drug or alcohol testing of current employees may be performed where (a) there are reasonable grounds to believe an employee is under the influence of or suspected of consuming alcohol or using marijuana during work hours or using illegal drugs at any time; (b) as a follow-up to a rehabilitative program; or (c) on a random basis when health and safety requirements for clients or projects necessitate testing.

If the alcohol or drug test reveals positive results, the employee may be suspended pending evaluation of the situation by management.

An employee who voluntarily seeks assistance on a timely basis for an alcohol- or drug-related problem, prior to the company identifying the problem, may do so without jeopardizing their employment status, provided the prescribed treatment is followed and work performance is acceptable. In some cases, temporary reassignment may be necessary.

If an employee is undergoing a prescribed medical treatment with a substance that may alter physical or mental capacity, the employee must report this to the Health and Safety Administrator, particularly if they will be conducting field work. The Health and Safety Administrator will coordinate with the Board of Directors, who will determine how to manage the affected employee's work load.

Any manager who observes or receives a report of alcohol or drug use must promptly investigate the allegations in a confidential manner. The Board of Directors should also be notified immediately. Any other employee who observes or has knowledge of a violation, whether by an employee or others, has an obligation to promptly report this to their immediate supervisor. If an employee's immediate supervisor is suspected of violating the company's drug and alcohol policy, the report should be made directly to the Board of Directors.

In any instance where there exists an imminent threat to the safety of persons or property, an employee shall immediately contact a Principal.

## 4.0 Emergency Procedures

This section defines the emergency procedures for Floyd|Snider. Reasonably foreseeable emergency situations include medical emergencies; accidental release of hazardous materials or hazardous waste; and general emergencies such as vehicle accident, fire, thunderstorm, and earthquake.

A muster point should be designated for all personnel. The Floyd|Snider office emergency muster point is at the Paramount Theatre, on the corner of Pine Street and 9<sup>th</sup> Avenue. A map of the office evacuation route and a map of the locations of first aid kits, fire extinguishers, and AEDs is posted in all communal office spaces including kitchens and conference rooms, is available on the Floyd|Snider SharePoint home page. On a job site, the SSO should designate a muster point that is clear of adjacent hazards and not located downwind of site activities and communicate this location to the field team each day. In an emergency, all personnel and visitors will evacuate to the muster point for roll call.

It is important that each person understand their role in an emergency and that they remain calm and act efficiently to ensure everyone's safety. Expected actions for potential emergency situations are outlined in the following sections.

### 4.1 MEDICAL EMERGENCIES

In the event of a medical emergency, the following procedures should be used:

- Stop any imminent hazard if you can safely do so.
- Remove ill, injured, or exposed persons from immediate danger if moving them will clearly not cause them harm and no hazards exist to the rescuers.
- Evacuate other personnel from the immediate vicinity until the ill, injured, or exposed persons have been evacuated and it is safe for work to resume.
- If serious injury or a life-threatening condition exists, call 911 for paramedics, fire department, and police. When in doubt, contact emergency services; do not drive a seriously ill or injured person to the hospital unless emergency services cannot be summoned (for example, if phone service is out or there is not an ambulance that can reach the location).
- Clearly describe the location, injury, and conditions to the dispatcher. Designate a person to go to the site entrance and direct emergency equipment to the injured persons. Provide the responders with information about any chemical hazards that might be present on a job site.
- Trained personnel may provide first aid/CPR if it is necessary and safe to do so. Remove contaminated clothing and PPE only if this can be done without endangering the injured person.

- Once more highly trained personnel (i.e., emergency services) have taken over care of the person experiencing the medical emergency, immediately contact the staff member's designated emergency contact person.
- If you are in the field, notify your PM and HSO/SS.
- If a person experiencing a medical emergency is taken to the hospital, another staff member should accompany whenever possible and remain at the hospital until a designated emergency contact person arrives.
- Immediately implement steps to prevent recurrence of the accident.

#### **4.2 ACCIDENTAL RELEASE OF HAZARDOUS MATERIALS OR WASTES**

In the event of a release of a hazardous material or waste:

1. Evacuate all personnel to the designated emergency muster point until it is safe for work to resume.
2. If you are in the field, instruct a designated person to contact the PM or HSO/SS and confirm a response. If a release occurs in the office, the Floor Wardens will contact building security.
3. Contain the spill, if it is a known material, is possible, and can be done safely.
4. If the release is not stopped, contact 911 to alert the fire department.
5. Contact the Washington State Emergency Response Commission at 1 (800) 258-5990 to report the release.
6. Initiate the cleanup process. Cleanup must be performed by professionals trained in cleanup response for the type of material released.
7. Submit a written report to the Washington State Department of Ecology in the event of a reportable release of hazardous materials or wastes.

#### **4.3 OTHER EMERGENCIES AND NATURAL DISASTERS**

##### ***Vehicle Accident***

In the event of an accident:

- Check yourself and your passengers and, if safe to do so, any other persons involved in the accident for serious injuries. If anyone is seriously injured, call 911 and wait for emergency personnel.
- If the vehicle can be moved, move to the shoulder or side of the road out of the way of traffic before calling 911. Do not leave the scene of the accident, and avoid engaging in conversation with other persons involved, aside from confirming injury status.
- If the vehicle cannot be moved, get yourself and your passengers to safety if possible. If the vehicle is disabled in a place with fast moving traffic (such as a multi-lane freeway), it may be safest to wait in the vehicle. Use your best judgment.

- If you are able to move the vehicle to the shoulder, use road flares (located in the vehicle emergency kit) to warn oncoming drivers.
- Wait for police to arrive and fill out an accident report.
- Call your PM or HSO/SS to report the accident. In the case of a minor accident, the PM or HSO/SS will consult with the Equipment Manager to determine whether the vehicle should be driven back to the office or towed to a repair facility. Contact roadside assistance if towing is needed.

## ***Fire***

During the incipient phase of a fire, the available fire extinguisher may be used by persons trained in putting out fires, if it is safe for them to do so.

If a fire is identified in the office building (either by smell or by the fire alarm), walk to the nearest emergency exit and walk down the stairs (do not use the elevator). Walk to the emergency muster point. Use common sense during a fire to avoid injury if areas are inaccessible.

In the case of a fire in a job site, work shall be halted and all onsite personnel will be immediately evacuated to the emergency muster point, if the fire cannot be extinguished. The local police/fire department shall be notified if the emergency poses a continuing hazard by calling 911.

## ***Thunderstorm***

A thunderstorm may present danger of lightning strike any time that visible lightning or audible thunder are present.

In the event of a thunderstorm, seek shelter inside a building if possible. Avoid concrete walls and floors, corded phones, and puddles. When a thunderstorm is accompanied by high winds, also avoid windows. If sheltering in a building is not possible, shelter inside your vehicle, and avoid direct contact with any metal objects in contact with the frame of the vehicle.

Do not resume work activities outdoors until at least 30 minutes have elapsed since the last thunder or lightning was observed.

## ***Earthquake***

If you are inside a building during an earthquake, the area near the exterior wall of a building is the most dangerous place to be. Windows, facades, and architectural details are often the first parts of the building to collapse. To stay away from this danger zone, stay inside if you are inside and outside if you are outside. In a high-rise: drop, cover, and hold on. Face away from windows and other hazards. Do not use elevators. Do not be surprised if sprinkler systems or fire alarms activate. Once the earthquake is over, be alert for aftershocks that might occur, follow instructions of your Floor Warden or building security, take your emergency kit or emergency supplies, proceed to the emergency exit, and walk down the stairs. Walk to the emergency

muster point. The above are general guidelines and are not meant to apply to every situation, so please use common sense during an earthquake to avoid injury. Additional office safety precautions for earthquakes are posted in the Production Room of the Floyd|Snider office and posted to the Health and Safety department page on SharePoint.

If you are on a jobsite when an earthquake occurs, move away from buildings, overhead power lines, and any other structures that may collapse. Get down low and stay down until the shaking stops to avoid injury. If you are in a moving vehicle, stop as quickly and safely as possible. Move to the shoulder or curb, away from utility poles, overhead wires, and under- or overpasses. Stay in the car and set the parking brake. Turn on the radio for emergency broadcast information. A vehicle may jiggle violently on its springs, but it is a good place to stay until the shaking stops. If a power line falls on the vehicle, stay inside until a trained person removes the wire. After the shaking stops, take your emergency supplies and proceed to the emergency muster point if it is safe to do so. Call your PM or HSO/SS when it is safe to do so.

#### **4.4 EMERGENCY COMMUNICATIONS**

Emergencies at Union Square will be communicated by building security using the public address system. If an emergency announcement is made, pause what you are doing and listen to the entire message. Emergencies involving the Floyd|Snider office only may be communicated over the office telephone system.

In the case of a job site emergency, signals may vary by site and should be discussed at daily tailgate meetings so all personnel on-site are aware of the site-specific signals and alarms. In general, horns (vehicle or airhorns) are used as needed to signal the emergency. One long (5-second) blast will be given as the emergency/stop work signal. If horns are not working, waving of arms is typically used to signal an emergency. In any emergency, all personnel will evacuate to the designated muster point and await further instruction.

After an emergency is resolved, the involved personnel or management will meet and debrief on the incident—the purpose is not to fix blame, but to improve the planning and response to future emergencies. The debriefing will review the sequence of events, what was done well, and what can be improved. The debriefing will be documented in a written format and filed by the Health and Safety Administrator.

#### **4.5 EMERGENCY EQUIPMENT**

The following minimum emergency equipment will be readily available in the office and at all job sites and functional at all times:

- First Aid Kit: Contents approved by the HSO/SS, including two blood-borne pathogen barriers. First aid kits are located in the company vehicle; a personal vehicle kit is located in the field room and should be used when field staff drive personal or rental vehicles; and in the office, first aid kits are located at each fire extinguisher location in the north hall, west hall, main kitchen, and large conference room. The location of

first aid kits and fire extinguishers will also be posted on maps kept in communal office spaces (kitchens and conference rooms).

- Portable fire extinguishers are included in the field first aid/safety kits and are also located in the office in the north hall, west hall, main kitchen south entrance, and Cedar Conference room.
- A copy of the HASP if on a job site.
- A binder of Safety Data Sheets (SDSs) for commonly encountered chemicals and all potential contaminants of concern that may be present on a job site. This binder is kept in the document organizer compartment of the company vehicle and an additional copy is kept in the field room.

## **4.6 INCLEMENT WEATHER**

Occasionally, there are weather conditions, like snow, that make travel difficult. If the Seattle Public Schools are closed for the day due to hazardous road conditions, then the office will also be closed out of concern for your safety. Any field work scheduled during an office closure due to inclement weather should also be postponed.

## **4.7 CATASTROPHIC EVENTS**

Floyd|Snider has formed an Emergency Planning Committee to develop preparation, communication, and safety plans to implement if a catastrophic event occurs. A catastrophic event is an event that disrupts or destroys critical infrastructure, such as a large-scale earthquake or other natural disaster.

### **Emergency Kits**

Each staff member is provided one emergency kit backpack in case of emergencies that disrupt transportation or utilities. These backpacks include a map with critical structures, contact list and work plan, 32-ounce water bottle (to be filled and replaced every 6 months by the employee), additional 14-ounce water bottle and Platypus water container, water purification tablets, food bars, magnesium firestarter and matches, a multi-purpose tool, an LED flashlight and extra batteries, an emergency radio, an emergency (heat reflective) blanket, rags, nylon rope, a tarp and trash bags, duct tape, hand cleanser, Super Glue, and a hiker's first aid kit. Employees should provide their own raingear, extra socks, walking/hiking shoes, family plan, sunscreen, and 3-day supply of critical medicines. Not all packs are exactly the same, but all should include the items listed above. The Emergency Planning Committee will send regular reminders to check emergency kits and replace expired items.

Staff members should keep their emergency contact card up to date, listing phone numbers for whom to contact if they are unable to make calls themselves. Emergency contact cards should be kept in the front pocket of the backpack, where they can be easily located by others.

Staff should familiarize themselves with the contents of the emergency backpack to make sure all necessary items are included and that they are operational. The Emergency Planning Committee will remind staff every 6 months to check and update backpack contents (replace water in water containers, check the expiration date on the nutrient bars, update contact list if it is not current, etc.). Staff are responsible for keeping the employee contact list updated and having a sensible pair of shoes available in the office.

## **WhatsApp Emergency Contact Group**

The purpose of our WhatsApp group is for group coordination needs during periods of emergency. It will be an easy way for management to communicate next steps back to the entire group, such as the status of the office/IT and expected timelines for returning to work. It also serves as an additional way to check in and communicate that staff and family are safe. Remember, immediately after an emergency, the initial call to check in with Jessi should still be made. Join the Floyd|Snider group on WhatsApp:

1. Download the WhatsApp app on to your phone and setup your account
2. Join the “F|S Emergency Contact” group by following the instructions on the Health & Safety Department site:  
<https://floydsnider.sharepoint.com/Dept/Safety/SitePages/Emergencies.aspx#emergency-coordination-whatsapp>

At the 6-month check-in time for backpack contents, employees should also confirm that they are still connected and included in the WhatsApp group. If an employee has been removed from the group (which can occur during software updates, etc.), the employee should notify the Emergency Planning Committee to have the group invitation resent so they can rejoin the group.

## **What to Do if You Are in the Office When a Disaster Occurs**

If you are in the office when an emergency occurs, first and foremost is to remain safe. Wait until the building gives instructions over the PA system, then take your emergency kit and exit the building safely and quickly to meet at the Floyd|Snider muster point at the Paramount Theatre, on the corner of Pine Street and 9<sup>th</sup> Avenue. Once you have checked in with other Floyd|Snider staff there, you should find your way home safely to check on family and property. Jessi Massingale has been identified as the Disaster Contact. One person from the muster point will contact Jessi once all employees have been safely evacuated. Floyd|Snider will use the WhatsApp group to communicate next steps, as well as email (if available). WhatsApp is described in more detail above.

## **What to Do if You Are Not in the Office When a Disaster Occurs**

If you are not in the office when an emergency occurs, the first thing to do after ensuring your safety and the safety of your family and property, is to text Jessi or Matt Massingale in Bend, Oregon. Report that you are okay and await further instructions. Other management team

members can also be contacted if needed. Floyd|Snider will use the WhatsApp group to communicate next steps, as well as email (if available).

<b>In Emergency, Text Jessi/Matt in Bend</b>		
Jessi	206.683.4307 (cell)	
Matt	206.255.2799 (cell)	541.241.6255 (work)
<b>Management Team Numbers</b>		
Allison	206.722.2460 (cell)	206.842.4484 (home)
Tiffany	206.779.2806 (cell)	

**Building Access**

Depending on the severity of the disaster, Union Square may be closed for inspection, bus routes may be disrupted, and cell phone service may be limited. The nature and likely duration of the emergency aftermath will affect decision-making around working at the office during this time. Floyd|Snider will send out communications via WhatsApp and/or email with information on when to resume work and when it is safe to return to the office.

## **5.0 Hazard Awareness and Mitigation**

In general, there are three broad hazard categories that may be encountered on the job: chemical exposure hazards, fire and explosion hazards, and physical hazards. Sections 5.1 through 5.3 discuss the specific hazards that fall within each of these broad categories and ways to mitigate these hazards.

Additional hazard analysis for specific chemicals present or tasks to be performed at a job site should be detailed in the HASP for the site.

### **5.1 CHEMICAL EXPOSURE HAZARDS**

Potential toxic effects can occur from significant acute or chronic exposure to hazardous chemicals.

Hazardous products used in the office or on the job site should be sealed and stored in places where they cannot be easily spilled. Always follow manufacturer instructions for storage and use of hazardous chemicals. Discard chemicals no longer in use in accordance with manufacturer's instructions, and discard chemicals if containers are damaged, corroded, or otherwise leaking. Consider nontoxic alternatives to cleaning and other products when possible. Consider use of gloves or eye protection when handling or using chemicals with the potential to irritate eyes or skin if contacted.

On contaminated sites and on work sites where hazardous chemicals are used, chemical exposure hazards, monitoring procedures, and decontamination procedures should be detailed in the site HASP.

### **5.2 FIRE AND EXPLOSION HAZARDS**

When storage of material posing a fire and explosion hazards is necessary, such material will be stored in containers approved by the Washington State Department of Transportation in a location not exposed to strike hazards and provided with secondary containment. A minimum 2A:20B fire extinguisher will be located within 25 feet of the storage location and where refueling occurs. Any subcontractors bringing flammable and combustible liquid hazards to a job site are responsible for providing appropriate material for containment and spill response, which should be addressed in their respective HASP, Job Hazard Analysis (JHA), or Job Safety Analysis (JSA). Transferring of flammable liquids (e.g., gasoline) will occur in areas with containment to capture any spillage, and only after making positive metal-to-metal connection between the containers, which may be achieved by using a bonding strap. Storage of ignition and combustible materials will be kept away from fueling operations.

### **5.3 PHYSICAL HAZARDS**

When working in or around any hazardous or potentially hazardous substances or situations, all personnel should plan all activities before starting any task. Personnel shall identify health and

safety hazards involved with the work planned. If you have concerns or uncertainty about the safety of a given task, always consult with your PM or, if in the field, with your HSO/SS to determine how the task can be performed in the safest manner.

All field personnel will adhere to general safety rules including wearing appropriate PPE—hard hats, steel-toed boots, high-visibility vests, safety glasses, gloves, and hearing protection, as appropriate. Eating, drinking, and/or use of tobacco or cosmetics will be restricted in all work areas. Personnel will prevent splashing of liquids containing chemicals and minimize dust emissions.

The following table summarizes a variety of physical hazards that may be encountered during work activities. For convenience, these hazards have been categorized into several general groupings with recommended preventative measures.

Hazard	Cause	Prevention
Head strike	Falling and/or sharp objects, bumping hazards	Hard hats will be worn by all personnel at all times when overhead hazards exist.
Foot/ankle twist, crush, slip/trip/fall	Sharp objects, dropped objects, uneven and/or slippery surfaces	Steel-toed boots must be worn at all times on site while heavy equipment is present. Pay attention to footing on uneven or wet terrain and do not run. Keep work areas organized and free from unmarked trip hazards.
Hand cuts, splinters, and chemical contact	Hands or fingers pinched or crushed; chemical hazards; cut or splinters from handling sharp/rough objects and tools	Nitrile safety gloves will be worn to protect the hands from dust and chemicals. Leather or cotton outer gloves will be used when handling sharp-edged rough materials or equipment. Refer to preventive measures for mechanical hazards below.
Eye damage from flying materials, or splash hazards	Sharp objects, poor lighting, exposure due to flying debris or splashes	Safety glasses will be worn at all times on a job site. If a pressure washer is used to decontaminate heavy equipment, a face shield will be worn over safety glasses or goggles. Care will be taken during decontamination procedures to avoid splashing or dropping equipment into decontamination water.

Hazard	Cause	Prevention
Electrical hazards	Electrical cord hazards	<p>Make sure that no damage to extension cords occurs. If an extension cord is used, make sure it is the proper size for the load that is being served and rated SJOW or STOW (an “-A” extension is acceptable for either) and inspected prior to use for defects. The plug connection on each end should be of good integrity. Insulation must be intact and extend to the plugs at either end of the cord.</p> <p>All portable power tools will be inspected for defects before use and must be either double-insulated or grounded with a ground-fault circuit interrupter.</p>
Mechanical hazards	Heavy equipment such as drilling machine	<p>Ensure the use of competent operators, backup alarms, “kill” switches, regular maintenance, daily mechanical checks on all hoses and cables, and proper guards. Verify that “whip checks” or similar securing devices are installed on “quick-connections,” where the failure of high-pressure connections could lead to the whipping of hoses. Discuss the need for plastic sheeting or other methods to contain drips (hydraulic oil, motor oil, etc.) to determine if measures are needed to prevent releases to the ground. Subcontractors will supply their own JHA, HASP, or JSA. All personnel will make eye contact with operator and obtain a clear OK before approaching or working within a hazardous radius of the heavy equipment.</p>
Noise damage to hearing	Machinery creating more than 85 decibels time-weighted average, less than 115 decibels continuous noise, or peak at less than 140 decibels	<p>Wear earplugs or protective ear covers when a conversational level of speech is difficult to hear at a distance of 3 feet or if an employee must shout to be heard by nearby coworkers; when in doubt, a sound level meter may be used on site to document noise exposure.</p>

Hazard	Cause	Prevention
Strains from improper lifting	Injury due to improper lifting techniques, overreaching/overextending, lifting overly heavy objects	<p>Use proper lifting techniques and mechanical devices where appropriate. The proper lifting procedure first involves testing the weight of the load by tipping it. If in doubt, ask for help. Do not attempt to lift a heavy load alone.</p> <p>Take a good stance and plant your feet firmly with legs apart, one foot farther back than the other. Make sure you stand on a level area with no slick spots or loose gravel. Use as much of your hands as possible, not just your fingers. Keep your back straight, almost vertical. Bend at the hips, holding load close to your body. Keep the weight of your body over your feet for good balance. Use large leg muscles to lift. Push up with one foot positioned in the rear as you start to lift. Avoid quick, jerky movements and twisting motions. Turn the forward foot and point it in the direction of the eventual movement. Never try to lift more than you are accustomed to lifting.</p>
Traffic hazards	Vehicle traffic and hazards when working near active operations	<p>When working in or near the right-of-way, orange cones and/or flagging will be placed around the work area. Safety vests will be worn at all times while conducting work in or near the right-of-way. Multiple staff will work together (buddy system) and spot traffic for each other. Avoid working with your back to traffic whenever possible.</p>
Cold stress	Cold temperatures and related exposure	<p>Workers will ensure appropriate clothing, stay dry, and take breaks in a heated environment when working in cold temperatures. Further detail on cold stress is provided in Section 5.3.1.</p>
Heat exposure	High temperatures exacerbated by PPE, dehydration	<p>Workers will ensure adequate hydration, shade, and breaks when temperatures are elevated. Further detail on heat stress is provided in Section 5.3.2.</p>
Accidents due to inadequate lighting	Improper illumination	<p>Work will proceed during daylight hours only or under sufficient artificial light.</p>
Drowning hazards	Work in or near water	<p>Wear a personal flotation device at all times when working in or near water. Be aware of surroundings including head strike and trip hazards that could cause a fall into water.</p>

Hazard	Cause	Prevention
Slip, trip, and fall hazards	Working in vegetated areas, areas with uneven ground surface, or areas with obstructions	Watch your step when walking and minimize distractions. Establish a path free of obstructions before mobilizing equipment.

### 5.3.1 Cold Stress

Exposure to moderate levels of cold can cause the body’s internal temperature to drop to a dangerously low level, causing hypothermia. Symptoms of hypothermia include slow, slurred speech, mental confusion, forgetfulness, memory lapses, lack of coordination, and drowsiness.

To prevent hypothermia, stay dry and avoid exposure. On a job site, personnel will have access to a warm, dry area, such as a vehicle, to take breaks from the cold weather and warm up. Site personnel will be encouraged to wear sufficient clothing in layers such that outer clothing is wind- and waterproof and inner layers retain warmth (wool or polypropylene), if applicable. Site personnel will keep hands and feet well protected at all times. The signs and symptoms and treatment for hypothermia are summarized below.

#### *Signs and Symptoms*

- Mild hypothermia (body temperature of 98 to 90 °F)
  - Shivering
  - Lack of coordination, stumbling, fumbling hands
  - Slurred speech
  - Memory loss
  - Pale, purplish gray, or dusky and cold skin
- Moderate hypothermia (body temperature of 90 to 86 °F)
  - Shivering stops
  - Unable to walk or stand
  - Confused and irrational
- Severe hypothermia (body temperature of 86 to 78 °F)
  - Severe muscle stiffness
  - Very sleepy or unconscious
  - Ice cold skin
  - Death

## ***Treatment of Hypothermia—Proper Treatment Depends on the Severity of the Hypothermia***

- Mild hypothermia
  - Move to warm area.
  - Stay active.
  - Remove wet clothes, replace with dry clothes or blankets, and cover the head.
  - Drink warm (not hot) sugary drinks.
- Moderate hypothermia
  - All of the above, plus:
    - Call 911 for an ambulance.
    - Cover all extremities completely.
    - Place very warm objects such as hot packs or water bottles on the victim's head, neck, chest, and groin.
- Severe hypothermia
  - Call 911 for an ambulance.
  - Treat the victim very gently.
  - Do not attempt to re-warm—the victim should receive treatment in a hospital.

## ***Frostbite***

Frostbite occurs when the skin actually freezes and loses water. In severe cases, amputation of the frostbitten area may be required. Although frostbite usually occurs when the temperatures are 30 °F or lower, wind chill factors can allow frostbite to occur in above-freezing temperatures. Frostbite typically affects the extremities, particularly the feet and hands. Frostbite symptoms include cold, tingling, stinging, or aching feeling in the frostbitten area followed by numbness and skin discoloration: Paler skin may change from red to purple, then to white or very pale, and darker skin may become more pale, dusky, or purplish. Frostbitten skin will be waxy and firm while still frozen and may redden, swell, or blister when thawed. Should any of these symptoms be observed, wrap the area in soft cloth, do not rub the affected area, and seek medical assistance. Call 911 if the condition is severe.

## ***Protective Clothing***

Wearing the right clothing is the most important way to avoid cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. The following are recommendations for working in cold environments:

- Wear at least three layers of clothing.
  - An outer layer to break the wind and allow some ventilation (like Gore-Tex or nylon)

- A middle layer of down or wool to absorb sweat and provide insulation even when wet
- An inner layer of cotton or synthetic weave to allow ventilation
- Wear a hat—up to 40 percent of body heat can be lost when the head is left exposed.
- Wear insulated boots or other footwear.
- Keep a change of dry clothing available in case work clothes become wet.
- Do not wear tight clothing—loose clothing allows better ventilation.

## **Work Practices**

- Drinking—Drink plenty of liquids, avoiding caffeine and alcohol. It is easy to become dehydrated in cold weather.
- Work Schedule—If possible, heavy work should be scheduled during the warmer parts of the day. Take breaks out of the cold in heated vehicles.
- Buddy System—Work in pairs to keep an eye on each other and watch for signs of cold stress.

## **5.3.2 Heat Stress**

To avoid heat-related illness, current regulations in WAC 296-62-095 through 296-62-09570 will be followed during all outdoor work activities. These regulations apply to any outdoor work environment from May 1 through September 30 when workers are exposed to temperatures greater than 89 °F when wearing breathable clothing, greater than 77 °F when wearing double-layered woven clothing (such as jackets or coveralls), or greater than 52 °F when wearing non-breathing clothing such as chemical resistant suits or Tyvek. Floyd|Snider will identify and evaluate temperature, humidity, and other environmental factors associated with heat-related illness including, but not limited to, the provision of rest breaks that are adjusted for environmental factors and encourage frequent consumption of drinking water. Drinking water will be provided and made readily accessible in sufficient quantity to provide at least 1 quart per employee per hour. All Floyd|Snider personnel performing outdoor work will be informed and trained for responding to signs or symptoms of possible heat-related illness and accessing medical aid.

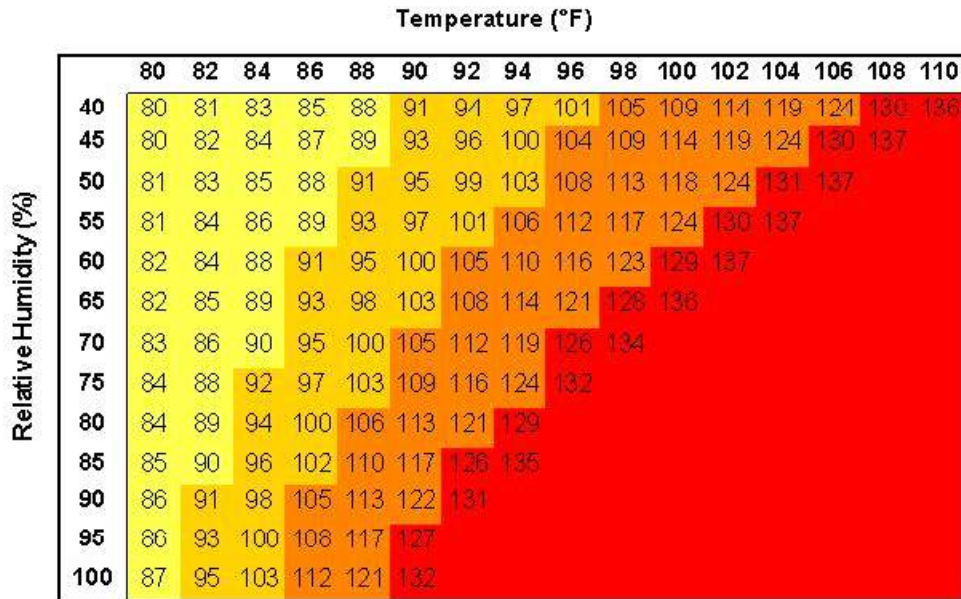
Employees showing signs or demonstrating symptoms of heat-related illness must be relieved from duty and provided with a sufficient means to reduce body temperature, including rest areas or temperature-controlled environments (i.e., air conditioned vehicle). Any employee showing signs or demonstrating symptoms of heat-related illness must be carefully evaluated to determine whether it is appropriate to return to work or whether medical attention is necessary.

Any incidence of heat-related illness must be immediately reported to the employer directly through the HSO/SS.

The signs, symptoms, and treatment of heat stress include the following:

Condition	Signs/Symptoms	Treatment
Heat cramps	Painful muscle spasms and heavy sweating	Increase water intake, rest in shade/cool environment.
Heat syncope	Brief fainting and blurred vision	Increase water intake, rest in shade/cool environment.
Dehydration	Fatigue, reduced movement, headaches	Increase water intake, rest in shade/cool environment.
Heat exhaustion	Pale and/or clammy skin, possible fainting, weakness, fatigue, nausea, dizziness, heaving sweating, blurred vision, body temperature slightly elevated	Lie down in cool environment, water intake, loosen clothing, and call 911 for ambulance transport if symptoms continue once in cool environment.
Heat stroke	Cessation of sweating, skin hot and dry, red or flushed face, high body temp, unconsciousness, collapse, convulsions, confusion or erratic behavior; life-threatening condition	<b>Medical Emergency!! Call 911</b> for ambulance transport. Move victim to shade and immerse in water.

If site temperatures are forecast to exceed 85 °F and physically demanding site work will occur in impermeable clothing, the HSO/SS will promptly consult with a certified industrial hygienist and a radial pulse monitoring method will be implemented to ensure that heat stress is properly managed among the affected workers. The following heat index chart indicates the relative risk of heat stress.



**Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity**

- 
 Caution
 - 
 Extreme Caution
 - 
 Danger
 - 
 Extreme Danger

### 5.3.3 Allergies and Biohazards

Allergens capable of triggering a severe reaction may be present in the office environment or the job site. Outdoor work presents additional biohazards such as bees and other insects and wildlife.

Staff with severe allergies should make these allergies known to Floyd|Snider and maintain appropriate preventative medications (EpiPen, Benadryl, etc.) as directed by their physician in a location that can be easily accessed in case of emergency. The locations of these medications should be shared with the Floor Wardens, along with instructions for delivery if needed.

In the field, persons with allergies to bees or other insects will make the HSO/SS aware of their allergies and will avoid areas where bees/insects are identified. Controls such as repellents, hoods, nettings, masks, or other personal protection may be used. Report any insect bites or stings to the HSO/SS and seek first aid, if necessary. Especially when working during the summer months, staff should monitor the work area for evidence of insect nests of stinging insects. A nest may be nearby if multiple flying insects are observed in the area, or if flying insects appear to be entering and leaving the same locations. Nests may be buried underground, located in vegetated areas, or in structures such as well monuments, vaults, and buildings.

Inspect the work area for hazardous plants, medical waste (syringes and similar items), and indications of hazardous organisms, and avoid such areas if possible. On job sites, personnel will maintain a safe distance from any urban wildlife encountered, including stray dogs, raccoons, and rodents, to preclude a bite from a sick or injured animal.

A severe allergic reaction, or anaphylaxis, is a rapid immune response that may be fatal if untreated. Persons experiencing anaphylaxis require medical care beyond preventative medication or first aid. The signs of anaphylaxis may include the following:

- Extensive skin rashes, itching, or hives
- Swelling of the lips, tongue, or throat
- Shortness of breath, trouble breathing, or wheezing
- Dizziness and/or fainting
- Stomach pain, bloating, vomiting, or diarrhea
- Uterine cramps
- Feelings of panic or dread

### 5.3.4 Fatigue

Worker fatigue can impair judgment and increase the risk of injuries on the job site. Fatigue may be caused by physical exertion from difficult tasks, extended working hours, and environmental challenges, including exposure and extreme weather. Fatigue can be caused by working extended hours for a duration of 1 week or more (including overtime work, consecutive long shifts, and extended work weeks) or by extremely physically and mentally demanding work of any duration. Tasks should be assessed individually for risk of fatigue. Variable weather conditions (high and

low temperatures, sustained strong winds) can place additional physical and mental strain on field personnel.

### **5.3.4.1 Fatigue Symptoms and Self-Monitoring**

Signs and symptoms of fatigue may present similarly to inebriation and can include:

- Reduced fine motor skills and coordination (e.g., tripping or dropping items)
- Impaired concentration
- Poor communication
- Poor judgment
- Mood swings or irritation

The above are typical symptoms of fatigue, but individuals can also experience or present fatigue in other ways that may be less obvious to an observer. The HSO/SS should additionally check in with staff members to ensure they are not experiencing any symptoms of fatigue that may impair their judgment or coordination in the field.

### **5.3.4.2 Managing Fatigue**

Fatigue should be managed by limiting working hours and implementing rest days. Signs and symptoms of fatigue and fatigue management should be discussed, when applicable, at the daily tailgate and debrief meetings.

Potential actions to minimize fatigue include the following:

- Plan to get 7 to 9 hours of sleep each night
- Take a lunch break inside, or out of the weather
- Take snack and hydration breaks throughout the day
- Take a late start, half-day, or rest day during the field event

### **5.3.4.3 Fatigue Response Actions**

In job situations where fatigue is likely, the HSO/SS should monitor employee fatigue using the following guide.

If the answer is yes to any of the following questions, the HSO/SS should consider implementing a shortened work day, light duty, or a day off for the affected employee.

- Do environmental factors pose an additional fatigue load (e.g., exposure to extreme hot/cold weather or wind)?
- Has the team member exhibited signs of fatigue?
- Has the team member worked on a physically intense task?

- Has the team member worked through the day without taking regular breaks to eat, stay hydrated, and rest?
- Has the team member had less than 6 hours of sleep in the past 24 hours?
- Did the team member work more than 12.5 hours in the past day?

If the answer is yes to either of the following questions, the HSO/SS will implement a day off for the affected employee.

- Did the team member work more than 75 to 80 hours in the past week?
- By the end of the shift, has the team member been awake for more than 17 hours?

Employees should also self-monitor for signs of fatigue and immediately report to the HSO/SS if fatigue becomes a concern.

If fatigue becomes a team-wide safety issue on the job site, the HSO/SS should coordinate with the PM to determine the actions that will be taken at the project level to manage fatigue. Actions may include adding team members, changing work practices, and/or adjusting the work schedule.

## 6.0 Job Site Controls

This section describes the best practices to be implemented on a field job site to protect personnel and the environment. These best practices are considered the minimum controls for any job site, and additional site-specific protocols should be detailed in the site-specific HASP.

- All site work should be completed in teams when possible. Teams should establish a primary means of communication on-site and with offsite contacts (generally via cell phones or radios on-site). An agreed-upon system of alerting via air horns and/or vehicle horns may be used around heavy equipment to signal an emergency if shouting is ineffective.
- Work area perimeter controls should be established to ensure that members of the public do not enter the work area and limit the potential for chemical exposure associated with site activities when hazardous materials may be present. These work areas include a support zone, a contaminant reduction zone (decontamination area), and an exclusion zone.
- Staff will take precautions to prevent contamination:
  - Inspect all PPE prior to entering the exclusion zone.
  - Avoid walking through puddles or areas of known or obvious surface soil contamination.
  - Do not carry unnecessary items into the exclusion zone.
  - Take care to limit contact with heavy equipment and vehicles.
  - Protect the ground surface when processing samples and wipe down or sweep surfaces frequently to minimize the amount of potential contaminated material that may be spread during site work.
- Staff will decontaminate all equipment and gear as necessary during field events. Decontamination procedures will be strictly followed to prevent offsite spread of contaminated materials. Decontamination procedures should be detailed in the site-specific HASP but at a minimum will include cleaning equipment to a visually debris-free surface. The HSO/SS will assess the effectiveness of decontamination procedures by visual inspection.
- Hands must be thoroughly washed before leaving the Site to eat, drink, or use tobacco or cosmetics.
- Visual monitoring for fugitive dust and soil track-out by vehicles leaving the job site should be conducted by the HSO/SS or a dedicated member of the field staff. If visible dust leaving the work area or track-out are observed, immediate action should be taken to correct the issue.
- The HSO/SS will ensure the proper collection, packaging, and identification of waste materials so that waste materials will be properly disposed of.

## 7.0 Training Requirements

All Floyd|Snider field personnel must comply with applicable regulations specified in WAC Chapter 296-843, Hazardous Waste Operations, and WISHA (WAC Chapter 296-800). WISHA states that personnel who may come into contact with hazardous materials must have current HAZWOPER certification and participate in an employer-sponsored medical monitoring program. Therefore, these sections apply to any employee at Floyd|Snider who performs work where they have the potential to come in to contact with hazardous or dangerous substances. Additionally, when doing site work, at least one person on-site must be trained in CPR/First Aid. In order to maintain compliance with the regulation, **employees whose medical clearance or HAZWOPER certification are expired may not conduct field work unless their medical examination or refresher course is scheduled to occur within 30 days of their previous certification expiration date.**

### 7.1 MEDICAL MONITORING

In accordance with state medical surveillance regulations, field staff employees must participate in the medical monitoring program, which benefits both the employees and Floyd|Snider by evaluating the overall health of each individual in connection with the work to be performed, as well as monitoring workplace health and safety initiatives. Employees who will be working on-site are required to participate in a baseline examination and biennial examinations, as well as completion of an exit exam should an employee no longer conduct onsite work requiring medical monitoring.

The purpose of the Floyd|Snider examination program is to:

- Provide a baseline of health information for an employee, which can be used for comparison in related future examinations;
- Detect any adverse health effect that might be a result of workplace exposures;
- Detect any underlying medical condition that may place an employee at higher risk for medical problems related to workplace activities; and
- Ensure that an employee is able to function safely while performing their essential job functions at Floyd|Snider.

When an employee is no longer participating in fieldwork and wishes to unenroll from the Floyd|Snider medical monitoring program, the employee should contact the Health and Safety Administrator for approval and to begin the medical monitoring program exit process described in Section 7.5.

### 7.2 HAZWOPER TRAINING

HAZWOPER training and certification are required for all staff on-site at sites regulated by the Model Toxics Control Act (MTCA) or the USEPA more than 30 days per year. This training typically

includes an initial 40-hour HAZWOPER certification and annual 8-hour refresher courses. Field staff who have the potential to contact contaminated materials must have 40-hour HAZWOPER certification and attend annual 8-hour refresher courses. HAZWOPER certification may also be necessary on a project-specific basis for PMs who are not active in the field safety training and medical monitoring program. Field staff who do not have the potential to contact contaminated material, and are not in a supervisory field role, may require fewer hours of HAZWOPER training, to be determined on a case-by-case basis. These employees will also be required to attend annual 8-hour refresher courses.

### **7.3 JOB-SPECIFIC TRAINING**

In addition to the 40-hour classroom training required by HAZWOPER, all field staff must complete 24 hours of job-specific training. This training is conducted on-site in the field under direct supervision of a skilled supervisor who is another Floyd|Snider employee. These training hours can occur on one or multiple field events and can cover an array of standard field activities. Once the 24-hours of training is complete, job-specific training forms (available on Floyd|Snider's Health and Safety department page on SharePoint) must be completed and signed by the trainer and submitted to the Health and Safety Administrator.

Additional site-specific training should be conducted to cover onsite hazards; PPE requirements, use, and limitations; decontamination procedures; and emergency response information as outlined in the HASP for the site.

### **7.4 CPR/FIRST AID**

When conducting field work, at least one person on-site must be trained in CPR/First Aid, with a current certification. All employees who are on-site at MTCA- or USEPA-regulated sites more than 30 days per year are required to have current CPR/First Aid certification. This training is also provided by the company to any interested employees, including those who do not do field work.

### **7.5 EXITING THE FIELD STAFF SAFETY TRAINING AND MEDICAL MONITORING PROGRAM**

This section presents the protocols to be followed in the event that an employee must exit the field staff safety training and medical monitoring program due to termination of their employment or transition to a different role at Floyd|Snider.

#### **7.5.1 Termination of Employment**

Washington's medical surveillance regulations require Floyd|Snider to schedule an exit exam for an employee upon termination of employment. Upon termination, employees will be notified of the appointment date and time and will be given information to reschedule the appointment if needed. The exit exam will be provided at Floyd|Snider's sole expense, and it is strongly recommended, in the best interest of your health, that you attend the appointment.

Floyd|Snider reserves the right to withhold payment of any severance package offered until confirmation of the exam is received.

## **7.5.2 Transition of Role**

Floyd|Snider is a company of versatile employees with technical expertise who collaborate effectively to meet client and project needs; because of this collaborative approach, we do not employ full-time field technicians who exclusively fill a sampling role. Therefore, to ensure that client needs are met even during our busiest times and spread workload equitably across the firm, it is essential that all staff involved in field data collection, including in a supervisory capacity, maintain current field safety certification and medical clearance.

However, under certain limited circumstances, an employee may transition roles at the company such that field certifications are no longer needed. An employee who wishes to exit the field staff safety training and medical monitoring program must:

- Document that employee has performed fewer than 30 partial or full days of field work for each of the past 2 calendar years; and
- Obtain approval from the Management Committee, by coordinating with the Health and Safety Administrator.

If an employee's exit from the program is approved, the employee is required by WISHA to complete a medical monitoring exit exam. Failure to complete an exit exam may result in withholding any bonus pay and a delay in annual pay increases.

A letter to document the date and reason for an employee's rationale for terminating participation in the field staff safety training and medical monitoring program, signed by the employee and a Principal, must be maintained in the employee's personnel file.

## **8.0 Record Keeping and Reporting**

Prompt and accurate recording and reporting is essential for continuing to improve the Floyd|Snider health and safety program and comply with the safety regulations.

### **8.1 RECORD KEEPING**

Records should be kept of all employee training, safety meetings including Health and Safety Committee meetings and daily tailgate safety meetings conducted in the field, and near misses and incidents. Forms for on-the-job employee training, daily tailgate safety meetings, and near misses and incidents are available on the company's Health and Safety department page on SharePoint.

The minutes of Health and Safety Committee meetings are recorded by the Health and Safety Administrator and maintained on Floyd|Snider's Health and Safety department page on SharePoint.

The HSO/SS, or a designated alternate, will be responsible for conducting daily tailgate safety meetings and recording the meeting on a daily tailgate safety meeting form. The form, which must be appended to all HASPs, lists the hazards discussed and is signed by all personnel present at the meeting. The HSO/SS will manage the administration of job-specific training. Job-specific training forms must be completed and signed by the trainer.

Daily tailgate safety meeting and job-specific training forms must be reviewed with the PM after completion of the field event. After PM review, scans of the forms should be saved to the appropriate project folder, and the original copies of the forms will be submitted to the Health and Safety Administrator. The PM and the Health and Safety Administrator will determine whether any issues identified on tailgate safety meeting forms require further review or follow-up actions.

### **8.2 REPORTING**

Near misses and incidents should be recorded on a Near Miss and Incident Reporting Form. The form gathers information regarding the circumstances of the near miss or incident, consequences, and corrective actions implemented. Near misses and incident report forms may be filled out by any Floyd|Snider staff. If a near miss or incident occurs in the field, the form must be reviewed and signed by the HSO/SS and the PM. This form must be appended to all site-specific HASPs.

Near Miss and Incident Reporting Forms will be maintained by the Health and Safety Administrator and made accessible to all staff for review after information that may identify specific individuals is redacted. In the event that an injury occurs in the workplace, the Health and Safety Administrator will coordinate with the PM or Management Committee to determine whether the injury is OSHA-reportable and implement follow-up reporting.

## 9.0 References

U.S. Centers for Disease Control and Prevention. 2024. "How Wildfire Smoke Affects Your Body." Last accessed 30 May 2025. <https://www.cdc.gov/wildfires/risk-factors/index.html>.

U.S. Environmental Protection Agency (USEPA). 2025. "Health and Environmental Effects of Particulate Matter (PM)." Last accessed 30 May 2025. <https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm>.



**Riverside HVOC Site**  
**Engineering Design Report**

**Appendix E**  
**Health and Safety Plan**

**Attachment E.2**  
**Daily Tailgate Safety Meeting Form**

## DAILY TAILGATE SAFETY MEETING FORM

**Instructions:** To be completed by the Field Lead or Site Safety Officer (SSO) prior to beginning of work each day, when changes in work procedures occur, or when additional hazards are present. Review with your Project Manager (PM) at the conclusion of your event and file with your field notes.

**PROJECT NAME AND SCOPE OF WORK:** \_\_\_\_\_ **SITE ADDRESS FOR EMERGENCY RESPONDERS:** \_\_\_\_\_

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**EMERGENCY RESPONSE:**

Muster Point:
Emergency Contacts & Resources:
Allergies/ Medical Alerts:

**GENERAL TOPICS/HAZARDS:** (Discuss all)

<input type="checkbox"/> Emergency Response Information <input type="checkbox"/> HASP Review and Location <input type="checkbox"/> Good Catch & Incident Reporting <input type="checkbox"/> Safety Equipment Location: AED, First Aid Kit & Fire Extinguisher <input type="checkbox"/> Chemicals of Concern & SDS locations	<input type="checkbox"/> Weather/Heat or Cold Stress <input type="checkbox"/> Required PPE: Overview and Verification <input type="checkbox"/> Slip, Trip, Fall Hazards <input type="checkbox"/> Buddy System and Communication <input type="checkbox"/> Vehicle Safety, Road Conditions
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**DETAILS OF DISCUSSION**

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**SITE SPECIFIC CONSIDERATIONS:** (Discuss as applicable)

<input type="checkbox"/> Lessons Learned <input type="checkbox"/> Fatigue <input type="checkbox"/> Site Access & Security <input type="checkbox"/> Establishing Work Zones <input type="checkbox"/> Urban Environment	<input type="checkbox"/> Construction <input type="checkbox"/> Heavy Equipment <input type="checkbox"/> Overhead Hazards <input type="checkbox"/> Excavation/Trenching <input type="checkbox"/> Flammables/Sparks <input type="checkbox"/> Tool Usage	<input type="checkbox"/> Forested/Brush Environment <input type="checkbox"/> Insects/Animals <input type="checkbox"/> Water Hazards & Vessel Safety <input type="checkbox"/> Decontamination <input type="checkbox"/> Mob/Demob <input type="checkbox"/> Other (Describe)
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**DETAILS OF DISCUSSION**

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**ATTENDEE NAME/AFFILIATION/SIGNATURE:**


**SSO/Field Lead Signature & Date:** \_\_\_\_\_

**Riverside HVOC Site**  
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**Appendix E**  
**Health and Safety Plan**

**Attachment E.3**  
**Good Catch and Incident Reporting Form**

## GOOD CATCH AND INCIDENT REPORTING FORM

<b>Date &amp; Time:</b>	<b>Project:</b>
<b>Incident Type:</b> <input type="checkbox"/> Good Catch <input type="checkbox"/> Incident	<b>Site/Location:</b>
<b>Check all that apply:</b> <input type="checkbox"/> Injury/illness <input type="checkbox"/> Vehicle/Equipment <input type="checkbox"/> Workplace Violence <input type="checkbox"/> Evacuation/Emergency <input type="checkbox"/> Other Stop Work Hazard (describe: _____)	

**Employee(s) Involved** (include witnesses, teaming partners, and subcontractors):


**Description of Incident** (include precise location, injuries, the task performed, equipment/materials involved, 3<sup>rd</sup> party involvement, structure, or property damage):


**Describe Any First Aid or Medical Treatment:**


**What Was the Root Cause of the Incident Based on the 5 Whys Approach?**


**What were the Contributing Factors or Conditions during the incident?** (weather, fatigue, low visibility, lighting, etc.):


**What actions can be taken to prevent the incident from reoccurring?** (Include any preliminary actions taken):


**Preparer Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**SSO or Field Lead Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Instructions:**

- A Good Catch is a potential hazard or incident in which no property was damaged, and no personal injury was sustained, but where, given a slight shift in time or position, damage or injury could have easily occurred. An incident is when injuries or damage do occur and can range in severity.
- If there are multiple employees involved in an incident or good catch, select one to be the primary reporter.
- Complete the form as soon as practical after the incident with any witnesses or involved employees. A witness may complete the form on behalf of an injured employee if they cannot complete the form themselves.
- Fill out the forms completely. If a section does not apply mark the section as “N/A”.

**Field Good Catch/Incident**

1. All Good Catches/Incidents in the field shall be reported to the Site Safety Officer or Field Lead.
  - A. Serious field incidents (Injury, equipment damage, stop work etc.) are to be reported to the Project Manager (PM) as soon as it is safe to do so.
2. Complete the Good Catch and Incident Reporting form with the SSO/Field lead as soon as practical after the good catch/incident.
  - A. The SSO/Field Lead will ensure any required reporting is made to the Client on the site.
3. Review the completed form with the PM at the end of the field work for the day.
4. Submit the final form to the Safety Program Manager after the PM review.

For incidents that result in injury, the SSO or PM will complete the Injury Reporting Follow-up Form within 24 hours and submit it to the Safety Program Manager.

**Non-Field Good Catch/Incidents**

5. Report the Good Catch or Incident to the Safety Program Manager or a Safety Committee Member.
6. Complete the Good Catch and Incident Reporting form as soon as practical after the incident with any witnesses or involved employees.
7. Review the completed form with the Safety Program Manager or a Safety Committee Member
8. For incidents that result in injury, the Safety Committee Member or Safety Program Manager will complete the Injury Reporting Follow-up Form within 24 hours.
9. Final versions of all forms should be submitted to the Safety Program Manager.

**Follow-Up From an Incident**

- For all good catches/incidents additional information (i.e., corrective action or medical updates) should be reported to the Safety Program Manager within 1 week.
- Notification of the event to the firm will be shared in a timely manner in the format most appropriate for the severity/complexity of the incident.
- Corrective action completion will be tracked and verified by the Safety Program Manager as applicable.
- Additional notifications to 3rd parties (agencies, teaming partners, or clients) may be required by the PM or Principal-in-charge as appropriate.
- For vehicle incidents, notify Tiffany of the accident as insurance reporting may be required.
- Notify the Field Equipment Manager of any damage to equipment or vehicles.

## INJURY REPORTING FOLLOW-UP FORM

Instructions for the Site Safety Officer or Project Manager:

- Complete this form following an incident with an injury within 24 hours of the incident.
- Submit this form with a copy of the completed Good Catch and Incident Reporting Form to the Safety Program Manager with copies to the Principal-in-Charge for the project if applicable.<sup>1</sup>
- Any additional information (i.e., corrective action or medical updates) should be reported to the Safety Program Manager within 1 week of the incident.

**Was this an OSHA- Recordable Injury/Illness? Why?**

<input type="checkbox"/> <b>Yes</b>	<input type="checkbox"/> Loss of consciousness <input type="checkbox"/> Days away from work <input type="checkbox"/> Restricted work/Job transfer <input type="checkbox"/> Medical Treatment Beyond First Aid <sup>1</sup> <input type="checkbox"/> Other _____
<input type="checkbox"/> <b>No</b>	<input type="checkbox"/> First Aid treatment only <input type="checkbox"/> Recordkeeping exemption <input type="checkbox"/> No treatment <input type="checkbox"/> Other _____

**Describe Any Follow-Up First Aid or Medical Treatment:**


**Did the Injury/Illness involve Inpatient Hospitalization, Amputation or Loss of an Eye?**

No    Yes – Contact the Principal-in-Charge

**What Was the Root Cause of the Incident Based on the 5 Why’s Approach?**


**Follow-Up Actions Taken (include owners & dates):**


**SSO or Field Lead’s Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Project Manager Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

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<sup>1</sup> First Aid is defined as: using non-prescription medication at non-prescription strength, cleaning wounds on the skin surface, applying wound coverings (not sutures/staples), removing foreign bodies from the eye using irrigation or a swab, removing foreign bodies from elsewhere (not the eye) using tweezers, hot/cold therapy, drinking fluids to relieve heat stress, using finger guards or eye patches, using non-rigid means of support (such as bandages), using temporary immobilizing devices while transporting an injured person, administering tetanus immunizations. Guidelines for determining what incidents are OSHA Recordable are available here: <https://www.osha.gov/recordkeeping/>. The principal in charge is to be notified of any Recordable Incidents.

# Engineering Design Report

Riverside HVOC Site

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## Appendix F Quality Assurance Project Plan

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## List of Abbreviations

<b>Abbreviation</b>	<b>Definition</b>
%R	Percent recovery
City	City of Bothell
CUL	Cleanup level
DCE	Dichloroethene
DO	Dissolved oxygen
DQI	Data quality indicator
Ecology	Washington State Department of Ecology
EDD	Electronic data deliverable
EDR	Engineering Design Report
HAZWOPER	Hazardous Waste Operations and Emergency Response
HVOC	Halogenated volatile organic compound
LCS	Laboratory control sample
MDL	Method detection limit
MS	Matrix spike
MSD	Matrix spike duplicate
ORP	Oxidation-reduction potential
PM	Project manager
PQL	Practical quantitation limit
PVC	Polyvinyl chloride
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RL	Reporting limit
RPD	Relative percent difference
SDG	Sample delivery group
Site	Riverside HVOC Site
SOP	Standard Operating Procedure
TM	Task manager
USEPA	U.S. Environmental Protection Agency

## 1.0 Introduction

This Quality Assurance Project Plan (QAPP) is presented as an appendix to the Engineering Design Report (EDR) for the City of Bothell (City) Riverside Halogenated Volatile Organic Compound (HVOC) Site (Site). It describes the quality assurance (QA) objectives, methods, and procedures for sample analysis to support design and implementation of a cleanup action at the Site. Sampling will include the collection and chemical analysis of environmental media to characterize HVOCs and gain additional physical information about Site media to inform aspects of cleanup action construction and performance.

The EDR presents the objectives, background, details regarding sampling locations and field sampling methods, data quality objectives for sampling. This QAPP presents more detailed information regarding data management responsibilities, laboratory analysis methods and procedures, and reporting requirements. This document was prepared in accordance with the U.S. Environmental Protection Agency's (USEPA's) guidance on preparing QAPPs (USEPA 2002a, 2006).

### 1.1 DOCUMENT ORGANIZATION

This QAPP provides detailed laboratory methods and protocols for all anticipated types of data collection. QAPP addenda may be prepared if additional data types not detailed in this plan are determined to be needed after completion of part or all of the groundwater sampling described in the EDR.

This QAPP is organized into the following sections:

- Section 2.0—Project Organization and Responsibilities
- Section 3.0—Data Generation and Acquisition
- Section 4.0—Assessment and Oversight
- Section 5.0—Data Validation and Usability
- Section 6.0—References
- Section 7.0—Approvals

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## 2.0 Project Organization and Responsibilities

### 2.1 PROJECT MANAGEMENT

The following sections describe the responsibilities of project team members for fulfillment of the QAPP. Contact information for the key QA project team members is provided in Table F.1. The contact information for key project team members will be provided to the City and the Washington State Department of Ecology (Ecology) prior to implementation of the EDR.

#### 2.1.1 Project Manager

The Floyd|Snider project manager (PM) will be involved in all aspects of this project, including discussion, review, and interpretation of this QAPP, and the results of the investigation. The Floyd|Snider PM will also be responsible for the overall implementation of this QAPP.

#### 2.1.2 Task Manager

The Floyd|Snider task manager (TM) will be responsible for providing oversight of planning and coordination, work plans, all project deliverables, and performance of the administrative tasks needed for timely and successful completion of the project. The TM will also be responsible for communicating with the PM on the progress of project tasks, conducting detailed planning and coordination, and monitoring and communicating to the PM any deviations from the QAPP. Significant deviations from the QAPP will be further reported to the City and Ecology. The TM will facilitate the transfer of analytical data to the principal data users.

#### 2.1.3 Field Coordinator

The Floyd|Snider field coordinator will be responsible for implementation of the field data collection program, including sample handling and custody documentation. The field coordinator will work closely with the TM and PM to ensure that the required sample collection and laboratory analyses are completed. The field coordinator, or their trained and qualified designee, is also responsible for oversight of daily calibration of field equipment in accordance with the EDR and inspection of sample containers as specified in Section 3.7.

#### 2.1.4 Quality Assurance/Quality Control

The QA and quality control (QC) coordinator or their designee will serve as the laboratory QA/QC coordinator. The QA/QC coordinator will oversee coordination of the field sampling and laboratory program and supervise data validation and project QA coordination, including coordination with the analytical laboratories and Ecology. The laboratory QA/QC coordinator will be a Floyd|Snider staff member specializing in QA/QC who is independent from the analytical laboratories and field staff responsible for generating the data.

Analytical laboratories will be responsible for chemical analyses and will ensure that submitted samples are handled and analyzed in accordance with the analytical testing procedures and

QA/QC requirements, as well as the other requirements specified in this QAPP. The laboratories will provide certified pre-cleaned sample containers and preservatives, as appropriate, and prepare a data report containing analytical and QA/QC results. The laboratory PM will oversee laboratory operations, including receipt of samples, chemical analyses, and laboratory report preparation. They will prepare and review laboratory reports and case narratives describing any discrepancies that occurred during chemical analyses. They will also notify the laboratory QA/QC coordinator of any problems as soon as they are identified.

## **2.2 PROBLEM DEFINITION/BACKGROUND**

The EDR describes the sample collection that will be performed as part of the cleanup action at the Site. The EDR sampling design is intended to provide sufficient documentation that cleanup standards are met in contaminated Site media including soil and groundwater. Extensive previous sampling data, as summarized in the EDR, informs the sampling design and selection of sample stations.

## **2.3 PROJECT TASK DESCRIPTION**

Sampling activities described in the EDR will be initiated after Ecology approval and issuance of notice to proceed to contractor(s) for construction of the cleanup action. Samples will be collected immediately upon completion of each element of the cleanup action, which will include installation of in situ groundwater treatment. Groundwater samples for assessing the remedy performance will be sampled regularly upon completion of in situ treatment installation and establishment of a performance monitoring well network.

## **2.4 SPECIAL TRAINING/CERTIFICATIONS**

The Floyd|Snider field coordinator and all field personnel will be 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) certified, consistent with the Occupational Safety and Health Administration 29 Code of Federal Regulations 1910.120, and be trained in the groundwater collection methods described in this QAPP. The field coordinator will be responsible for ensuring that field staff and contractors have the necessary training and that field staff are up to date on the annual 8-hour HAZWOPER refresher course.

All analytical laboratories will have current environmental laboratory accreditation from Ecology for the analytical methods to be used.

## **2.5 DOCUMENTATION AND RECORDS**

This QAPP will be approved by the Floyd|Snider PM, the Ecology Site Manager and all laboratory and data validation contractor PMs (refer to Section 7.0 for approvals). The document will be maintained and updated by the Floyd|Snider PM, who will be responsible for distribution of the approved document and any updated versions to key project contacts and team members (key project contacts are provided in Table F.1). The Ecology Site Manager or the City may distribute this QAPP to project stakeholders at their discretion.

Floyd|Snider will store all project records in a secure manner. Each project team member is responsible for filing all project information and records according to internal Floyd|Snider requirements. All electronic data will be maintained in a database in a designated directory at Floyd|Snider.

### 2.5.1 Field Records

Documents and records generated in the field should be considered controlled documents that become part of the project file. Floyd|Snider field staff will keep a daily record of significant events, observations, and measurements on forms specific to the field activity. All field documents will be maintained by the field coordinator. All sampling forms will contain information on the sample collected and will include at a minimum the following information:

- Project name
- Field staff on site
- Field observations
- Sample collection date and time
- Sampling method and/or description of field activities
- Instruments or equipment used
- Location ID and sample ID
- Sample analysis
- Deviations from the EDR

### 2.5.2 Laboratory Records

The analytical laboratories will retain all analytical records. Additionally, Floyd|Snider will retain a copy of analytical data in the internal project files. Laboratory data packages will include those items necessary to complete data validation. Elements to be reported in the laboratory data packages are listed in Section 5.1.

All instrument data will be fully restorable at the laboratory from electronic backup. The laboratory will be required to maintain records relevant to project sample analyses for a minimum of 7 years. The PM is responsible for determining and communicating specific requirements for record maintenance if they are different than the default. Data validation reports will be maintained within the Floyd|Snider internal project files with the laboratory data packages.

Each laboratory employs an internal QA manager who is responsible for ensuring that laboratory Standard Operating Procedures (SOPs) are followed, and laboratory staff perform routine audits for SOP compliance; routine audits are required for state accreditation. The Floyd|Snider PM, City, or Ecology Site Manager may request to review records of SOP compliance.

The analytical laboratories will submit data electronically, in the Floyd|Snider standard electronic data deliverable (EDD) format. Guidelines for EDDs will be communicated to the analytical laboratories by the QA/QC coordinator or database manager.

All electronic data submittals must be tab-delimited text files that include all results, method detection limits (MDLs; as applicable), and reporting limits (RLs) consistent with those provided in the laboratory report. If laboratory replicate analyses are conducted on a single submitted field sample, the laboratory sample identifier must distinguish each replicate analysis.

### **2.5.3 Data Management and Reduction**

The Floyd|Snider database manager will oversee data management and reduction in coordination with the PM and TM or field coordinator. Once all required data are confirmed to be received and validated, the database manager will load all records to Floyd|Snider's electronic database accessed using Microsoft Access software. The database is maintained on the Floyd|Snider server and is backed up with a hard disk. The database manager will manage data exports and will confirm that data are assembled in the required deliverable format with appropriate qualifiers.

### 3.0 Data Generation and Acquisition

#### 3.1 SAMPLING DESIGN

Analytical data will be collected for the following purposes to support the cleanup action:

- Assess the effectiveness of injection treatment by evaluating changes in the magnitude and horizontal extent of HVOCs in Site groundwater relative to cleanup levels (CULs)
- Measure conventional geochemical parameters (referred to as monitored natural attenuation parameters) that may promote or inhibit anaerobic degradation of HVOCs to inform conclusions about in situ treatment performance

#### 3.2 SAMPLING METHODS

This section summarizes the collection and analysis of groundwater samples presented in detail in the EDR. Additional sampling design, if determined to be necessary, would be addressed in a supplemental work plan document.

##### 3.2.1 Sample Collection

The new groundwater performance wells will be installed using roto-sonic or hollow stem auger drilling methodologies, and soils will be logged during drilling to identify the appropriate depth for the screened interval. Wells will be constructed of 2-inch diameter, 0.10-inch slotted polyvinyl chloride (PVC) screen with 2-inch diameter PVC riser and completed with flush-mounted protective monuments. Proposed well screen interval depths are presented in EDR Table 6.1. After installation, wells will be developed by surging and overpumping in accordance with the procedures presented in Attachment F.1. Wells will be developed a minimum of 1 week prior to the first round of sampling. Drill soil cuttings and purge water will be containerized pending characterization for off-site disposal.

The horizontal and vertical position of all new wells will be recorded by a licensed surveyor with a horizontal accuracy of  $\pm 0.1$  foot and a vertical accuracy of  $\pm 0.01$  foot in Washington State Plane North and North American Vertical Datum of 1983.

All wells will be purged and sampled using low-flow procedures in accordance with the Floyd|Snider low-flow groundwater sample collection guidelines (refer to Attachment F.1). During the groundwater sampling event, the depth to groundwater will be recorded using an electronic water level meter prior to sampling at all wells specified for water level measurement. Water levels will additionally be monitored during sampling to measure drawdown of the water column.

During purging, field staff will periodically measure and record pH, dissolved oxygen (DO), temperature, specific conductivity, and oxidation-reduction potential (ORP) using a multiparameter water quality meter. The field parameter measurements, particularly DO and

ORP, will be used to evaluate current geochemical conditions (i.e., oxidizing or reducing) of the aquifer.

### 3.2.2 Sample Analysis

Groundwater samples will be analyzed for the groundwater COCs as well as geochemical parameters, as described in Section 6.1 and Table 6.1 of the EDR, including the following:

- COCs:
  - HVOCs (tetrachloroethene, trichloroethene, *cis*-1,2-dichloroethene [DCE], *trans*-1,2-DCE, and vinyl chloride) by USEPA Method 8260D
- Secondary Geochemical Parameters for Monitored Natural Attenuation:
  - Anions (nitrate and nitrite) by USEPA Method 353.2
  - Sulfide by method SM 4500-S2
  - Sulfate by ASTM D516-16
  - Ferrous iron by SM 3500-FE-D or colorimetric field test
  - Dissolved gases (ethene, ethane, and methane) by Method RSK-175
  - Total Organic Carbon by SM 5310B

### 3.3 ANALYTICAL METHODS

Laboratory analytical methods were selected to ensure that the samples can be compared to the CULs presented in the Cleanup Action Plan and/or provide meaningful data for design of treatment components. The laboratory quantitation limits including practical quantitation limits (PQLs) or RLs and MDLs for the selected analytical methods are presented in Table F.2.

### 3.4 DATA QUALITY OBJECTIVES AND CRITERIA

Field and laboratory data quality objectives include obtaining data that are technically sound and properly documented, having been evaluated against established criteria for the principal data quality indicators (DQIs; i.e., precision, bias, accuracy, representativeness, completeness, comparability, and sensitivity). Evaluation of the principal DQIs is summarized in the following sections. Data QA/QC criteria (also known as measurement quality objectives) and frequencies are presented in Tables F.3 and F.4, respectively.

#### 3.4.1 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. Precision is assessed by performing multiple analyses, such as laboratory duplicate or field duplicate samples, and is defined as the relative percent difference

(RPD) between results. Precision will be evaluated for both laboratory and field duplicate samples and calculated as follows.

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

Where:

RPD = relative percent difference

C<sub>1</sub> = larger of the two observed values

C<sub>2</sub> = smaller of the two observed values

Laboratory duplicate sample precision criteria and frequency requirements are presented in Tables F.3 and F.4, respectively. Field duplicate precision will be screened against an RPD of 50% for all samples. Data will not be qualified based solely on field duplicate precision.

For precision calculations (i.e., for calculating RPD), the RL will be used when a non-detect result is included in the evaluation. Additionally, the result/s based on the final dilution will be used in the calculation (i.e., values flagged as estimated greater than a given concentration, which are superseded with subsequent sample dilutions, will not be used).

### 3.4.2 Accuracy and Bias

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Bias is “the systematic or persistent distortion of a measurement process that causes error in one direction” (USEPA 2002a). Analytical bias and accuracy may be assessed by analyzing “spiked” samples with known concentrations, such as laboratory control samples (LCSs), blank spikes, and standard reference materials. Additionally, matrix spike (MS) samples can be analyzed to provide accuracy or bias information in the actual sample matrix. Precision criteria and frequency requirements are presented in Tables F.3 and F.4, respectively. Accuracy will be evaluated as percent recovery (%R) and will be calculated as follows.

$$\%R = 100\% \times \frac{(S-U)}{C_{sa}}$$

Where:

%R = percent recovery

S = measured concentration in the spiked aliquot

U = measured concentration in the unspiked aliquot

C<sub>sa</sub> = actual concentration of spike added

For accuracy calculations (i.e., for calculating %R), non-detect results will be assigned a value of zero. Additionally, the results based on the final dilution will be used in the calculation (i.e., values flagged as estimated greater than a given concentration, which are superseded with subsequent sample dilutions, will not be used).

### 3.4.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent an environmental condition. This DQO is addressed by the design of the sampling plan. A list of analytes has been identified to provide a comprehensive assessment of known or potential contaminants. Care has been taken in the design of the sampling program to ensure that sample locations are properly selected, sufficient numbers of samples are collected to accurately reflect conditions at the locations, and samples are representative of the sampling locations as described in the EDR. Sufficient volume of samples will be collected at each sampling location to minimize bias or errors associated with sample particle size and heterogeneity.

Representativeness in laboratory data will be assessed by evaluating holding time compliance and the results of the method blanks and instrument blanks.

### 3.4.4 Completeness

Completeness is defined as the number of acceptable data points relative to the total number of data points and is also a measure of the amount of validated data reported versus the expected amount of data (the amount of data collected). Completeness will be assessed for each sample medium. The QA/QC objective for completeness for all components of this project is 90% (Table F.3). 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 have been qualified as estimated will be further reviewed for usability. Data that were qualified as rejected will not be considered valid for their intended use or for the purpose of assessing completeness. If a sample medium has an unacceptable completeness percentage (less than 90%), original samples will be re-analyzed if sufficient sample volume is available, archived samples will be analyzed if appropriate, or additional samples will be obtained (if feasible). The equation used to calculate completeness is as follows:

$$\text{Completeness} = \frac{\text{number of valid measurements}}{\text{total number of data points planned}} \times 100$$

### 3.4.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another. To ensure that results are comparable, samples will be analyzed using USEPA methods, Standard Methods, ASTM methods, and/or other acceptable method protocols. Calibration and reference standards will be traceable to certified standards, and standard data reporting formats will be employed.

### 3.4.6 Sensitivity

Analytical sensitivity is the minimum concentration of an analyte above which a data user can be reasonably confident that the analyte was reliably detected and quantified. For this investigation, the PQL will be used as the measure of sensitivity for each analyte.

### 3.5 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Guidance for QA/QC is derived from the protocols developed for USEPA's Test Methods for the Evaluation of Solid Waste: Physical/Chemical Methods (USEPA 1986), the USEPA National Functional Guidelines (USEPA 2020a, 2020b, 2020c), and cited methods.

The field coordinator or field personnel will assess and implement field QC procedures as required in this QAPP.

#### 3.5.1 Field Quality Assurance/Quality Control Procedures

##### 3.5.1.1 Sample Identification

Each sample will have a label affixed to the container, and the container will be labeled at the time of collection. The minimum information will be recorded on the label:

- Sample identifier
- Date and time of collection
- Preservative type (if applicable)
- Project name
- Sampler's name or initials

Groundwater samples collected from monitoring wells will be identified using the following format: "Sample Location"- "Date." For example, a sample collected from monitoring well RMW-6 on June 15, 2026, would be labeled "RMW-06-20260615."

At each laboratory, a unique sample identifier will be assigned to each sample. The laboratory will ensure that a sample tracking record follows each sample through all stages of laboratory processing. The sample tracking record must contain, at a minimum, the name/initials of individuals responsible for performing the analyses, dates of sample extraction/preparation and analysis, and types of analyses being performed. The analytical laboratories will meet the sample handling requirements and follow the procedures described in the following sections.

##### 3.5.1.2 Field Quality Control Sampling and Identification

Field QC is evaluated through the analysis of field duplicates and trip blanks. Field duplicates are used to assess proper homogenization in the field, reproducibility of the sample preparation and analysis, and heterogeneity of the matrix. Trip blank samples are used to evaluate potential cross contamination from volatile compounds from ambient conditions or from other samples during sample handling and transport. Field duplicate QC samples will be collected at a rate of 1 per 20 investigation samples. Trip blank QC samples will be collected for each cooler containing field samples for HVOC analysis. Field QA/QC criteria and frequency are presented in Tables F.3 and F.4.

The labeling of field QC samples is described as follows:

- Field duplicates will be labeled with a fictitious sample location by adding 100 to the sample location. For example, a field duplicate collected from monitoring well RMW-6 on June 15, 2026, would be named “RMW-106-20260615.”
- Trip blanks will be collected by pouring laboratory-provided distilled water into sample containers during the sampling event near a sample collection location. Trip blanks will be labeled using the following format: “TB”-“Number”-“Date.” For example, a trip blank collected on June 15, 2026, would be named “TB-1-20260615.”

### **3.5.1.3 Sample Custody Procedures and Requirements**

Sample custody is a critical aspect of environmental investigations. Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analyses, to delivery of the sample results to the recipient. Procedures to be followed for sample custody related to shipping are detailed in Section 3.5.1.4.

Samples are considered to be in custody if they are (1) in the custodian's possession or view; (2) in a secured place (under lock) with restricted access; or (3) in a container and secured with a custody seal such that the sample cannot be reached without breaking the seal. Chain-of-custody forms will accompany all samples, and each person who has custody of the samples will sign the chain-of-custody form and ensure that the samples are not left unattended unless properly secured. Information on chain-of-custody forms will include at a minimum the following:

- Sampling location, project name, and unique sample ID
- Sample collection date and time
- Any special notations on sample characteristics or problems
- Name of the person who initially collected the sample
- Date sample was sent to the laboratory
- Shipping company name and waybill number (if applicable)

The field coordinator or qualified designee will be responsible for all sample tracking and custody procedures. They will also be responsible for final sample inventory and will maintain sample custody documentation. The field coordinator or designee will complete chain-of-custody forms prior to transporting samples. Information on the sample labels will be checked against sample collection forms and chain-of-custody forms, and sample containers will be recounted prior to transporting samples. Copies of all chain-of-custody forms will be retained and included as appendices to the data reports.

The analytical laboratories will ensure that chain-of-custody forms are properly signed upon receipt of the samples and will note any questions or observations concerning sample integrity on the chain-of-custody forms. The analytical laboratories will contact the field coordinator and

project QA/QC coordinator immediately if discrepancies are discovered between the chain-of-custody forms and the sample shipment upon receipt.

#### **3.5.1.4 Sample Preservation and Shipping Requirements**

Sample volumes will be placed in laboratory-provided certified pre-cleaned sample containers and preserved in accordance with the requirements presented in Table F.5. The laboratory will maintain manufacturer documents certifying the cleanliness of containers and/or purity of preservatives provide. The field coordinator or a designee will also inspect containers for cleanliness, for signs of damage or tampering, and for presence of preservative if pre-preserved containers will be used. Individual containers with evidence of damage or tampering will be discarded.

Prior to shipping or transporting samples, containers will be securely packed inside a cooler with ice packs or wet ice and bubble wrap. The original signed chain-of-custody forms will be placed in a sealed plastic bag and taped to the inside lid of the cooler. If third-party shipping (e.g., shipping with FedEx rather than a laboratory courier), each cooler will be sealed with a custody seal.

#### **3.5.2 Laboratory Sample Handling and Holding Times**

Samples will be stored in accordance with the conditions specified in the methods or laboratory SOPs. Samples transferred to other laboratories will be packed in coolers on ice and delivered via courier service or shipped on ice in coolers at temperatures less than 6 degrees Celsius, not frozen. The temperature inside each cooler will be checked by the laboratory upon receipt of the samples. The laboratory will specifically note any coolers that are not sufficiently cold upon receipt.

All samples will be handled to prevent contamination or sample loss. Any remaining sample material will be disposed of upon receipt of written notification by the Floyd|Snider PM. Holding times will vary by analysis and are summarized in Table F.5.

#### **3.5.3 Laboratory Quality Assurance/Quality Control**

Laboratory results will be evaluated by reviewing analytical results of method blanks, LCSs, certified reference materials, MS/matrix spike duplicate (MSD) samples, duplicate samples, internal standards, calibrations, and performance evaluation samples, as specified by the analytical methods.

All samples will be diluted and re-analyzed if target compounds are detected at levels that exceed their respective established calibration ranges. Any required cleanups will be conducted prior to the dilutions. Re-analyses will be performed if surrogate, internal standard, or spike recoveries are outside of the QA parameters. QC samples may be re-analyzed if results are not within control limits and it cannot be determined that the sample matrix is the cause.

### **3.5.3.1 Sample Delivery Groups**

A sample delivery group (SDG) is defined by the laboratory and is generally considered 20 samples, or a group of samples from the same sampling period received at the laboratory on the same day. Although an SDG may span 2 weeks, all holding times specific to each analytical method will be met for each sample in the SDG.

### **3.5.3.2 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 20 samples.

### **3.5.3.3 Laboratory Control Samples**

LCSs are prepared from a clean matrix source using the same process as project samples and are spiked with known amounts of the target compounds. The recoveries of the compounds are used as a measure of the accuracy of the test methods.

### **3.5.3.4 Matrix Spikes and Matrix Spike Duplicates**

The analysis of MS and MSD samples provides information on the extraction efficiency of the method for the sample matrix and is used to evaluate the precision of the method. A minimum of one MS/MSD pair will be analyzed for every 20 samples, when sufficient sample volume is available. A laboratory duplicate sample may be analyzed in place of MSD samples, as allowed by the analytical method.

### **3.5.3.5 Laboratory Duplicates**

Laboratory duplicate samples provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Laboratory duplicates are subsamples of the original sample that are prepared and analyzed as separate samples. A minimum of one laboratory duplicate sample will be analyzed for every 20 samples, when sufficient sample volume is available.

### **3.5.3.6 Surrogates**

All samples, including laboratory QC samples (blanks, LCSs, MS/MSDs, and duplicate samples), analyzed for organic analytes will be spiked with appropriate surrogate compounds. Surrogate recoveries will be reported by the analytical laboratories; however, no sample results will be corrected for recovery using these values.

### **3.5.3.7 Internal Standards**

Internal standards may be used for calibrating and quantifying organic compounds and metals. If internal standards are required by the method, all calibration, QC, and project samples will be

spiked with the same concentration of the selected internal standards. Internal standard recoveries and retention times must be within method criteria, laboratory criteria, or both.

### **3.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE**

Inspection and maintenance of field and laboratory equipment are important to determine the quality of sampling and analysis results.

#### **3.6.1 Field Equipment Maintenance and Calibration and Frequency**

Field equipment for groundwater sampling that requires maintenance or calibration includes the following: pH probes, specific conductivity probes, turbidity meters, reduction–oxidation potential probes, and dissolved oxygen probes.

Field equipment will be maintained and calibrated in accordance with the procedures described in the operations manuals supplied by the manufacturer at the intervals recommended in the manual. The manufacturers' manuals will accompany each instrument for use during equipment calibration and to support troubleshooting. Equipment maintenance information will be documented in the instrument's maintenance log. Equipment calibration performed by field staff will be documented in a calibration log. The calibration log will include at minimum, the equipment type and model number, date and time, project name, the calibration results, and the initials of the calibrator. Any discrepancies or calibration failures will be noted in the calibration log and corrected prior to sampling. During the sampling event, any discrepancies or calibration failures will be noted in the field notes and corrected prior to continuing sampling. Maintenance and calibration records will be verified prior to each sampling event by the field coordinator.

The subcontractor responsible for navigation will confirm proper operation of the navigation equipment daily, and all equipment will be operated and maintained according to manufacturer specifications.

#### **3.6.2 Laboratory Instruments Calibration and Frequency**

Laboratory equipment will be maintained and calibrated according to the manufacturers' recommendations, the laboratory QA plan, SOPs, and standard methodologies. Calibrations will be performed on each analytical instrument prior to analysis. Calibrations are performed at a frequency determined by the analytical method and/or the laboratory SOP. The analysis must stop if the calibration does not meet the specified criteria. The analysis may resume after corrective actions have been taken to meet the method specifications. All project samples analyzed by an instrument found to be out of compliance must be reanalyzed. Laboratories will be responsible for their own preventative maintenance and calibration of laboratory equipment.

### **3.7 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES**

Inspection and acceptance of field supplies, including laboratory sampling containers, will be the responsibility of the field coordinator. Any chemical standards and solutions (such as hydrochloric acid for sample preservation) used in this project will be provided by a reliable, commercial source and will be traceable. Any discrepancies will be documented by the field coordinator.

### **3.8 DATA MANAGEMENT AND REPORTING**

Analytical chemistry results will be provided by the laboratory in PDF and EDD formats. Data packages will be returned within the time frame specified in the service agreement contract or work order between Floyd|Snider and each laboratory, with a duration not to exceed 10 or 15 business days, unless delays are otherwise communicated to and approved by the Floyd|Snider PM. The data packages will be reviewed to ensure that the correct analyses were performed for each sample submitted and that all analyses requested on the chain-of-custody forms were performed. If discrepancies are noted, the QA/QC coordinator will be notified and will promptly follow up with the laboratory to resolve any issues. After completion of data validation, the digital files will be used to generate the appropriate report tables.

Laboratory data, which are electronically provided and loaded into Floyd|Snider's electronic database, will undergo a check against the laboratory data deliverable. Data will be validated or reviewed manually, and qualifiers, if assigned, will be entered manually. All manually entered data will be verified by a secondary review performed by Floyd|Snider staff. As a final review, after entry into the database, the EDD data will be compared to the field information (e.g., station/location identifiers, sample identifiers, requested analyses) previously entered into the database to confirm that all requested analytical data have been received.

## 4.0 Assessment and Oversight

The project field activities will be overseen by the Floyd|Snider PM and laboratory activities will be overseen by the laboratory PM. Once data are received from the laboratory, a number of QC procedures will be followed to evaluate data quality and attainment of the data QA/QC objectives and criteria. Specific procedures will be followed to assess the principal DQIs (precision, bias, accuracy, representativeness, completeness, comparability, and sensitivity).

### 4.1 FIELD OVERSIGHT AND CORRECTIVE ACTIONS

The field coordinator or designated field lead will be responsible for field oversight and identifying issues that may result in noncompliance with this QAPP that could adversely affect data quality. The FC is responsible for performing corrective actions. The field coordinator and the QA/QC coordinator will be responsible for completing and for verifying and documenting completion of any corrective actions.

Field performance inspections may be conducted at the discretion of the Floyd|Snider PM to determine the effectiveness of QA/QC procedures and compliance with the QAPP. Field performance inspections should be conducted by the field coordinator, health and safety officer, or the Floyd|Snider PM. During a field performance inspection, the inspector will observe and review field procedures and health and safety procedures, including but not limited to documentation of sample collection, packaging procedures, sample shipment to the laboratories, and proper use of personal protection equipment per the Health and Safety Plan (refer to Appendix E of the EDR).

If issues are identified that may adversely affect data quality, corrective actions will be identified and implemented as soon as possible, and potential impacts to data quality will be evaluated. The inspector or a key member of the project team may temporarily stop work until deficiencies adversely affecting data quality are corrected. The field coordinator and the QA/QC coordinator will be responsible for verifying and documenting completion of any corrective actions.

### 4.2 LABORATORY OVERSIGHT AND CORRECTIVE ACTIONS

Laboratory audits and performance inspections consist of on-site reviews of QA systems and equipment. Laboratory audits will not be conducted as part of this study; however, the laboratory will provide reports from laboratory audits performed as part of general operations to the QA/QC coordinator upon request. The laboratory will provide written details of all method modifications planned prior to project commencement.

The laboratory is required to comply with its SOPs. The laboratory PM will be responsible for ensuring that appropriate corrective actions are initiated as required for compliance with this QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data. If QC results exceed the laboratory control limits, the analyst will identify and correct the anomaly before continuing with the sample analyses, if possible. If the issue

cannot be overcome with standard corrective action (e.g., re-preparation and re-analysis), the causes of the exceedance and corrective actions will be described in the data package narrative. If the exceedance is gross or widespread, the Floyd|Snider PM and project QA/QC coordinator will be notified immediately, and the appropriate action will be decided.

## 5.0 Data Validation and Usability

### 5.1 DATA REVIEW

Floyd|Snider will review the laboratory reports for internal consistency, transmittal errors, laboratory protocols, and adherence to the objectives specified in this QAPP. A Stage 2A Data Quality Review will be performed as described in this section for all data. The results of the Data Quality Review will be summarized in the EDR.

A Stage 2A Data Quality Review (Summary Validation) includes the following:

- Evaluation of package completeness
- Verification that sample numbers and analyses match those requested on the chain-of-custody form
- Review of method-specified preservation and sample holding times
- Verification that the required detection limits and RLs have been achieved
- Verification that the field and laboratory duplicates, MS/MSDs, and LCSs were analyzed at the proper frequency
- Verification of analytical precision and accuracy via replicate analysis and analyte recoveries
- Verification that the surrogate compound analyses have been performed and meet QC criteria
- Verification that the laboratory method blanks are free of contaminants

### 5.2 VALIDATION METHODS AND RECONCILIATION WITH USER REQUIREMENTS

Data validation programs have been established in accordance with USEPA guidance (USEPA 2002a). Data validation will be based on the QA/QC criteria as recommended in the methods identified in this QAPP and in the USEPA's National Functional Guidelines (USEPA 2020a, 2020b, 2020c) and environmental data verification and validation guidance (USEPA 2002b).

Data usability 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 PMs, Floyd Snider PM, and data validators in consultation.

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## 6.0 References

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- \_\_\_\_\_. 2006. *EPA Requirements for Quality Assurance Project Plans*. EPA QA/R-5. Office of Environmental Information. Washington, DC. March 2001, reissued May 2006.
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- \_\_\_\_\_. 2020c. *National Functional Guidelines for Organic Superfund Methods Data Review*. Prepared by the Office of Superfund Remediation and Technology Innovation. EPA-540-R-20-005/OLEM 9240.0-51. November.

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### 7.0 Approvals

*By signing below, I acknowledge that I have reviewed the Quality Assurance Project Plan and agree to follow the methods and quality assurance procedures contained therein.*

\_\_\_\_\_  
Kristin Anderson, Associate Principal, Floyd | Snider Date \_\_\_\_\_

\_\_\_\_\_  
Chell Black, QA Manager, Floyd | Snider Date \_\_\_\_\_

\_\_\_\_\_  
Sunny Becker, Site Manager, Ecology Date \_\_\_\_\_

\_\_\_\_\_  
David Baumeister, Project Manager, OnSite Environmental Date \_\_\_\_\_

\_\_\_\_\_  
Aaron Young, Project Manager, AmTest Date \_\_\_\_\_

\_\_\_\_\_  
Mike Ridgeway, Project Manager, Fremont Analytical Date \_\_\_\_\_

# Engineering Design Report

Riverside HVOC Site

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## Appendix F

### Tables

**Table F.1  
Key Project Quality Assurance Contacts**

Title	Name	Phone	Email	Address
Floyd   Snider Principal	Lynn Grochala	206-292-2078	lynn.grochala@floydsnider.com	601 Union Street Suite 600 Seattle, WA 98101
Floyd   Snider PM	Kristin Anderson		kristin.anderson@floydsnider.com	
Floyd   Snider QA/QC Coordinator	Chell Black		chell.black@floydsnider.com	
Floyd   Snider Field Coordinator	Danielle Gallaher		danielle.gallaher@floydsnider.com	
Ecology Site Manager	Sunny Becker	425-457-3842	HLIN461@ecy.wa.gov	P.O. Box 330316 Shoreline WA 98133
OnSite Environmental PM	David Baumeister	425-883-3881	dbaumeister@onsite-env.com	14648 NE 95 <sup>th</sup> Street Redmond, WA 98052
AmTest PM	Aaron Young	425-885-1664	aarony@amtestlab.com	13600 NE 126 <sup>th</sup> Place, Suite C Kirkland, WA 98034
Fremont Analytical PM	Mike Ridgeway	206-352-3790	mridgeway@fremontanalytical.com	3600 Fremont Ave N Seattle, WA 98103

Abbreviations:

- Ecology Washington State Department of Ecology
- PM Project Manager
- QA/QC Quality assurance/quality control

**Table F.2**  
**Quality Assurance Project Plan Analyte List for Water and Soil**

Analyte	Method	Units	Cleanup Level	Laboratory Detection Limits	
				MDL	RL
<b>Groundwater</b>					
<b>Volatile Organic Compounds</b>					
Tetrachloroethene	USEPA 8260D	µg/L	4.9	0.095	0.20
Trichloroethene			0.38	0.081	0.20
cis-1,2-Dichloroethene			16	0.110	0.20
trans-1,2-Dichloroethene			--	0.070	0.20
Vinyl Chloride	USEPA 8260D/SIM		0.020	n/a	0.020
<b>Conventionals</b>					
Total Organic Carbon	SM 5310B	mg/L	--	--	1.0
Nitrate	USEPA Method 353.2	mg/L	--	--	0.050
Nitrite			--	--	0.020
Sulfate	ASTM D516-11	mg/L	--	--	5.0
Sulfide	SM 4500-S2	mg/L	--	--	0.050
Chloride	SM 4500-CIE	mg/L	--	--	2.00
Ethene	RSK-175	µg/L	--	--	0.58
Ethane			--	--	0.56
Methane			--	--	0.55
Ferrous iron <sup>(1)</sup>	SM 3500-FeB	mg/L	--	0.0060	0.15
	Colorimetric field test/ 1,10 Phenanthroline	mg/L	--	--	0.5 (maximum detect 7.0)

Notes:

- Not applicable or not established.
- 1 Ferrous iron may be analyzed by either the listed laboratory (1,10 Phenanthroline) or field method (colorimetric field test).

Abbreviations:

- MDL Method detection limit
- µg/L Micrograms per liter
- mg/kg Milligrams per kilogram
- mg/L Milligrams per liter
- RL Reporting limit

**Table F.3**  
**Quality Assurance/Quality Control Criteria**

Parameter	Precision	Accuracy	Completeness
<b>Groundwater</b>			
VOCs	±20%	66–133%	90%
TOC	±20%	75–125%	90%
Nitrate/Nitrite	≤22% RPD / 11% RPD	85–121% / 85–121%	90%
Sulfate	≤11% RPD	69–134%	90%
Sulfide	≤15% RPD	75–124%	90%
Ethene/ethane/methane	≤25% RPD	75–125%	90%
Ferrous Iron <sup>(1)</sup>	≤20% RPD	85–115%	90%

Notes:

1 Criteria apply only to laboratory analysis for ferrous iron.

Abbreviations:

- QA/QC Quality Assurance/Quality Control
- RPD Relative percent difference
- TOC Total organic carbon
- VOC Volatile organic compound

**Table F.4**  
**Quality Assurance/Quality Control Frequency**

Parameter	Method Blank <sup>(1)</sup>	Laboratory Control Samples <sup>(1)</sup>	Matrix Spike	Matrix Spike Duplicate <sup>(2)</sup>	Laboratory Duplicate	Surrogate Spike	Field Duplicate	Trip Blank	
Total solids	--	--	--	--	--	--		--	
VOCs	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	--	Every sample	1 per 20 samples	1 per cooler	
Metals			--	--	1 per 20 samples			--	--
TOC									
Nitrate/Nitrite									
Sulfate									
Sulfide									
Ethene/ethane/methane									
Ferrous Iron <sup>(3)</sup>									

Notes:

- Not applicable.
- 1 If less than 20 samples, analyze 1 per analytical batch.
- 2 Duplicates may be analyzed in place of matrix spike duplicates.
- 3 Criteria apply only to laboratory analysis for ferrous iron.

Abbreviations:

- TOC Total organic carbon
- VOC Volatile organic compound

**Table F.5  
Container and Preservation Criteria for Water and Soil**

Analyte	Method	Sample Handling		
		Container	Holding Time	Sample Preservation Technique
<b>Groundwater</b>				
VOCs	USEPA 8260D	Three 40-mL pre-weighted VOA vials	14 days	HCl pH<2, Cool <6 °C
Total organic carbon	SM 5310B	One 250-mL HDPE	28 days	HCl pH<2, Cool <6 °C
Nitrate/Nitrite	USEPA 353.2	One 250-mL HDPE	48 hours	Cool <6 °C
Sulfate	ASTM D516-11	One 250-mL HDPE	28 days	Cool <6 °C
Sulfide	SM 4500-S2	One 100-mL HDPE, add zinc acetate	7 days	NaOH pH>9, Cool <6 °C
Ethene/Ethane/Methane	RSK-175	Two 40-mL pre-weighted VOA vials	14 days	HCl pH<2, Cool <6 °C
Ferrous Iron	SM 3500-FeB	500 mL amber glass, no headspace	24 hours	HCl pH<2, Cool to <4 °C
	Color disc/ 1,10 Phenanthroline	Two 18-mm plastic viewing tubes with color comparator box	Analyze immediately—field method	Ferrous iron reagent power (added to one 25-mL sample aliquot)

Abbreviations:

- °C Degrees Celsius
- HCl Hydrochloric acid
- HDPE High-density polyethylene
- mL Milliliters
- mm Millimeters
- NaOH Sodium hydroxide
- VOA Volatile organic analysis
- VOC Volatile organic compound
- WMG Wide-mouth glass

# **Engineering Design Report**

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## **Appendix F**

### **Attachment F.1 Field Procedures**

## F | S STANDARD GUIDELINE

# Low-Flow Groundwater Sample Collection

DATE/LAST UPDATE: December 2022

*These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.*

*All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.*

### 1.0 Scope and Purpose

This standard guideline provides details necessary for collecting representative groundwater samples from monitoring wells using low-flow methods. These guidelines are designed to meet or exceed guidelines set forth by the Washington State Department of Ecology (Ecology). Low-Flow sampling provides a method to minimize the volume of water that is purged and disposed from a monitoring well, and minimizes the impact that purging has on groundwater chemistry during sample collection.

### 2.0 Equipment and Supplies

#### Groundwater Sampling Equipment and Tools

- For wells with head less than 25 feet:
  - Peristaltic pump with fully charged internal battery or standalone battery and appropriate connectors
- For wells with head greater than 25 feet:
  - Bladder pump and controller, as well as an air cylinder, or air compressor (with extension cord if near an electrical outlet; with battery and appropriate connectors or generator if not near an outlet)

**OR**

- Low-flow submersible pump and controller (with extension cord if near an electrical outlet; with battery and appropriate connectors or generator if not near an outlet)
- Multi-parameter water quality meter
- Water level meter
- Polyethylene tubing, Teflon tubing, or similar (assume polyethylene unless otherwise specified in SAP) and tubing weights (for wells deeper than approximately 10 feet)
- Silicone tubing
- Filters (if field filtering)
- Tools for opening wells and drums (1/2-inch, 9/16-inch, 5/8 and 15/16-inch sockets ratchet, screwdriver, hammer/rubber mallet, bung wrench; any other necessary tools if non-standard monuments have been used)
- Well keys
- Tube cutters, razor blade, or scissors
- 5-gallon buckets, lids, and clamp
- Decontamination supplies: Alconox (or similar), distilled or deionized water, spray bottles, and paper towels
- Bailer or hand pump to drain well box if full of stormwater
- Trash bags

### Lab Equipment

- Sample jars/bottles
- Coolers
- Chain-of-Custody Forms
- Labels
- Ice
- Ziploc bags

### Paperwork

- Field notebook with site maps
- Table of well construction details and/or well logs, if available
- Sampling forms (enclosed)
- Purge water plan
- Rite-in-the-Rain pens, paper, and permanent markers

- Site-Specific Health and Safety Plan (HASP) and F|S Accident Prevention Plan (APP)
- List of emergency contacts for the Site or facility
- Safety Data Sheets (SDS) binder
- Sampling and Analysis Plan (SAP) and/or Quality Assurance Project Plan (QAPP) (including tables of analytes and bottle types)

### **Safety Equipment**

- PPE:
  - Waterproof boots (safety toed, depending on site)
  - Safety vest
  - Safety glasses
  - Rain gear
  - Nitrile gloves
  - Work gloves
- First Aid kit
- Emergency kit (fire extinguisher, road flares)
- Traffic barricades or cones

## **3.0 Standard Procedures**

Low-flow groundwater sampling consists of purging groundwater within the well casing at a rate equal to or less than the flow rate of representative groundwater from the surrounding aquifer into the well screen. The flow rate will depend on the hydraulic conductivity of the aquifer and the drawdown, with the goal of minimizing drawdown within the monitoring well. Field parameters are monitored during purging and groundwater samples are collected after field parameters have stabilized. Deviations from these procedures should be approved by the Project Manager and fully documented.

### **3.1 OFFICE PREPARATION**

First, meet with the PM to identify the key objectives of the groundwater sampling effort. This may include the order of wells to be sampled (e.g., if using non-dedicated equipment, wells may need to be sampled in order of least contaminated to most contaminated), whether any wells require redevelopment at least 24-hours prior to sampling, and/or key stabilization parameters (e.g., elevated turbidity may require purging beyond 30 minutes, even if the readings are within 10%).

Conduct a kick-off meeting with the sampling team to discuss site health and safety protocols, data quality objectives, and any site-specific special considerations or sampling procedures.

### 3.2 TAILGATE SAFETY MEETING

Conduct a tailgate safety meeting prior to beginning work at the site. Emergency evacuation procedures, rally points, and onsite communication protocols should be discussed at the first tailgate meeting and repeated if new personnel join the field team onsite.

The safety meeting should cover the hazards specific to groundwater sampling. Typical hazards include the following:

- Chemical hazards (refer to HASP for site chemical exposure hazards)
- Site hazards
  - Traffic hazards onsite (e.g., truck traffic, heavy machinery)
  - Biological hazards (e.g., spiders or wasps within well monuments)
- Physical hazards associated with lifting and carrying heavy equipment and repeated bending while sampling
- Cuts and abrasions associated with using blades and tools
- Electrical hazards (make sure all wires/cables are in good condition and connections to battery or outlet are secure)
- Heat stress and cold stress

Record the meeting attendees and topics discussed on the front page of the tailgate safety meeting form (included as an attachment to the HASP). All attendees should sign the form.

### 3.3 OTHER HEALTH AND SAFETY GUIDELINES

The following are additional health and safety guidelines that should be followed in the field. These guidelines are intended to supplement the guidelines and requirements identified in the HASP and are not intended to replace the HASP.

- Review and sign the HASP prior to going into the field.
- Conduct a tailgate safety meeting prior to beginning work at the site as discussed in Section 3.2
- When moving between monitoring wells or switching to different tasks (e.g., transitioning from sampling to cooler QC prior to lab pickup), assess any additional hazards that may be associated with the new location or task. Record additional hazards noted and corrective actions to address those hazards on the Daily Tailgate Safety Meeting and Debrief Form (included as an attachment to the HASP).
- Record near misses and incidents on the Near Miss and Incident Reporting Form (included as an attachment to the HASP) and conduct management/client notifications according to the protocols detailed in the HASP.

### 3.4 CALIBRATION OF WATER QUALITY METERS

All multi-parameter water quality meters to be used will be calibrated prior to each sampling event. Calibration procedures are outlined in each instrument's specific user manual.

### 3.5 MONITORING, MAINTENANCE, AND SECURITY

Prior to sampling, depth to water and total depth measurements will be collected and recorded for accessible monitoring wells onsite (or an appropriate subset for larger sites). Check for an existing measuring point (notch or visible mark on top of casing). If a measuring point is not observed, a measuring point should be established on the north side of the casing. The conditions of the well box and bolts will also be observed, and deficiencies will be recorded on the sampling forms or logbook (i.e., missing or stripped bolt). The following should also be recorded:

- Condition of the well box, lid, bolts, locks, and gripper cap, if deficiencies
- Condition of gasket if deficient and if water is present in the well box
- Note any obstructions or kinks in the well casing
- Note any equipment in the well casing, such as transducers, bailers, or tubing
- Condition of general area surrounding the well, such as subsidence, potholes, or if the well is submerged within a puddle.

Replace any missing or stripped bolts and redevelop wells if needed.

### 3.6 LOW-FLOW PURGING METHOD AND SAMPLING PROCEDURES

Groundwater samples will be collected using low-flow purging and sampling procedures consistent with Ecology guidelines and the U.S. Environmental Protection Agency (USEPA) standard operating procedures (USEPA 1996). The following describes the Low-Flow purging and sampling procedures for collecting groundwater samples using a peristaltic pump. If the water level is greater than approximately 20 to 25 feet below ground surface (bgs), Grundfos or Geotech submersible pumps or bladder pumps can be used since their pumping rates can be adjusted to low-flow levels. Submersible pumps are preferable to bladder pumps in situations where less than 5 feet of water column are present in the well casing.

- Place the peristaltic pump and water quality equipment near the wellhead. Slowly lower new poly tubing down into the well casing approximately to the middle of the well screen. When sampling wells with a bottom screen depth greater than approximately 10 feet, it is important to measure the length of tubing prior to placement as longer lengths of tubing are more likely to get caught or otherwise obstructed and feel like it has reached the well bottom; this issue can be mitigated by using decontaminated stainless steel tubing weights. If the depth of the well screen is not known, lower the appropriate length of tubing to the bottom of the well, making sure that the tubing has not been caught on the slotted well casing, and then raise the tubing 3 to 5 feet off the bottom of the casing (limit this distance to 2 feet for wells with total depth less than 10 feet). Document the estimated depth of the tubing

placement within the well. Connect the tubing to the peristaltic pump using new flex tubing and connect the discharge line to the flow-through cell of the water quality meter. The discharge line from the flow cell should be directed to a bucket to contain the purged water.

- If using a low-flow submersible pump, connect the pump head to dedicated or disposable tubing. If using a bladder pump, connect both the air intake and water discharge ports to decontaminated or disposable tubing, using the manufacturer's instructions to ensure a secure connection. Lower the pump with tubing into the well as described above and connect the water discharge tubing directly to the flow-through cell.
- Measure the depth to water to the nearest 0.01 foot with a decontaminated water level meter and record the information on a sampling form.
- Start pumping the well at a purge rate of 0.1 to 0.2 liters per minute and slowly increase the rate. Purge rate is adjusted using a speed control knob or arrows on peristaltic and low-flow submersible pumps. The purge rate for bladder pumps is controlled by the air compressor, which first pressurizes the pump chamber in order to compress the flexible bladder and force water through the discharge line, and then vents the chamber in order to allow the bladder to refill with water.
  - A good rule of thumb is to pressurize to 10 psi + 0.5 psi/foot of tubing depth and begin with 4 discharge/refill cycles per minute; using greater air pressure and accelerating the pump cycles will increase the purge rate.
- Check the water level. If the water level is dropping, lower the purge rate. Maintain a steady flow with no or minimal drawdown (less than 0.33 feet according to USEPA 2002). Maintaining a drawdown of less than 0.33 feet may not be feasible depending on hydrogeological conditions. If possible, measure the discharge rate of the pump with a graduated cylinder or use a stopwatch when filling sampling jars (500 milliliters [mL] polyethylene or glass ambers) to estimate the rate. When purging water through a flow cell, the maximum flow rate for accurate water quality readings is about 0.5 liters per minute (L/minute).
- The discharge tubing should be connected to the flow cell immediately upon initial water discharge, unless the discharge water is visibly turbid or flocculant is observed. Monitor and record water quality parameters every three to five minutes after one tubing volume (including the volume of water in the flow cell) has been purged.
  - One foot of ¼-inch interior diameter tubing holds about 10 mL of water, and flow-through cells typically hold less than 200 mL of water; one volume should be purged after about 5 minutes at a flow rate of 0.1 L/minute.
- Water-quality indicator parameters that will be monitored and recorded during purging include:
  - pH
  - Specific conductivity

- Dissolved oxygen
- Temperature
- Turbidity
- Oxidation reduction potential (ORP)
- Continue purging until temperature, pH, turbidity, and specific conductivity are approximately stable (when measurements are within 10 percent) for three consecutive readings, or 30 minutes have elapsed. Because these field parameters (especially dissolved oxygen and ORP) may not reach the stabilization criteria, collection of the groundwater sample will be based on the professional judgment of field personnel at the time of sampling. A minimum of 5 water quality readings should be collected prior to sampling.
- The water sample can be collected once the criteria above have been met.
- If drawdown in the well cannot be maintained at 0.33 feet or less, reduce the flow or turn off the pump for 15 minutes and allow for recovery. If the water quality parameters have stabilized, and if at least two tubing volumes and the flow cell volume have been purged, then sample collection can proceed when the water level has recovered, and the pump is turned back on. This should be noted on the sampling form.
- To collect the water sample, maintain the same pumping rate. After the well has been purged and the sample bottles have been labeled, the groundwater sample will be collected by directly filling the laboratory-provided bottles from the pump discharge line prior to passing through the flow cell. All sample containers should be filled with minimum disturbance by allowing the water to flow down the inside of the bottle or vial. When collecting a volatile organic compound (VOC) sample, fill to the top to form a meniscus over the mouth of the vial prior to placing the cap to eliminate air bubbles. Be careful not to overflow preserved bottles/pre-cleaned Volatile Organic Analyte (VOA) vials.
- If sampling for filtered metals, collect these samples last and fit an in-line filter at the end of the discharge line. Take note of the flow direction arrow on the filter prior to fitting, invert filter to eliminate air bubbles, and allow minimum of 0.5 to 1 liter of groundwater to pass through the filter prior to collecting the sample.
- Sample labels will clearly identify the project name, sampler's initials, sample location and unique sample ID, analysis to be performed, date, and time. After collection, place samples a cooler maintained at a temperature of approximately 4 to 6 degrees Celsius (°C) using ice (if required). Complete the chain-of-Custody forms. Upon transfer of the samples to the laboratory, the Chain-of-Custody Form will be signed by the persons transferring custody of the sample containers to document change in possession.
- When sample collection is complete at a designated location, remove and properly dispose of the non-dedicated tubing. In most cases, this waste is considered solid waste and can be disposed of as refuse. Close and lock the well.

## 4.0 Decontamination

All reusable equipment that comes into contact with groundwater should be decontaminated using the processes described in this section prior to moving to the next sampling location.

**Water Level Meter:** The water level indicator and tape will be decontaminated between sampling locations and at the end the day by spraying the entire length of tape that came in contact with groundwater with an Alconox (or similar)/clean water solution followed by a thorough rinse with distilled or deionized water.

**Water Quality Sensors and Flow-Through Cell:** Distilled water or deionized water will be used to rinse the water quality sensors and flow-through cell. No other decontamination procedures are recommended since they are sensitive equipment. After the sampling event, the water quality meters will be cleaned and maintained according to the specific manual.

**Submersible Pump (if applicable):** Decontaminating the pump requires running the pump in three progressively cleaner grades of water.

1. Fill a bucket with approximately 4 gallons of an Alconox (or similar)/clean water solution to sufficiently cover the pump. Place the pump and the length of the power cord (if applicable) that was in contact with water into the bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.
2. Fill a second bucket containing approximately 4 gallons of clean water to sufficiently cover the pump. Place the pump and cord into this bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.
3. Fill a third bucket with approximately 4 gallons of distilled or deionized water to sufficiently cover the pump. Place the pump and cord into this bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.

The soap/water solution may be reused; however, rinse water should be collected for disposal as described in Section 5.0 below. When done for the day, dry the exterior of the pump and cord with clean towels to the extent practical prior to storage.

**Bladder Pump:** Clean the inside and outside of the pump body with an Alconox (or similar)/clean water solution, followed by a thorough rinse with distilled or deionized water. The outside of the air supply line that came in contact with groundwater may also be cleaned with Alconox (or similar) solution and re-used; bladders and water discharge lines must be replaced after each sample is collected.

## 5.0 Investigation-Derived Waste (IDW)

Unless otherwise specified in the project work plan, water generated during groundwater sampling activities will be contained, transported, disposed of in accordance with applicable laws, and stored in a designated area until transported off-site for disposal. This includes purge water and decontamination waste water.

The approach to handling and disposal of these materials for a typical cleanup site is as follows.

For IDW that is containerized, such as purge water, 55-gallon drums (or other smaller sized drums) approved by the Washington State Department of Transportation will be used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “purge water”), the dates on which the wastes were placed in the container, the owner’s name and contact information for the field person who generated the waste, and the site name.

IDW containerized within drums will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used, as appropriate for disposal. Refer to the FS Special Condition Standard Guideline for Investigation Derived Waste for additional information regarding proper profiling and disposal of wastewater generated by groundwater sampling.

Disposable sampling materials and incidental trash such as tubing, paper towels and gloves/other disposable used in sample processing will be placed in heavy-duty garbage bags or other appropriate containers and disposed of as trash in the municipal collection system unless otherwise specified in the SAP.

## 6.0 Field Documentation

Groundwater sampling activities will be documented in field sampling forms and/or field notebooks, and Chain-of-Custody Forms. Information recorded will, at a minimum, include personnel present (including subcontractors or client representatives), purpose of field event, weather conditions, sample collection date and times, sample analytes, depths to water, water quality parameters, well box/lid conditions, amount of purged water generated, and any deviations from the SAP. Photographs of damaged well casings or well boxes should be taken.

At the end of the day, complete and review the second page of the tailgate safety meeting form detailing additional hazards, corrective actions, near-misses or incidents. Any incidents that result in equipment damage or field staff injuries should be reported immediately to the PM.

## 7.0 Demobilization

Upon returning to the office, ensure that all equipment is properly cleaned and put away in the field room. Equipment with rechargeable batteries should be plugged in as appropriate. It is

preferable to dispose of trash on-site, but any trash left in the field vehicle should be disposed as regular trash at Two Union Square.

If rented equipment or sample coolers will be placed at the front desk for pickup, clearly label each item with the company picking it up, anticipated pickup time frame, and your contact information so front desk staff can contact you if there are any questions. Notify front desk staff if any items require a signature at pickup.

Within one week of returning from the field, the field lead for the event should review field notes, sampling forms and tailgate safety meeting forms with the PM. Following PM review and approval, field notes will be scanned and saved to the project folder. Hard copies should be filed. The PM will provide copies of near miss and incident reports to the Safety Program Manager.

### 8.0 References

U.S. Environmental Protection Agency (USEPA). 1996. Low-Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, Revision 2. Region 1. July 30, 1996.

\_\_\_\_\_. 2002. Groundwater Sampling Guidelines for Superfund and CAR Project Managers. Office of Solid Waste and Emergency Response. EPA 542.S-02-001. May 2002.

**Enclosures:** Groundwater or Surface Water Sample Collection Form

**Record of Revisions:**

Revisions	Date
Added health and safety information, reviewed EPA guidance, and added revisions table.	12/9/2022



# F | S STANDARD GUIDELINE

## Soil Sample Collection

DATE/LAST UPDATE: December 2022

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### 1.0 Scope and Purpose

This standard guideline presents commonly used procedures for collection of soil samples for characterization and laboratory analysis. The methods presented in this guideline apply to the collection of soil samples during the following characterization activities: soil borings via drilling, manual collection of shallow soil samples, test pit excavation, excavation confirmation, and stockpile characterization. Specific details regarding the collection of discrete and composite samples, and special sampling techniques for volatile organic compounds (VOCs) are also included. The guideline is intended to be used by staff who collect soil samples in the field.

It is important that the field staff completing the soil sample collection discusses the specific needs for a particular investigation with the project geologist, the project manager, or whoever will ultimately be responsible for interpreting the findings of the field investigation. This discussion is in addition to field training and general knowledge about soil sampling, and should happen prior to entering the field, with additional follow-up before finalizing the field forms, after the investigation is complete.

## 2.0 Equipment and Supplies

### Soil Sampling Equipment and Tools:

- Tape measure or measuring wheel
- Stainless steel bowls and spoons
- Trowel, hand auger, or shovel (if needed)
- Table and disposable sheeting, tape or clamps to hold down sheeting (if needed).
- White board and dry erase pen
- Graduated plunger and collection tubes for VOC samples (if needed)
- Photoionization detector (PID) (if needed)
- Ziploc bags (sandwich and gallon sizes)
- Trash bags
- Decontamination tools including:
  - Paper towels or shop towels
  - Spray bottles of Alconox (or similar) solution
  - Deionized or distilled water
  - Scrubbing brush and bucket
- Adhesive drum labels, and paint or grease pen
- Washington State Department of Transportation- (WSDOT) approved drums for investigation-derived waste (IDW) disposal, if needed (if drilling, to be provided by driller)
- Camera
- Hand-held global position system (GPS; if needed)
- Coolers, sample jars, labels, ice

### Paperwork:

- Work Plan and/or Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP)
- Field map printed on Rite in the Rain paper
- Site-specific Health and Safety Plan (HASP)
  - Tailgate meeting form (for each day you expect to be on Site)
  - Safety Data Sheets
- Floyd|Snider's Accident Prevention Plan (APP)

- Sample collection forms printed in Rite in the Rain paper
- Boring Logs
- Rite in the Rain field notebook
- Chain of custody forms
- Emergency contact numbers for utilities, property owner/manager, etc. (as needed)

**Safety Equipment:**

- Steel-toed boots
- Safety vest
- Safety glasses
- Nitrile gloves
- Rain gear
- Work gloves
- Hard hat
- Ear protection
- Traffic barricades or cones
- Vehicle emergency kit (road flares, fire extinguisher, first aid kit, etc.)
- Sunscreen if needed
- Hand and foot warmers, if needed
- Mosquito repellent, Hornet Spray, if needed
- Drinking water
- Rain or sun shelter, if needed
- Cell phone and charger cables

### 3.0 Standard Procedures

#### 3.1 OFFICE PREPARATION

Prior to going into the field, review the SAP and QAPP to become familiar with the sampling goals, data quality objectives, desired sample intervals and nomenclature, field Quality Assurance (QA) samples (i.e., frequency of field duplicates, MS/MSDs) to be collected, analytes, sample containers, and holding times for each analytical method.

At least one week prior to sampling, coordinate with the laboratory specified in the SAP/QAPP to receive coolers and appropriate sample containers (including additional containers for

QA samples). Familiarize yourself with the volume requirements and container types, preservation methods, and holding times for each class of analytes.

If drilling or digging test pits, mark the sample area and sample locations with white spray paint prior to sampling, then submit an 811 public utility locate request at least 3 business days prior to work. Hire a private utility locator and schedule to locate utilities on private property and ensure proposed boring and/or excavation locations are free of utilities (Note: not all locators are equipped to mark non-conductible utilities).

### **3.2 TAILGATE SAFETY MEETING**

Conduct a tailgate safety meeting prior to beginning work at the Site. Include any subcontractors working with you at the Site in this meeting. The safety meeting should cover the hazards specific to soil sampling. Typical hazards include:

- Heavy machinery/drill rig awareness (overhead hazards, pinch points, noise, uncontrolled release of energy). Always make eye contact before approaching an operator.
- Physical hazards (heavy lifting, uneven ground/trip hazards)
- Chemical hazards (dust, site-specific contaminants of concern, lab preservatives)
  - Refer to HASP for specific air monitoring requirements, permissible exposure limits (PELs), and actions if PELs are exceeded.

Additional hazards that may be present at any job site include traffic, adverse weather, slips, trips, falls, biological hazards (such as insects, plants, animals), and worksite distractions (such as pedestrians or other onsite activities).

Record the meeting attendees and topics discussed on the front page of the tailgate safety meeting form. All attendees should sign the form.

### **3.3 OTHER HEALTH AND SAFETY GUIDELINES**

The following are additional health and safety guidelines that should be followed in the field. These guidelines are intended to supplement the guidelines and requirements identified in the HASP and are not intended to replace the HASP.

- Review and sign the HASP prior to going out into the field.
- Conduct a tailgate safety meeting prior to beginning work at the site as discussed in Section 3.2.
- If conditions change (e.g., weather or personnel) or when moving between sampling locations/switching to different sampling tasks, assess any additional hazards that may be associated with the new condition or location/task. Record additional hazards noted and corrective actions to address those hazards on the second page of tailgate safety meeting form.

Record near misses and incidents on the Near Miss and Incident Reporting Form (included as an attachment to the HASP) and conduct management/client notifications according to the protocols detailed in the HASP.

### 3.4 GENERAL SOIL SAMPLE COLLECTION PROCEDURES

1. Locate the desired sample location and depth interval using a handheld GPS or by taking field measurements from known site features. Record the soil type and any other observations or indications of contamination on a soil boring log (enclosed), soil sample collection form, or field notebook, as described in the Soil Logging Standard Guideline. Note the location and depth of the sample on the whiteboard or notecard and take a photograph with a scale (e.g., tape measure), if possible.
2. Refer to Sections 3.4.1 through 3.4.4 for the appropriate soil collection procedures for drilling, shallow soil, test pit excavation, excavation confirmation, and stockpiles. If collecting samples for VOC analysis by the U.S. Environmental Protection Agency (USEPA) Method 5035, refer to Section 3.5 for specific sample collection procedures for this method. If composite soil sampling is recommended, refer to Section 3.6 for details.
3. Once soil has been collected from the desired depth or interval, mix thoroughly in a disposable or decontaminated stainless-steel bowl until the sample is homogenous in color, texture, and moisture.
4. Fill the required laboratory-provided jars, taking care not to overfill. If large gravels (diameter greater than ~ 1 inch) are encountered, these should be discarded to ensure that an adequate soil volume is collected for analysis. If necessary, use a clean paper towel to remove soil particles from the threaded mouth of the jar before securing lids to ensure a good seal. Remove any soil or dirt from the outside of the jar with a clean paper or shop towel.
5. Label each jar with the sample name, date, time, field staff initials and required analyses. If collecting a field duplicate, use the sample nomenclature specified in the SAP\QAPP and note the field duplicate name and sample time in the sample log and/or field notebook. If extra volume for matrix spike/matrix spike duplicate (MS/MSD) analysis is required, use the same name on all jars. Soil samples should be protected from moisture by placing the filled sample jars into separate sealed Ziploc bags before placing them into a cooler.
6. Upon completion of each day of sampling, complete a chain-of-custody form for all samples, including sample names, date and time of collection, number of containers, and required analyses and methods. Write neatly and make sure information on the chain is legible. If you need to correct an entry, strike the incorrect entry out once, and add your initials next to the strike out. Samples collected for waste characterization purposes should be recorded on a separate chain-of-custody. Keep samples on ice (unless otherwise specified in the SAP/QAPP) to maintain

temperatures of 4-6 degrees Celsius (°C) and transport to the laboratory under chain-of-custody procedures.

### 3.4.1 Soil Sample Collection via Drilling

These procedures should be used for drilling via direct-push, hollow stem auger, or roto-sonic methods where a pre-designated sample interval (i.e., 0 to 5 feet below ground surface [bgs]) is retrieved from the subsurface using a split spoon sampling device, lined core, or bag sampler.

1. Ensure that reusable sampling equipment has been thoroughly decontaminated prior to sampling.
2. Collect PID measurements and other field tests, if necessary. PID measurements should be collected using the head-space method: put a small amount of soil from the selected interval into a sandwich bag and seal the bag. Label the bag with the soil interval. After at least 10 seconds, insert the tip of the PID into the bag and record the PID reading on the boring log or field collection form. If a sheen test is necessary, place a small amount of soil into a disposable or decontaminated stainless steel bowl, spray it with tap water or deionized water and observe whether a sheen appears on the water. Record results on the boring log or sample collection form.
3. Prior to sample collection, log soil on the boring log or sample collection form following the Soil Logging Standard Guideline.
4. Use a stainless-steel spoon or trowel, or disposable scoop to remove an equal volume of soil across the targeted depth interval from the sampler.
  - a. If using a split spoon sampler or other reusable sampler, avoid collecting the soil that is touching the sides of the sampler to the extent practical.
  - b. If the soil touching a reusable sampler must be collected to obtain adequate volume for analysis, notify the PM and record in the field logbook.

### 3.4.2 Manual Collection of Shallow Soil Samples

These procedures should be used for shallow soil sampling via scoop, trowel, shovel, or hand auger.

1. Dig or auger to the bottom depth of the shallowest sample to be collected, using a tool that has been thoroughly decontaminated. Verify that the target depth has been reached using a measuring tape.
2. If using a scoop or trowel, collect the soil directly into a decontaminated stainless-steel bowl.
3. If using a shovel, the soil may either be collected in bowls or set aside on plastic sheeting in favor of collecting the sample from the sidewall of the hole. If sampling the sidewall, use a decontaminated or disposable scoop or trowel to collect soil from the target depth, or scrape along the sidewall to collect soil across a target depth

- interval. Transfer soil to a disposable or decontaminated stainless-steel bowl, repeating until a sufficient volume has been collected.
4. If using a hand auger, empty the cylinder of the auger directly into a disposable or decontaminated stainless-steel bowl. It may be necessary to empty the hand auger onto plastic sheeting or into a bowl to reach the target depth without overflowing the sampler.
  5. Any soil from depth intervals that are not targeted for sampling should be set aside on plastic sheeting and returned to the hole after sampling.
  6. Collect PID measurements and other field tests as described in Section 3.4.1.

### **3.4.3 Sample Collection from Test Pits or Limited Soil Excavations**

These procedures should be used for collecting samples from test pit explorations excavated using a backhoe or excavator. These same general procedures should also be followed for post-excavation soil samples used to confirm that an excavation has removed contaminated material or to document post-excavation conditions after target excavation limits have been reached.

1. Measure the length, width, and depth of the test pit or excavation area to verify that the target extents have been reached. The lateral spacing of the test pit or excavation confirmation samples, or exact location of samples should be specified in the work plan and typically depend on the size of the excavation area but can vary significantly by project.
2. If not specified in the work plan, sidewall samples may be collected either midway between the ground surface and base of the excavation, or incrementally along the entire height of the sidewall. Both sidewall and base (bottom) samples should penetrate a minimum of 6 inches into the excavated surface.
3. If the test pit or excavation is less than 4 feet deep, or has been benched to accommodate safe entry, a sample may be collected directly from the sidewall(s). Do not enter an excavation before reviewing and verifying the necessary safety requirements. Most excavations can be sampled without entering, which is preferred. If entering is safe, based on the depth or accommodations to support entry, to collect soil from a sidewall, use a decontaminated or disposable scoop, trowel, or shovel to obtain soil from the desired depth or depth interval directly into a decontaminated stainless-steel bowl.
4. If a test pit or excavation cannot be safely entered, instruct the excavator operator to scoop sidewall material from the target depth or depth interval. Collect the soil sample from the excavator bucket using a decontaminated stainless-steel spoon, trowel, or disposal scoop, avoiding material that has come into contact with the teeth or sides of the bucket. Place an adequate volume of soil into a decontaminated stainless-steel bowl. If necessary, follow the compositing procedures in Section 3.6.

### 3.4.4 Stockpile Sampling

These procedures should be used for classifying stockpiled soil, including excavated soil and imported backfill material.

1. Where potentially contaminated soils have been previously excavated and stockpiled on site, Washington State Department of Ecology (Ecology) guidance recommends using a decontaminated or disposable scoop or trowel, penetrating 6 to 12 inches beneath the surface of the pile at several locations until sufficient volume for analysis is achieved. A decontaminated shovel may also be used to facilitate collection of soil from large piles. The locations for soil collection should be where contamination is most likely to be present based on field screening (i.e., staining, odor, sheen, or elevated photoionization detector [PID] readings). If there are not field indications of contamination, the locations should be distributed evenly around the stockpile.
2. The stockpile may need to be broken up into sections for sample collection depending on the size of the pile (i.e., segregate the pile in half or quarters). If this is necessary, it is important to document where each set of samples were collected from (i.e., north quadrant) and create a field sketch in the project notebook of the pile for reference and mark sample locations with flags.
3. If a sampling frequency is not specified in the work plan, the general rule of thumb for contaminated soil stockpile profiling is to collect and submit 3 analytical samples (these samples can be multi-point composites or grabs) for stockpiles less than 100 cubic yards (CY), 5 samples for stockpiles between 100 and 500 CY, 7 samples for stockpiles 500 to 1,000 CY, 10 samples for stockpiles 1,000 to 2,000 CY, and 10 samples for stockpiles larger than 2,000 CY with an additional sample collected for every 500 CY of material. This rule of thumb is consistent with the Washington State Guidance for Remediation of Petroleum Contaminated Site (Ecology 2016).
4. Samples for characterization of stockpiles of imported backfill or other presumed clean material should also be collected as described under 3. If not described in the work plan, the typical sample frequency for imported or clean material characterization is one sample per 500 CY.

### 3.5 SOIL SAMPLE COLLECTION FOR VOC ANALYSIS

If collecting soil samples for VOC analysis by USEPA Method 5035, collect these samples first before disturbing the soil. This method uses a soil volume gauge fitted with a disposable soil sampling plunger tube to collect a soil plug that can be discharged directly to a VOA vial, limiting the loss of volatiles during sampling. The collection of VOC samples using the 5035 method specifies use of an airtight VOA vial with a septum lid. Ecology's interpretation of the USEPA 5035 method allows for field preservation of the sample with methanol or sodium bisulfate, or laboratory preservation (i.e., field collection into an un-preserved vial). It is important to note that if laboratory preservation is the selected method, samples must be received at the laboratory within 48-hours of sample collection. The method of sample preservation for the 5035 method will vary for each site and is dependent on site-specific conditions. Preservation

method selection should be coordinated with the laboratory and specified in the sampling plan. Note that not all labs use the soil volume gauge as described below (some use syringes or Terra Core samplers) and that it is important to verify the sampling process with the lab.

1. Note the volume of soil needed for analysis as specified by the laboratory (commonly 5 or 10 grams). Raise the handle of the soil volume gauge to the slot in the gauge body corresponding to the desired volume and turn clockwise until the tabs in the handle lock into the slot.
2. Insert a sample tube at the open end of the gauge body and turn clockwise until the tabs on the tube lock into the “0 gram” slot. Remove the cap from the sample tube and press directly (where possible) into the shallow soil, soil core/sampler, excavation base or sidewall, or stockpile.
3. Continue pressing the sample tube until the plunger is stopped by the sample volume gauge. If a depth interval (for example 9 to 10 feet) is targeted for VOC sampling, collect small volumes of soil across this interval until the sample tube is filled.
4. Twist counterclockwise to disengage the sample tube, then depress the plunger to eject the soil plug directly into a laboratory-provided VOA vial. Wipe off any soil particles on the VOA vial threads before tightening the lid. Grit on the VOA vial threads can cause a poor seal and interfere with the laboratory analyses. If multiple vials per sample are required, the same plunger may be re-used to fill the remaining vials.

### 3.6 COMPOSITE SAMPLE COLLECTION

For this guideline, composites are considered samples that are collected across more than one location, or multiple depth intervals at a single location. Samples collected over continuous depth intervals within a sampling device (i.e., split spoon) are addressed for each sampling method in Section 3.4 above.

Compositing of sample material may be performed in the field or by the analytical laboratory. To collect a field composite sample, identify the locations and depth(s) that will comprise the composite. Collect soil from the first target sub-sample depth or depth interval and hold in a decontaminated stainless-steel bowl, covered with aluminum foil to prevent cross contamination and label with the location and depth. Continue to collect and hold individual sub-samples until all components of the composite have been collected, then transfer an equal amount of each sub-sample to a clean bowl and homogenize. Fill necessary sample jars from homogenized composite. In some cases, project plans may require that each individual sample that comprised the composite be collected in jars and submitted to the laboratory if individual sample analysis is desired, or if laboratory compositing is requested in addition to field compositing as a field quality control measure. In this case, label each individual jar, but indicate HOLD on the chain-of-custody, and note that the sample is part of composite XYZ.

To collect a laboratory composite sample, collect, and label each sub-sample using the procedures described above in Section 3.4. Record each sub-sample on the chain-of-custody form, and indicate on this form which samples should be composited by the laboratory and the

desired name of the composite sample. It is important to communicate to the laboratory if discrete samples will also require analysis (in some cases) or only the composite sample. It is helpful to send a follow up email to the laboratory PM with laboratory compositing details.

#### **4.0 Decontamination**

All reusable equipment that contacts soil or dust should be decontaminated prior to moving to the next sampling location.

Stainless-steel bowls and spoons, and any tools used for sample processing will be decontaminated between each sample; alternatively, disposable bowls and spoons may be used. Equipment decontamination will consist of a tap water rinse to remove soil particles, followed by scrubbing with brushes and an Alconox (or other soap)/tap water solution, and a final rinse with distilled or deionized water.

#### **5.0 Investigation-Derived Waste**

Unless otherwise specified in the project work plan, waste soils accumulated as investigation derived waste (IDW) will be contained, transported, disposed of in accordance with applicable laws, and stored in designated drums in a designated area until transported off-site for disposal.

The approach to handling and disposal of these materials is as follows. For IDW that is containerized, such as waste soils, 55-gallon drums approved by WSDOT (or the applicable stage agency) will be used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., "soil"), the dates on which the soil was accumulated, the site owner's name (i.e., the generator), Floyd|Snider name, and the Floyd|Snider field person contact information or front desk telephone number.

Refer to the IDW Special Conditions SOP for further information on IDW storage, sampling, profiling, and handling.

Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy duty garbage bags or other appropriate containers and disposed of as solid waste in the municipal collection system (i.e., site dumpster).

#### **6.0 Field Documentation**

All observations including sample collection locations, soil descriptions, sample depths, collection times, analyses, and field QC samples should be recorded on a boring log, soil sample collection form, and/or bound field notebook. Information recorded should additionally include personnel present (including subcontractors), purpose of field event, weather conditions, sample collection date and times, sample analytes, and any deviations from the SAP.

At the end of the day, complete and review the second page of the tailgate safety meeting form detailing additional hazards, corrective actions, near-misses or incidents. Any incidents that result in field staff injuries or have the potential to result in staff injuries (such as hitting buried utility lines when drilling) should be reported immediately to the PM.

### 7.0 Demobilization

Upon returning to the office, ensure that all equipment is properly cleaned and put away in the field room. Equipment with rechargeable batteries should be plugged in as appropriate so it is ready for use by the next person. It is preferable to dispose of trash at the project site, but any trash left in the field vehicle should be brought upstairs, labeled, and placed in the front production room for building staff to dispose of.

If equipment or sample coolers will be placed at the front desk for pickup, clearly label each item with the company picking it up, anticipated pickup time frame, and your contact information so front desk staff can contact you if there are any questions. Notify front desk staff if any items require a signature at pickup.

Within one week of returning from the field, the field lead for the event should review field notes, sampling forms and tailgate safety meeting forms with the PM. Following PM review and approval, field notes will be scanned and saved to the project folder. Hard copies should be filed. The PM will provide copies of near miss and incident reports to the Health and Safety Administrator.

**Enclosures:** Boring Log  
 Test Pit Log and Sample Collection Form

**Record of Revisions:**

Revisions	Date
Added H&S information and line edits for clarity.	7/22/2022
Reviewed with minor updates	SD 12/9/2022







# 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 (annular 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.
6. 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).

<b>Unified Soil Classification System (USCS) Classification</b>	<b>U.S. Sieve Size</b>	<b>Grain Size (inches)</b>	<b>Grain Size (millimeters)</b>
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

<b>Example Sand Pack Gradations (U.S. Sieve Sizes)</b>	<b>Grain Size (inches)</b>	<b>Grain Size (millimeters)</b>
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

7. 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.
  
8. 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 than 5 feet) above the top of the well screen.
9. 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 annular 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.
  10. Communicate the desired surface completion to the driller (i.e., an aboveground well monument or a monument flush with the ground surface) if you have not already done so. Verify that the well monument has been installed correctly. For flush-mounted wells, ensure that the well is level with the surrounding grade, especially in areas with pedestrian or vehicle traffic. In areas with frequent or heavy vehicle traffic, heavy-duty traffic-rated monuments or manholes should be used. For aboveground well monuments (i.e., stand pipes), ensure that the monument is level, anchored in a minimum of 2 feet of concrete, and protected by steel bollards, unless otherwise specified in the work plan. The concrete surrounding any well monument should seal the borehole at the ground surface.

#### 4.0 Decontamination

All reusable equipment that comes into contact with soil and groundwater should be decontaminated as follows prior to moving to the next sampling location.

Split spoons, stainless steel bowls and spoons, the water level tape, and any other tools used for well drilling and installation must be decontaminated between boring locations. If collecting soils samples for chemical analysis, split spoons and any tools used for sample processing will be decontaminated between each sample; alternatively, disposable bowls and spoons may be used. Equipment decontamination will consist of a tap water rinse to remove soil particles, followed by scrubbing with brushes and an alconox (or similar)/clean water solution, and a final rinse with distilled or deionized water.

## 5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, waste soils, liquids, and other drilling materials generated during well drilling and installation will be contained in accordance with applicable laws, and stored in a designated area until transported off-site for disposal.

The approach to handling and disposal of these materials is as follows. For investigation-derived waste (IDW) that is contained, such as waste soils, 55-gallon drums approved by the Washington State Department of Transportation (WSDOT) will be supplied by the driller and used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled with its contents (e.g., "soil cuttings"), the date(s) on which the wastes were placed in the container, the owner's name, contact information for the field person who generated the waste, and the site name.

IDW contained within drums will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used as appropriate for disposal.

Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy-duty garbage bags or other appropriate containers and disposed of as solid waste in the municipal collection system (i.e., site dumpster).

## 6.0 Field Documentation

All observations should be recorded on a soil boring/well completion form appropriate for the drilling method or in a bound field notebook. Field staff should record as much detail as possible in the field log (including well construction materials, Ecology well ID tag number, and surface completions) and note any anomalies or details that varied from the SAP. After the field work is complete, a set of final well construction logs (usually electronic) that serve as the record for the project will be completed in consultation with the project manager or field manager.

# F|S STANDARD GUIDELINE

## Well Development

DATE/LAST UPDATE: May 2015

*These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.*

*All field staff should be sufficiently trained in the standard guidelines and should review and understand these procedures prior to going in the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.*

### 1.0 Scope and Purpose

This Standard Guideline for Well Development presents commonly used procedures for monitoring well development for newly installed monitoring wells and/or existing wells that may require redevelopment. Monitoring well development restores hydraulic conductivity with the surrounding formations that were disturbed during the drilling process. Development removes residual fines from well filter pack materials and the borehole wall and reduces the turbidity of the water, which provides more representative groundwater samples. These wells may include groundwater monitoring wells, piezometers, or groundwater extraction wells. This guideline describes the purge and surge method of development and is intended to be used by field staff who are overseeing or completing well development. Often, the drilling subcontractors are asked to complete well development activities subsequent to new well installations, in which case, Floyd|Snider staff would oversee the development. Other development methods, such as jetting, are not described herein, but may be used if specified in the project-specific Work Plan or Sampling and Analysis Plan (SAP).

Well development shall be completed by continuous pumping at a steady rate using a portable pump and polyethylene tubing, with regular surging (e.g., using a surge block) to force water through the filter pack and surrounding formation. Wells should ideally be developed either during installation (following sand placement but prior to sealing) or soon after installation,

unless otherwise specified in the work plan, using the described methodologies or equivalents. For wells that are completed using a grout or concrete seal, if development does not take place prior to sealing, it should be completed within 48 hours following well installation in order allow for grout and concrete to cure.

## 2.0 Equipment and Supplies

### Well Development Equipment and Tools:

- Appropriate high volume pump (centrifugal, submersible, etc.) and correct diameter tubing, or bailer
- Hose clamps (optional)
- Power source (generator, 12-volt battery, or car battery) and appropriate power adapter for pump
- Water quality meter or turbidity meter (if needed)
- 2-, 4-, or 6-inch surge block (typically provided by the driller)
- Water level meter
- Washington State Department of Transportation (WSDOT)-approved 55-gallon drums
- Equipment decontamination supplies including:
  - Scrub brushes
  - Alconox or other soap
  - Distilled or deionized water
  - Paper towels
- Trash bags
- Camera

### Paperwork:

- Work Plan and/or SAP/Quality Assurance Project Plan (QAPP)
- Bound field notebook or appropriate field forms
- Well development form (printed on Rite in the Rain paper)
- Health and Safety Plan (HASP)
- Well installation forms (printed on Rite in the Rain paper)

### Personal Equipment:

- Steel-toed boots

- Safety vest
- Safety glasses
- Nitrile gloves
- Rain gear
- Work gloves

## 3.0 Standard Procedures

### 3.1 OFFICE PREPARATION

Meet with the project manager to identify key information and goals of the well development, including how long after construction the wells should be developed. Determine if Floyd|Snider or the driller will be doing the development.

### 3.2 WELL DEVELOPMENT PROCEDURES

The following procedures are general guidelines for monitoring well development. These same procedures are also appropriate for extraction wells, injection wells, and/or piezometers. Specific instructions provided in individual work plans shall supersede these procedures in the event there are discrepancies.

Visually inspect all well development equipment for damage; repair as necessary.

1. Decontaminate all hoses, surge blocks, and/or submersible pump by scrubbing with brush and alconox or other soap solution and rinsing with deionized water.
2. Prior to development, use a water level meter to measure the depth in each well to the static water level and total depth to a reference mark on the top of the well casing.
3. Attach a length of clean or disposable tubing, approximately 5 feet longer than the well casing, to the outlet of the submersible pump.
4. Each well development cycle consists of surging followed by well evacuation (pumping). Surging may be accomplished with a surge block sized to fit snugly inside the well casing, or with the submersible pump. Surging using a pump increases the hydraulic gradient and velocity of groundwater near the well by drawing the water level down and moving more fine-grained soil particles into the well casing. Surging using a pump is only effective if the well produces enough water for continuous pumping and the pump is of a large enough diameter relative to the well casing. If pumping must be stopped to allow the well to recharge, a surge block is preferable for surging. If using a surge block, connect polyvinyl chloride (PVC) pipe or other rods longer than the well casing to the surge block. Lower the surging device into the well to a depth within the screened interval. A bailer can be used to surge in situations

- when a surge block is not available and the well has insufficient recharge for the submersible pump.
5. During development, it is important to note the color and clarity of the water and any other visual or olfactory observations on the field form or in the field notebook. Note any significant changes as development progresses.
  6. Surging should consist of a minimum of ten consecutive surges (i.e., quickly raise and lower surge block or pump in well) with an appropriately sized surge block or pump over the full length of the screen. For long well screens (greater than 10 feet), surging should be done in short intervals of 2 to 3 feet at a time. In cases where the screen extends to above the water table, clean water may have to be added to the well to develop the top of the filter pack.
  7. After surging, water is purged from well until the pumped stream starts to run clear. At that point, stop pumping and initiate another surge cycle. If a well has more hydraulic head than the pump is able to overcome, or if an insufficient volume of water for pumping is present, a disposable bailer may also be used for purging.
  8. Repeat this procedure until evacuated water is visibly clear and essentially free of sediment. Perform a minimum of three surge and pump cycles.
  9. Well development will be terminated when the variation in the turbidity Nephelometric Turbidity Units (NTUs) readings is less than 10 percent or until the discharge is visibly clear and free of sediment after a minimum of three surge and purge cycles. As an alternative, periodic water samples can be collected for field measurements of temperature, specific conductivity, and pH; well development should continue until field parameters stabilize to within  $\pm 5$  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 them 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



# Engineering Design Report

Riverside HVOC Site

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## Appendix G Inadvertent Discovery Plan

<b>DAHP USE ONLY</b>
Date Received:
DAHP Log #:
Reviewer(s):
<input type="checkbox"/> ARCHY <input type="checkbox"/> BEU



**EZ-1 FORM**

Request to initiate consultation for Governor's Executive Order 21-02 (GEO 21-02) projects

**GEO 21-02**

New Consultation?  YES  NO  ADDITIONAL INFORMATION PROVIDED PER REQUEST

Questions? Contact DAHP at 2102@dahp.wa.gov or (360) 586-3065. You may also find answers to your questions online at www.dahp.wa.gov/2102.

**SECTION 1: PROJECT INFORMATION**

Project Title: <b>Riverside Soil and Groundwater Remediation</b>	Provide 1-2 sentence summary of the project. Installation of soil vapor extraction wells to remediate chlorinated solvent contaminated soil. Installation of groundwater remediation wells connected to a closed-loop bioremediation system to treat chlorinated solvent contaminated groundwater.
Property Name: <b>Riverside HVOC Site</b> <small>if applicable</small>	
Project Address: <b>Parcel No. 0826059120</b>	
City / State / Zip: <b>Bothell WA</b>	County: <b>King</b> Township / Range / Section: <b>T26R05E08</b> <small>leave blank if unsure</small>

**SECTION 2: PROJECT DESCRIPTION**

Project includes (check all that apply):  NEW CONSTRUCTION  DEMOLITION  GROUND DISTURBANCE  REHABILITATION / RENOVATION  ACQUISITION

Does the project involve any buildings, objects, sites, structures or districts that are over 45 years old?  YES  NO  NOT SURE \*Contact DAHP  Check here if the project involves multiple resources. If so, attach a table including all information in Sections 1 and 2 for each resource.

Does the project involve any properties determined eligible for or listed in the National Register of Historic Places or Washington Heritage Register?  YES  NO  NOT SURE

Is the building, structure or site already recorded in WISAARD?  YES  NO  NOT SURE [!] See Note \*Contact DAHP

If Yes, what is the Property ID # or Site #? \_\_\_\_\_ **[!] If the resource is not recorded in WISAARD, please contact DAHP Staff. Go to www.dahp.wa.gov/wisaard for more information. Check the box when complete.**

Are there any Federal funds, lands, permits, or licenses involved in/required by this project?  YES  NO  NOT SURE If Yes, what Federal Agency? \_\_\_\_\_

What is the nature of your request? (Check all that apply)  PREDESIGN  DESIGN  CONSTRUCTION  APPLYING FOR GRANT / LOAN  TRYING TO GET UNDER CONTRACT  NOT SURE

**SECTION 3: STATE AGENCY INFORMATION**

State Agency: **WA State Dept of Ecology** Grant / Loan Program Name: **Toxics Cleanup Program**  Direct Appropriation?

Contact Person: **Lydia Lindwall** Phone: **360.515.6217** e-mail: **Lydia.Lindwall@ecy.wa.gov**

Funding biennium? **2023/2024** Requested grant / loan amount: **TBD** Total project amount: **TBD**

**SECTION 4: CONTACT INFORMATION**

If different from State Agency contact person.

Submitter Name: **Ryan Roberts** Submitter Organization: **City of Bothell**

Submitter Address: **18415 101st Ave NE** City / State / Zip: **Bothell WA**

Submitter Phone: **425-806-6823** Submitter e-mail: **Ryan.Roberts@bothellwa.gov**

**SECTION 5: ATTACHMENTS**

Please email completed form and all attachments to: **2102@dahp.wa.gov**

MAP / APE - Be sure to show the project boundary and location of property(ies). See Section 7 on Page 3 for optional template. May also submit online through WISAARD using eAPE.

DESCRIPTION / SCOPE OF WORK - Describe the project, including any ground disturbance. See Section 6 on Page 2 for optional template.

SITE PLAN / DRAWINGS - Indicate location and dates of resources, proposed improvements and ground disturbance, etc.

PHOTOGRAPHS - Attach digital photographs showing the project site, including images of all resources. Photos submitted through WISAARD may suffice.

**DAHP DETERMINATION (DAHP USE ONLY)**

<input type="checkbox"/> EXEMPT from GEO 21-02 review.	<input type="checkbox"/> The project will have an <b>ADVERSE IMPACT</b> on historic properties.	DAHP REVIEWER _____ DATE _____
<input type="checkbox"/> There are <b>NO HISTORIC PROPERTIES IMPACTED</b> by the proposed project.	<input type="checkbox"/> DAHP requires <b>ADDITIONAL INFORMATION</b> in order to complete review (see attached).	
<input type="checkbox"/> The project will have <b>NO ADVERSE IMPACT</b> on historic properties.	<input type="checkbox"/> SURVEY REQUIRED <input type="checkbox"/> IDP REQUIRED <input type="checkbox"/> MONITORING REQUIRED	

**Instructions:** Please describe the type of work to be completed. Be as detailed as possible to avoid a request for additional information. Be sure to describe all ground disturbing activities in the appropriate box below, and provide photos of areas of work.

### SECTION 6: ADD'L PROJECT INFORMATION

**NOTE:** To save this fillable form you must fill it out in Adobe Acrobat or use the PRINT to PDF function in Acrobat Reader. In Reader choose File > Print and choose Adobe PDF as the printer. The fill will save to your computer.

Please be aware that this form may only initiate consultation. For some projects, DAHP may require additional information to complete our review such as plans, specifications, and photographs. An historic property inventory form may need to be completed by a qualified cultural resource professional.

Provide a detailed description of the proposed project:

Closed-loop groundwater treatment will be accomplished through bioremediation and groundwater recirculation. This work involves the pumping of groundwater from existing and new extraction wells at the Site, treatment of this water with a bioremediation product, and reinjection of this treated groundwater into the Site subsurface via injection wells. This method will also serve as the treatment of saturated soils which extend down to a depth of approximately 30 feet bgs. Proposed well locations associated with this work are shown in the attached figure. The wells will be connected in trenches no deeper than 18 inches to a temporary portable remediation shed. Vertical soil vapor extraction (SVE) wells will be installed and connected using 1-inch diameter PVC pipe in trenches no deeper than 18 inches in the northern portion of the site along the sidewalk bordering Hwy 522. The SVE wells are connected to an air blower in a temporary shed which draws a vacuum. The SVE wells will remediate unsaturated contaminated soils on the Site.

Describe the existing project site conditions (include building age, if applicable):

The property is currently occupied by areas of an existing roadway and gravel parking area for access to Bothell Landing Park south and adjacent to former State Highway Route 522. The planned future use is to remain in parking use.

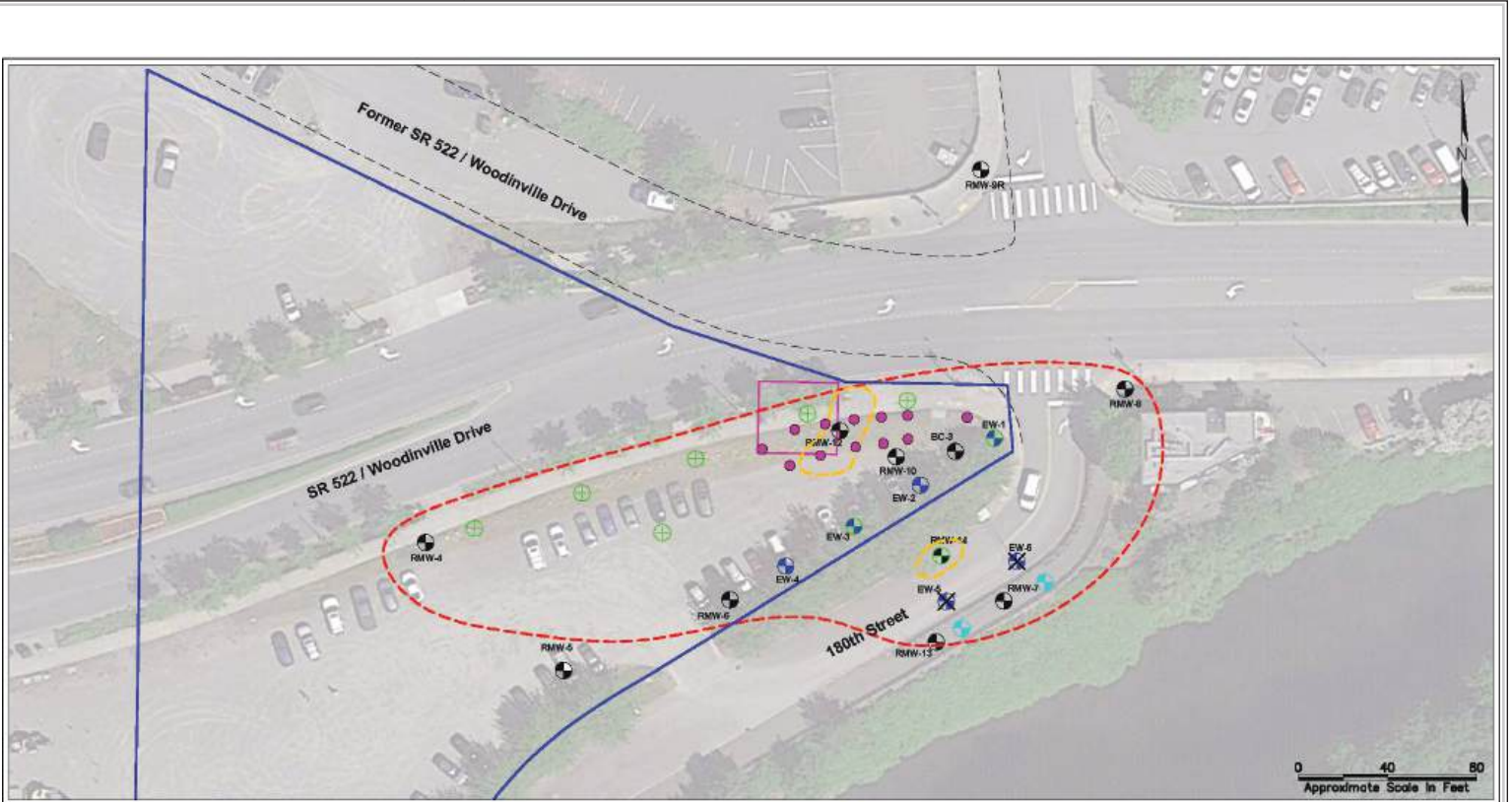
The property is located at 47.760 degrees north, -122.209 degrees west in Section 8 of Township 26 north, Range 5 east. The property is presently vacant of structures, except for a small shed containing permitted groundwater extraction pumps that discharge directly into the King County sanitary sewer.

If there are ground disturbing activities proposed, describe them *including the approximate depth of ground disturbance*:

Shallow trenches no deeper than 18 inches will be excavated to connect the SVE wells and bioremediation extraction and injection wells to associated pumps located in the shed with 1-inch diameter PVC pipe.

Instructions: Please attach a MAP of the project area. (Use WISAARD with USA Topo Basemap background. Click HERE for Snipping Tool Tutorial. Draw an outline of the Area of Potential Effect (APE) that clearly delineates the project boundary.

SECTION 7: MAP / Area of Potential Effect



LEGEND			
	Approximate location of monitoring well		Approximate location of historical Riverside property
	Approximate location of extraction well		Approximate location of Riverside HVOC Site Boundary and approximate extent of groundwater containing HVOCs contaminants above SBe-specific cleanup levels
	Approximate location of historical machine shop		Approximate extent of soil containing HVOC contaminants at concentrations exceeding MTCA Method A/B Cleanup Levels
	Approximate location of new bioremediation injection well		Approximate location of existing monitoring/extraction well to be converted to bioremediation injection well
	Approximate location of soil vapor extraction well		Approximate location of existing extraction well to be decommissioned
	Approximate location of new extraction well		



Supplemental Remedial Investigation / Feasibility Study  
 Riverside HVOC Site  
 Bothell, Washington 98011

Bioremediation and  
 Groundwater Recirculation  
 Combined with SVE







# INADVERTENT DISCOVERY PLAN PLAN AND PROCEDURES FOR THE DISCOVERY OF CULTURAL RESOURCES AND HUMAN SKELETAL REMAINS

To request ADA accommodation, including materials in a format for the visually impaired, call Ecology at 360-407-6000 or visit <https://ecology.wa.gov/accessibility>. People with impaired hearing may call Washington Relay Service at 711. People with a speech disability may call TTY at 877-833-6341.

Site Name(s): Riverside HVOC Site

Location: Bothell, Washington

Project Lead/Organization:

County: King

Ryan Roberts/ City of Bothell

*If this Inadvertent Discovery Plan (IDP) is for multiple (batched) projects, ensure the location information covers all project areas.*

## 1. INTRODUCTION

The IDP outlines procedures to perform in the event of a discovery of archaeological materials or human remains, in accordance with applicable state and federal laws. An IDP is required, as part of Agency Terms and Conditions for all grants and loans, for any project that creates disturbance above or below the ground. An IDP is not a substitute for a formal cultural resource review (Executive 21-02 or Section 106).

Once completed, **the IDP shall always be kept at the project site** during all project activities. All staff, contractors, and volunteers shall be familiar with its contents and know where to find it.

## 2. CULTURAL RESOURCE DISCOVERIES

A cultural resource discovery could be prehistoric or historic artifacts. Examples include (see images for further examples):

- An accumulation of shell, burned rocks, or other food related materials.
- Bones, intact or in small pieces.
- An area of charcoal or very dark stained soil with artifacts.
- Stone tools or waste flakes (for example, an arrowhead or stone chips).
- Modified or stripped trees, often cedar or aspen, or other modified natural features, such as rock drawings.
- Agricultural or logging materials that appear older than 50 years. These could include equipment, fencing, canals, spillways, chutes, derelict sawmills, tools, and many other items.
- Clusters of tin cans or bottles, or other debris that appear older than 50 years.
- Old munitions casings. **Always assume these are live and never touch or move.**
- Buried railroad tracks, decking, foundations, or other industrial materials.
- Remnants of homesteading. These could include bricks, nails, household items, toys, food containers, and other items associated with homes or farming sites.

The above list does not cover every possible cultural resource. When in doubt, assume the material is a cultural resource.

### 3. ON-SITE RESPONSIBILITIES

If any employee, contractor, or subcontractor believes that they have uncovered cultural resources or human remains at any point in the project, take the following steps to **Stop-Protect-Notify**. **If you suspect that the discovery includes human remains, also follow Sections 5 and 6.**

#### STEP A: Stop Work.

All work must stop immediately in the vicinity of the discovery.

#### STEP B: Protect the Discovery.

Leave the discovery and the surrounding area untouched and create a clear, identifiable, and wide boundary (30 feet or larger) with temporary fencing, flagging, stakes, or other clear markings. Provide protection and ensure integrity of the discovery until cleared by the Department of Archaeological and Historical Preservation (DAHP) or a licensed, professional archaeologist.

Do not permit vehicles, equipment, or unauthorized personnel to traverse the discovery site. Do not allow work to resume within the boundary until the requirements of this IDP are met.

#### STEP C: Notify Project Archaeologist (if applicable).

If the project has an archaeologist, notify that person. If there is a monitoring plan in place, the archaeologist will follow the outlined procedure.

#### STEP D: Notify Project and Washington Department of Ecology (Ecology) contacts.

##### Project Lead Contacts

###### Primary Contact

Name: Ryan Roberts  
Organization: City of Bothell  
Phone: 425.471.1837  
Email: ryan.roberts@bothellwa.gov

###### Alternate Contact

Name: Steven Morikawa  
Organization: City of Bothell  
Phone: 425.419.3742  
Email: steven.morikawa@bothellwa.gov

##### Ecology Contacts (completed by Ecology Project Manager)

###### Ecology Project Manager

Name: Sunny Becker  
Program: Toxic Cleanup Program  
Phone: 360.515.6217  
Email: HLIN461@ECY.WA.GOV

###### Alternate or Cultural Resource Contact

Name:  
Program:  
Phone:  
Email:

### **STEP E: Ecology will notify DAHP.**

Once notified, the Ecology Cultural Resource Contact or the Ecology Project Manager will contact DAHP to report and confirm the discovery. To avoid delay, the Project Lead/Organization will contact DAHP if they are not able to reach Ecology.

DAHP will provide the steps to assist with identification. DAHP, Ecology, and Tribal representatives may coordinate a site visit following any necessary safety protocols. DAHP may also inform the Project Lead/Organization and Ecology of additional steps to further protect the site.

**Do not continue work until DAHP has issued an approval for work to proceed in the area of, or near, the discovery.**

#### DAHP Contacts:

Name: Rob Whitlam, PhD  
Title: State Archaeologist  
Cell: 360-890-2615  
Email: [Rob.Whitlam@dahp.wa.gov](mailto:Rob.Whitlam@dahp.wa.gov)  
Main Office: 360-586-3065

#### **Human Remains/Bones:**

Name: Guy Tasa, PhD  
Title: State Anthropologist  
Cell: 360-790-1633 (24/7)  
Email: [Guy.Tasa@dahp.wa.gov](mailto:Guy.Tasa@dahp.wa.gov)

### **4. TRIBAL CONTACTS**

In the event cultural resources are discovered, the following tribes will be contacted. See Section 10 for Additional Resources.

Tribe: Muckleshoot Indian Tribe  
Name: Laura Murphy  
Title: Preservation Program, Cultural Resources  
Phone: 253-876-3272  
Email: [laura.murphy@muckleshoot.nsn.us](mailto:laura.murphy@muckleshoot.nsn.us)

Tribe: Snoqualmie Indian Tribe  
Name: Steven Mullen-Moses,  
Title: Director of Archaeology & Historic Preservation  
Phone: 425) 292-0249 x2010  
Email: [steve@snoqualmietribe.us](mailto:steve@snoqualmietribe.us)

Tribe: Sauk-Suiattle Indian Tribe  
Name: Kerry Lyste  
Title: Tribal Historic Preservation Officer  
Phone: (360) 572-7072  
Email: [klyste@stillaguamish.com](mailto:klyste@stillaguamish.com)

Tribe: Suquamish Tribe  
Name: Dennis E. Lewarch,  
Title: Tribal Historic Preservation Officer  
Phone: (360) 394-8529  
Email: [dlewarch@suquamish.nsn.us](mailto:dlewarch@suquamish.nsn.us)

Tribe: Tulalip Tribes  
Name: Richard Young  
Title: Cultural Resources  
Phone: (360) 716-2652  
Email: [ryoung@tulaliptribes-nsn.gov](mailto:ryoung@tulaliptribes-nsn.gov)

Please provide contact information for additional tribes within your project area, if needed, in Section 11.

## 5. FURTHER CONTACTS (if applicable)

If the discovery is confirmed by DAHP as a cultural or archaeological resource, or as human remains, and there is a partnering federal or state agency, Ecology or the Project Lead/Organization will ensure the partnering agency is immediately notified.

Federal Agency:

Agency: N/A

Name:

Title:

Phone:

Email:

State Agency:

Agency: N/A

Name:

Title:

Phone:

Email:

## 6. SPECIAL PROCEDURES FOR THE DISCOVERY OF HUMAN SKELETAL REMAINS

Any human skeletal remains, regardless of antiquity or ethnic origin, will at all times be treated with dignity and respect. Follow the steps under **Stop-Protect-Notify**. For specific instructions on how to handle a human remains discovery, see: [RCW 68.50.645: Skeletal human remains—Duty to notify—Ground disturbing activities—Coroner determination—Definitions](#).

**Suggestion:** If you are unsure whether the discovery is human bone or not, contact Guy Tasa with DAHP, for identification and next steps. Do not pick up the discovery.

Guy Tasa, PhD State Physical Anthropologist

[Guy.Tasa@dahp.wa.gov](mailto:Guy.Tasa@dahp.wa.gov)

(360) 790-1633 (Cell/Office)

For discoveries that are confirmed or suspected human remains, follow these steps:

1. Notify law enforcement and the Medical Examiner/Coroner using the contacts below. **Do not call 911** unless it is the only number available to you.

Enter contact information below (required):

- Local Medical Examiner or Coroner name and phone: Richard Harruff / 206.731.3232 ext 5
  - Local Law Enforcement main name and phone: Cam Johnson/ 425.486.1254
  - Local Non-Emergency phone number (911 if without a non-emergency number): 425.486.1254
2. The Medical Examiner/Coroner (with assistance of law enforcement personnel) will determine if the remains are human or if the discovery site constitutes a crime scene and will notify DAHP.

3. **DO NOT speak with the media, allow photography or disturbance of the remains, or release any information about the discovery on social media.**
4. If the remains are determined to be non-forensic, cover the remains with a tarp or other materials (not soil or rocks) for temporary protection and to shield them from being photographed by others or disturbed.

Further activities:

- Per [RCW 27.44.055](#), [RCW 68.50](#), and [RCW 68.60](#), DAHP will have jurisdiction over non-forensic human remains. Ecology staff will participate in consultation. The Project Lead/Organization may also participate in consultation.
- Documentation of human skeletal remains and funerary objects will be agreed upon through the consultation process described in [RCW 27.44.055](#), [RCW 68.50](#), and [RCW 68.60](#).
- When consultation and documentation activities are complete, work in the discovery area may resume as described in Section 8.

If the project occurs on federal lands (such as a national forest or park or a military reservation) the provisions of the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) apply and the responsible federal agency will follow its provisions. Note that state highways that cross federal lands are on an easement and are not owned by the state.

If the project occurs on non-federal lands, the Project Lead/Organization will comply with applicable state and federal laws, and the above protocol.

## **7. DOCUMENTATION OF ARCHAEOLOGICAL MATERIALS**

Archaeological resources discovered during construction are protected by state law [RCW 27.53](#) and assumed eligible for inclusion in the National Register of Historic Places under Criterion D until a formal Determination of Eligibility is made.

The Project Lead/Organization must ensure that proper documentation and field assessments are made of all discovered cultural resources in cooperation with all parties: the federal agencies (if any), DAHP, Ecology, affected tribes, and the archaeologist.

An archaeologist will record all prehistoric and historic cultural material discovered during project construction on a standard DAHP archaeological site or isolate inventory form. They will photograph site overviews, features, and artifacts and prepare stratigraphic profiles and soil/sediment descriptions for minimal subsurface exposures. They will document discovery locations on scaled site plans and site location maps.

Cultural features, horizons, and artifacts detected in buried sediments may require the archaeologist to conduct further evaluation using hand-dug test units. They will excavate units in a controlled fashion to expose features, collect samples from undisturbed contexts, or to interpret complex stratigraphy. They may also use a test unit or trench excavation to determine if an intact occupation surface is present. They will only use test units when necessary to gather information on the nature, extent, and integrity of subsurface cultural deposits to evaluate the site's significance. They will

conduct excavations using standard archaeological techniques to precisely document the location of cultural deposits, artifacts, and features.

The archaeologist will record spatial information, depth of excavation levels, natural and cultural stratigraphy, presence or absence of cultural material, and depth to sterile soil, regolith, or bedrock for each unit on a standard form. They will complete test excavation unit level forms, which will include plan maps for each excavation level and artifact counts and material types, number, and vertical provenience (depth below surface and stratum association where applicable) for all recovered artifacts. They will draw a stratigraphic profile for at least one wall of each test excavation unit.

The archaeologist will screen sediments excavated for purposes of cultural resources investigation through 1/8-inch mesh, unless soil conditions warrant 1/4-inch mesh.

The archaeologist will analyze, catalogue, and temporarily curate all prehistoric and historic artifacts collected from the surface and from probes and excavation units. The ultimate disposition of cultural materials will be determined in consultation with the federal agencies (if any), DAHP, Ecology, and the affected tribe(s).

Within 90 days of concluding fieldwork, the archaeologist will provide a technical report describing any and all monitoring and resultant archaeological excavations to the Project Lead/Organization, who will forward the report to Ecology, the federal agencies (if any), DAHP, and the affected tribe(s) for review and comment.

If assessment activities expose human remains (burials, isolated teeth, or bones), the archaeologist and Project Lead/Organization will follow the process described in **Section 6**.

## **8. PROCEEDING WITH WORK**

The Project Lead/Organization shall work with the archaeologist, DAHP, and affected tribe(s) to determine the appropriate discovery boundary and where work can continue.

Work may continue at the discovery location only after the process outlined in this plan is followed and the Project Lead/Organization, DAHP, any affected tribe(s), Ecology, and the federal agencies (if any) determine that compliance with state and federal laws is complete.

## **9. ORGANIZATION RESPONSIBILITY**

The Project Lead/Organization is responsible for ensuring:

- This IDP has complete and accurate information.
- This IDP is immediately available to all field staff at the site and available by request to any party.
- This IDP is implemented to address any discovery at the site.
- That all field staff, contractors, and volunteers are instructed on how to implement this IDP.

## 10. ADDITIONAL RESOURCES

### Informative Video

Ecology recommends that all project staff, contractors, and volunteers view this informative video explaining the value of IDP protocol and what to do in the event of a discovery. The target audience is anyone working on the project who could unexpectedly find cultural resources or human remains while excavating or digging. The video is also posted on DAHP's inadvertent discovery language website.

[Ecology's IDP Video](https://www.youtube.com/watch?v=ioX-4cXfbDY) (<https://www.youtube.com/watch?v=ioX-4cXfbDY>)

## **Informational Resources**

[DAHP](https://dahp.wa.gov) (<https://dahp.wa.gov>)

[Washington State Archeology \(DAHP 2003\)](https://dahp.wa.gov/sites/default/files/Field%20Guide%20to%20WA%20Arch_0.pdf)

([https://dahp.wa.gov/sites/default/files/Field%20Guide%20to%20WA%20Arch\\_0.pdf](https://dahp.wa.gov/sites/default/files/Field%20Guide%20to%20WA%20Arch_0.pdf))

[Association of Washington Archaeologists](https://www.archaeologyinwashington.com) (<https://www.archaeologyinwashington.com>)

## **Potentially Interested Tribes**

[Tribal Contacts: Interactive Map of Tribes by Area](https://dahp.wa.gov/archaeology/tribal-consultation-information)

(<https://dahp.wa.gov/archaeology/tribal-consultation-information>)

[Tribal Contacts - WSDOT Tribal Contact Website](https://wsdot.wa.gov/tribal/TribalContacts.htm)

(<https://wsdot.wa.gov/tribal/TribalContacts.htm>)

## **11. ADDITIONAL INFORMATION**

Please add any additional contact information or other information needed within this IDP.

**Implement the IDP if you see...**

**Chipped stone artifacts.**

Examples are:

- Glass-like material.
- Angular material.
- “Unusual” material or shape for the area.
- Regularity of flaking.
- Variability of size.



*Stone artifacts from Oregon.*



*Stone artifacts from Washington.*



*Biface-knife, scraper, or pre-form found in NE Washington. Thought to be a well knapped object of great antiquity. Courtesy of Methow Salmon Rec. Foundation.*

## Implement the IDP if you see...

### Ground stone artifacts.

Examples are:

- Unusual or unnatural shapes or unusual stone.
- Striations or scratching.
- Etching, perforations, or pecking.
- Regularity in modifications.
- Variability of size, function, or complexity.



Above: Fishing Weight - credit [CRITFC Treaty Fishing Rights website](#).



Artifacts from unknown locations (left and right images).

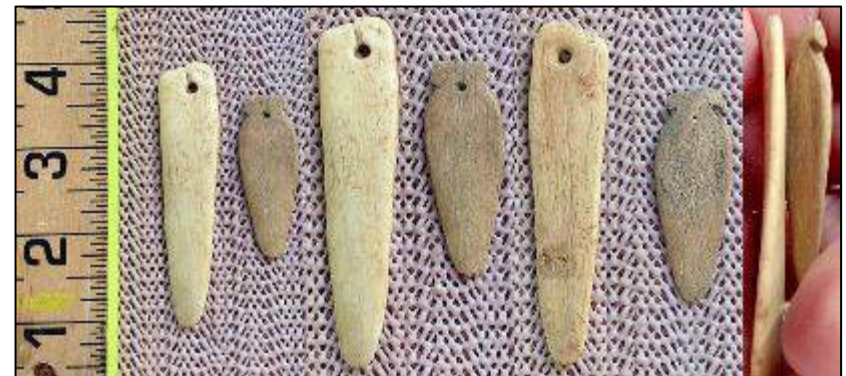


**Implement the IDP if you see...**

**Bone or shell artifacts, tools, or beads.**

Examples are:

- Smooth or carved materials.
- Unusual shape.
- Pointed as if used as a tool.
- Wedge shaped like a “shoehorn”.
- Variability of size.
- Beads from shell (dentalium) or tusk.



Upper Left: *Bone Awls from Oregon.*

Upper Center: *Bone Wedge from California.*

Upper Right: *Plateau dentalium choker and bracelet, from Nez Perce National Historical Park, 19th century, made using Antalis pretiosa shells*  
*Credit: Nez Perce - Nez Perce National Historical Park, NEPE 8762, Public Domain.*

Above: *Tooth Pendants.*

Right: *Bone Pendants. Both from Oregon and Washington.*

## Implement the IDP if you see...

### Culturally modified trees, fiber, or wood artifacts.

Examples are:

- Trees with bark stripped or peeled, carvings, axe cuts, de-limbing, wood removal, and other human modifications.
- Fiber or wood artifacts in a wet environment.
- Variability of size, function, and complexity.



Left and Below: *Culturally modified tree and an old carving on an aspen (Courtesy of DAHP). These are examples of above ground cultural resources.*

Right, Top to Bottom: *Artifacts from Mud Bay, Olympia: Toy war club, two strand cedar rope, wet basketry.*



## Implement the IDP if you see...

### Strange, different, or interesting looking dirt, rocks, or shells.

Human activities leave traces in the ground that may or may not have artifacts associated with them. Examples are:

- “Unusual” accumulations of rock (especially fire-cracked rock).
- “Unusual” shaped accumulations of rock (such as a shape similar to a fire ring).
- Charcoal or charcoal-stained soils, burnt-looking soils, or soil that has a “layer cake” appearance.
- Accumulations of shell, bones, or artifacts. Shells may be crushed.
- Look for the “unusual” or out of place (for example, rock piles in areas with otherwise few rocks).



*Shell Midden pocket in modern fill discovered in sewer trench.*



*Underground oven. Courtesy of DAHP.*

*Shell Midden with fire cracked rock.*



*Hearth excavated near Hamilton, WA.*

## Implement the IDP if you see...

Historic period artifacts (historic archaeology considered older than 50 years).

Examples are:

- Agricultural or logging equipment. May include equipment, fencing, canals, spillways, chutes, derelict sawmills, tools, etc.
- Domestic items including square or wire nails, amethyst colored glass, or painted stoneware.



Left: Top to Bottom: *Willow pattern serving bowl and slip joint pocket knife discovered during Seattle Smith Cove shantytown (45-KI-1200) excavation.*

Right: *Collections of historic artifacts discovered during excavations in eastern Washington cities.*



**Implement the IDP if you see...**

**Historic period artifacts (historic archaeology considered older than 50 years).**

Examples are:

- Railway tokens, coins, and buttons.
- Spectacles, toys, clothing, and personal items.
- Items helping to understand a culture or identity.
- Food containers and dishware.



Main Image: *Dishes, bottles, work boot found at the North Shore Japanese bath house (ofuro) site, Courtesy Bob Muckle, Archaeologist, Capilano University, B.C. This is an example of an above ground resource.*



Right, from Top to Bottom: *Coins, token, spectacles and Montgomery Ward pitchfork toy discovered during Seattle Smith Cove shantytown (45-KI-1200) excavation.*



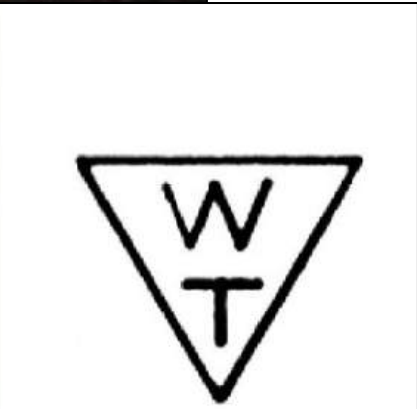
**Implement the IDP if you see...**

- Old munition casings – if you see ammunition of any type – ***always assume they are live and never touch or move!***
- Tin cans or glass bottles with an older manufacturer’s technique – maker’s mark, distinct colors such as turquoise, or an older method of opening the container.



Far Left: .303 British cartridge found by a WCC planting crew on Skagit River. ***Don't ever touch something like this!***  
 Left: Maker's mark on bottom of old bottle.

Right: Old beer can found in Oregon. ACME was owned by Olympia Brewery. Courtesy of Heather Simmons.



Logo employed by Whithall Tatum & Co. between 1924 to 1938 (Lockhart et al. 2016).



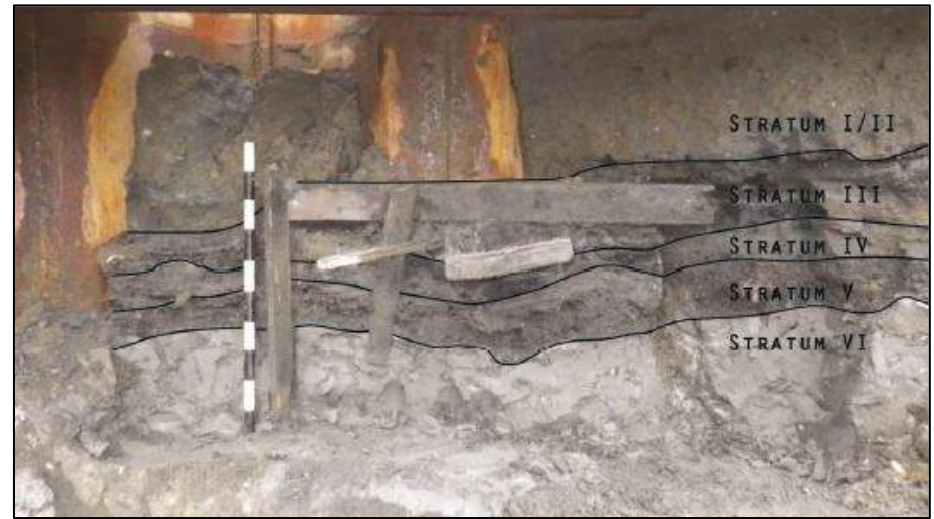
Can opening dates, courtesy of W.M. Schroeder.

**Implement the IDP if you see...**

**Historic foundations or buried structures.**

Examples are:

- Foundations.
- Railroad and trolley tracks.
- Remnants of structures.



Counter Clockwise, Left to Right: *Historic structure 45KI924, in WSDOT right of way for SR99 tunnel. Remnants of Smith Cove shantytown (45-KI-1200) discovered during Ecology CSO excavation, City of Spokane historic trolley tracks (above ground historic resources) uncovered during stormwater project, intact foundation of historic home that survived the Great Ellensburg Fire of July 4, 1889, uncovered beneath parking lot in Ellensburg.*

**Implement the IDP if you see...**

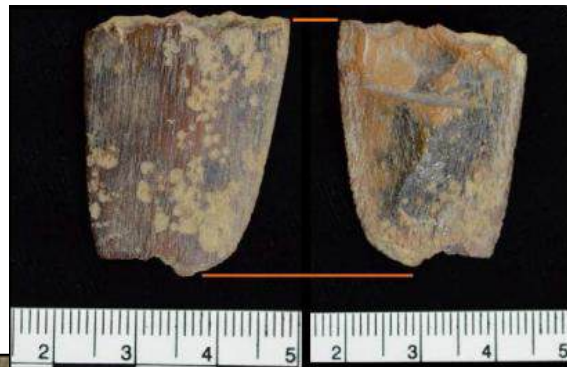
**Potential human remains.**

Examples are:

- Grave headstones that appear to be older than 50 years.
- Bones or bone tools--intact or in small pieces. It can be difficult to differentiate animal from human so they must be identified by an expert.
- These are all examples of animal bones and are not human.

Center: *Bone wedge tool, courtesy of Smith Cove Shantytown excavation (45KI1200).*

*Other images (Top Right, Bottom Left, and Bottom) Center: Courtesy of DAHP.*



Directly Above: *This is a real discovery at an Ecology sewer project site.*

*What would you do if you found these items at a site? Who would be the first person you would call?*

*Hint: Read the plan!*

# **Engineering Design Report**

Riverside HVOC Site

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## **Appendix H Contaminated Soil and Groundwater Protocol (Appendix E of the Bothell Design and Construction Standards and Specifications)**

# **APPENDIX E: CONTAMINATED SOIL AND GROUNDWATER PROTOCOL**

E-2 Protocol

E-4 Contamination Review Area

E-5 Department of Ecology Memorandum of Agreement

## Protocol When Contaminated Soil or Groundwater

May be Encountered During Private Development Work on Private Property or  
in the Public ROW or Utility Work in the Public ROW in Downtown Bothell

---

**All projects within areas identified on the attached map should follow through with the following protocol since they may encounter contaminated soil or groundwater.**

**An environmental peer review consultant shall be made available to provide support to City staff.**

---

### **If contaminated soil/groundwater is suspected to exist on private property**

1. Notification
  - a. The City shall notify the developer at the pre-application meeting and provide available documents
  - b. The City shall indicate that the developer needs to meet all local, state, and federal
  - c. requirements
  - d. The developer shall acknowledge in writing receipt of this information. The City shall document that the information was provided to the developer.
  
2. The City shall review the design of the development with the objective of not exacerbating and/or spreading contamination
  - e. The review by the City will include a review by the City's environmental peer review consultant
  - f. The design may need to include such things as, but not limited to, check dams on utility trenches; no foundation, French drains, or under drains; no groundwater resource wells; and/or special requirements during dewatering of groundwater, and other current Best Management Practices (BMPs).

### **If contaminated soil and/or groundwater is suspected to exist in the public ROW where the private developer is required to do utility work and/or frontage work**

1. Notification
  - a. The City shall notify the developer at the pre-application meeting and provide available documents
  - b. The City shall indicate that the developer needs to meet all local, state, and federal requirements
  - c. The developer shall acknowledge in writing receipt of this information. The City shall document that the information was provided to the developer.
  
2. The City shall review the design of the development work with the objective of not exacerbating and/or spreading contamination
  - a. City shall provide the developer or utility company with existing location, analytical laboratory results, field reports, consultant reports, and all other available information related to the presence of contamination.

- b. Developer or utility company shall notify the City of any planned cleanup activities, excavation or stockpiling of suspected or confirmed contaminated soils, treatment or disposal of suspected or confirmed contaminated soils, and any associated dewatering. The City may monitor and inspect the work.
  - c. Developer or utility company shall notify the City of any planned storage, testing, treatment, or discharge of suspected or confirmed contaminated water, and provide copies of all permits required to discharge or remove any contaminated water (water removed from storage tanks via vacuum truck, 55-gallon water drums, and other water storage vessels).
3. Soil/ water disposal
- a. Developer or utility company shall meet all local, state, and federal requirements for handling, management and disposal of any contaminated soil, water, or underground storage tanks encountered.
4. Reporting
- a. Developer or utility company shall provide the City with copies of all manifests, bills of lading, and soil disposal certificates for all contaminated and impacted soils disposed of off-site as either Washington State designated hazardous or dangerous waste. Contaminated or impacted soils contain detectable concentrations of any potential chemical of concern listed in the Washington State Department of Ecology Cleanup Levels and Risk Calculation (CLARC) database.
  - b. Developer or utility company shall provide the City with copies of all maps or figures showing the exact location of contaminated soil or ground water, analytical laboratory results, field reports, consultant reports, and all other available information documenting the handling and disposal of contaminated or impacted soil or ground water.

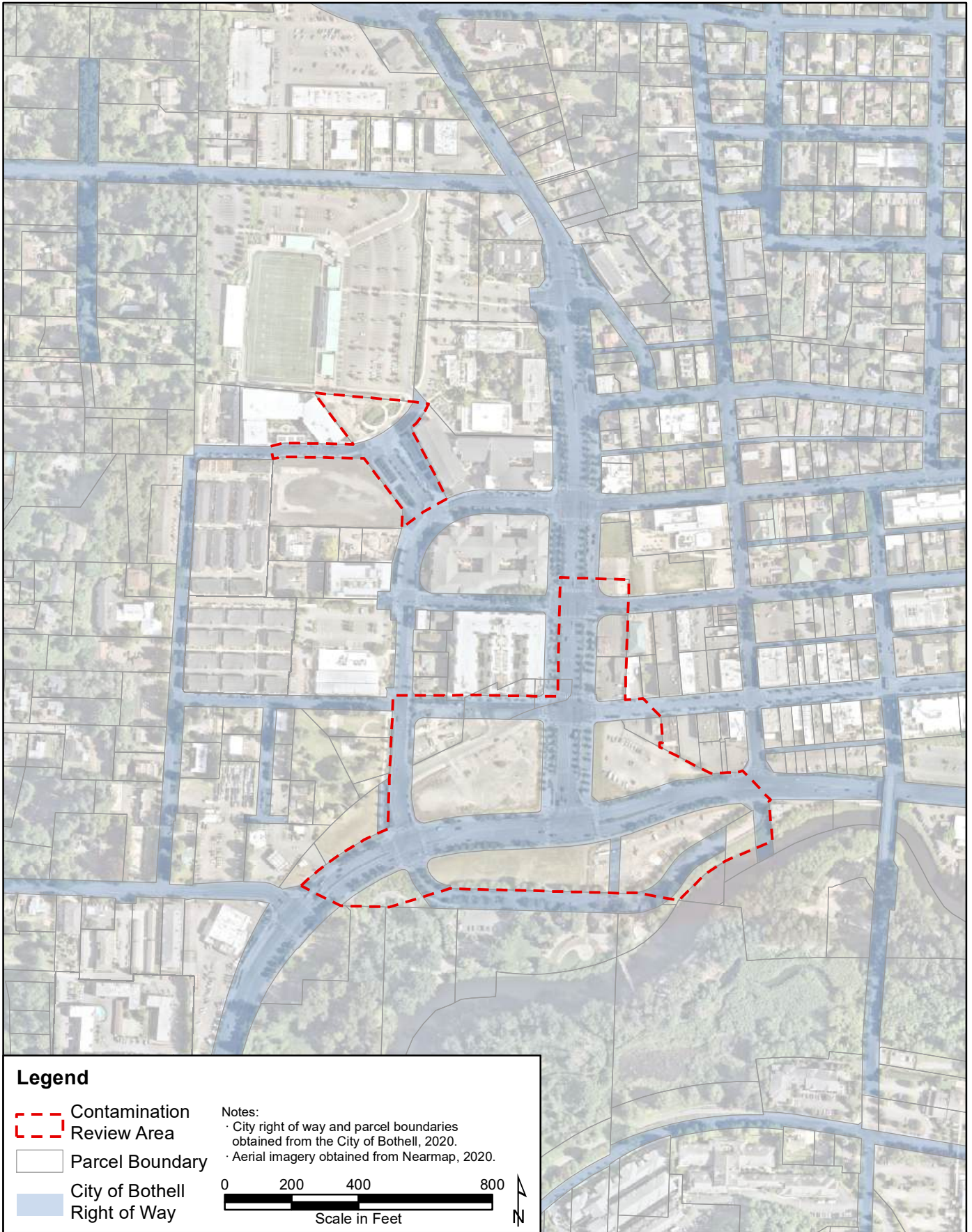
**The following disclaimers shall be included in any letter, formal notice, and map that is sent to the developers and utility companies.**

#### **MAPS**

This map has been prepared by the City of Bothell to identify and depict areas within the City's downtown core that may potentially contain contaminated or impacted soil or groundwater. The map was created using information collected by the City and by others. The City does not guarantee the completeness or accuracy of the information. This information may no longer be current or accurate and is provided to you as a courtesy only. It is the property owner or developer's responsibility to verify the condition of the land upon which they are working and to comply with all local, state, and federal laws and regulations regarding contaminated soil and groundwater.

#### **INFORMATION**

The following information has been provided by the City of Bothell to identify and depict areas within the City's downtown core that may potentially contain contaminated or impacted soil or groundwater. The information was collected by the City and by others. The City does not guarantee the completeness or accuracy of the information. This information may no longer be current or accurate and is provided to you as a courtesy only. It is the property owner or developer's responsibility to verify the condition of the land upon which they are working and to comply with all local, state, and federal laws and regulations regarding contaminated soil and groundwater.



**Legend**

- Contamination Review Area
- Parcel Boundary
- City of Bothell Right of Way

Notes:  
 · City right of way and parcel boundaries obtained from the City of Bothell, 2020.  
 · Aerial imagery obtained from Nearmap, 2020.

0      200      400      800  
 Scale in Feet

**MEMORANDUM OF AGREEMENT BETWEEN  
THE WASHINGTON STATE DEPARTMENT OF ECOLOGY (ECOLOGY)  
AND  
THE CITY OF BOTHELL (CITY)  
REGARDING  
CITY STREETS AND RIGHT-OF-WAYS AT MTCA SITES**

**I. INTRODUCTION**

A. The Washington State Department of Ecology (“Ecology”) and the City of Bothell (“City”) have entered into a series of agreements pursuant to the Model Toxics Control Act, RCW 70A.305 (“MTCA”), governing the cleanup and long-term monitoring of the release of hazardous substances associated with historical activities on various properties within the City;

B. The Cleanup Agreements are listed in Exhibit D and require the City to undertake certain remedial actions (the “Remedial Action”). As part of the Remedial Action, certain public streets and rights of way contain residual hazardous substances to be managed in a manner that protects public health and the environment while accommodating continued use for a range of public purposes, including transportation and utilities, using institutional controls as required by MTCA. The City owns fee title to some street segments and has maintenance responsibilities in others;

C. Ecology may require institutional controls at cleanup sites or properties at any stage of the cleanup to assure the integrity of the cleanup and continued protection of human health and the environment. MTCA, the Uniform Environmental Covenant Act, RCW 64.70 (“UECA”) and the MTCA regulation, WAC 173-340-440, describe the provisions that need to be included in an environmental covenant and the procedures for establishing such covenants;

D. Ecology and the City have explored implementing restrictive (environmental) covenants that are recorded with the King County Recorder’s Office as an institutional control for streets and rights-of-way but have determined this approach to be infeasible and inefficient given the number of streets and cleanup actions involved and the manner in which the King County Assessor records instruments that affect public streets and rights of way;

E. Without a parcel number, a covenant cannot be recorded with the county recorder. WAC 173-340-440(8)(b) permits an alternative system to a restrictive covenant for properties owned by local governments if the entity can demonstrate: (1) that it does not routinely file with the county recording officer based on the type of interest in real listed segments that it has in the site; and (2) the alternative system meets the requirements of WAC 173-340-440(9). Use of an alternative system, as described here, makes sense because these restrictions become part of the City’s routine right-of-way management practices. As such, these restrictions are more likely to be recognized and complied with.

F. Ecology and the City have determined that this Memorandum of Agreement (“MOA”) will be an effective and efficient institutional control for public streets and rights of way that is also consistent with MTCA and the Cleanup Agreements.

NOW THEREFORE, ECOLOGY AND THE CITY MUTUALLY AGREE TO UNDERTAKE THE ACTIONS SET FORTH HEREIN.

**Section 1. Listed segments**

Streets and rights of way subject to this MOA are listed in Exhibit A-1. This MOA refers to the subject streets and rights of way as “listed segments.” Exhibit A-2 depicts the right of way segments and intersections (“listed segments”) which are subject to the provisions of this MOA.

**Section 2. Contaminants**

Soil or groundwater in specific areas under the listed segments may contain one or more of the hazardous substances listed in Exhibit B, at concentrations above MTCA cleanup levels.

**Section 3. Ecology Responsibilities**

Ecology will upload this document and its attachments to Ecology’s document repository for the sites listed in Exhibit D, and reference this instrument in the Environmental Covenants List.

**Section 4. City Responsibilities**

- a. The City will incorporate the terms of this MOA by reference in the City’s Design and Construction Standards (<http://www.ci.bothell.wa.us/DocumentCenter/View/688/Design-and-Construction-Standards-and-Specifications-PDF?bidId=> ).
- b. The City will provide a copy of this MOA to City contractors, third parties, or their contractors before authorizing work in the listed segments. The City will provide the entity performing the work access to current information known about contaminants in the listed segment, and advise the entity of any remedial equipment in the work area.
- c. All contaminated materials removed by the City or its contractors will be disposed in accordance with applicable laws and regulations, including but not limited to WAC 173-303 and WAC 173-304. Work performed by the City or its contractors must comply with worker safety regulations concerning potential exposure to hazardous substances in solid, liquid, or vapor form.
- d. The City will require in the Right-of-Way Invasion Permit that all contaminated materials removed be disposed in accordance with applicable laws and regulations, including but not limited to WAC 173-303 and WAC 173-304. As a condition of any Right-of-Way Invasion Permit granted for work in the listed segments, the City will require compliance with worker safety regulations

concerning potential exposure to hazardous substances in solid, liquid, or vapor form.

## **Section 5. General Restrictions and Requirements.**

The following general restrictions and requirements shall apply to the listed segments:

- a. Interference with Remedial Action.** The City shall not permit or engage in any activity on the listed segments that may impact or interfere with the Remedial Action and any operation, maintenance, inspection or monitoring of that Remedial Action without prior written approval from Ecology.
- b. Protection of Human Health and the Environment.** The City shall not permit or engage in any activity in the listed segments that may threaten continued protection of human health or the environment without prior written approval from Ecology. This includes, but is not limited to, any activity that results in the release of residual contamination that was contained as a part of the Remedial Action or that exacerbates or creates a new exposure to contamination remaining on the listed segments.
- c. Continued Compliance Required.** City shall not convey any interest in any portion of the listed segments without providing for the continued adequate and complete operation, maintenance and monitoring of Remedial Action and continued compliance with this MOA. The City agrees to require that, within 30 days after conveyance, the party accepting title must record an Ecology approved environmental covenant with the appropriate county auditor.
- d. Preservation of Reference Monuments.** City shall make a good faith effort to preserve any reference monuments and boundary markers used to define the areal extent of coverage of this MOA. Should a monument or marker be damaged or destroyed, City shall have it replaced by a licensed professional surveyor within 30 days of discovery of the damage or destruction.

## **Section 6. Specific Prohibitions and Requirements.**

In addition to the general restrictions in Section 5 of this MOA, the following additional specific restrictions and requirements shall apply to the listed segments.

- a. Land Use.** The listed segments may only be used for usual and accustomed public right of way uses such as transportation and utilities. The City will not vacate or convey any interest in any listed segment without at least 30 days prior notice to Ecology.
- b. Containment of Soil/Waste Materials.** Contaminated soil remains at least four (4) feet under caps consisting of asphalt road and concrete sidewalk located as illustrated in Exhibits B and C. The primary purpose of these caps is to minimize the potential for contact with contaminated soil and to minimize the leaching of contaminants to groundwater. As such, the following restrictions shall apply within the areas illustrated in Exhibits B and C.

Any activity in the illustrated areas that will compromise the integrity of the cap including: drilling; digging; piercing the cap with sampling device, post, stake or similar device;

grading; excavation; installation of underground utilities; removal of the cap; or, application of loads in excess of the cap load bearing capacity is prohibited, except as follows:

i. If the activity occurs four (4) feet or less below ground surface, the City shall notify Ecology ten (10) working days ahead of the work and shall promptly repair any damage to the cap by replacing the damaged area with similar materials and submit written documentation of the repairs to Ecology within ninety (90) days of completing the repairs.

ii. If the activity occurs more than four (4) feet below ground surface, the City must obtain prior written approval from Ecology. Should the City propose to remove all or a portion of the cap so that access to the underlying contamination is feasible, Ecology may require treatment or removal of the underlying contaminated soil. Unless otherwise agreed to by Ecology, the City shall promptly repair any damage to the cap by replacing the damaged area with similar materials and submit written documentation of the repairs to Ecology within ninety (90) days of completing the repairs.

c. **Work in the Listed Segments.** The listed segments contain areas of contamination in soil and/or groundwater at concentrations above cleanup levels protective of human health. At least ten (10) working days prior to undertaking or permitting work to begin in a listed segment, the City shall notify Ecology's site manager in writing. If previously undocumented contamination is encountered in the course of the work, the City will notify Ecology.

d. **Groundwater Use.** Groundwater beneath the listed segments shall not be extracted for any purpose other than temporary construction dewatering, investigation, monitoring or remediation. Drilling of a well for any water supply purpose is strictly prohibited. Groundwater extracted within these segments for any purpose shall be considered potentially contaminated and any discharge of this water shall be done in accordance with state and federal law.

e. **Stormwater facilities.** New stormwater infiltration facilities may have an impact on groundwater plumes if constructed in the listed segments. Permit applications for stormwater infiltration facilities planned for the listed segments should note that the planned facility is in proximity to areas of contamination.

f. **Monitoring.**

Several groundwater monitoring wells are located in the listed segments to monitor the performance of Remedial Action. The City shall maintain clear access to these devices and protect them from damage. The City shall report to Ecology within forty-eight (48) hours of the discovery of any damage to any monitoring device. Unless Ecology approves of an alternative plan in writing, the City shall promptly repair damage to wells installed by the City and submit a report documenting this work to Ecology within thirty (30) days of completing the repairs.

**Section 7. Access.** The City shall maintain clear access to all Remedial Action components necessary to construct, operate, inspect, monitor and maintain the Remedial Action.

**Section 8. Notice Requirements.**

**a. Conveyance of Any Interest.** The City, when conveying any interest in any part of the listed segments including but not limited to title, easement, leases, and security or other interests, must:

- i. Provide written notice to Ecology of the intended conveyance at least thirty (30) days in advance of the conveyance.
- ii. Include in the conveying document a notice in substantially the following form, as well as a complete copy of this MOA:

**NOTICE: THIS PROPERTY IS SUBJECT TO USE RESTRICTIONS DETAILED BY THE WASHINGTON STATE DEPARTMENT OF ECOLOGY ON [Date] AND AVAILABLE AT THE ECOLOGY ENVIRONMENTAL COVENANTS LIST. USES AND ACTIVITIES ON THIS PROPERTY MUST COMPLY WITH THE RESTRICTIONS, A COMPLETE COPY OF WHICH IS ATTACHED TO THIS DOCUMENT.**

iii. Unless otherwise agreed to in writing by Ecology, provide Ecology with a complete copy of the executed document within thirty (30) days of the date of execution of such document.

iv. In the case of conveyance of title, require that within 30 days after conveyance the party accepting title must file with the county auditor an environmental covenant approved by Ecology.

**b. Reporting Violations.** Should the City become aware of any violation of this MOA, City shall promptly report such violation in writing to Ecology.

**c. Emergencies.** For any emergency or significant change in site conditions due to Acts of Nature (for example, flood or fire) resulting in a violation of this MOA, the City is authorized to respond to such an event in accordance with state and federal law. The City must notify Ecology in writing of the event and response actions planned or taken as soon as practical but no later than within 24 hours of the discovery of the event.

**d. Notification procedure.** Any required written notice, approval, reporting or other communication shall be personally delivered or sent by first class mail to the following persons. Any change in this contact information shall be submitted in writing to Ecology and the City.

Erin Leonhart Interim City Manager City of Bothell 18415 101st Avenue NE Bothell, WA 98011 (425) 806-6100 Erin.Leonhart@bothellwa.gov	Environmental Covenants Coordinator Washington State Department of Ecology Toxics Cleanup Program P.O. Box 47600 Olympia, WA 98504 – 7600 (360) 407-6000 <a href="mailto:ToxicsCleanupProgramHQ@ecy.wa.gov">ToxicsCleanupProgramHQ@ecy.wa.gov</a>
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As an alternative to providing written notice and change in contact information by mail, these documents may be provided electronically in an agreed upon format at the time of submittal.

**Section 9. Modification or Termination.**

The parties will endeavor to meet and confer at least once every two (2) years to update, as appropriate, the exhibits to this agreement. In addition, if the conditions necessitating these restrictions have changed or no longer exist, then the City may submit a request to Ecology that these restrictions be amended or terminated.

**Section 10. Enforcement and Construction.**

- a. This MOA is enforceable according to the terms of the Cleanup Agreements and any disputes arising under this MOA should be resolved in accordance with the terms of the Cleanup Agreements.
- b. The City shall be responsible for all costs associated with implementation of this MOA, including but not limited to costs to process a request by the City for any modification or termination of this MOA and any approval or consultation conducted under this MOA. The City reserves the right to recover its costs from third parties through easement agreements, permit fees or similar regulatory mechanisms, and/or through claims arising under MTCA.
- c. This MOA shall be liberally construed to meet the intent of MTCA and UECA.
- d. The provisions of this MOA shall be severable. If any provision in this MOA or its application to any person or circumstance is held invalid, the remainder of this MOA or its application to any person or circumstance is not affected and shall continue in full force and effect as though such void provision had not been contained herein.
- e. Nothing in this agreement shall be construed to restrict in any way Ecology's authority to fulfill its oversight and enforcement responsibilities under MTCA or other applicable State laws.

The undersigned individual warrants he/she has authority to execute this MOA on behalf of the City of Bothell.

EXECUTED this 8th day of June, 2021.

  
\_\_\_\_\_

By: Erin Leonhart  
Title: Interim City Manager

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**REPRESENTATIVE ACKNOWLEDGEMENT**

STATE OF Washington  
COUNTY OF King

On this 8th day of June, 2021, I certify that Erin Leonhart personally appeared before me, acknowledged that **he/she** signed this instrument, on oath stated that **he/she** was authorized to execute this instrument, and acknowledged it, as the Representative of the City of Bothell, to be the free and voluntary act and deed of such party for the uses and purposes mentioned in the instrument.

  
\_\_\_\_\_

Notary Public in and for the State of Washington

Residing at Bothell, WA

My appointment expires 2-8-25



STATE OF WASHINGTON  
DEPARTMENT OF ECOLOGY

[Signature]

By: ROBERT W. WARREN

Title: SECTION MANAGER

Dated: 7/9/21

STATE ACKNOWLEDGMENT

STATE OF Washington

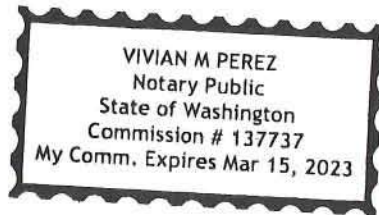
COUNTY OF King

On this 9<sup>th</sup> day of July, 2021, I certify that Robert W. Warren personally appeared before me, acknowledged that **he/she** is the Section Manager of the state agency that executed the within and foregoing instrument, and signed said instrument by free and voluntary act and deed, for the uses and purposes therein mentioned, and on oath stated that **he/she** was authorized to execute said instrument for said state agency.

[Signature: Vivian M. Perez]  
Notary Public in and for the State of Washington

Residing at 1527 N. 107<sup>th</sup> Seattle WA 98133

My appointment expires Mar. 15, 2023



**EXHIBIT A-1**  
**Right of Way Segments and Intersections**

*Bothell Way NE*

Bothell Way NE beginning 250 feet west of 98th Avenue NE to Main Street including intersections at Bothell Way NE and 98th Ave NE and Bothell Way NE and Woodinville Drive but excluding the intersection at Bothell Way NE and Main Street.

*98th Avenue NE*

98th Ave NE from Bothell Way NE to Main Street including intersections at 98th Ave NE and Main Street and at 98th Ave NE and Bothell Way NE

*Main Street*

Main Street from 98th Ave NE to Bothell Way NE including the intersection at Main Street and 98th Ave NE but excluding the intersection at Main Street and Bothell Way NE

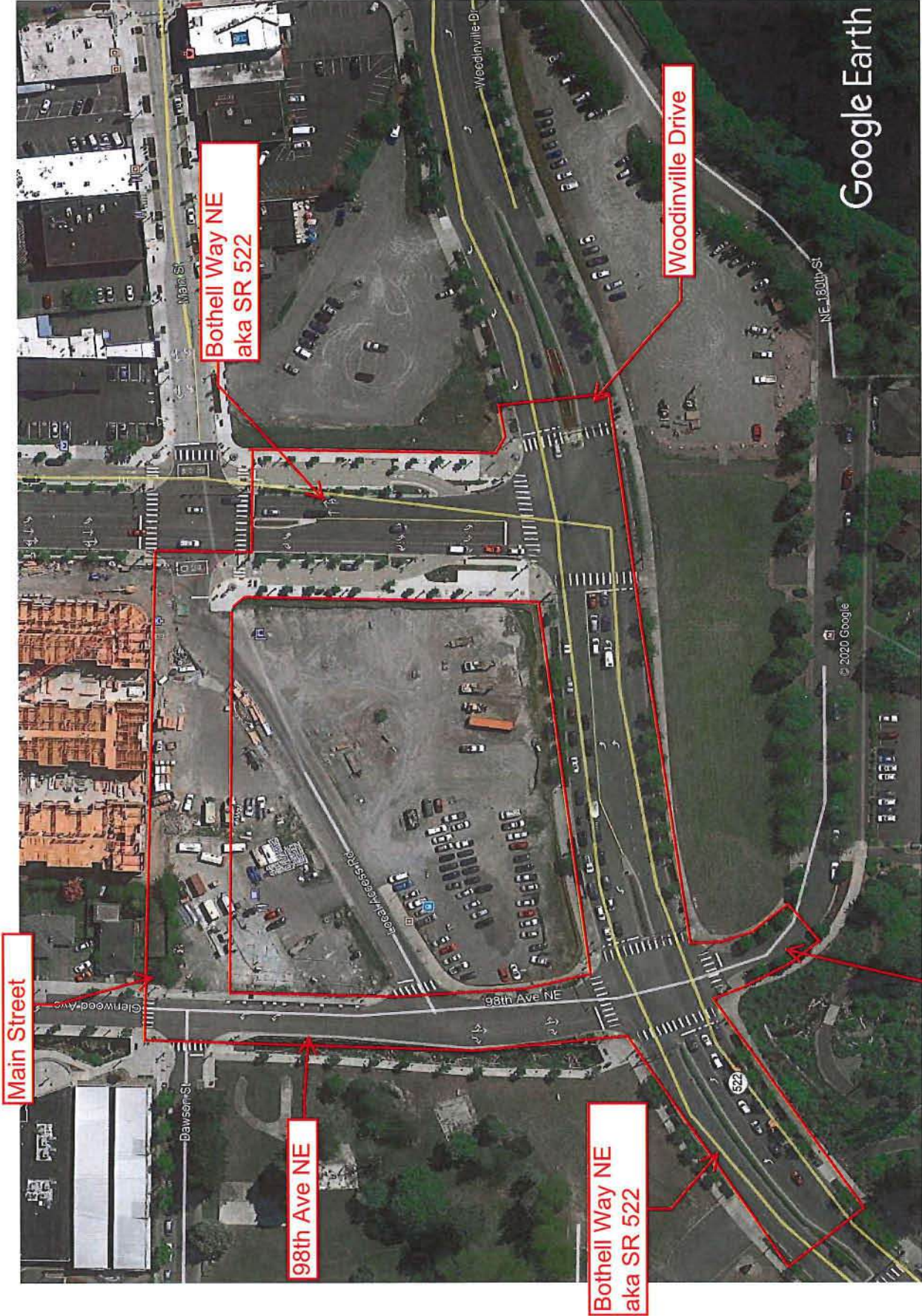
*NE 180th Street*

NE 180th Street 100 feet south from Bothell Way NE including the intersection at NE 180th Street and Bothell Way NE

*Woodinville Drive*

Woodinville Drive extending approximately 50 feet east from the east edge of Bothell Way NE at the intersection of NE Bothell Way and Woodinville Drive

Exhibit A-2



## EXHIBIT B

THAT PORTION OF THE EXISTING BOTHELL WAY NE RIGHT-OF-WAY, SAID RIGHT-OF-WAY, LYING WITHIN THE EAST HALF OF SECTION 7, TOWNSHIP 26 NORTH, RANGE 5 EAST, W.M., IN KING COUNTY WASHINGTON, SAID PORTION BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

### INSTITUTIONAL CONTROL AREA:

BEGINNING AT THE MOST WESTERLY CORNER OF PARCEL #3 OF CITY OF BOTHELL BOUNDARY LINE ADJUSTMENT NO. BLA2014-05666, RECORDED UNDER KING COUNTY RECORDING NUMBER 20150819900001, SAID CORNER LYING ON THE SOUTHEASTERLY RIGHT-OF-WAY LINE OF BOTHELL WAY NE;

THENCE LEAVING SAID SOUTHEASTERLY RIGHT-OF-WAY LINE, NORTH 71°04'06" WEST, A DISTANCE OF 79.09 FEET;

THENCE NORTH 21°34'43" EAST, A DISTANCE OF 110.01 FEET TO THE NORTHWESTERLY RIGHT-OF-WAY LINE OF SAID BOTHELL WAY NE, AND THE BEGINNING OF A NON-TANGENT CURVE TO THE RIGHT, HAVING A RADIUS OF 846.44 FEET, AND TO WHICH BEGINNING A LINE FROM THE RADIUS POINT BEARS NORTH 35°28'31" WEST;

THENCE NORTHEASTERLY ALONG SAID NORTHWESTERLY RIGHT-OF-WAY LINE AND SAID CURVE, AN ARC LENGTH OF 170.76 FEET THROUGH A CENTRAL ANGLE OF 11°33'33" TO ITS INTERSECTION WITH THE WESTERLY RIGHT-OF-WAY LINE OF 98<sup>TH</sup> AVENUE NE;

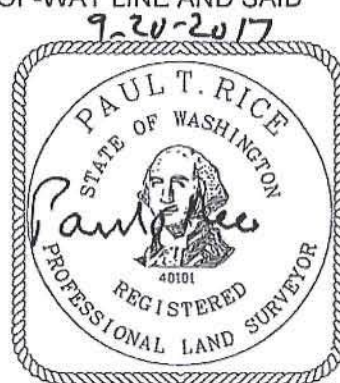
THENCE SOUTH 73°21'25" EAST, A DISTANCE OF 41.15 FEET;

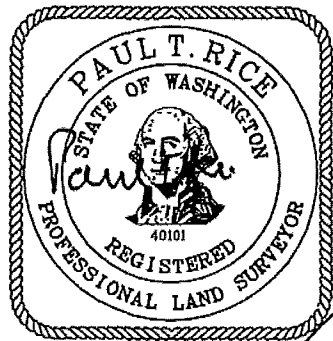
THENCE SOUTH 00°53'03" EAST, A DISTANCE OF 104.64 FEET TO THE SOUTHEASTERLY RIGHT-OF-WAY LINE OF SAID BOTHELL WAY NE, AND THE BEGINNING OF A NON-TANGENT CURVE TO THE LEFT, HAVING A RADIUS OF 723.44 FEET, AND TO WHICH BEGINNING A LINE FROM THE RADIUS POINT BEARS NORTH 24°40'56" WEST;

THENCE SOUTHWESTERLY ALONG SAID SOUTHEASTERLY RIGHT-OF-WAY LINE AND SAID CURVE, AN ARC LENGTH OF 167.25 FEET THROUGH A CENTRAL ANGLE OF 13°14'45", TO THE BEGINNING OF A NON-TANGENT CURVE TO THE LEFT, HAVING A RADIUS OF 833.50 FEET, AND TO WHICH BEGINNING A LINE FROM THE RADIUS POINT BEARS NORTH 36°46'24" WEST;

THENCE SOUTHWESTERLY ALONG SAID SOUTHEASTERLY RIGHT-OF-WAY LINE AND SAID CURVE, AN ARC LENGTH OF 15.33 FEET, THROUGH A CENTRAL ANGLE OF 1°03'14" TO THE POINT OF BEGINNING.

SAID PORTION CONTAINS 28,122 SQUARE FEET, 0.6456 ACRES, MORE OR LESS.





9-20-17

PARCEL # 9

98TH AVENUE NE

PARCEL # 8

INSTITUTIONAL CONTROL AREA

S73°21'25"E  
41.15'

$\Delta=11^{\circ}33'33''$   
L=170.76' R=846.44'

BOTHELL WAY NE  
104.64'  
S0°53'03"E

$\Delta=13^{\circ}14'45''$   
R=723.44'  
L=167.25'

PARCEL # 3  
CITY OF BOTHELL  
BLA2014-05666

N21°34'43"E  
110.01'

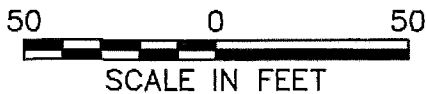
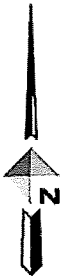
$\Delta=1^{\circ}03'14''$   
R=833.50'  
L=15.33'

N71°04'06"W  
79.09'

POINT OF BEGINNING

PARCEL # 2

PARCEL # 1



**DOWL**

WWW.DOWL.COM

8420 154th Avenue NE  
Redmond, Washington 98052  
425-869-2670

PROJECT	13691.06
DATE	9/20/2017
SCALE	1"=50'

## EXHIBIT C

THAT PORTION OF THE EXISTING NE BOTHELL WAY RIGHT-OF-WAY, SAID RIGHT-OF-WAY LYING WITHIN THE NORTHEAST QUARTER OF THE NORTHEAST QUARTER OF SECTION 7, TOWNSHIP 26 NORTH, RANGE 5 EAST, W.M., IN KING COUNTY WASHINGTON, SAID PORTION BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

### INSTITUTIONAL CONTROL AREA:

COMMENCING AT THE MOST NORTHERLY CORNER OF PARCEL # 6 OF CITY OF BOTHELL BOUNDARY LINE ADJUSTMENT NO. BLA2014-05666, RECORDED UNDER KING COUNTY RECORDING NUMBER 20150819900001, SAID CORNER LYING ON THE SOUTHERLY RIGHT-OF-WAY LINE OF MAIN STREET;

THENCE SOUTH 85°18'53" WEST, ALONG SAID SOUTHERLY RIGHT-OF-WAY LINE, A DISTANCE OF 68.82 FEET TO A CURVE TO THE LEFT HAVING A RADIUS OF 15.00 FEET;

THENCE SOUTHWESTERLY ALONG SAID CURVE, AN ARC LENGTH OF 21.85 FEET THROUGH A CENTRAL ANGLE OF 83°28'40" TO THE EASTERLY RIGHT-OF-WAY LINE OF NE BOTHELL WAY;

THENCE SOUTH 01°50'13" WEST, ALONG SAID EASTERLY RIGHT-OF-WAY LINE, A DISTANCE OF 132.91 FEET;

THENCE NORTH 81°17'09" WEST, A DISTANCE OF 79.22 FEET TO THE POINT OF BEGINNING;

THENCE CONTINUING NORTH 81°17'09" WEST, A DISTANCE OF 42.71 FEET;

THENCE NORTH 0°07'50" EAST, A DISTANCE OF 76.27 FEET;

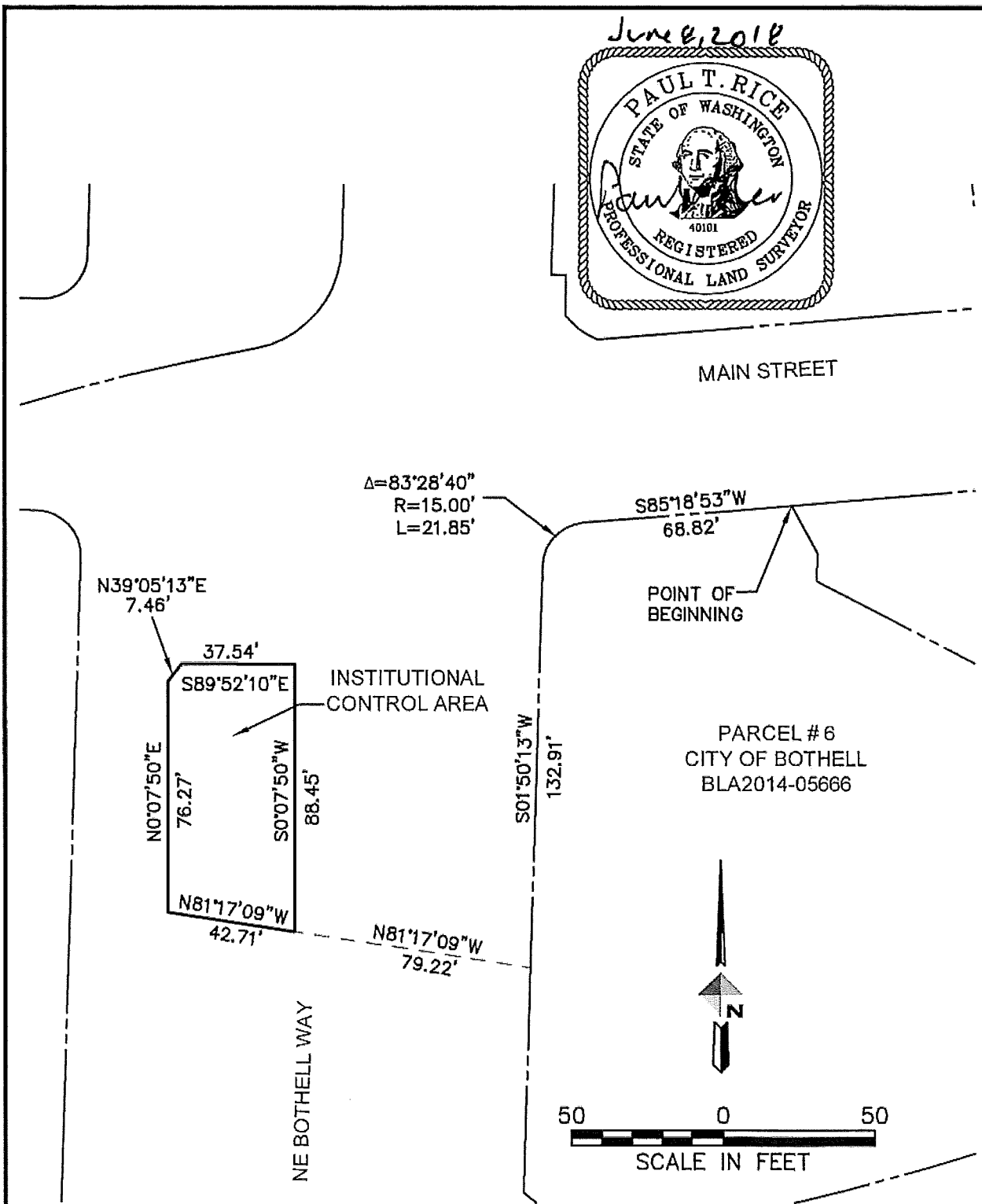
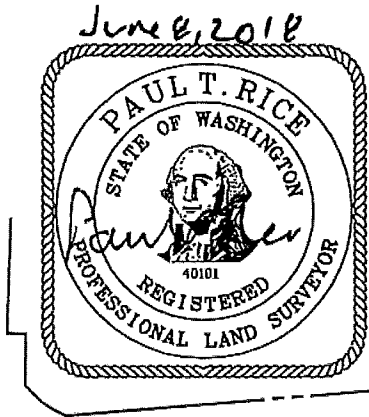
THENCE NORTH 39°05'13" EAST, A DISTANCE OF 7.46 FEET;

THENCE SOUTH 89°52'10" EAST, A DISTANCE OF 37.54 FEET;

THENCE SOUTH 0°07'50" WEST, A DISTANCE OF 88.45 FEET TO THE POINT OF BEGINNING;

SAID PORTION CONTAINS 3,587 SQUARE FEET, 0.0823 ACRES, MORE OR LESS.





**DOWL**  
 8420 154th Avenue NE  
 Redmond, Washington 98052  
 425-869-2670

PROJECT	13691.06
DATE	6/08/2018
1"=50'	

**Exhibit D**  
**Cleanup Agreements and Hazardous Substances in Listed Segments**

Bothell Paint & Decorating Site Agreed Order No. DE 15748 (May 31, 2018)

Petroleum hydrocarbons in groundwater  
Arsenic in groundwater  
Petroleum hydrocarbons in soil

Bothell Former Hertz Site Agreed Order No. DE 15747 (May 31, 2018)

Petroleum hydrocarbons in groundwater  
Arsenic in groundwater  
Halogenated volatile organic compounds in groundwater  
Halogenated volatile organic compounds in soil

Bothell Landing Site Agreed Order No. DE 15746 (June 11, 2018)

Arsenic in groundwater  
Petroleum hydrocarbons in soil

Bothell Service Center Simon and Sons Site First Amended Consent Decree No. 18-2-02852-3-SEA (October 31, 2019)

Halogenated volatile organic compounds in groundwater  
Petroleum hydrocarbons in groundwater