PUBLIC REVIEW DRAFT

Remedial Investigation/Feasibility Study

Former Eatonville Landfill

State of Washington Department of Ecology
Facility Site ID No. 85933/Cleanup Site ID No. 15271

February 2024

Prepared for:

Weyerhaeuser

Town of Eatonville

Prepared by:

GSI Water Solutions, Inc.

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Prepared by:

GSI Water Solutions, Inc.

Benjamin Johnson, LHG
Principal Hydrogeologist

February 26, 2024

Date

GSI Water Solutions, Inc.

Joshua Bale, PE
Principal Civil/Environmental Engineer

February 26, 2024

Date

GSI Water Solutions, Inc.

Jenna DiMarzio, GIT
Consulting Geologist

February 26, 2024

Date

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Executive Summary

This combined Remedial Investigation (RI)/Feasibility Study (FS) was developed for the Former Eatonville Landfill (Site), owned by Weyerhaeuser Company (Weyerhaeuser) near State Route 7 in unincorporated Pierce County, Washington (Property) and adjacent to Nisqually State Park (Figure 1-1). This RI/FS was prepared by GSI Water Solutions, Inc. (GSI), on behalf of Weyerhaeuser and the Town of Eatonville (Town) in accordance with the Model Toxics Control Act (MTCA) Chapter 70A.305 RCW and its implementing regulations Chapter 173-340 Washington Administrative Code (WAC). The Washington State Department of Ecology (Ecology) is supervising the remedial activities at the Site pursuant to the terms and conditions of Agreed Order No. DE 20072 (Order), which was executed with the Town and Weyerhaeuser in 2021. The Site is composed of a former municipal waste landfill (referred to as the "Landfill Area") and the area beyond the toe of the landfill (referred to as the "Wetland Area") where wastes and select contaminants have migrated over time.

The Site is located approximately 400 feet northwest of the Mashel River. The Site contains steep slopes that are an erosional feature of the historical Mashel River channel, and ongoing erosion and mass wasting have resulted in natural slopes as steep as 1 foot (ft) horizontal to 1 ft vertical within the Landfill Area of the Site. The steep Landfill Area of the Site gives way to a flat region of land that eventually transitions to the Mashel River floodplain and riverbanks. The Wetland Area south of the landfill receives stormwater runoff from over the landfill and the surrounding bluff, and from natural springs that discharge at various points along the bluff. These conditions have resulted in variably saturated upland soil conditions between the Site and the Mashel River floodplain, but seasonally inundated conditions have not been observed.

In 2020, the Nisqually Indian Tribe contacted Ecology about the presence of polybrominated diphenyl ethers (PBDEs or BDEs) in the Nisqually River system, of which the Mashel River is a tributary. These concerns led to the identification of the Site as a potential source of PBDEs that warranted further evaluation (Bellon and Gavin, 2020). The source of contamination believed to be associated with the Site is solid waste that was dumped during the active landfilling period, between 1950 and 1980 (Tacoma-Pierce County Health Department, 2010). There is little documentation available identifying the types of waste dumped during and post-operations, but observations of exposed waste indicate that, in addition to general municipal solid waste, the landfill contains tires, automobile bodies and parts, and household appliances. Over time, limited waste (i.e., tires and large metal debris) has migrated beyond the landfill prism into the Wetland Area. Separately, after landfill closure, it appears that unauthorized firearm shooting/target practice was conducted across and in the vicinity of the Site, as indicated by shotgun casings and other evidence of firearm use found in various states of decomposition at the top of the landfill slope and a nearby borrow pit on Washington State Parks and Recreation Commission (State Parks) property that was used as a source of cover materials (Appendix A).

The objectives of the RI were to determine the nature and extent of contamination associated with the Site and to collect data sufficient to support the selection of preferred remedial action alternatives (also referred to as cleanup action alternatives in this document) in the FS. Determining the depth of contamination in the middle and lower portions of the Landfill Area was impracticable for drill rig access because of the presence of dense brush and steep, unimproved terrain. The dataset obtained during the RI is adequate pursuant to MTCA to support the development and assessment of cleanup action alternatives in the FS and to identify a preferred remedy. Historical data collected before the RI and two sitewide sampling events associated with the RI (i.e., a dry-season event in September/November 2021 and a wet-season event in January and February 2022) were reviewed to evaluate contaminants of potential concern (COPCs) in multiple media (soil, groundwater, and surface water). A subsequent soil investigation was conducted in the Wetland Area at additional step-out locations in August 2022 to better delineate metals concentrations. Other data were gathered in 2021 and 2022, according to MTCA and Ecology guidance, from landfill soil gas measurements, a geotechnical evaluation of the waste prism, a geophysical survey (to determine waste prism thickness), a land/elevation survey, a wetland delineation, and a Terrestrial Ecological Evaluation (TEE). Landfill-related COPCs (PBDEs and other potential contaminants) were evaluated using screening levels (SLs). The COPCs with detectable concentrations exceeding Human Health and/or Ecological SLs are considered contaminants of concern (COCs). PBDEs, which were initially identified as COPCs for the Site, were not detected above SLs and are not considered COCs. The COCs identified for the Site vary by media and area and include the following:

Metals:

- Landfill area soil: arsenic, cadmium, chromium, copper, iron, lead, nickel, and zinc
- Wetland Area soil: iron and zinc
- Surface water: hexavalent chromium and zinc
- Groundwater: hexavalent chromium, iron, and zinc

Semivolatile organic compounds (SVOCs):

- Landfill area soil: pentachlorophenol (PCP) and total carcinogenic polycyclic aromatic hydrocarbons (cPAHs)

Total petroleum hydrocarbons (TPH):

- Landfill area soil: total petroleum hydrocarbons in the diesel range/oil range (TPH-DRO/ORO) and in the gasoline range (TPH-GRO)
- Wetland Area soil: TPH-DRO/ORO and TPH-GRO

The proposed cleanup levels (pCULs) were developed using the COCs identified for the different Site media and areas. This process takes into consideration the active pathways between media and the different receptor scenarios (human health and ecological) that have been shown to be active.

The goal of the preferred remedial action (RA) will be to achieve unrestricted use throughout the Landfill Area of the Site at completion of cleanup through permanent removal of landfill waste materials and impacted soils and prevent impacts to groundwater and surface. Within the Wetland Area, the investigation did not identify adverse effects to ecological conditions from the COCs. The preferred RA approach is to limit human contact with impacted soils in the Wetland Area with appropriate controls and preserve the high-quality wetland ecosystem present.

Points of compliance (POCs) for each impacted media are where Site cleanup levels (CULs) must be attained. A standard POC for soil is proposed for the Site. This addresses both Human Health and Ecological receptors which extend from the ground surface to a depth of 15 ft (based on human exposure through direct contact) or 6 ft (for screening based on ecological exposure). For the Wetland Area of the Site, the preferred RA is degradation/attenuation within the Wetland Area. This RA is appropriate for Wetland Area soils based on compliance with the provisions of WAC 173-340-740(6)(f) because (1) the Landfill Area contamination will be removed, which is the primary original, and likely ongoing, source of contamination to the Wetland Area, and (2) removal of Wetland Area soils would cause significantly greater harm and damage to the environment than leaving those soils isolated in place. Furthermore, with the removal of the landfill, natural processes, such as bioturbation, phytoaccumulation, and biological and chemical degradation, will naturally result in achieving TPH-DRO/ORO and TPH-GRO CULs in the Wetland Area soils within a reasonable restoration time frame, and further reduce metals concentrations that are below CULs even before the implementation of the remedy.

Standard POCs are also proposed for groundwater and surface water and will be met throughout the Site within a reasonable restoration time frame after completion of the RA. The standard POC for groundwater will be measured at two areas: (1) underneath the former landfill waste prism and (2) as close to the toe of the landfill in the Wetland Area as practicable. The standard POC for surface water will be monitored at locations near the downgradient property line that commonly have surface water present and/or where Site runoff (composed of surface water and groundwater discharged at the Site) could potentially reach the Mashel River. Within the Wetland Area, achievement of CULs for surface water is assumed to occur following RA or within a reasonable restoration time frame.

Based on coordination with Ecology, State Parks, and the Nisqually Tribe, and considering Site-specific conditions and regulatory requirements, the Landfill and Wetland Areas were evaluated as separate RA areas. Two different RA alternatives were developed for both the Landfill Area (Alternatives 1A and 1B) and for the Wetland Area (Alternatives 2A and 2B).

For the Landfill Area, Alternative 1A includes full removal and re-grading and restoration of the waste prism and removal of landfill debris/waste materials in the Wetland Area, and Alternative 1B includes partial waste prism removal and removal of wastes in the Wetland Area, re-grading of remaining waste prism, and containment (capping).

For the Wetland Area, Alternative 2A includes removal of landfill debris/waste materials and contaminated soil above CULs. Alternative 2B includes removal of landfill debris/waste material in the Wetland Area (as previously indicated under Alternatives 1A and 1B), but no significant soil removal and human contact to any remaining impacted soils within the Wetland Area would be restricted through controls. Under Alternative 2B, an environmental covenant, if necessary, may be required to restrict use and protect human health by preventing direct human contact with TPH-GRO-impacted soil and restrict the use of groundwater for human consumption.

These alternatives assume that the wetland ecosystem is subject to permitting requirements under federal and/or state regulations. The RAs are also based on the findings from the terrestrial ecological evaluation Weight of Evidence approach, which determined the soil conditions in the Wetland Area are not adversely affecting terrestrial ecological receptors. All presented alternatives meet or exceed minimum MTCA cleanup action requirements and are a permanent remedy for this Site.

Based on the findings from the RI and the results of the FS, Alternative 1A (Landfill Area; full waste and impacted soil removal) and Alternative 2B (Wetland Area: waste/debris removal, monitored natural attenuation, and institutional controls) were selected as the preferred RA alternatives. This combination of alternatives meets the MTCA threshold and other requirements for the Site and was determined to be permanent to the maximum extent practicable through the disproportionate cost analysis (DCA) process. Additionally, this combination of RA alternatives prevents harm to the existing thriving wetland ecosystem. The restoration time frame for soil in the Landfill Area will be immediately following excavation of the waste prism and impacted native soils to the maximum extent practicable. The restoration time frame for Wetland Area soil and Site groundwater, and surface water is anticipated to be no longer than 10 years.

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Abbreviations and Acronyms

°C	degrees Celsius
µg/L	micrograms per liter
µS/cm^2	micro siemens per square centimeter
Apex	Apex Laboratories, LLC
ARAR	Applicable or Relevant and Appropriate Requirement
BaP	benzo(a)pyrene
BBP	benzyl butyl phthalate
bgs	below ground surface
BMP	best management practice
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	Cleanup Action Plan
CLARC	Cleanup Levels and Risk Calculation
cm	centimeter
COC	contaminant of concern
COPC	contaminant of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSM	Conceptual Site Model
CUL	cleanup level
CY	cubic yard
DCA	disproportionate cost analysis
DCE	1,2-Ddichloroethylene
DRO	diesel range organics
EC	engineered control
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
ERTS	Environmental Report Tracking System
FS	Feasibility Study
ft	foot or feet
GRO	gasoline range organics
GSI	GSI Water Solutions, Inc.
IC	institutional control
ISM	Incremental Sampling Methodology
MCL	Maximum Contaminant Level
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter

MNA	monitored natural attenuation
MTCA	Model Toxics Control Act
mV	millivolts
NAD 83	North American Datum of 1983
NAVD 88	North American Vertical Datum of 1988
NTU	nephelometric turbidity unit
NWEPH	Northwest Extractable Petroleum Hydrocarbon
NWTPH	Northwest Total Petroleum Hydrocarbon
NWVPH	Northwest Volatile Petroleum Hydrocarbon
OHW	ordinary high water
Order	2021 Agreed Order No. DE 20072
ORO	oil-range organics
ORP	oxygen-reduction potential
PAH	polycyclic aromatic hydrocarbon
PBDE or BDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PCP	pentachlorophenol
pCUL	proposed cleanup level
POC	point of compliance
PQL	practical quantitation limit
Property	Parcel of land owned by the Weyerhaeuser Company and containing the Former Eatonville Landfill
QAPP	Quality Assurance Project Plan
RA	remedial action
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RI	Remedial Investigation
RIWP	Remedial Investigation Work Plan
RL	reporting limit
SAP	Sampling and Analysis Plan
Site	Former Eatonville Landfill
SL	screening level
SM	Standard Method
State Parks	Washington State Parks and Recreation Commission
SVOC	semi-volatile organic compound
TEE	Terrestrial Ecological Evaluation
TOC	total organic carbon
Town	Town of Eatonville

TPH	total petroleum hydrocarbons
UCL	upper confidence limit
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UTL	upper tolerance limit
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbons
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
Weyerhaeuser	Weyerhaeuser Company
WOE	Weight of Evidence

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1 Introduction

This combined Remedial Investigation (RI)/Feasibility Study (FS) report was prepared for the former Eatonville Landfill, Cleanup Site ID 15271 (Site), which includes a parcel of land owned by Weyerhaeuser Company (Weyerhaeuser) in unincorporated Pierce County, Washington (Property), and adjacent Nisqually State Park land that abuts the Property (Figure 1-1). This RI/FS was prepared by GSI Water Solutions, Inc. (GSI), on behalf of Weyerhaeuser and the Town of Eatonville (Town) in accordance with the requirements of the 2021 Agreed Order No. DE 20072 (Order) between the Washington State Department of Ecology (Ecology), Weyerhaeuser, and the Town, pursuant to the Washington State Model Toxics Control Act (MTCA) (Revised Code of Washington [RCW] 70A.305) and MTCA regulations (Washington Administrative Code [WAC] Chapter 173-340). Weyerhaeuser's representative is Luke Thies (luke.thies@weyerhaeuser.com). The Town's representative is Seth Boettcher (sboettcher@eatonville-wa.gov). Weyerhaeuser's and the Town's Project Manager is Benjamin Johnson of GSI (bjohnson@gsiws.com). The Ecology Project Manager is Sam Meng of the Southwest Regional Office (same461@ecy.wa.gov).

1.1 Purpose and Objectives

This RI/FS was developed pursuant to MTCA and the terms and conditions of the Order between Ecology, Weyerhaeuser, and the Town. The Order requires that the following actions be taken:

1. Development of an RI Report and an FS Report, combined into a common RI/FS Report (as approved by Ecology), to determine the extent of impacts, develop and evaluate alternatives for cleanup actions (also referred to as RA or remedial alternatives in this document), and select a preferred remedial action(s) (RAs), as required by the MTCA regulations.
2. Development of a draft Cleanup Action Plan (CAP).

The RI portion (Sections 2 through 9) of this RI/FS was scoped and developed in accordance with the Ecology-approved Remedial Investigation Work Plan (RIWP) (GSI, 2021a). The RI presents data that adequately characterizes the nature and extent of contamination at the Site and:

- Presents a detailed Conceptual Site Model (CSM).
- Identifies contaminants of potential concern (COPCs) and adequately characterizes the nature, extent, and magnitude of contamination for affected media (i.e., soil, groundwater, and surface water) using data from field investigations conducted by GSI in 2021 and 2022, as well as any appropriate historical data.
- Identifies contaminants of concern (COCs) by media through the screening of COPCs.
- Identifies the applicable cleanup standards, including proposed cleanup levels (pCULs) and proposed points of compliance (POCs) for affected media and COCs.

Data presented in the RI is used in the FS (Sections 10 through 14) to develop and evaluate RA alternatives using WAC 173-340-360 through 173-340-390 and:

- Identifies remedial action objectives (RAOs), applicable or relevant and appropriate laws and regulations, and an initial screening of remedial alternatives.
- Details the evaluation of two cleanup action alternatives (also referred to as remedial alternatives) for the former municipal waste landfill (referred to as the "Landfill Area" in this report) and two alternatives for the area beyond the toe of the landfill (referred to as the "Wetland Area" in this report).

- Evaluates the retained cleanup action alternatives using the MTCA criteria and its disproportionate cost analysis (DCA) process to determine the alternative that is permanent to the maximum extent practicable.
- Proposes and describes a preferred RA composed of the cleanup action alternatives presented.

Per WAC 173-350, the objective of the combined RI/FS is to "collect, develop, and evaluate sufficient information regarding a site to select a cleanup action under WAC 173-340-360 through 173-340-390." Upon approval of the RI/FS, a draft CAP for the Site will be prepared for the preferred alternative identified in this FS or as otherwise determined by Ecology.

1.2 Site Information

The Site is composed of the area where contamination has come to be located at a former municipal waste landfill and wetland area beyond the landfill toe where waste or contaminants have migrated over time. The Site is located west of Eatonville, in unincorporated Pierce County, Washington and entirely contained within the Property and Nisqually State Park (Figure 1-1). The coordinates for the center of the Site are 46°51'35.47" N latitude and 122°19'19.78" W longitude in the northwest quarter of Section 20, Township 16N, Range 4E. The Town leased the Property from Weyerhaeuser from November 1950 to March 1, 1980, for use as a municipal landfill (Tacoma-Pierce County Health Department, 2010; Weyerhaeuser, 2014; Ecology, 2021). Ecology identifies the Site using Facility Site ID No. 85933 and Cleanup Site ID No. 15271. The Site is largely located within and centered around the extents of the Property, a 6.3-acre rectangular parcel of land owned by Weyerhaeuser (Tax Parcel No. 0416201007), and extends into the adjoining Nisqually State Park property managed by Washington State Parks and Recreation Commission (State Parks).

The Site is accessed via unpaved roads stemming off Medical Springs Road (a turnoff from State Highway 7). The Mashel River is located approximately 500 feet (ft) to the south of the Site. Figures 1-1 and 1-2 show the Site and surrounding areas.

The landfill was developed over a bluff, with a shallower grade of approximately 2 ft horizontal to 1 ft vertical (2H:1V or less) on the upper portions and a steeper grade of close to 1H:1V in the middle and lower portions of the landfill. The grade varies across the Site with the Wetland Area sloping no more than 1 to 2 percent away from the landfill on average. The landfill was covered during its operational period using fill materials from a the borrow pit directly across the access road from the landfill (Figure 1-2) on Nisqually State Park property. The original cover material has gradually settled and/or eroded over time, leaving refuse exposed. Accessing the middle and lower portions of the Site is difficult because of the presence of dense brush and the steep, loose, and unimproved grade. There are currently no developed access roads or trails. However, a historical access road is present at the top of the landfill, which provides relatively easy access from maintained State Park roads to the upper edge of the landfill only. Figure 1-2 shows the former borrow pit, Site access point, and estimated extent of the landfill.

While steep slopes have hindered efforts to fully define the extents and thickness of the landfill waste prism, the investigation has adequately characterized the extent of the landfill footprint. The footprint is bound by the limits of where tree establishment has occurred, which roughly correlates to the extents of native soil at the perimeter. The landfill is approximately 250 ft long by 200 ft wide, covering approximately 1.3 acres. The waste prism is estimated to be up to 10 to 15 ft thick in the upslope portion of the landfill and up to 20 to 30 ft thick in the center and lower portions. The total estimated volume of the landfill waste prism is approximately 21,500 cubic yards (CY) based on an estimated pre-landfilling topographic contour interpolation, current topographic elevations, and the geophysical survey conducted in January 2022.

1.3 Background

Between 1996 and 2020, Weyerhaeuser, Ecology, and the Town completed several investigations and closure evaluations for the Site (Parametrix, 1996; O'Neill et al., 2020). A 1996 analysis of surface water runoff indicated that zinc was present downstream of the Site at concentrations that exceeded the Washington State Surface Water Quality Standards for Aquatic Life (Figure 1-3) (Parametrix, 1996). A 2017 investigation conducted by the Washington Department of Fish and Wildlife (WDFW) of the surrounding watershed identified the landfill as a potential source of polybrominated diphenyl ethers (PBDEs or BDEs) adversely affecting steelhead trout (*Oncorhynchus mykiss*) in the Mashel and Nisqually Rivers (Figure 1-3) (O'Neill et al., 2020).

Following the September 2020 release of the WDFW's investigation results, the Nisqually Indian Tribe notified Ecology about potential releases of PBDEs to the Nisqually River from various sources within the watershed, including the Site (O'Neill et al., 2020). Weyerhaeuser and the Town agreed to further investigate PBDE and coordinated with Ecology and the Nisqually Indian Tribe on options for remediating the landfill (Weyerhaeuser, 2020). Investigations of PBDEs and other potential contaminants at the Site began in 2021 and are documented in the RIWP (GSI, 2021a) and in this RI. Historical sampling of surface waters and groundwater at the Site during prior investigations showed that PBDEs were not detected above the method detection limits (MDLs) in the samples collected (Figures 1-3 and 1-4). Although the Site was not a source of PDBE impacts, , additional investigation was determined to be necessary to identify if the former landfill was a source of other releases of hazardous substances. Ecology is providing formal oversight to the cleanup activities under the Order.

1.4 Document Organization

This report is organized into the sections listed below:

- **Section 1 – Introduction**

Remedial Investigation

- **Section 2 – Site History and Use:** Summarizes the pre-industrial development and the operational and regulatory history of the landfill.
- **Section 3 – Site Setting:** Summarizes the Site setting, natural conditions, and nearby beneficial water use.
- **Section 4 – Field Investigations:** Summarizes field investigations, sampling activities, and data validation results from 1996 through 2022.
- **Section 5 – Conceptual Site Model:** Describes the CSM.
- **Section 6 – Site Areas:** Describes the different areas of the Site, namely the Landfill and Wetland Areas.
- **Section 7 – Screening Levels:** Provides the applicable regulatory levels used to evaluate the RI dataset used in support of development of proposed cleanup standards for the Site presented in Section 8.
- **Section 8– Remedial Investigation Results:** Summarizes the nature and extent of contamination based on the RI dataset.
- **Section 9 – Proposed Cleanup Levels and Points of Compliance:** Presents the pCULs and POCs for the Site and Site area (soils only) by media.

Feasibility Study

- **Section 10 – Remedial Action Objectives and Requirements:** Presents the RAOs and appropriate regulatory requirements.
- **Section 11 – Identification of Applicable Remedial Alternatives:** Identifies applicable remedial technologies.
- **Section 12 – Remedial Action Alternatives:** Describes proposed remedial alternatives.
- **Section 13 – Remedial Action Alternative Evaluation Criteria:** Presents the evaluation of the remedial alternatives and DCA.
- **Section 14 – Preferred Remedial Action Alternative:** Recommends and describes the preferred remedial alternatives for the Landfill and Wetland Areas.
- **Section 15 - Stakeholder Engagement and Public Participation:** Describes Ecology's ongoing and future engagement with stakeholders, sovereign nations, and the public.
- **Section 16 – References**

REMEDIAL INVESTIGATION

The RI was conducted from 2021 to 2022 and gathered data to determine the nature and extent of contamination at the Site. This data, in tandem with historical investigations and knowledge of former Site use, was used to develop a CSM, select screening levels (SLs), COCs, and pCULs based on the human health and ecological risk and active pathways present at the Site. The RI provides the necessary framework for evaluating and selecting preferred remedial alternatives in the FS.

2 Site History and Use

This section describes the Site's previous uses, current and future uses, and existing infrastructure.

2.1 Previous and Planned Land Use

Land use at the Site can be broken up into distinct time periods, which include pre-development, landfill operations and post-closure monitoring, current Site use, and future planning. These periods are discussed more in the following sections.

2.1.1 Pre-development

The Site is centrally situated within the Nisqually River watershed, in the area where the Nisqually Indian Tribe and its ancestors, the Squalli-absch, have resided for time immemorial. The Tribe has established several villages in the basin, including a major village near the Mashel River (Nisqually Indian Tribe, 2021). No known settlements have been identified within or immediately adjacent to the Site.

The first white settlement in the area was established in 1833 and the Nisqually Reservation was established under the 1854 Medicine Creek Treaty. European American settlement in the area expanded when Congress passed the Homestead Act in 1862 (Trost, 2021).

Weyerhaeuser Timber Company acquired the land encompassing what is now Nisqually State Park by 1915. Its holdings, potentially including the Site, were intermittently harvested for timber from 1915 until 2010, when the land was sold to State Parks (Trost, 2021). Weyerhaeuser likely did not use the property for other purposes, based on a review of historical records.

Prior to landfilling activities, the slope now underlain by the waste prism was wooded. Evidence of vegetation clearing on the landfill slopes can be seen between 1941 and 1957 in Figure 2-1; however, the purpose of this clearing is not known. As of 1957, the slope became barren, or less vegetated, due to the use of the Site for landfilling activities (Figure 2-1).The Wetland Area has a slightly less developed canopy, which can be seen in the photos provided in Appendix A.

2.1.2 Landfill Operations and Post-Closure Monitoring

Historical aerial photographs indicate that the Site and surrounding areas were largely undisturbed before the 1950s, except for the logging that Weyerhaeuser began in 1915 (Figure 2-1). The Town leased the Property from Weyerhaeuser from approximately November 1950 to March 1, 1980, for use as a municipal landfill (Tacoma-Pierce County Health Department, 2010; Weyerhaeuser, 2014; Ecology, 2021). The landfill was unlined and received municipal (household) solid waste during operations; tires, appliances, and car bodies were received either during operation or from unauthorized dumping after the landfill closure, as evidenced by visual observation of the current surficial contents (photos provided in Appendix A) and previously conducted testing pitting in limited locations near the top of the landfill (PES, 2013). Additionally, approximately 25 empty barrels were disposed of in September 1977. The landfill was burned and treated several times to reduce rodent infestation (Tacoma-Pierce County Health Department, 2010).

Directly northeast of the access road to the Site is a soil borrow pit that resides within what is now Nisqually State Park property and is not part of the Property (Figure 1-2). During active landfilling years, soil and gravel were excavated from the borrow pit and intermittently used as landfill cover material, but the steep slopes of the landfill limited the ability to effectively cover waste (PES, 2013). The intermittent cover material has gradually settled and/or eroded over time, leaving waste exposed at the surface.

The Site has been vacant and undeveloped since the informal closure of the landfill in 1980 (Parametrix, 1996; Tacoma-Pierce County Health Department, 2010). During closure of the landfill, a barrier of tree stumps and snags was placed at the upslope landfill ridge to restrict vehicle access; however, illegal dumping and firearm use still occurred after formal landfill closure (Parametrix, 1996).

At varying times, the land on and near the landfill appears to have been used for unauthorized recreational shooting. GSI personnel have observed shotgun shells, targets, and clay pigeons (skeet) at the upper slope of the landfill and in the borrow pit (Appendix A).

2.2 Current Site Use

In 2010, following the development of a 2005 to 2007 master plan for Nisqually State Park by the Washington State Legislature, 1,230 acres of the land surrounding the Property was officially designated as Nisqually State Park (Fields, 2010). The park has slowly been developed since the initial land purchase, with critical phase construction (including the addition of trails, trailhead parking, and camping facilities) anticipated to be completed by 2025. The unauthorized recreational shooting likely continued at the Site during development of Nisqually State Park, as evidenced by the large amount of firearm related materials found throughout the Site and borrow bit (Appendix A). Based the apparent young age and large quantity of shooting evidence at the Site, it is likely that the shooting activities have continued to present day.

There are no known utilities or other underground infrastructure present within the Site. The nearest known infrastructure are overhead power transmission lines located immediately north and adjacent to the access road along the Nisqually State Park gravel road. An unimproved and overgrown access road spurs off of the gravel road running through Nisqually State Park and serves as the Site access point (Figure 1-2).

2.3 Future Planning

Future development plans include formal incorporation of the Property into Nisqually State Park through a transfer of ownership from Weyerhaeuser to State Parks and consistent with the Timberland Purchase and Sale Agreement established between Weyerhaeuser and Washington State Parks in 1998.The state park is currently used for several outdoor activities, including biking, fishing, bird watching, horseback riding, hiking, walking, rolling, and running (Washington State Parks, 2023).

3 Site Setting

This section describes the Site setting and establishes a basis for the development of the CSM presented in Section 5.

3.1 Natural Conditions

Physical conditions, including Site geology, surface water, hydrogeology, and wetland ecosystem, are described in the sections below.

3.1.1 Geology

Regionally, the Site is situated between the Puget Sound Lowland to the west and north and the Mount Rainier foothills to the east, in an area geologically shaped by volcanic activity, plate tectonics, glacial processes, mass wasting, and fluvial processes. The Puget Lobe of the Cordilleran ice sheet has advanced and retreated several times into the Puget Lowland from the mountains of British Columbia since the beginning of the Quaternary Period and has left behind a complex sequence of alternating unconsolidated glacial and interglacial deposits. Tertiary bedrock units underlie the unconsolidated deposits (Walters and Kimmel, 1968). These geologic units are consistent with Site drilling observations and are described below. Figures 3-1 and 3-2 present a geologic cross section, and Appendix B presents copies of Site boring and piezometer logs.

Within the Vashon Formation, three units characterized by similar grain size were observed during RI drilling at the top of the landfill (which is approximately 150 ft higher in elevation than the base of the landfill):

- **Coarse-Grained Unit.** From the ground surface to approximately 30 ft below ground surface (bgs), gravel and sands with some silts were encountered. Although the shallow gravel unit was relatively dry, a thin lens of perched groundwater was observed at the base of this coarse-grained unit, consistent with the elevation of a natural spring present on the northwest corner of the landfill.
- **Fine-Grained Unit.** From approximately 30 to 90 ft bgs, finer-grained silts, sands, and clays were observed. Saturated soil indicative of the top of the water table was encountered near the base of the fine-grained unit at depths of approximately 80 to 85 ft bgs, although water levels after piezometer construction were measured at shallower depths between approximately 70 to 80 ft bgs.
- **Coarse-Grained Unit.** From approximately 90 to 100 ft bgs, a deeper gravel and sand unit was observed.

Beneath the Vashon Formation, the upper Mashel Formation was encountered at approximately 100 ft bgs. The Mashel Formation consists of unconsolidated clay, sand, and lignite deposits (Tertiary-age). Outcrops of the Mashel Formation are also visible on the slopes of the Mashel River (Figure 3-2) (Schasse, 1987; Walters and Kimmel, 1968).

The Site is located on top of a bluff north of the Mashel River and is surrounded and underlain by unconsolidated glacial deposits that are part of the Vashon Formation. The bluff is an erosional feature of the historical Mashel River channel, and ongoing erosion and mass wasting have resulted in natural slopes as steep as 1.5H:1V near the Site. Anthropogenic landfill deposits on top of the erosional slope are as steep as 1H:1V, with evidence of ongoing slope instability and debris runout near the toe of the slope. The steep bluff gives way to a flat region of land that eventually transitions to the Mashel River floodplain and riverbanks.

3.1.2 Wetland Ecosystem

The wetland ecosystem south of the toe of the landfill receives stormwater runoff, along with spring and seep discharges at various points along the toe of the landfill, resulting in variably saturated soil conditions. These conditions exist between the toe of the landfill and the Mashel River ordinary high water (OHW) line (Figure 3-3). The OHW line defines the elevation within the riverbed below which soil characteristics are "distinct from that of the abutting upland, in respect to vegetation" as defined by Washington's Shoreline Management Act (RCW 90.58) (Figure 3-3). This wetland between the toe of the landfill slope and the Mashel River OHW mark is a minerotrophic fen/ephemeral wetland. A 2022 wetland delineation (Section 4.2.2.4) determined that the area is defined as a potential jurisdictional wetland per the U.S. Army Corps of Engineers (USACE) *Wetland Delineation Manual* (USACE, 1987) and the *Regional Supplement to the USACE Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (USACE, 2010) (Appendix C). For the purpose of the FS, the delineated wetland ecosystem is assumed to be a jurisdictional waterbody of the state. The RAs consider this sensitive environment at the Site and propose a cleanup design planned to restore or recover the wetlands post-remedy.

Wetland boundaries near and adjacent to the landfill were delineated with the northern extent beginning at the spring adjacent to the landfill. The wetlands extend to the south, adjacent to the northwestern edge of the landfill. The full extents of the wetlands were not delineated and are inferred, as well as the historical extents under the waste prism. Inferring these wetland boundaries based on reconnaissance is an acceptable practice consistent with guidance from Chapter 431 of the Washington State Department of Transportation *Environmental Manual* (WSDOT, 2022). At the toe of the slope, the wetlands extend to the south, west, and east and include a portion of the toe of the landfill where wastes have settled. The wetlands appear to extend south to the Mashel River; however, the delineation for the RI objective was needed only near the preliminary assumed construction boundaries for remedial activities (Figure 3-3).

The materials in the Wetland Area (part of the larger delineated wetlands, which extend through the Landfill Area to the spring) are considered soils pursuant to MTCA, as they do not meet the definition for sediment as outlined in WAC 173-204-505, which defines sediments as:

> *"….settled particulate matter located at or below the ordinary high water mark, where the water is present for a minimum of six consecutive weeks, to which biota (including benthic infauna) or humans may potentially be exposed, including that exposed by human activity (e.g., dredging)."*

This determination of Wetland Area materials being classified as soils is based on the following:

- Wetland soil types at the Site are not characteristic of settling particulate matter derived from water bodies (i.e., no laminae [a sequence of thin layers of soil/sediment deposited in planar structures in settling environments]) (Appendix C).
- The Wetland Area is located approximately 25 to 30 ft above the approximate OHW line of the Mashel River (Figure 3-3).
- No significant or widespread inundation has been observed nor is anticipated.
- Benthic organisms and aquatic plants were not observed during the Terrestrial Ecological Evaluation (TEE) field data collection efforts or during any Site visits conducted by GSI (Appendix D).

The Wetland Area is considered separately from the Landfill Area during discussion of the remedial investigation results and proposed alternatives in the FS. This distinction is made for several reasons, including the unique settings (physical slopes, soils, and waters), different sources of contamination (waste prism, leached surface water and groundwater impacts), and different ecological conditions (landfill is in poor condition, but the wetlands are in good condition) present in the two areas. The different ecological conditions in particular present a strong argument for separating the Site into different areas, as the Wetland Area largely contains thriving floral and faunal communities that appear to be unaffected by onsite contamination (see Section 8.4). The wetland may also act as a buffer limiting downgradient transport of landfill impacts to the Mashel River and may help counter the effects of climate change (Section 3.3).

3.1.3 Surface Water

Based on data from the weather station located near Centralia, Washington, with readily available historical data the average annual precipitation in the area is 34.6 inches per year during the past 15-year period (2006 through 2021) (Lawrimore et al., 2022). Most of this precipitation occurs during the fall and winter months (October to March). This is thought to be representative of the general conditions in the area of the Former Eatonville Landfill.

The Site is part of the 460,172-acre Nisqually River watershed, whose headwaters begin approximately 26.5 miles east at the summit of Mount Rainier. The Nisqually River discharges into the southern end of the Puget Sound, located 25 miles to the Northwest. The Mashel River's confluence with the Nisqually River is approximately 1 mile downstream of the Site. The Mashel River and Nisqually River watershed are considered sensitive environments at the Site.

Figures 1-1 and 1-2 show the Site vicinity and surrounding areas. The point where any Site-related surface water has the potential to discharge to the Mashel River channel is via an unnamed creek forming within the Wetland Area of the Site and flowing to the south-southwest only when sufficient water is present. Surface water from the spring and seeps at the base of the landfill present largely as sheet flow discharge into the Wetland Area with discharge volumes varying significantly based on season. Stormwater either infiltrates in place or crosses the Wetland Area, mainly as sheet flow, and infiltrates within the wetland or flowing into the unnamed creek that continues past the Property line. Except for the unnamed creek and ravine on the west side of the landfill created by the intersection of the landfill prism and native slope of the bluff, no concentrated stormwater/spring discharge pathways have been noted.

After stormwater and springs/seeps reach the toe of the landfill, any concentrated water likely disperses as sheet flow across the gradually graded Wetland Area towards the unnamed creek (Figure 3-3). Water appears to infiltrate back into the ground surface or eventually reach the unnamed creek bed approximately 500 ft south of the toe of the landfill before flowing to the south/southwest approximately 0.25 mile and eventually entering the Mashel River floodplain. The unnamed creek appears to take an extended southerly track consistent with historical braided channels in floodplain areas, rather than the most direct path to the Mashel River. This unnamed creek drops approximately 15 ft to the Mashel River floodplain and ultimately the Mashel River itself (Figure 3-3). Figure 3-3 shows the Site and its regional topography and features. Figure 3-4 shows the locations of the piezometers and the natural spring and resulting ephemeral flow path adjacent to and below the northwest corner of the landfill. The hillslope spring is currently active with discharge volumes varying depending on the time of year and size of rainfall events.

3.1.4 Hydrogeology

Groundwater at the Site is present within a shallow unconfined aquifer, mapped as the A1 Aquifer by the U.S. Geological Survey (USGS) (2010). This aquifer may present as seeps or springs at the ground surface in some locations, and the thickness of the aquifer typically ranges from between 35 and 150 ft bgs. Water supply wells located near the Site beneficially use water from the A1 Aquifer. The nearest well, located approximately 1,000 ft to the northeast and upgradient, reportedly obtains groundwater from as shallow as 49 ft bgs.

Groundwater was measured at the Site's five-piezometer network in November 2021 and February 2022 at depths ranging between 73 and 77 ft bgs at the top of the landfill and at or just below the ground surface beyond the toe of the landfill. Groundwater is estimated to flow to the south-southwest toward the Mashel River and may present as surface water or remain in the unconfined shallow groundwater zone within the wetlands. Based on piezometers installed at the top of the landfill (PZ-01 and PZ-05, which are in close proximity to each other), a 3 to 5 ft thick lens of perched groundwater is present at shallow depths of approximately 22 to 25 ft bgs overlying a fine-grained unit in the Vashon Formation. Although the vertical and lateral extent of the perched groundwater was not delineated, it appears to emerge on the west side of the slope at the edge of the landfill as a spring. Other seeps and springs are present near the toe of the landfill and likely originate from surface water infiltration above the landfill, over the landfill itself, or groundwater in contact with waste. The groundwater moves through coarser-grained units and discharges as seeps and springs where lower-permeability units outcrop along the slope.

Figures 3-5 and 3-6 present groundwater level elevation contour maps for the November 2021 and February 2022 events, respectively, and capture the location of the spring. Table 3-1 presents depth to water/groundwater level elevation measurements. Groundwater measurements indicate a potentiometric surface sloping to the southwest at a gradient of approximately 0.16 ft per ft as measured between PZ-01 and PZ-04.

3.2 Designated and Local Beneficial Water Uses

Designated water uses in the State of Washington under WAC 173-201A-600 include aquatic life uses, recreational uses, water supply uses, and other miscellaneous uses, which include but are not limited to wildlife habitat, fish harvesting, and aesthetic values. Beneficial use, as defined in WAC 173-545-030, means uses of water for domestic, stock watering, industrial, commercial, agricultural, irrigation, hydroelectric power production, mining, fish and wildlife maintenance and enhancement, recreational, thermal power production, and preservation of environmental and aesthetic values, and all other uses compatible with the enjoyment of the public waters of the state. As such, designated and beneficial uses specific to the Site that could be adversely impacted by contaminated surface water or groundwater include upland wildlife habitat, aquatic fish habitat, anglers through direct contact with the water or harvesting fish for consumption, and drinking water uses. Further, if any of these uses are not known to occur near the Site, aesthetic and environmental values still require protection of waters of the state.

A local beneficial water use determination to evaluate groundwater and surface water conditions in the vicinity of the Site and to identify wells and surface waterbodies that may serve beneficial uses to complete the CSM and exposure-pathway evaluation was completed, as required by Ecology guidance. The search radius of 0.5 mile was used, which represents a protective buffer extending beyond potential contaminant movement. The drinking water evaluation was conducted using Ecology's Well Report Viewer online database (Ecology, n.d.[a]), Ecology's Water Rights Map Search (Ecology, n.d.[b]), and the Washington State Department of Health's Source Water Assessment Program Mapping Tool (Washington State Department of Health, n.d.) to search for wells and surface water rights located within a 0.5-mile radius of the Site. Figure 3-7 shows drinking water wells identified within 0.5 miles of the Site. Based on the results of the database review and the following lines of evidence, with the exception of anglers coming into direct contact with impacted surface or groundwater, no beneficial groundwater or surface water use appears likely within 1,000 ft of the Site, and no Site water is currently beneficially used. Findings from the beneficial use evaluation include:

- No water wells downgradient within the 0.5-mile search area were identified. Six water supply wells are located within the 0.5-mile search area but are all located up- or cross-gradient of the Site.
- The nearest groundwater supply well (Well Log ID No. 24487) is located approximately 1,000 ft upgradient of the Site.

- No beneficial surface water use is known or suspected within 0.5 miles of the Site because of the lack of current surface water collection infrastructure or access to allow for the development of future infrastructure. However, park users likely access the nearby Mashel River for fishing and other recreational and aesthetic uses.

However, it is recognized that beneficial use of groundwater must be protected, both for the protection of groundwater directly and because of its potential to discharge to surface water resources. Separately, surface water has the potential to provide future beneficial use and expose human and ecological receptors to any impacts from the Site.

The ecological evaluation for designated and beneficial water use was conducted through field efforts performed during the TEE (Section 4.2.6) and used the WDFW Priority Habitats and Species Viewer online database (WDFW, n.d.[a]), Salmon Scape Viewer online database (WDFW, n.d.[b]), and the DataBasin.org Viewer online database (Conservation Biology Institute, 2017) to identify potentially affected ecological communities. Based on the results of the database review and field investigations, designated and beneficial uses of surface water (and groundwater as it may discharge to surface water at the Mashel River) are present within 1,000 ft of the Site. At a minimum, the ecological designated/beneficial use (WAC 173-201A-600 and 173-545-030) must be protected for the following:

- Human consumption of fish potentially impacted by contaminated surface water.
- Potential future use as a drinking water supply.
- Protection of evolutionarily significant units of salmon species and distinct population segments of winter and summer steelhead in the Mashel River and downriver.
- Protection of the Townsend's big-eared bat (*Corynorhinus townsendii*), a species of concern.
- Protection of amphibians anticipated to be present within or near the Site.
- Protection of American black bear (*Ursus americanus*) as identified through the wildlife camera placed in support of the TEE.
- Protection of Site wildlife and birds as identified through the wildlife camera placed in support of the TEE.
- Protection of Site ecosystems for aesthetic value in support of the State Parks' uses.

3.3 Potential Impacts of Climate Change

WAC 173-340-350(6)(f) notes that, based on best available science, sufficient information should be presented in the RI on current and projected local and regional climatological characteristics to determine which could affect the migration of hazardous substances or the resilience of cleanup action alternatives. The relevant climate change characteristics of the Site and their potential impacts are discussed below:

- **Seasonal Patterns of Rainfall.** Depending on the climate models referenced, changes in average annual precipitation in the vicinity of the Site in 2060 range from -2.2 to +6.7 percent (EPA, 2016). Increases in annual average precipitation could lead to erosion along the slope and increased flow along the ravine from the seep, which has the potential to expose hazardous materials in the landfill and mobilize impacted soils.
- **Magnitude and Frequency of Extreme Storm Event.** The Site ranks in the 83rd percentile for properties currently at flood risk and in the 82nd percentile of properties at flood risk in the next 30 years (EPA, 2023). However, the Site is not currently within a 100-year floodplain (EPA, 2023). In 2060, the change in 100-year storm intensity is projected to increase from between 5.7 and 16.8 percent (EPA, 2016). This increase in storm intensity has the potential to increase erosion at the Site and mobilize impacted soil.

- **Potential for Landslides.** The risk of landslides increases with high gradients and high precipitation volumes. The Site is located on a steep slope and along a natural ravine, which may be vulnerable to landslides in the event of high-flow storms. As noted previously, anthropogenic landfill deposits on top of the erosional slope are as steep as 1H:1V, with evidence of ongoing slope instability and debris runout near the toe of the slope.

Other climate indicators, including wildfire potential and temperature extremes, were considered, but the impacts of these indicators were relatively low at the Site (U.S. Federal Government, 2023).

4 Field Investigations

This section summarizes the main findings of previous investigations and interim actions. Field and analytical data are compiled on Tables 4-1 and 4-2, and sample locations are illustrated on Figures 4-1 and 4-2. Geotechnical laboratory reports and laboratory analytical reports are presented in Appendices E and F, respectively.

4.1 Pre-Remedial Investigation Independent Studies (1996–2021)

Summaries of previous studies at the Site conducted between 1996 and January 2021 before the RI are provided below:

- In 1996, surface water and seeps were sampled upstream and downstream of the landfill and analyzed for biological oxygen demand, N-ammonia, chloride, sulfate, iron, manganese, and zinc. Analytical results indicated elevated zinc concentrations up to 490 micrograms per liter (µg/L) in seeps at the toe of the landfill (Figures 1-3 and 1-4) (Parametrix, 1996).
- In 2013, a total of 27 test pits were excavated on the upper portion of the landfill where the grade was shallower to determine the geologic conditions underlying the landfill and better understand the composition of wastes, where accessible (PES, 2013). The results of this work did not further the delineation of the waste prism as the test pits were not georeferenced and were designed only to assess the types and compositions of wastes present.
- In 2017, 11 co-located water and biofilm samples were collected within the Mashel and Nisqually Rivers and analyzed for PBDEs. Total PBDE concentrations in both surface water and biofilms were an order of magnitude larger upstream of the Site than samples downstream of the potential point where landfill impacts could have occurred (O'Neill et al., 2020). Four of the locations with Sample ID numbers 8, 9a (immediately down river from the Site), 9b (upriver) and 10 (Nisqually River) closest to the Site are shown in Figure 1-3. The findings indicate that the Site is not likely to be a contributing source of PBDEs to the Mashel River.
- In January 2021, Weyerhaeuser hired GSI to perform preliminary sampling of surface water at seepage points along and below the landfill. Three surface water samples (SW-01, SW-02, and SW-03), two presumptive seep samples (SE-01 and SE-02), and one shallow groundwater sample (GW-01) were collected at the Site and analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), PBDEs, and metals (Figures 1-3 and 1-4). Metals (lead and zinc) were detected above applicable MTCA cleanup levels (CULs) (Aquatic Life: Fresh Water/Chronic, WAC 173-201A) in four samples. These samples included two seeps (SE-01 and SE-02) that had concentrations up to 7.32 µg/L for total lead and 205 µg/L (SE02) for total zinc; a surface water sample (SW-02) that had a total lead concentration of 2.59 µg/L; and a shallow groundwater grab sample from a hand-excavated temporary well point (GW-01) that had a total zinc concentration of 580 µg/L (GSI, 2021a). VOCs, SVOCs, and PBDEs were not detected in any samples. Reporting limits were all at least three orders of magnitude below applicable MTCA CULs (Groundwater Method B: Noncancer and Potable Groundwater).

4.2 Remedial Investigation (2021–2022)

Following the execution of the Agreed Order in August of 2021, the objectives of the RI were set to determine the nature and extent of contamination associated with the Site and collect data sufficient to support the selection of preferred remedial alternatives for the Site. During the investigation, determining the extent of contamination in the middle and lower portions of the landfill was limited by access constraints due to dense brush, steep unimproved terrain, and exposed and loose refuse. Pursuant to MTCA, the dataset obtained during the RI is sufficient to adequately define the nature and extent of the contamination and to complete FS and propose RAs.

The RI field efforts focused on gathering additional information necessary to develop cleanup alternatives to be evaluated in the FS, which are presented as RAs in Sections 10 through 14 of this RI/FS, and to inform the selection of Ecology's final remedy in the CAP. Two sitewide sampling events (i.e., a dry-season event and a wet-season event) were conducted to evaluate concentrations of COPCs in multiple media (soil, groundwater, and surface water) in both the Landfill and Wetland Areas. The dry-season event was conducted in September and November 2021, and the wet-season event was conducted in February 2022 to evaluate potential seasonal effects on water quality and groundwater/surface water interactions. A subsequent soil investigation was conducted at additional step-out locations in the Wetland Area in August 2022 and was intended to fully delineate metals concentrations. Other information gathered in 2021 and 2022 included landfill soil gas measurements, geotechnical parameters, geophysical survey, land/elevation survey, wetland delineation, and a terrestrial ecological evaluation based on Ecology guidance.

The following sections describe the field activities that were conducted as part of the RI, including a general description of the data collection locations and analytical program. Section 8 contains detailed results from the RI field programs. Soil sampling locations collected as part of the RI in 2021 and 2022 are shown on Figure 4-1. Groundwater and surface water sampling locations collected as part of the RI in 2021 and 2022 are shown on Figure 4-2. Specific details regarding sampling techniques, analytical methods, and quality assurance/quality control measures were provided in the RIWP (GSI, 2021a). Unless otherwise noted in this section, all work was conducted in accordance with the Sampling and Analysis Plan (SAP) (Appendix A of the RIWP [GSI, 2021a]) and Quality Assurance Project Plan (QAPP) (Appendix B of the RIWP [GSI, 2021a]). All work was conducted pursuant to the *Site Inadvertent Discovery Plan* (Town of Eatonville and Weyerhaeuser, 2020), which outlines procedures to perform in the event of a discovery of archaeological materials or human remains.

4.2.1 Dry-Season Event (September and November 2021)

The dry-season event was conducted during two separate mobilizations in September and November of 2021 to collect preliminary data and is summarized below. Key tasks conducted during this event included the following:

- Waste prism delineation
- Geotechnical investigation of the Landfill Area
- Surface soil investigation in the Landfill and Wetland Areas
- Surface soil sampling to evaluate potential use of the borrow pit soil during a RA
- Soil gas investigation
- Surface water investigation
- Groundwater investigation

During the initial September 2021 mobilization, a total of 10 borings were advanced in the Landfill Area by Stratus Corporation of Gaston, Oregon (licensed in Washington). Six direct push borings (SB-10, SB-11, SB-14, SB-16, SB-18, and SB-19) were advanced at the upslope portion of the Site. Two hollow stem auger borings SB-17 and B-1 were advanced within the estimated landfill extents. Boring B-1 (immediately adjacent to SB-16) encountered refusal near the surface. Two additional hollow stem auger borings B-2 and B-3 were also advanced during the attempted installation of piezometers PZ-01 and PZ-02 on the upgradient side of the Site. These borings also encountered refusal. Therefore, no upgradient groundwater piezometers were installed during this mobilization.

Hand tools were also used during the September mobilization to collect surface and shallow subsurface soil samples at and immediately below the toe of the landfill (transect HA-01) and in the Wetland Area beyond the toe of the landfill (transects HA-02 through HA-03) at up to 3 ft bgs and to install two groundwater piezometers (PZ-03 and PZ-04). Details of these explorations are discussed further below.

During the November 2021 mobilization, three piezometers (PZ-01, PZ-02, and PZ-05) were installed using sonic drilling methods. Figure 4-1 shows boring locations. Figure 4-2 shows the groundwater and surface water sample locations and piezometers. Appendix B includes logs of all borings.

4.2.1.1 Waste Prism Delineation

To delineate the location and depth of the waste prism within the Landfill Area, direct push borings SB-10, SB-11, SB-14, SB-16, SB-18, and SB-19 were advanced as far down the landfill slope as accessible (Figure 4-1). Despite these efforts, borings SB-10, SB-11, and SB-14 were still outside of the upper end of the waste prism. Boring SB-18 contained shredded plastic and crushed glass between 5 and 10 ft bgs, indicating the edge of the waste prism may be immediately upslope of this location. Two hollow stem auger borings, SB-17and B-1 (immediately adjacent to SB-16), were advanced within the upper portions of the landfill waste prism, in support of the geotechnical evaluation and waste delineation efforts.

The soil borings ranged in depth from 10.0 to 19.5 ft bgs with the exception of borings SB-10 and SB-17, which were advanced to 47.5 and 41.5 ft, respectively. Trace glass was found in boring SB-10 (furthest upland), but measurable waste was not discovered until moving further downslope in borings SB-17 through SB-19. In the location furthest downslope, boring SB-17, a 15 ft thick waste layer was encountered at 10 to 25 ft bgs, mostly consisting of various types of plastic. No soil samples were collected beneath the wastes at SB-17 and SB-19 because of the lack of adequate sample volumes.

At a depth of 9 to 10 ft bgs (soil boring SB-18), signs of potential impacts (black staining) were observed. A sample was collected and submitted for laboratory analysis of COPCs. At a depth of 10 ft bgs, native soil below the waste prism was observed. Although increased moisture was evident within the native material at a depth of approximately 35 ft bgs in SB-10, insufficient groundwater entered the borehole to collect a grab sample.

4.2.1.2 Geotechnical Investigation

Greenfield Geotechnical, LLC (Portland, Oregon), evaluated geotechnical conditions in the Landfill Area in support of the FS evaluations and for use in designing the RAs. A representative of Greenfield Geotechnical was onsite during drilling activities in September 2021 to classify and log the soil borings and to collect samples for geotechnical lab testing. Samples were collected from selected direct push borings and all hollow stem borings and were saved in air-tight plastic jars until analyzed.

During completion of the hollow stem auger borings, standard penetration tests were conducted, and blow counts were recorded. Split spoon soil samples were examined and classified by Greenfield Geotechnical. Individual soil samples were then selected for geotechnical laboratory analyses and delivered to Central Geotechnical Services, LLC (Portland, Oregon). The selected soil samples were tested for natural moisture content, Atterberg limits, washed sieve gradation analysis, and fine-grained soil particle content. Select samples obtained from the landfill material were also delivered to A&L Western Agricultural Laboratories (Portland, Oregon) for natural moisture content and organic content testing. Appendix B includes boring logs with the geotechnical test results. Appendix E presents copies of the geotechnical laboratory reports, including full gradation curves and raw data reports.

4.2.1.3 Soil Investigation

Three composite soil samples (HA-01 through HA-03) were collected during the September 2021 field event along transects consisting of five discrete subsample locations. The HA-01 transect contained considerable amounts of waste; soil was collected where accessible or after moving pieces of waste to expose soil. Because of this finding, transect HA-01 is considered to be within the waste prism itself. Subsamples were collected from the soil surface (0 to 6 inches bgs) using a decontaminated hand auger or shovel. Subsamples collected at each subsample location on a transect were homogenized to form composite samples.

One soil sample (DU-2) was collected from the landfill cover material. The sample was collected using the Incremental Sampling Methodology (ISM) on a systematic random grid, with the 50-point composite sample collected from the soil surface (0 to 6 inches bgs) using a decontaminated stainless-steel trowel. The area represented by the DU-2 soil sample is shown on Figure 4-1. Appendix F contains laboratory and data validation reports.

4.2.1.4 Borrow Pit Use Determination

Historically, the borrow pit across the access road from the Site (to the north) on Nisqually State Park property was used as cover for landfill operations. To determine whether soil within the borrow pit may present a viable option for backfill materials (if needed) during RA, one ISM soil sample (DU-1) was collected from the borrow pit. The sample was collected using a 50-point ISM composite sample on a systematic random grid from the soil surface (0 to 6 inches bgs) using a decontaminated stainless-steel trowel. It was assumed that the top 6 inches would represent the worst-case potential contaminant concentrations in soil. During sampling it was noted that spent shell casings were found throughout the borrow pit floor, likely occurring after landfill closure based on shell casing conditions (Appendix A). Soil results for lead (6,000 milligrams per kilogram [mg/kg]), other metals, and polycyclic aromatic hydrocarbons (PAHs) eliminated the consideration of the borrow pit for use of future backfill during RA. The source of these metals could be from use of the borrow pit for recreational shooting (Appendix A) or through other activities undertaken at the borrow pit from other parties. The elevated lead concentrations within this soil have the potential to be a contributing factor to elevated lead results within the landfill portions of the Site, but borrow pit use only occurred during landfilling operations. However, there may be risk of contaminants leaching from borrow pit materials and migrating to the Site. The area represented by the DU-1 soil sample is shown on Figure 4-1 and the analytical results are presented in Section 8. These results from the borrow pit (Site No. 712931) were reported to the Environmental Report Tracking System (ERTS) on February 23, 2022, in an email.[1]

4.2.1.5 Groundwater Investigation

Hand-augered piezometers (PZ-03 and PZ-04) were installed during the September 2021 mobilization at two locations immediately below the toe of the landfill in the Wetland Area between soil sample transects HA-01 and HA-02. The locations for PZ-03 and PZ-04 were selected based on their accessibility and proximity to the landfill. A decontaminated 6-inch hand auger was used to bore through soft wetland soils until reaching refusal at depths up to 3.5 ft bgs on the coarse-grained Vashon formation. The piezometers were completed with slotted screens, sand pack filtering, and annular seals to the ground surface. A variance was obtained to eliminate aboveground protective casing and bollards because of access limitations and material hauling challenges at the toe of the landfill. The bottom of the 1 ft well screen intervals were 2.8 ft bgs (PZ-03) and 3.4 ft bgs (PZ-04). The piezometers were developed before sampling and effectively represent shallow, unconfined (perched) groundwater present at the toe of the landfill. Borings were not attempted to deeper

[1] Email from Chris Rhea (GSI) to Kirsten Wecker (Ecology) on February 23, 2022.

depths with a drill rig because of an inability for mechanized equipment to access the base of the landfill. The field parameter results from sampling appear to indicate low oxygen conditions, low turbidity, as well as conductivity and oxygen-reduction potentials (ORPs) that suggests the wells are representative of localized groundwater conditions rather than surface water infiltration.

During the same mobilization, installation of two piezometers using a hollow stem auger was attempted on the upper slope of the landfill, but refusal was encountered on cobbles at depths between 3 and 10 ft bgs in the glacial till layer before reaching groundwater. Appendix B includes boring logs for these attempted piezometers (referred to as B-2 and B-3).

During the November 2021 mobilization, three piezometers (PZ-01, PZ-02, and PZ-05) were installed using sonic drilling methods by Holt Drilling Services (Puyallup, Washington). Saturated soil was first noted in piezometer PZ-01, starting at 78 ft bgs. In piezometer PZ-02, saturated soil was first noted starting at 86 ft bgs. PZ-01 was drilled to a total depth of 100 ft bgs, with screened intervals of approximately 92 to 102 ft bgs. PZ-02 was drilled to a total depth of 120 ft bgs, with screened intervals of approximately 89.5 to 99.5 ft bgs. An additional piezometer, PZ-05, was added to the RI scope to evaluate if perched groundwater discharging as a spring along the western landfill edge was able to be encountered upgradient of the landfill. PZ-05 was drilled to 30 ft bgs in an estimated alignment with the spring and was screened at 21 to 31 ft bgs in an attempt to match the elevation of the discharge point of the spring. A well construction variance was obtained from Washington Department of Ecology to eliminate the use protective bollards because no vehicular access to the well exists, without tracked equipment. Data from this well is not reliable for comparison to the spring since it ran dry during sampling.

One week after the November 2021 piezometer installation, all five Site piezometers (PZ-01 through PZ-05) were sampled using a low-flow sampling methodology (EPA, 1996). Water quality parameters were field-measured with a YSI 556 before sample collection. Piezometer locations are shown on Figure 4-2. Table 4-1 provides groundwater field parameters. Appendix F contains laboratory and data validation reports.

4.2.1.6 Surface Water Investigation

On September 16, 2021, surface water was collected from the spring (SW-06) in the northwest corner of the Site and at two spring/seep locations in the Wetland Area at the toe of the landfill (SW-04 and SW-05). SW-05 is within the toe of the landfill waste prism. Water quality parameters (temperature, pH, conductivity, ORP, and dissolved oxygen content) were field measured with a YSI 556 before sample collection. Figure 4-2 shows surface water sampling locations. Table 4-1 provides surface water field parameters during both the September 2021 and February 2022 sampling events. Appendix F contains laboratory and data validation reports.

4.2.1.7 Soil Gas Investigation

During the drilling that occurred in September 2021, landfill gas sampling was conducted on a subset of the waste prism delineation boring locations where wastes were identified. These locations include borings SB-16 (from 8 to 12 ft bgs), SB-18 (from 5 to 9 ft bgs), and SB-19 (from 5 to 9 ft bgs). Figure 4-1 shows the locations where the presence of landfill gas was evaluated. Table 4-2 provides landfill gas measurements.

Soil gas locations were approved by Ecology at depths and locations where the waste was encountered in soil borings. Soil gas samples were collected using a calibrated Landstar Gem field instrument and deployed to take samples from a sealed temporary well screen. Table 4-2 summarizes landfill gas field measurements.

Methane concentrations were detected no higher than 0.1 percent, indicating no significant methane generation is occurring in the areas evaluated. Other landfill gas screening results, including carbon dioxide (3.9 to 4.1 percent) and oxygen (15.2 to 18.0 percent), are consistent with slightly aerobic conditions within the landfill waste that tend to occur late in a landfill lifecycle (Reinhart et al., 2005). Additionally, lower explosive limit concentrations were detected no higher than 3.0 percent. The results of the landfill gas evaluation indicate decomposition of organic matter is largely complete and subsurface vapors are not expected to pose a risk of explosion.

Landfill gas samples were not collected for VOCs or SVOCs during the RI. Elevated concentrations of VOCs and SVOCs are not anticipated to off-gas from the landfill based on the types and age of the wastes present and these chemicals are generally absent in Site soil, surface water, and groundwater. Although the presence of VOCs and SVOCs in subsurface vapors cannot be ruled out, they are not expected to adversely impact potential receptors based on current and future Site use and the analytical results thus far.

4.2.2 Wet-Season Event (January and February 2022)

An additional sampling event was conducted in January and February 2022 to evaluate the remaining data gaps and is summarized in the sections below. Key tasks conducted during this event included:

- Additional impacted soil investigation in the Wetland Area (Figure 4-1)
- Additional groundwater and surface water investigation to evaluate seasonal water quality conditions (Figure 4-2)
- Wetland delineation and quality assessment (Appendix C)
- Professional land survey (Appendix C)
- Geophysical survey to assess the thickness and extent of the landfill waste prism (Appendix G)

4.2.2.1 Soil Investigation

To further delineate soil impacts in the Wetland Area, a supplemental soil investigation was conducted in February 2022. Transects HA-01 to HA-03 were resampled for analysis of individual subsamples (subsamples were composited during prior sampling event). Two additional transects extending further south (HA-04 and HA-05) were established and soil samples were collected from each subsample location within these transects. Samples were collected using a post-hole digger or shovel that was decontaminated between the collection of each sample. All transects contained five subsample points and depth intervals of 0.0 to 0.5 ft bgs, 0.5 to 1.0 ft bgs, and 1.0 to 2.0 ft bgs. Subsamples were composited for the depth intervals not previously collected and discrete samples were retained for each subsample and depth interval for potential future laboratory analysis, as needed, based on results of composited samples. Figure 4-1 shows sample locations. Appendix F contains laboratory and data validation reports.

4.2.2.2 Groundwater Investigation

A groundwater sampling event was conducted in February 2022 to evaluate seasonal high water table conditions. All five piezometers (PZ-01 through PZ-05) were sampled for dissolved COPCs only (to assess metals mobility) using low-flow sampling methodology (Ecology, 2018; EPA, 1996). Figure 4-2 shows the piezometer locations. Table 4-1 provides groundwater field parameters. Appendix F contains laboratory and data validation reports.

4.2.2.3 Surface Water Investigation

Surface water samples were collected from the spring and Wetland Area during the wet-season event. Of these, three samples were collected in previously sampled locations, including the spring entering the Site on the west edge of the landfill (SW-06 [dry season], SW-13 [wet season]; Figure 4-2). Seven new locations (SW-07, SW-08, SW-09, SW-10, SW-11, SW-12, and SW-14) were sampled in the Wetland Area between the toe of the landfill and the south edge of the Property. Surface water was sampled from low-turbidity, slow-moving, or standing water where approximately 2 to 6 inches in depth was available (SW-07, SW-10, SW-11, SW-12). Additionally, surface water from the most concentrated flow path downgradient of the spring was sampling (up to 2 ft deep in naturally occurring depressional points) and at a free-falling point between the ravine and wetland in the spring's discharge path (SW-08, SW-09, and SW-14). Samples were analyzed for dissolved metals only to assess metals mobility and avoid sampling suspended solids. Figure 4-2 shows surface water sampling locations. Table 4-1 provides surface water field parameters. Appendix F contains laboratory and data validation reports.

4.2.2.4 Partial Wetland Delineation

In support of studying alternatives and RA design planning, a partial wetland delineation and quality assessment between the toe of the landfill and the Property boundary was conducted by a professional wetland scientist from Pacific Habitat Services (Portland, Oregon) on January 20, 2022. Findings from the delineation indicate a potential "jurisdictional wetland" is likely present starting at the spring and extending beneath the western portions of the landfill and broadening at the toe of the landfill out into the Wetland Area where they extend to the southwest towards the Mashel River floodplain (Figure 3-3). These wetlands are assumed to be jurisdictional water bodies of the state for the purposes of the FS. The wetlands, which are assumed to be subject to permitting requirements under federal and/or state regulations, will be evaluated further and in parallel with remedial design through consultation with Ecology and, if necessary, the USACE.

The *Wetland Delineation Report* (Appendix C) describes the wetlands as a palustrine emergent-persistent, seasonally saturated soil wetland. The wetlands are described as having flowing surface water from the head of the spring (located on the west edge of the landfill [Figure 3-3]) at the time of the delineation. Shallow surface water was observed at the base of the slope within the spring terrace, but the report notes that this surface water infiltrates the soil. The current wetland delineation extents are sufficient to support the remedial alternatives presented in the FS.

4.2.2.5 Geophysical Survey

A non-intrusive geophysical survey was conducted by Geophysical Survey, LLC (Kennewick, Washington), on January 20 and 21, 2022, to further characterize the thickness and extent of the waste prism in the Landfill Area. The survey was performed across six alignments using one seismic refraction method and two seismic surface wave measurement methods (Figure 4-3). The former uses the refraction of seismic waves to characterize subsurface geologic conditions. The latter uses either microtremor array measurements or multi-channel analysis of surface waves, which generate seismic energy at specific locations and measures the resulting surface waves to determine subsurface geologic properties. Results can be used to differentiate the material composition of the subsurface and differentiate wastes of anthropogenic origin from native bedrock and soil deposits.

The lower third of the landfill could not be evaluated by these methods because of steep slopes and limited soil cover. Transects were conducted across other accessible portions of the waste prism, including the middle portion where the waste prism had not been previously evaluated through drilling or test pitting. Additional details about the geophysical survey are included in Appendix G and discussed in Section 8.7.

4.2.2.6 Land Survey

From February 2 through 4, 2022, Foresight Surveying (Chehalis, Washington) conducted a land survey of the installed piezometers, the flagged wetlands extents, limited topographical points. As part of the surveying effort Foresight Surveying also updated the datum used to present previous sampling locations conducted by others to be consistent with the project datum North American Datum of 1983 (NAD 83) (horizontal) and North American Vertical Datum of 1988 (NAVD 88) (vertical). Appendix C provides the results of the land survey.

4.2.3 Step-Out Soil Sampling (August 2022)

An additional sampling event was conducted in August 2022 to further define elevated concentrations of lead and zinc in surface soil (0 to 0.5 ft bgs) in the Wetland Area in support of FS alternative evaluations and the TEE. Additional soil samples were collected beyond the lateral extents of transects HA-01 through HA-05, with the goal of collecting samples on the ridgeline slopes beyond where metals concentrations above CULs were likely to occur plus two additional step-out transects further south (HA-06 and HA-07). Location HA-X in the ravine to the west of the landfill (not a part of the Wetland Area) was also sampled during this time to evaluate potential impacts on the far side of the ravine. Samples were collected using a post-hole digger or shovel that was decontaminated between each sample. Compositing was not performed, and all locations were analyzed as discrete sampling results. In addition, samples were collected and archived for the 0.5 to 1.0 ft bgs intervals for future analysis. Figure 4-1 shows these sample locations.

4.2.4 Field Measured Water Quality Parameters

Water quality parameters, including pH, temperature, ORP, specific conductance, dissolved oxygen, turbidity, and ferrous iron content, were measured in the field during the 2021 through 2022 monitoring events to evaluate groundwater and surface water quality conditions at the Site. Table 4-1 summarizes the water quality parameter field measurements taken. The dataset indicates the following:

- Neutral to slightly alkaline pH conditions were measured in surface and groundwater at the Site with pH ranging between 6.32 and 8.07 units. No discernable pH trends were noted.
- Temperature conditions in surface water and groundwater at the Site varied with the seasons (i.e., surface water collected in September 2021 ranged from 9.74 to 10.3 degrees Celsius [°C], while surface water collected in February 2022 ranged from 6.1 to 8.8°C). Temperatures were slightly higher in groundwater during the February event, with the average piezometer groundwater temperature of 8.3°C and the average surface water temperature of 7.4°C.
- Variable redox conditions were observed across the Site and are consistent with anticipated conditions. ORP values ranging between -421 and -51 millivolts (mV) were measured at upgradient water table piezometers PZ-01 and PZ-02. Near neutral ORP values ranging between -65 and 14 mV were measured in shallow groundwater in the Wetland Area at piezometers PZ-03 and PZ-04, while positive ORP values ranging between 44 and 168 mV were measured at the shallow piezometer PZ-05 and all surface water sampling locations.
- Conductivity in groundwater ranged between approximately 97 (PZ-03) and 825 (GW-01) micro siemens per square centimeter (μS/cm^2). Lower conductivity (less than approximately 100 μS/cm^2) was measured in surface water except in samples SE-02 (pre-RI sample co-located with SW-12; 630 μS/cm^2), SW-10 (342 μS/cm^2), and SW-12 (co-located with pre-RI sample SE-02; 944 μS/cm^2) located

near the southern portion of the landfill toe. The higher conductivity near SW-12 may be indicative of landfill leaching impacts to surface water.

- The dissolved oxygen concentration in upgradient piezometers (PZ-01, PZ-02, and PZ-05) averaged 2.73 milligrams per liter (mg/L) across both measurement seasons and the downgradient (Wetland Area) piezometers (PZ-03 and PZ-04) averaged lower at 1.39 mg/L. Dissolved oxygen was only measured in surface water in February 2022 because of probe issues in September 2021. Surface water dissolved oxygen was much higher at 8.81 mg/L on average in surface water at the Site.
- Field turbidity measurements were generally consistent between dry and wet weather sampling events in surface water and groundwater. Significant variation existed between events for samples collected at PZ-02 (788 nephelometric turbidity units [NTUs] in the dry weather event and 8.04 NTUs in the wet weather event) located at the top of landfill. This discrepancy is likely because of insufficient time between installation and piezometer development to fully remove settled fine particulates and may indicate that total metal concentrations are not representative of groundwater conditions. For this reason, dissolved metals samples from locations with high turbidity should be given greater consideration during screening.
- During the February 2022 field event, ferrous iron was measured (using a Hach Color Disc Test Kit, including reagent and visual guide) in groundwater and surface water with groundwater measurements averaging 2.00 mg/L in upgradient piezometers PZ-01 and PZ-02 and <0.5 mg/L (not detected) in PZ-05. Downgradient (Wetland Area) piezometers measured 0.75 and 5.75 mg/L in PZ-03 and PZ-04, respectively. No surface water samples contained detectable ferrous iron.

4.2.5 Wetland Area Debris Observations

Most waste is contained within the landfill prism extents, as measured using geophysical surveying (Appendix G) and confirmed during field observations. At the upslope end of the landfill, the waste prism is buried under surficial cover soil. As the slope steepens, gravity and erosional processes have stripped the majority of the cover soil off the landfill, further exposing the waste prism and leading to sloughing of waste at the lower end of the landfill near transect HA-01. These processes, combined with the spring eroding the west edge of the waste prism, have resulted in limited wastes being present up to approximately 75 ft beyond the toe of the landfill and into the Wetland Area, as shown on Figure 4-4. The dispersed wastes are surficial in nature and composed primarily of car tires, which are light and were likely pushed to the Wetland Area over time. Additional wastes visually observed in the Wetland Area include a car body, small appliances, and furniture such as mattresses and box springs. Photos of these landfill wastes in the Wetland Area are presented in Appendix A.

4.2.6 Terrestrial Ecological Evaluation (September 2022)

In accordance with Ecology guidance, MTCA requirements (WAC 173-340-7490), and approval from Ecology, GSI implemented a Site-specific TEE approach to assess whether the conditions in the Wetland Area represent a threat of significant adverse effects to terrestrial-ecological receptors. The approach is detailed in the final work plan memorandum submitted on August 29, 2022 (GSI, 2022) and approved by Ecology on August 31, 2022. This evaluation was part of the Weight of Evidence (WOE) evaluation (WAC 173-340-7493[3][f]) for the Wetland Area to develop Site-specific soil pCULs protective of terrestrial ecological receptors. The TEE included a literature review to evaluate existing SLs for terrestrial ecological receptors in addition to the WOE field investigation and calculation of pCULs for select metals.

The field investigation involved measuring the following:

- Species diversity
- Relative abundance of the plant community in "impacted" and "reference" (relatively low in metal concentrations) sample cells (based on RI results for copper, lead, and zinc in soil)
- The mean abundance of terrestrial soil biota (pot worms [*Enchytraeidea*] and earthworms [*Lumbricidae/Megascolecidae*]) in all cells

The results were used to calculate whether there were statistically significant differences in biodiversity between the cells. In addition, game cameras were used to evaluate observable adverse toxicological impacts to wildlife from Site contaminants. Figure 4-5 shows the different TEE WOE "impacted" (indicated by the yellow dots on Figure 4-5 at locations HA-02B, HA-02C, HA-02D, HA-02E, HA-03E, HA-05A, and HA-06D) and "reference" (locations HA-02A, HA-03B, HA-03F, HA-04A, HA-04D, HA-05E, and HA-07C) locations that were evaluated and the location of the game cameras.

5 Conceptual Site Model

This section contains the CSM, which describes the potential sources and transport pathways of COPCs, and identifies how potential human or ecological receptors may be exposed to Site contaminants via exposure media (e.g., soil, groundwater, and surface water) and exposure routes (e.g., direct contact, ingestion, bioaccumulation). The CSM helps identify and prioritize potential data needs, as well as potential RA requirements.

Figures 5-1 through 5-3 are graphical representations of the CSM reflecting current conditions and illustrating the relationship among potential sources, transport media and mechanisms, and receptors. Each of these categories is discussed in the following sections.

5.1 Contaminant Sources

The source of contamination at the Site is largely household solid waste that was dumped during the landfilling period, which occurred between 1950 and 1980 (Tacoma-Pierce County Health Department, 2010). There is little documentation of the types of waste dumped at this time, but observations of exposed waste indicate that, in addition to general municipal household solid waste, the landfill received tires, automobile parts, and household appliances, some of which may have been illegally dumped after landfill closure. Separately, after landfill closure, it appears unauthorized shooting/target practice was occurring at the Site. These activities are suspected because of the shotgun casings found in various states of decomposition at the top of the landfill slope and in the borrow pit across the road from the landfill. This borrow pit soil was previously used as a cover material for the landfill and may have contributed lead contamination to soils on the Site (Appendix A). However, it is unknown if shooting was occurring in the borrow pit during active landfilling periods and would have been less likely or prolific during periods of active land use.

5.2 Contaminant Migration Pathways

The results of the Site investigations identify landfill soil, groundwater (which may be expressed as spring and seeps), and surface water in the wetlands at the base of the landfill, as the primary media of concern; and air as a secondary media. However, the RI also considered impacts to soil in the Wetland Area from landfill migration pathways such as soil and waste erosion, wind-blown dust, ambient air from possible residual volatile compounds, and metals related to the recreational shooting of firearms. Cleanup standards, TEE procedures, and contaminants identified in WAC 173-340-720 through 173-340-760 were used to further evaluate migration pathways and exposure routes. Historical and current contaminant migration pathways are discussed by media in the following sections. Human health and ecological receptors identified for each contamination migration pathway were then initially assessed against appropriate SLs to determine Site COCs and develop appropriate pCULs.

5.2.1 Soil

Potential migration pathways for contaminants in soil are the following:

- Clean cover or off-site soil encountering contaminated waste, landfill leachate, or impacted groundwater and contaminants redepositing on soil particles.
- Stormwater runoff entraining impacted soil and landfill debris that resettles in other downslope locations.
- Clean soil in contact with landfill wastes.
- Wind erosion and redistribution of impacted soil.

Attempts to cover the landfill post-closure have not prevented erosion over time, causing waste and potentially impacted soil to be re-exposed at the ground surface.

Soil that erodes from the landfill surface is not anticipated to reach the Mashel River as slopes through the wetland beyond the toe of the landfill are not sufficiently steep (1 to 2 percent average grade) to allow for soil particles to stay entrained in surface water over long distances, especially through dense vegetation. The potential for landfill-impacted soil to migrate to permanent surface waters (e.g., Mashel River or Nisqually River) is low. Similarly, wind-eroded soil particle transport is limited by the dense vegetation and tree stands in the Wetland Area beyond the toe of the landfill.

5.2.2 Groundwater

Potential migration pathways for contaminants in groundwater are the following:

- Percolation of water through the buried waste material and the generation of leachate discharging to the groundwater.
- COCs can leach from firearm shot present in the Landfill and Wetland Areas.

The limited groundwater impacts observed at the Site indicate that the soil to groundwater pathway is minimally impacted and of issue for only a few select COCs. This is likely because of the age of the landfill and/or the wastes that were placed there. Had significant leaching been occurring during the period wastes have been present (>70 years) groundwater impacts would be expected.

5.2.3 Surface Water

Potential migration pathways for contaminants in surface water are the following:

- Stormwater contacting exposed waste or impacted soil and discharging to surface water beyond the toe of the landfill.
- Groundwater contacting buried waste or impacted soil, becoming impacted, and discharging as leachate through seeps or the spring to surface water in the wetlands or the Mashel River.
- Surface water from the Wetland Area discharging to the Mashel River via the unnamed creek.

The dissolution of contaminants from soil to surface water and the dry deposition of wind-transported soil to surface water has a potential to occur, but historical sampling has not shown elevated concentrations of any contaminants in surface water away from the point of leaching at the toe of the landfill.

5.2.4 Air

The potential migration pathways for contaminants in air include the following:

- Methanogenesis (creation of methane gas by methane-generating microorganisms) caused by reducing landfill conditions within the waste prism, with residual waste providing a continued microbial food source. Only a minimal amount of methane is present; therefore, this does not pose a significant pathway.
- Release of landfill gases from waste and volatile or semi-volatile contaminants, or microbial and/or chemical conversion of landfill waste to volatile or semi-volatile contaminants. These contaminants can migrate to the cover soil and bind with clean cover soil. Only minimal vapor impacts are present; therefore, this does not pose a significant pathway.
- Wind erosion and transport of impacted soil as dust particles.

5.3 Receptors

Potential human and ecological receptors for the Site are summarized below. The potential receptors are derived based on the Site setting and use, ecology, and beneficial-use determinations.

5.3.1 Humans

Potential future receptors were identified based on current and future land use. It is anticipated that the Site and Property will remain undeveloped in the future, except for potential trails passing near the Property after ownership is transferred to State Parks. Current and potential future human receptors include the following:

- Park visitors
- Occupational workers, researchers, construction/utility workers, or park employees/workers, including those hired for maintenance purposes at the restored Site.
- Vulnerable populations and overburdened communities that may consume Site groundwater and surface water or who subsist off of species that could accumulate contaminants associated with the Site. It should be noted that the Site is not frequently accessed or used for prolonged periods of time, as it is currently on private land, and no subsistence practices are known to take place at the Site.

5.3.1.1 Potentially Exposed Populations

The census tract in which the Site is located (073200) and the two adjacent tracts (073006 and 012510) were assessed per RCW 70A.02.010 and WAC 173-350(5) for vulnerable populations and overburdened communities using the U.S. Environmental Protection Agency's (EPA's) Implementation Memorandum No. 25 (Ecology, 2024). In addition, as the Nisqually Indian Tribe is known to use the Nisqually River, to which the Mashel River is a tributary, the census tract containing the Tribe's main settlement (012320) was also similarly assessed.

Vulnerable populations include population groups that are more likely to be at higher risk for poor health outcomes in response to environmental harms, due to the following:

- **Adverse Socioeconomic Factors.** Unemployment, high housing and transportation costs relative to income, limited access to nutritious food and adequate health care, linguistic isolation, and other factors that negatively affect health outcomes and increase vulnerability to the effects of environmental harms
- **Sensitivity Factors.** Low birth weight and higher rates of hospitalization.

Overburdened communities are defined as geographic areas where vulnerable populations face combined, multiple environmental harms and health impacts.

The Washington State Department of Health's Environmental Health Disparities Map (Washington State Department of Health, 2022) and EPA's EJScreen tool (EPA, 2023) were used to screen the Environmental Health Disparities Index, the Demographic Index, and the Supplemental Demographic Index. The following shows the result of the screening:

- **Environmental Health Disparities Index.** The Environmental Health Disparities Index is based on 19 indicators across four themes. The themes include environmental exposures, environmental effects, sensitive populations, and socioeconomic factors. The Site's census tract and the two surrounding tracts rank 2 out of 10, and the Nisqually Indian Tribe census tract ranks 4 out of 10. The criteria for a likely overburdened community or vulnerable population is a 9 or 10 out of 10.
- **Demographic Index.** The demographic index is based on the average of two socioeconomic indicators, namely low-income and people of color. The Site's census tract ranks in the 43rd percentile for

Washington State. The two surrounding tracts rank in the 31st and 32nd percentiles, and the Nisqually Indian Tribe's census tract ranks in the 57th percentile. The criteria for a likely overburdened community or vulnerable population is at or above the 80th percentile.

- **Supplemental Demographic Index.** The supplemental demographic index is based on the average of five socioeconomic indicators: low-income, unemployment, limited English, less than high school education, and low-life expectancy. The Site's census tract ranks in the 47th percentile for Washington State. The two surrounding tracts rank in the 38th and 55th percentiles, and the Nisqually Indian Tribe's census tract ranks in the 50th percentile. The criteria for a likely overburdened community or vulnerable population is at or above the 80th percentile.

Based on these results, the census tracts evaluated are not home to overburdened communities or vulnerable populations.

However, the Nisqually Indian Tribe's use of the Nisqually River watershed and its rights and interests present a disproportionate risk for exposure to and contact with contaminants from the Site through contact with environmental media (i.e., soil, groundwater, and surface water) and in consumption of species that bioaccumulate contaminants. The Site was historically used by native peoples and is of Tribal significance; these factors will need to be considered during any proposed cleanup actions through the implementation of the Site-specific Inadvertent Discovery Plan (Town of Eatonville and Weyerhaeuser, 2020). Therefore, the Nisqually Indian Tribe and members of other Tribes that rely on the watershed may benefit from the implementation of a cleanup at the Site.

5.3.2 Ecological Receptors

Potential ecological receptors were identified based on current and future land use. The full suite of current and potential future ecological receptors is identified in the TEE (Appendix D) and includes:

- Terrestrial plants (such as Vine maple [*Acer circinatum*], red alder [*Alnus rubra*], and salmonberry [*Rubus spectabilis*])
- Soil biota (primarily pot worms and earthworms),
- Wildlife (such as American black bear, coyote [*Canis latrans*], blacktail deer, raccoons [*Procyon lotor*], Douglas squirrels [*Tamiasciurus douglasii*], Steller's jay [*Cyanocitta stelleri*], Cooper's hawk [*Accipiter cooperii*], and/or sharp-shinned hawk [*Accipiter striatus*]).

The wetland ecosystem is not adequately inundated to support aquatic biota receptors. However, if groundwater impacts were identified and discharged to the surface water of the Mashel River, aquatic biota could be impacted and therefore aquatic biota are retained as potential receptors.

5.4 Exposure Routes and Media

Exposure media and complete exposure pathways that are relevant to remedy selection are summarized in the following sections.

5.4.1 Exposure Media

Human and ecological receptors could be exposed to Site contaminants through direct contact, ingestion, and bioaccumulation (ecological receptors only) with landfill wastes and leachate, as well as through the following media:

- Soil
- Groundwater (humans only and only if future drinking water wells were developed on or downgradient of the Site)
- Surface water (including potential surface water drinking sources)
- Air (humans only)

5.4.2 Human Exposure Routes

The most likely human exposure routes to contaminants are summarized below. These are derived based on the Site setting (Section 3) and beneficial-use determinations (Section 3.2).

5.4.2.1 Soil Direct Contact

Direct exposure through contact with soil could exist in two scenarios:

- Potential exposure of current and future excavation and utility workers to COPCs via direct contact with soil.
- Potential exposure of current and future park visitors and occupational workers to COPCs via direct contact with soil.

5.4.2.2 Groundwater Ingestion and Direct Contact

No current beneficial use of groundwater has been identified within 0.5 miles of the Site (Section 3.2), but the ingestion/direct contact exposure pathway is retained as a conservative measure, in accordance with WAC 173-340-720, to protect the highest potential beneficial uses as a future source of drinking water or other designated uses and protection of surface water beneficial use. There is the potential for exposure to COPCs in the future by park users and workers via ingestion and direct contact with groundwater if State Parks install a well in the aquifer between the landfill and the river.

5.4.2.3 Surface Water Ingestion and Direct Contact

Current and/or future park visitors or occupational workers could potentially be exposed to contaminants via ingestion and direct contact to surface water while on Site. Other current surface water beneficial use is not known or suspected at or near the Site (Section 3.2), but the ingestion/direct contact exposure pathway is retained, in accordance with WAC 173-340-730 and WAC 173-201A-240 and -600 for protection aquatic life and human health and protection for freshwater designated uses.

5.4.2.4 Air Inhalation

Based on the lack of structures with indoor air, the age of the landfill waste prism and near absence of VOC concentrations detected in soil and groundwater, potential exposure of excavation/trench workers to COPCs via inhalation of volatile compounds released from soil, waste, or water is not anticipated. Exposure via inhalation of contaminated dust particles is not anticipated because dust mitigation will be performed (as needed) during the RA.

5.4.3 Ecological Exposure Routes

The most probable ecological exposure routes to contaminants originating at the Site are summarized below.

5.4.3.1 Soil Direct Contact

Soil direct contact could exist through potential exposure of terrestrial and avian ecological receptors to COPCs via direct contact with soil within the biologically active zone.

5.4.3.2 Bioaccumulation

Bioaccumulation could exist through potential exposure of terrestrial and avian ecological receptors to COPCs via foraging of impacted plants and/or soil biota.

5.4.3.3 Groundwater Ingestion and Direct Contact

Aquatic ecological receptors may be exposed if COPCs are present in groundwater that discharges to the Mashel River at concentrations above CULs protective of aquatic life.

5.4.3.4 Surface Water Ingestion and Direct Contact

Surface water ingestion and direct contact exposure pathways could exist for terrestrial and avian ecological receptors through ingestion and direct contact to surface water and seeps in the wetlands. In addition, if surface water or groundwater discharges to the Mashel River with concentrations of COPCs above SLs protective of aquatic life, the aquatic ecological receptor pathway would be complete.

6 Site Areas

Two distinct areas of the Site have been established to facilitate the screening process, data evaluation, and evaluation of FS remedial alternatives:

1. Landfill area
2. Wetland Area

These two areas are shown in Figure 6-1 and discussed further in the following sections.

6.1 Landfill Area

The Landfill Area refers to the portion of the Site containing the waste prism, along the slope and inclusive of the interface between the waste prism and the wetland (Figure 6-1). The Landfill Area encompasses soil samples DU-2 (landfill cover), SB-18-9-10 (soil underneath waste prism), the entire transect HA-01 (waste/wetland interface), including bounding locations HA-01Aa, HA-01Ab, and HA-01F; and locations HA-02G and HA-X (which are outside of the waste extents but considered within the Landfill Area for screening and development of remedial alternatives). Surface water sample locations within the Landfill Area include SW-05 at the toe of the landfill and SW-06/SW-13 (spring samples). GW01 was the only groundwater sample collected from within the landfill and that was done before the formal RI. Samples from PZ-03 and PZ-04 could be considered representative of landfill impacts to shallow groundwater given their down gradient location and proximity to the waste prism.

6.2 Wetland Area

The Wetland Area refers to the portions of the Site between the toe of the landfill and downgradient/downhill end of the Site delineated as wetlands (Appendix C) or on the flanks of the delineated wetland. The area is inclusive of all soil samples from transects HA-02 to HA-07 (except for HA-02G), surface water locations SW-04, SW-07 through SW-12, and SW-14, and groundwater locations PZ-03 and PZ-04 (Figure 6-1).

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7 Screening Levels

The SLs for COPCs were selected by media and exposure scenarios, as described in Section 5. An explanation of the selection of SLs for each media (surface water, groundwater, and soil) and analyte is provided in the following sections. The screening process detailed in the following sections starts with surface water and groundwater. If COPCs in groundwater and/or surface water are above SLs, the MTCA Method B Soil CULs Protective of Groundwater or Protective of Groundwater as Surface Water are used in the selection of SLs for soil to make determinations as to whether the soil-to-groundwater and/or soil-to-groundwater-to-surface water pathways are potentially active for different COPCs.

7.1 Surface Water Screening Levels

COPCs in surface water have likely migrated from landfill seeps at the toe of the slope or in stormwater that came into contact with impacted soil or waste. The surface water SLs applicable to the Site are discussed in the following section and are presented in Tables 7-1a and 7-1b.

Practical Quantitation Limit. Per WAC 173-340-730(5)(c), CULs shall not be set at below the practical quantitation limit (PQL) or natural background, whichever is higher. The PQLs (regardless of method) for each analyte with a surface water SL are provided in Tables 7-1a and 7-1b. Documentation of these PQLs (based on reporting limits) is provided in the laboratory reports for the Site (Appendix F).[2]

Natural Background. Per WAC 173-340-720(7)(c), CULs shall not be set at levels below natural background (or PQL, whichever is higher). Natural background concentrations may be selected for use as either Human Health or Ecological SLs if they are higher than the CULs identified by MTCA, as discussed in the following sections. Limited data are available to establish natural background concentrations of metals in surface water. However, given that the Site CSM indicates surficial expressions of groundwater are present, the use of arsenic natural background concentrations in groundwater for surface water screening purposes is appropriate. Tables 7-1a and 7-1b detail the arsenic groundwater/surface water background concentration of 4.9 µg/L (Ecology, 2022).

Human Health. Surface water at or near the Site is not anticipated to be directly contacted or used for drinking water by humans. However, values from the following MTCA Method B and Applicable or Relevant and Appropriate Requirements (ARARs) were evaluated, and the most stringent of these listed values was chosen as the Human Health surface water SL:

- Method B, Non-Cancer, WAC 173-340-730
- Method B, Cancer, WAC 173-340-730
- ARARs:
  - Criteria for direct consumption of water and organisms under WAC 173-201A-240
  - EPA National Recommended Water Quality Criteria for Human Health, Clean Water Act (CWA), Section 304
  - Revision of certain federal water quality criteria applicable to Washington 40 CFR 131.45

[2] The PQLs shown in the results tables are the lowest reporting limits (RLs) provided in the laboratory reports. RLs can be used as the PQL because common laboratory techniques are not expected to be able to reliably quantify concentrations lower than the RL.

If the selected SL was less than the PQL or natural background, the SL was adjusted upward to whichever is higher. Table 7-1a provides a summary of the surface water Human Health SLs selected for use in the RI.

Ecological. Ecological receptors are most likely to be exposed to COPCs in surface water through direct contact or ingestion. If COPCs in surface water reach the Mashel River above risk-based concentrations, aquatic receptors could be impacted. As such, the following criteria were evaluated for use as Ecological SLs for surface water:

- Chronic and acute Washington State surface water quality criteria for the protection of freshwater aquatic life, WAC 173-201A-240
- Chronic and acute CWA Section 304 criteria

The lower of the freshwater chronic values and freshwater acute values was selected as the SL. If the selected SL was less than the PQL, the SL was adjusted to the PQL. Table 7-1b provides a summary of the surface water Ecological SLs selected for use in the RI.

Prescreening Results. The maximum detected concentration above the DL of each surface water analyte with a Human Health SL (Table 7-1a) and Ecological SL (Table 7-1b) was screened against the selected SLs to determine if it could be a surface water COC. Based on this prescreening process, the following COPCs were identified:

- pH was below the range of Ecological SL, based on the freshwater WAC 173-201A-240 chronic criteria.
- Hexavalent chromium exceeded the Human Health MTCA Method B Cancer CUL. This exceedance only occurred at the upgradient spring.
- Lead exceeded its Ecological SL based on fresh water chronic criteria.
- Zinc exceeded its Ecological SL based on fresh water acute and chronic criteria.

All other COPCs were either detected below their respective Human Health or Ecological SLs or were not detected in surface water. In some cases (for PCBs and select VOCs and SVOCs), the PQLs were higher than the relevant Human Health and/or Ecological SLs. When PQLs are elevated above the relevant SLs, it is not known whether these analytes are impacting the surface water at the Site. However, detected COPCs from these chemical classes were all below their relevant Human Health and Ecological SLs in surface water.

Based on this prescreening, only hexavalent chromium, lead, and zinc are carried forward and screened using the soil Method B Protective of Saturated Zone Groundwater to Surface Water CULs.

7.2 Groundwater Screening Levels

Groundwater 0.5 miles downgradient of the Site has no current beneficial use but was still considered because of potential future use. Residential wells are present in the nearby area (Section 3.2), but these wells are not anticipated to be impacted by COPCs from the Site because they are not located downgradient. Groundwater that contacts landfill waste materials or leachate may discharge through surface seeps at the toe of the landfill or re-enter the shallow groundwater formation and re-emerge at the Mashel River. Therefore, because the CSM shows that Site groundwater potentially reaches the Mashel River, groundwater is also evaluated against surface water (freshwater) criteria. Three up-gradient piezometers (PZ-01, PZ-02, and PZ-05) were installed to support the evaluation of groundwater flow and assess Site-specific background concentrations of COPCs. Two downgradient groundwater piezometers (PZ-03 and PZ-04) were installed in the Wetland Area to analyze shallow groundwater impacts near the landfill. The groundwater SLs applicable to the Site are discussed in the following sections and presented in Tables 7-2a and 7-2b.

Practical Quantitation Limit. Per WAC 173-340-720(7)(c), CULs shall not be set at levels below the PQL or natural background, whichever is higher. The PQLs (regardless of method) for each analyte with a groundwater SL are provided in Tables 7-2a and 7-2b. Documentation of these PQLs is provided in the Project laboratory reports (Appendix F).[3]

Natural Background. Per WAC 173-340-720(7)(c), CULs shall not be set at levels below natural background or the PQL, whichever is higher. Natural background concentrations may be selected for use as either Human Health or Ecological SLs if they are higher than the CULs identified by MTCA, as discussed in the following sections. Limited data are available to establish natural background concentrations of metals in groundwater, and the available data are limited to arsenic (4.9 mg/L). Tables 7-2a and 7-2b list this background concentration (Ecology, 2022).

Human Health. The following Human Health groundwater CULs and ARARs were evaluated for use as a Human Health SL, and the most stringent value was selected as the SL:

- Method B, Non-Cancer, WAC 173-340-720
- Method B, Cancer, WAC 173-340-720
- MTCA Method B Potable Groundwater CUL, WAC 173-340-720
- ARARs:
  - Washington State Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs) from WAC 246-290-310
  - EPA National Recommended Water Quality Criteria, Human Health, Fresh Water, from Section 304 of the CWA
  - Criteria for direct consumption of water and organisms under WAC 173-201A-240
  - Revision of certain federal water quality criteria applicable to Washington (40 CFR 131.45)

If none of the above-listed values were available, the MTCA Method A CULs for groundwater (WAC 173-340-720, Table 720-1) were used. If the selected SL was less than the natural background concentration (Ecology, 2022) or the PQL, the SL was adjusted to the higher of natural background or the PQL. Table 7-2a provides a summary of the Human Health groundwater SLs selected for use in the RI.

Ecological. Groundwater that contacts waste has the potential to discharge at the toe of the landfill. If contaminants ultimately reach the Mashel River, they may impact ecological surface water receptors. As such, the following criteria were evaluated for use as Ecological SLs for groundwater:

- Chronic and acute Washington State surface water quality criteria for the protection of freshwater aquatic life, WAC 173-201A-240
- Chronic and acute CWA Section 304 aquatic life criteria

The lower of the freshwater chronic and acute values was selected as the SL. If the selected SL was less than the natural background concentration or the PQL, the SL was adjusted to the higher natural background or the PQL. Table 7-2b provides a summary of the groundwater Ecological SLs selected for use in the RI.

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[3] The PQLs shown in the results tables are the lowest RLs) provided in the laboratory reports. RLs can be used as the PQL because common laboratory techniques are not expected to be able to reliably quantify concentrations lower than the RL.

Prescreening Results. The maximum detected concentration of each groundwater analyte with a Human Health (Table 7-2a) and Ecological (Table 7-2b) SL was screened against the selected SLs to determine if it could be a groundwater COC. Based on this prescreening process, the following COPCs were identified and evaluated as potential groundwater COCs:

- Exceedances of hexavalent chromium only occurred in the upgradient piezometer, which was installed in a perched water table representative of the spring. These upgradient exceedances were above the Human Health SL, which is based on the MTCA Method B Cancer CUL and the MTCA Method B Potable Groundwater CUL.
- Exceedances of total copper occurred in the upgradient piezometer that produced turbid water. These upgradient exceedances were above the Ecological SL, which is based on the aquatic life fresh water chronic criteria. Turbid water may lead to elevated total metals concentrations due to the tendency for fine particulates to adsorb metals (Ifeoma and Anyedikachi, 2019). These turbid waters are often the product of fine particulates in the formation entering the well and may lead to an overestimate of the soluble and bioavailable fractions of metals present. In addition, none of the dissolved groundwater samples exceeded copper SLs. Because of this, copper is not a groundwater COC. Therefore, because the soil to groundwater pathway is not likely to be complete underneath the waste prism or in the Wetland Area, copper in soil is not evaluated using MTCA Method B Protective of Groundwater, Saturated CUL.
- Iron exceeded the Human Health SL, which is based on the MTCA Method B Potable Groundwater CUL and the Ecological SL, based on the freshwater chronic criteria. The MTCA Method B Non-Cancer CUL was not exceeded.
- An exceedance of total lead occurred in the upgradient piezometer that produced turbid water. The upgradient exceedance was above the Ecological SL, based on freshwater chronic criteria, in one sample. Turbid water may lead to elevated total metals concentrations due to the tendency for fine particulates to adsorb metals (Ifeoma and Anyedikachi, 2019). These turbid waters are often the product of fine particulates in the formation entering the well and may lead to an overestimate of the soluble and bioavailable fractions of metals present. In addition, none of the dissolved groundwater samples exceeded lead SLs. Because of this, lead is not a groundwater COC. Therefore, because the soil to groundwater pathway is not likely to be complete underneath the waste prism or in the Wetland Area, lead in soil is not evaluated using MTCA Method B Protective of Groundwater, Saturated CUL.
- Zinc was above the Ecological SL, based on fresh water chronic criteria.

All other COPCs were either detected below their respective Human Health or Ecological SLs or were not detected in groundwater. In some cases (select VOCs and SVOCs), the PQLs were higher than the relevant Human Health and/or Ecological SLs. When PQLs are elevated above the relevant SLs, it is not known whether these analytes are impacting surface water because the basis for the SL is below the laboratory reporting capabilities for a given sample. However, detected COPCs from these chemical classes were all below their relevant Human Health and Ecological SLs in groundwater.

Based on this prescreening, only hexavalent chromium, iron, and zinc are carried forward and screened using the soil MTCA Method B Protective of Groundwater, Saturated CULs.

7.3 Soil Screening Levels

Although the Site contains wetland ecosystems and intermittent surface water features, these features are above the OHW elevation of the Mashel River. Inundation within the Site has not been observed or is not anticipated to occur based on its location well above the Mashel River flood plain and absence of perennial streams, especially for the 6-week period defined for use of sediment screening criteria (WAC 173-204-

505(22)). In addition, aquatic biota were not observed at the Site or identified during the WOE field surveys, and features indicative of particulate settling are not present (i.e., laminae). Furthermore, Site soil does not conform with Ecology's definition of sediment. Therefore, the materials in both the Landfill and Wetland Areas of the Site are considered upland soil rather than sediment and are screened as such. Based on the prescreening results for the surface water and groundwater pathways, only select metal COPCs (i.e., iron, lead, and zinc) warrant evaluation via the MTCA Method B Soil CULs Protective of Groundwater or Protective of Groundwater to Surface Water. The soil SLs applicable to the Site are discussed in the following sections and presented in Tables 7-3a and 7-3b.

Practical Quantitation Limit. Per WAC 173-340-740(5)(c), CULs shall not be set at levels below laboratory PQLs (or natural background, whichever is higher). The PQLs achieved during the RI can be used as the CUL because common laboratory techniques are not expected to be able to reliably quantify concentrations that are lower than the PQL. Tables 7-3a and 7-3b show the laboratory PQLs for soil samples. Documentation of the PQLs is provided in the Project laboratory reports (Appendix F).[4]

Natural Background. Tables 7-3a and 7-3b use two sets of data to establish natural background concentrations of metals in soils. These datasets include the following:

- Statewide 90th percentile natural background concentrations for metals in Washington State (Ecology, 1994)
- 90 percent upper tolerance limits (UTLs) with 90 percent coverage calculated with ProUCL 5.2 (EPA, 2022) using background metals concentrations from the top 5 centimeters (cm) of the soil column in mixed forest settings in Washington State from the U.S. Geologic Survey (USGS) (Geochemical and Mineralogical Data for Soils of the Conterminous United States) (USGS, 2013; Appendix F).

Per WAC 173-340-740(5)(c), CULs shall not be set at levels below natural background (or the PQL, whichever is higher). Natural background concentrations may be selected for use as either Human Health or Ecological SLs if they are higher than the CULs identified by MTCA, as discussed below.

Human Health. The Site is surrounded by Nisqually State Park, which is open for public use. Vehicular access is controlled by gates maintained by State Parks. Access by foot is not restricted, but vegetation overgrowth at the boundary between the access road and the main gravel road managed by State Parks deters entry. Foot access to the face of the Landfill and Wetland Areas below is limited by steep slopes, thick vegetation, and exposed solid waste. Humans who have the highest potential to contact contaminants in soil at the Site are future construction workers, park workers performing forest studies or surveys within the Site, recreational hikers who go off the trail at the location of the landfill, and unauthorized hunters or recreational shooters (Nisqually State Park prohibits unauthorized hunting and recreational shooting). There is also potential for the soil to groundwater and groundwater to surface water pathways to be complete for select metals (iron, lead, and zinc [Sections 7.1 and 7.2]). The evaluation of Human Health soil SLs was conducted based on these considerations. The following MTCA Human Health criteria for soil were evaluated, and the most stringent value was selected as the Human Health SL:

- Method B Direct Contact, Non-Cancer, WAC 173-340-740 (all analytes)
- Method B Direct Contact, Cancer, WAC 173-340-740 (all analytes)
- Method B Protective of Saturated Zone Groundwater (iron and zinc only; iron was not evaluated in soil as part of the RI; Section 7.2).

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[4] The PQLs shown in the results tables are the lowest RLs) provided in the laboratory reports. RLs can be used as the PQL because common laboratory techniques are not expected to be able to reliably quantify concentrations lower than the RL.

- Method B Protective of Saturated Zone Groundwater to Surface Water (lead and zinc only; Section 7.1)

The lower of these Human Health criteria for each analyte was selected as the soil Human Health SL because the pathways are potentially complete. If none of the listed values were available, the applicable MTCA Method A Unrestricted Land Use soil CUL (WAC 173-340-740, Table 740-1) was used. However, MTCA Method A values represent a conservative scenario because (1) the potential for the Site to be used for residential development in the future is limited and (2) the assumptions around the duration and frequency of exposure are more conservative than is supported by the Site CSM. If the selected SL was less than the natural background concentration or the PQL, the SL was adjusted to the higher of natural background or the PQL. Table 7-3a provides a summary of the Human Health soil SLs selected for use in the RI.

Ecological. Potential ecological exposures to contaminants may occur sitewide, but primarily within the Wetland Area at the toe of the landfill where the ecosystem is intact. The terrestrial habitat within the Wetland Area was evaluated during the TEE WOE (Appendix D), which established Ecological SLs applicable to copper, lead, and zinc in the Wetland Area only. These metals were identified for evaluation in the TEE because they are above Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals in MTCA Table 749-3 and background concentrations (Ecology, 1994; USGS, 2013).

Appendix F provides documentation supporting the derivation of the 95th percentile UCL using the Wetland Area dataset. Selenium and thallium were not detected in any samples and were not retained for the TEE. In the absence of a TEE-derived Site-specific SL, the most stringent default ecological indicator soil concentration (protective of plants, soil biota, or wildlife) established in Table 749-3 of WAC 173-340-7493 was selected as the SLs for contaminants in the Landfill and Wetland Areas. If the selected SL was less than the natural background concentration or PQL, the SL was adjusted to the higher of natural background or the PQL. Table 7-3b provides a summary of the Ecological SLs selected for use in the RI.

Prescreening Results. The maximum detected concentration of each soil analyte with a Human Health (Table 7-3a) and Ecological (Table 7-3b) SL was screened to determine if it could be a soil COC for the Site. Based on this prescreening process, the following COPCs were identified and evaluated as potential Site soil COCs:

- Arsenic exceeded the MTCA B CULs and the WAC 173-340-7493 plant soil indicator concentration.
- Cadmium exceeded the WAC 173-340-7493 plant soil indicator concentration.
- Chromium exceeded the WAC 173-340-7493 plant and soil biota soil indicator concentrations.
- Cobalt exceeded the MTCA Method B Direct Contact, Non-Cancer CUL, and the WAC 173-340-7493 plant soil indicator concentration.
- Copper exceeded the WAC 173-340-7493 plant and soil biota soil indicator concentrations.
- Lead exceeded the MTCA Method B Protective of Groundwater to Surface Water, Saturated CULs, and the WAC 173-340-7493 plant, soil biota, and wildlife soil indicator concentrations.
- Nickel exceeded the WAC 173-340-7493 plant soil indicator concentration.
- Zinc exceeded the MTCA Method B Protective of Groundwater, Saturated and Protective of Groundwater to Surface Water, Saturated CULs, and the WAC 173-340-7493 plant, soil biota, and wildlife soil indicator concentrations.
- TPH-GRO exceeded the MTCA Method A CUL.
- PCP exceeded the MTCA Method B Direct Contact, Cancer CUL, and the WAC 173-340-7493 plant soil indicator concentration.
- Total cPAHs exceeded the MTCA Method B Direct Contact, Cancer CUL.

All other COPCs were either detected below their respective Human Health or Ecological SLs or were not detected in soil. In some cases (hexavalent chromium and select VOCs and SVOCs), the PQLs were higher than the relevant Human Health and/or Ecological SLs.

Table 7-4 shows a secondary direct contact screening of Wetland Area chemical concentrations in soil. This screening uses the most stringent direct contact Human Health SL, the maximum detected concentration. and the 95th percentile UCL to demonstrate that direct contact Human Health risks posed by chemicals in the Wetland Area are limited to cobalt, lead, and TPH-GRO.

Table 7-5 shows a secondary ecological screening of Wetland Area metals concentrations in soil. This screening uses the most stringent Ecological SL, the maximum detected concentration, and the 95th percentile UCL to demonstrate that ecological risks posed by chemicals in the Wetland Area are limited to copper, lead, and zinc. These metals were all evaluated as part of the TEE WOE (Section 8.5).

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8 Remedial Investigation Results

The formal RI was conducted from 2021 to 2022 and included surface water, groundwater, and soil sampling. Surface water sampling was completed across the Site, extending to the downgradient property limits with sufficient surface water characterization obtained. Downgradient groundwater well installation was limited to hand methods because of drill rig access limitations, but high-quality shallow piezometers were installed at the toe of the landfill. Soil sampling was conducted over multiple events to adequately delineate the extents of elevated metals concentrations in the landfill and within the wetlands. Challenging conditions were present for collection of some RI data. The results of data collected during the RI are adequate for defining the Site and sufficient for development of the FS and remedy selection.

This section identifies COPCs for surface water, groundwater, and soil (Section 8.1); describes analytical methods and data handling (Section 8.2); and presents screening results for the COPCs evaluated in surface water, groundwater, and soil during the RI and select historical sample events (Section 8.3). Most COPCs were either not detected or were detected at levels below SLs. Those COPCs that were detected above SLs were retained as Site COCs, as discussed in Section 8.4. Additionally, this section also describes the results of the TEE (Section 8.5), geotechnical investigation and analyses (Section 8.6), and geophysical surveying programs (Section 8.7), which relied on analyses performed outside of the field setting.

8.1 Contaminants of Potential Concern

The results of previous investigations only identified elevated concentrations of lead and zinc in surface water. Based on the nature and age of the waste (Lee and Jones, 1991) and discussion with Ecology, other common landfill contaminants were considered during the RI, including PAHs, total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCBs), PBDEs in groundwater (surface water was sampled in January 2021 for PBDEs), and additional metals. During the 2021 to 2022 RI, samples were analyzed for the following COPCs:

- COPCs evaluated in surface water and groundwater:
  - Total/dissolved metals: Arsenic, barium, beryllium, cadmium, chromium, hexavalent chromium, cobalt, copper, lead, nickel, selenium, thallium, vanadium, and zinc
  - TPH: DRO, ORO, and GRO
  - VOCs: 68 compounds
  - SVOCs: 76 compounds
  - PBDEs: 57 congeners/congener mixtures plus penta- and octa-, -BDE
- Miscellaneous inorganics and organics evaluated in surface water and groundwater:
  - Inorganics: Total hardness, sulfate and nitrate/nitrite, TOC, total alkalinity, ammonia, and ferrous iron
  - Organics: Methane, ethane, and ethene
- COPCs evaluated in soil:
  - Metals: Arsenic, barium, beryllium, cadmium, chromium (total and hexavalent), cobalt, copper, lead, nickel, selenium, thallium, vanadium, and zinc
  - PCBs: Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260, and Total PCB Aroclors
  - TPH: DRO, ORO, and GRO hydrocarbons
  - VOCs: 67 compounds
  - SVOCs: 78 compounds and total carcinogenic polycyclic aromatic hydrocarbons (cPAHs)
  - TOC

Given that the waste in the landfill is likely highly variable, additional contaminants may be present. The selected COPCs are representative of the majority of the risks that exist to human and ecological receptors from exposure to surface water, groundwater, and soil at the Site. For that reason, these media and COPCs are the subject of the data screening process presented in this section.

8.2 Laboratory Analyses and Data Validation

The following sections detail the laboratory analyses and data validation processes that were conducted on RI samples.

8.2.1 Laboratory Analyses

The main laboratories retained for analysis of samples collected during the RI include Apex Laboratories, LLC (Apex), of Tigard, Oregon, and Vista Laboratories (now Enthalpy Analytical) of El Dorado Hills, California. Other laboratories were used where necessary.

Laboratory analysis was conducted for the follow COPCs:

- Total metals in soil using EPA Method 6020B by Apex
- Hexavalent chromium in soil using EPA Method 7196A by Apex
- Total and dissolved metals (no dissolved metals were collected in February 2022 event) in surface water and groundwater matrices:
  - EPA Method 6020B by Apex
  - EPA Method 218.6 by Weck Laboratories (Weck) of City of Industry, California (hexavalent chromium only)
- VOCs in all matrices using EPA Method 8260D by Apex
- SVOCs in all matrices using EPA Method 8270E (PAHs and pentachlorophenol [PCP]) by Apex
- PCBs in all matrices using EPA Method 8082A by Apex
- TPH in all matrices using the Northwest Total Petroleum Hydrocarbon (NWTPH) method for GRO and DRO organics by Apex, and TPH extractable and volatile aliphatic and aromatic hydrocarbons in all matrices using Northwest Extractable Petroleum Hydrocarbon (NWEPH)/Northwest Volatile Petroleum Hydrocarbon (NWVPH) by Fremont Analytical of Seattle, Washington
- PBDEs in surface and groundwater only using EPA Method 1614 by Vista Laboratories and Weck

In addition, the following natural attenuation indicators were analyzed in groundwater and surface water:

- Alkalinity (bicarbonate, carbonate, hydroxide, and total) using Standard Method (SM) 2320B by Apex
- Ammonia (as nitrogen) using SM 4500NH3G by Apex
- Ferrous iron (field-measured using a Hach ferrous iron test kit Model IR-18C)
- Hardness (as calcium carbonate and total hardness) using SM 2340B by Apex
- Nitrate and nitrite (as nitrogen) using EPA Method 300.0 by Apex
- Sulfate using EPA Method 300.0 by Apex
- TOC using SM 5310C by Apex
- Ethane, ethene, and methane using RSK 175 by Air Technology Labs of City of Industry, California

Appendix F includes laboratory reports.

8.2.2 Data Validation and Quality Assurance/Quality Control

Upon collection, all samples were placed on ice and shipped to the laboratory for analysis within 3 days of collection. No hold times were exceeded during sample transit.

Appendix F includes laboratory reports. Field and laboratory data were subjected to a formal verification and validation process in accordance with EPA guidance documents as described in the Ecology-approved QAPP (Appendix B of the RIWP [GSI, 2021a]). A summary of Level II data validation procedures and findings for each laboratory report were prepared and are provided in Appendix F. Data validation was performed to confirm the usability of the data for meeting project objectives.

Data qualifiers were assigned during data validation when applicable quality assurance/quality control limits were not met and the qualification was warranted following EPA guidance, quality control requirements specified in the Ecology-approved SAP (Appendix A of the RIWP [GSI, 2021a]), and method-specific quality control requirements, as applicable. Final, qualified (as necessary) laboratory results were combined into a project-specific database using the Ecology Environmental Information Management (EIM) data format. Data will be uploaded to the Ecology EIM database upon finalization of the RI/FS.

After verification and validation of the field and laboratory data, data completeness was calculated by comparing the total number of acceptable data (non-rejected data) to the total number of data points generated. Overall, completeness for the RI dataset is 97.4 percent because 134 results of the total 5,234 results were rejected. Except for the rejected sample data identified below, all data are considered complete and usable for the intended purposes:

- **Report A1I0619.** Samples *DU-01-0921---After Processing* and *DU-02-0921---After Processing* were extracted for SVOC analysis beyond the holding time requirements (greater than 2 times the time limit). Because of this, the non-detect results were rejected (a total of 134 results). Detected results were given a J- qualifier, indicating the results are estimated.

The data validation report in Appendix F contains a detailed discussion regarding the qualification and usability of the data.

8.2.3 Duplicate Analyses

Several COPCs were analyzed multiple times because they were reported under multiple different methods. For example, naphthalene was reported in EPA Method 8270E, EPA Method 8260D, and in NWVPH. Where this duplication occurred, laboratory PQLs for the COPCs in question were examined, and the method with the lowest PQL was selected for that analyte for screening purposes. To avoid confusion, analyte results are only screened once for each sample, but all sample results are reported. This approach also ensures that data are presented in a conservative manner. All data are available in the laboratory reports within Appendix F. It should also be noted that no COPCs were removed from the screening process because of this approach.

The list of duplicative analyses of COPCs and their methods are shown below. The selected and preferred method for reporting and screening is shown in **bold** text, and this method's results are used where available.

- 1,2,4-Trichlorobenzene by EPA Method 8260D and **EPA Method 8270E**
- 1,2-Dichlorobenzene by EPA Method 8260D and **EPA Method 8270E**
- 1,3-Dichlorobenzene by EPA Method 8260D and **EPA Method 8270E**
- 1,4-Dichlorobenzene by EPA Method 8260D and **EPA Method 8270E**

- Benzene by NWVPH and **EPA Method 8260D**
- Ethylbenzene by NWVPH and **EPA Method 8260D**
- Hexachlorobutadiene by EPA Method 8260D and **EPA Method 8270E**
- m,p-Xylene by NWVPH and **EPA Method 8260D**
- Methyl tertbutyl ether by NWVPH and **EPA Method 8260D**
- Naphthalene by NWVPH, EPA 8260D, and **EPA Method 8270E**
- o-Xylene by NWVPH and **EPA Method 8260D**
- Toluene by NWVPH and **EPA Method 8260D**

Note that if this method duplication is not present, the available reported results are used for screening (e.g., NWVPH results are used to screen benzene if EPA Method 8260D results are not available).

8.2.3.1 TPH Summations

TPHs were analyzed on project samples using two different methods. The NWEPH and NWVPH methods include analysis of extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH). This method pair reports groups of aliphatic/aromatic extractable and volatile hydrocarbons by number of carbon atoms. In addition, the NWVPH method reports several individual compounds, namely m,p-xylene, o-xylene, methyl tertbutyl ether, benzene, ethylbenzene, naphthalene, and toluene. However, the NWTPH-Dx and NWTPH-Gx methods only report three larger hydrocarbon groups: DRO, ORO, and GRO.

Several project samples were analyzed for TPH using only one of these two method pairs. Therefore, in order to compare results between these two methods, results from the EPH/VPH methods were summed using guidelines from the NWTPH-Gx/-Dx method, as provided by Apex.[5] These summations produced calculated DRO, ORO, and GRO concentrations that were comparable with the results of the NWTPH-Gx/Dx methods. These summation rules are summarized below:

- **TPH-GRO.** Benzene, toluene, ethylbenzene, xylenes, methyl tert-butyl ether, and naphthalene, as well as hydrocarbons with fewer than 10 carbon atoms
- **TPH-DRO.** Hydrocarbons with between 10 and 25 carbon atoms
- **TPH-ORO.** Hydrocarbons with more than 25 carbon atoms
- Hydrocarbon results that span two carbon number ranges were included in the range corresponding to most of the compounds (i.e., the C10 to C12 range was included in the diesel-range and not the gasoline-range). Due to the nature of the EPH and VPH methods, certain hydrocarbon ranges are reported in both the EPH and the VPH methods. These results were included in the summations of GRO, DRO, and ORO, regardless of duplication. This treatment of TPH data is more conservative than the treatment specified in Ecology's guidance, which calls for adjustments of hydrocarbon fractions through subtraction of specific hydrocarbon compounds and ranges to ensure that hydrocarbons are not double counted when calculating total TPH concentrations (Ecology, 2016). In addition, although Ecology's guidance suggests that adjusted hydrocarbon range concentrations should be set to zero if the subtraction of duplicative hydrocarbons results in a negative concentration (Ecology, 2016), the above summations include hydrocarbons that were not detected at one half the DL. This results in a more conservative approach to treatment of TPH data.

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[5] Email message from Philip Nerenberg (Apex) to Genevieve Schutzius (GSI) on October 21, 2022.

- Per Ecology's guidance, the DRO and ORO fractions must be added together before diesel-range TPH results can be screened (Ecology, 2016). The DRO and ORO fractions reported for each sample by NWTPH-Dx were added together to comply with this guidance, and non-detect results were included at one half the detection limit. For the EPH/VPH methods, hydrocarbon ranges from the second and third bullets stated above (TPH-DRO and TPH-ORO) were summed, and non-detect results were included at one half the detection limit. This summation is termed TPH-DRO/ORO, and this result was used in all screening and data evaluation activities. The DRO and ORO fractions were not evaluated individually for any matrix.

8.2.4 Elevated Detection and Practical Quantitation Limits

The DLs and PQLs for some undetected COPCs were elevated above those provided in the QAPP in select samples and media for several reasons. Samples were often diluted as part of sample preparation when concentrations of target analytes were elevated above the calibration range of the instrument; this dilution is necessary to ensure results are accurate and is a common lab practice (EPA, 2010). Such dilution will increase DLs and PQLs proportional to the dilution factor. Metals, SVOCs, and VOCs in soil were most frequently diluted as part of sample preparation. Detection limits were also raised when a sample had either a matrix interference or interference from co-eluting compounds (e.g., PCB Aroclors for sample SB18-9-10-0921). In other cases, the laboratory elevated PQLs for specific COPCs that had known erratic recoveries that may have led to QC failures to ensure confidence levels for these types of non-detects (i.e., sample HA-1003-0921 for 3,3'-dichlorobenzidine). Some DLs and PQLs were elevated for some samples that required re-extraction or re-analysis but did not have adequate sample volume remaining to meet stated detection limits (e.g., sample SW-12_0222 for several metals). Some soil samples at the toe of the Landfill Area (HA-01 transect) where seeps and organic material are abundant had very low total solids (< 30 percent) and very high moisture contents. When results were adjusted in these samples to report them on a dry-weight basis, the adjusted dry weight of the original sample used for analysis was less than that required for the stated DLs (e.g., sample HA-03-Comp-0.5-1.0_0222 for ORO).

Of all the compounds affected by elevated PQLs for these reasons, some had elevated DLs and PQLs that interfered with the screening process. These analytical groups and media are listed below and discussed with the screening results in Section 8.3:

- Hexavalent chromium (soil)
- VOCs (soil)
- SVOCs (soil)

8.2.5 Variable Detection and Practical Quantitation Limits

PBDEs were analyzed using EPA Method 1614. EPA Method 1614 is a high-resolution method that requires reporting of non-detected values to an estimated detection limit (EDL) instead of to a standard DL. The EDL is calculated on an analyte-to-analyte basis using chromatographic noise levels, and EDLs are typically lower than DLs. Where the EDL is significantly less than the DL, the disparity between the EDL and PQL can be quite large. However, this variability in reported limits did not impact data quality and did not affect the completeness of the data screening.

In addition, results from the NWEPH/NWVPH methods sometimes had DLs that were higher than the reported PQL for a particular analyte. This discrepancy may be due to several variables, including sample preparation, changes in achievable limits caused by noise and interference (NWEPH/NWVPH are semi-quantitative methods that screen a range of hydrocarbons, so interference is likely), and the moisture content of the samples. Because the reported limits are therefore variable, the PQL from a single matrix and analyte may be higher than the DL from another sample, which results in a lower PQL being used to screen a higher DL. However, this variability in reported limits did not impact data quality and did not affect the completeness of the data screening.

8.3 Contaminants of Potential Concern Screening

The CSM was used to identify COPCs, exposure pathways, and potential receptors to select appropriate SLs for the Site. The COPCs were evaluated against the SLs identified in Section 7 to facilitate the data screening process and identify COCs. A comprehensive description of the results of the COPC screening and the outcome of the COC identification process is provided by chemical class and media in the following sections.

8.3.1 Metals and Inorganics

The following sections present the analytical and screening results for metals and inorganics by media. Table 8-1 summarizes the results for various water quality inorganic and organic analytes without SLs in groundwater and surface water. Tables 8-2, 8-3, and 8-4 present the metals results for surface water, groundwater, and soil, respectively.

8.3.1.1 Surface Water

Three distinct sampling events were performed to characterize surface water at the Site. These events included:

- **January 2021.** Surface water samples were collected from five locations (SW-03 [spring], SE-01, SE-02, SW-01, and SW-02) and analyzed for total and dissolved metals.
- **September 2021.** Surface water samples were collected from three locations (SW-04, SW-05, and SW-06 [spring]) and analyzed for total and dissolved metals.
- **February 2022.** Surface water samples were collected from eight locations (SW-07, SW-08, SW-09, SW-10, SW-11, SW-12, SW-13 [spring], and SW-14) and analyzed for total and dissolved metals.

Table 8-2 shows the results of screening the metals concentrations in surface water based on the Human Health and Ecological SLs detailed in Tables 7-1a and 7-1b, respectively. Figure 8-1 illustrates dissolved lead and zinc concentrations in surface water at the Site. The following is a summary of the surface water screening results for metals identified as Site surface water COCs in Section 7.1:

- pH was below the Ecological SL based on the freshwater WAC 173-201A-240 chronic criteria at one location (the upgradient spring sample SW-06 [pH=6.32]) during one sampling event (September 16, 2021). This pH exceedance is not thought to be related to the Site because of the spring's upgradient location. Additionally, other pH measurements taken at the upgradient spring (SW-03 and SW-13) had pH values between 6.5 and 8.5 within the SL range. No other surface water samples collected at the Site were outside of the SL range for pH. For this reason, pH is not considered a surface water COC at the Site.
- Total and dissolved hexavalent chromium exceeded the MTCA Method B Cancer CUL at one location (the upgradient spring sample SW-06) and diminished in concentration along the flow path through the Landfill Area as represented by sample location SW-05. Because of the upgradient background concentration of hexavalent chromium above the Human Health SL and the concentrations seen along the flow path in the Landfill Area, hexavalent chromium is considered a Site surface water COC. Because the surface water source is likely not related to the Site, Site surface water may require additional assessment during the cleanup and/or post-cleanup monitoring.

- Total lead was detected in 14 samples, at concentrations between 0.145 µg/L (SW-04) and 7.32 µg/L (SE-02, collected before the RI). Dissolved lead was detected at concentrations between 0.103 µg/L (SW-02, collected before the RI) and 0.493 µg/L (SW-01, collected before the RI). Four samples from locations SE-01, SE-02, SW-02, and SW-09 had total lead concentrations above the Ecological SL. However, the samples collected for dissolved lead at these locations were all below the Ecological SL. For this reason, the Ecological SL exceedances for lead in surface water are not shown in Figure 8-1. The dissolved and total lead results may indicate that the lead in these surface water samples is associated with particulates and may not be as bioavailable as dissolved phase lead would be. In addition, both WAC 172-201A-240 and 33 United States Code § 1314 (CWA Section 304) regulate lead based on the dissolved, not total, fraction. Therefore, lead is not considered a Site surface water COC and lead should only be evaluated in soil against the Direct Contact screening levels.
- Total zinc was detected in all samples except for three from the spring (SW-06, SW-06 duplicate, and SW-13). Total zinc in surface water from the upgradient spring and Landfill Area was found to range from detected concentrations of 4 µg/L (SW-03) to 43.7 µg/L (SW-05). Total zinc in surface water in the Wetland Area was found to range from 3.95 µg/L (SW-07) to 205 µg/L (SE-02, collected before the RI). Dissolved zinc was detected in samples ranging between 3.73 µg/L (SW-07) and 137 µg/L (SW-12). Both the SW-12 samples collected in February 2022 (135 and 137 µg/L for total and dissolved, respectively) and the SE-02 sample collected in January 2021 (205 and 134 µg/L for total and dissolved, respectively) exceeded the Ecological SL for soil. However, samples more distant from the toe of the landfill were below the most stringent SLs, and it appears zinc SL exceedances are limited to the point of leachate discharge. Based on the presence of zinc in surface water above Human Health and Ecological SLs, zinc is considered a Site surface water COC.

The metals screening results for surface water indicate that hexavalent chromium and zinc should be retained as Site surface water COCs.

8.3.1.2 Groundwater

Two distinct sampling events were performed to characterize groundwater at the Site. These events included:

- **January 2021.** Total and dissolved metals were analyzed from GW-01 (within the Landfill Area).
- **November 2021.** Total and dissolved metals were analyzed from groundwater piezometers PZ-01, PZ-02, and PZ-05 (upgradient of the landfill) and PZ-03 and PZ-04 (downgradient of the landfill in the Wetland Area).

Table 8-3 shows the results of screening the metals concentrations in groundwater based on the Human Health and Ecological SLs previewed in Tables 7-2a and 7-2b, respectively. Figure 8-2 illustrates dissolved lead and zinc concentrations in groundwater at the Site. The following is a summary of the groundwater screening results for metals identified as groundwater COCs in Section 7.2:

- Hexavalent chromium was above the Human Health MTCA Method B Cancer and the Potable Groundwater CUL in a single upgradient well location (PZ-05) associated with the depth of the water table near the spring which also had a hexavalent chromium surface water SL exceedance (Section 8.3.1.1). Because the upgradient background concentration of hexavalent chromium indicates a potential risk from the human use of groundwater at the Site, hexavalent chromium is considered a Site groundwater COC, although it is not thought to be the result of Site impacts. Because the hexavalent chromium is not thought to be a result of Site impacts, it may require additional assessment during the cleanup and/or post-cleanup monitoring.

- Total copper was above the Ecological SL based on fresh water chronic criteria in two samples from one upgradient well location (PZ-01, 15.4 µg/L and 13.9 µg/L). This location produced high turbidity samples (102 and 216 NTU, Table 4-1). Dissolved copper concentrations in the same samples were an order of magnitude below the total copper concentrations and below Human Health and Ecological SLs. Because the SL exceedances for copper in groundwater are limited to turbid samples collected at an upgradient location away from ecological receptors, it is not considered a Site groundwater COC.
- Total iron was detected in every groundwater sample, and dissolved iron was detected in every groundwater sample except for PZ-05. Concentrations of total and dissolved iron in five samples were above the Human Health SL. All five total iron samples and four dissolved iron samples exceeded the Ecological SL. The highest detected iron concentration (9,320 µg/L) was found at the base of the landfill in a sample collected from PZ-04. Therefore, iron is considered a Site groundwater COC despite the unlikely scenario where Site groundwaters will be used for human consumption.
- Total lead was above the Ecological SL based on fresh water chronic criteria in one sample from an upgradient well location (PZ-01, 2.58 µg/L), an upgradient well location that produced turbid samples. This location produced high turbidity samples (102 and 216 NTU, Table 4-1) and is located away from ecological receptors. Dissolved lead concentrations in the same samples were an order of magnitude below the total lead concentrations and below Human Health and Ecological SLs. The dissolved and total lead results may indicate that the lead in these upgradient groundwater samples is associated with particulates and may not be as bioavailable as dissolved phase lead would be. In addition, both WAC 172-201A-240 and CWA Section 304 regulate lead based on the dissolved, not total, fraction. Therefore, lead is not considered a Site groundwater COC.
- Zinc was detected at concentrations ranging from 2.60 µg/L (PZ-05) to 580 µg/L (GW-01). Dissolved zinc was detected at concentrations ranging between 2.36 µg/L (PZ-02) and 547 µg/L (GW-01). Only the GW-01 sample from the landfill waste prism had zinc concentrations exceeding the Ecological SL. Zinc is also a Site surface water COC. Based on this, zinc is considered a Site groundwater COC.

Upward adjustment of the applicable Human Health SLs to the PQL was required for thallium, but thallium was not detected in groundwater. This occurrence is identified by a lack of color fill in the far-right columns in Table 7-2a. However, thallium was not above the relevant surface water (Section 8.3.1.1) and soil (Section 8.3.1.3) SLs, and, for that reason, thallium is not considered a groundwater COC.

The metals screening results for groundwater indicate that hexavalent chromium, iron, and zinc should be retained as Site groundwater COCs.

8.3.1.3 Soil

Three distinct sampling events were performed to characterize soil at the Site. These events included the following:

- **September 2021.** ISM sampling of DU-01 and DU-02. Collection of surface (0 to 0.5 ft bgs) composite samples along transects HA-01 through HA-03. Collection of grab sample from 9 to 10 ft bgs at SB-18.
- **February 2022.** Composite sampling of the 0 to 0.5, 0.5 to 1.0, and 1.0 to 2.0 ft bgs depth intervals along transects HA-01 through HA-05. Collection of discrete samples between 0 and 2 ft bgs for metals on transects HA-01 through HA-05.
- **August 2022.** Sampling of surface grab step-out samples along transects HA-01 through HA-05 to further constrain chemical delineations. Addition of step-out transects HA-06 and HA-07 and surface grab sampling.

Table 8-4 shows the results of screening the metals concentrations in soil based on the Human Health and Ecological SLs detailed in Tables 7-3a and 7-3b, respectively. Elevated metals are present at the Site within the soils of the Landfill and Wetland Areas at concentrations exceeding Human Health and Ecological SLs. More specifically, arsenic, cobalt, copper, lead, nickel, and zinc were detected in soils above Human Health or Ecological SLs in at least one sample (Table 8-4).

Upward adjustment of the relevant hexavalent chromium Human Health SLs to the PQL was required in soil. However, hexavalent chromium was not detected in soil and had elevated DLs. This occurrence is identified by a lack of color fill in the far-right columns in Table 7-3a. Because of this, the potential for residual hexavalent chromium impacts to Site soil may need to be assessed during the cleanup and/or post-cleanup monitoring.

Lead and/or zinc SL exceedances are co-located with all other metal SL exceedances in soil, and lead/zinc exceedances are typically greater in magnitude than those of other metals. For that reason, they are used to depict chemical concentrations in the portions of the Site below the landfill (transects HA-01 to HA-07). Figures 8-3a through 8-3d show lead sampling locations and isoconcentration maps of the results screened against Human Health and Ecological SLs by depth. Note that the 1.0 to 2.0 ft bgs samples from locations on transects HA-01 through HA-03 were not analyzed for lead; therefore, that depth interval is not presented in Figures 8-3a through 8-3d. Figures 8-4a through 8-4f show zinc sampling locations and isoconcentration maps of the results screened against Human Health and Ecological SLs by depth. Figures 8-5a and 8-5b present an overlay of the surface soil lead and zinc isoconcentration maps to demonstrate the difference in their distribution patterns. The soil metals concentrations are discussed by Site area in more detail in the following sections.

8.3.1.3.1 Off-site Borrow Pit Soil

Soil from the off-site borrow pit is represented by ISM sample DU-01. Both the Human Health and Ecological SLs were exceeded in this sample for arsenic, copper, lead, and zinc. This sample contained the highest arsenic (17.7 mg/kg) and lead (6,000 mg/kg) concentrations out of all the analyzed soil samples. The arsenic concentration in DU-01 was higher than all Wetland Area soil samples and all landfill soil samples except for SB-18-9-10. Copper and zinc concentrations were comparable with or lower than those from the Landfill and Wetland Areas.

8.3.1.3.2 Landfill Area Soil

Soil within the estimated extent of the Landfill Area occurs in three distinct zones:

1. The landfill surface cover (DU-02)
2. Native soil beneath the waste prism (SB-18)
3. At the toe of the landfill or on its flanks adjacent to the Wetland Area (HA-01A through HA-01F, HA-02G, and HA-X)

Soil samples were not collected in the waste prism zone due to poor recovery. In total, 25 Landfill Area soil samples were analyzed for metals (Table 8-4). The following is a summary of the Landfill Area soil testing results for metal COCs identified in Section 7.3:

- Arsenic exceeded its Human Health MTCA Method B Direct Contact, Cancer SL based on natural background (7 mg/kg) in three Landfill Area samples; and its Ecological SL the WAC 173-340-7493 plant soil indicator concentration (10 mg/kg) in two samples HA-01B (7.79 mg/kg) and HA-01D (10.5 mg/kg) at the toe of the landfill, and sample location SB-18 representative of native soil beneath the landfill waste prism (30.5 mg/kg). Based on this, arsenic is considered a soil COC in the Landfill Area.
- Cadmium exceeded the Ecological SL based on the WAC 173-340-7493 plant soil indicator concentration (4 mg/kg) in two Landfill Area samples HA-01C (10.9 mg/kg) and HA-01D (6.33 mg/kg). Based on this, cadmium is considered a soil COC in the Landfill Area.

- Chromium exceeded the Ecological SL based on WAC 173-340-7493 plant and soil biota soil indicator concentrations (42 mg/kg) in one Landfill Area sample SB-18 (45.0 mg/kg) representative of the native soil beneath the landfill waste prism. Based on this, chromium is considered a soil COC in the Landfill Area.
- Hexavalent chromium was not detected in Landfill Area soils, and is not retained as a Landfill Area soil COC. However, hexavalent chromium was detected above SLs in Landfill Area groundwater and surface water. These exceedances are discussed in Sections 8.3.1.1 and 8.3.1.2, but are not thought to be the result of Site impacts.
- Cobalt was not above Human Health or Ecological SLs in the Landfill Area. Based on this, cobalt is not considered a soil COC in the Landfill Area.
- Copper exceeded Ecological SLs based on the WAC 173-340-7493 plant (100 mg/kg) and soil biota (50 mg/kg) soil indicator concentrations in seven Landfill Area samples representative of all zones. Landfill cover materials represented by sample DU-2 had a copper concentration of 90.8 mg/kg. Sample location HA-01C in the 0.0 to 0.5 ft bgs interval had the highest copper concentration in the Landfill Area, 166 mg/kg. Other concentrations in the HA-01 transect at the toe of the landfill were similar. Sample location SB-18, representative of native soil beneath the landfill waste prism, also had a similar concentration of 164 mg/kg. Based on this, copper is considered a soil COC in the Landfill Area. Because there were no surface water exceedances in the Landfill Area, and groundwater exceedances were limited to total copper only, human health evaluations of copper in soil are only conducted using direct contact SLs.
- Iron was not evaluated in soil at the Site. However, iron was identified as a groundwater COC (Section 8.3.1.2). Because of this, and the fact that the wastes present at the Site are likely high in iron, it should be considered a soil COC for the purposes of the Landfill Area cleanup.
- For lead, it was determined in Section 8.3.1.1 that the MTCA Method B Protective of Groundwater to Surface Water, Saturated CUL was not applicable to Landfill Area soil, as there were no surface water exceedances. Therefore, for human health evaluations, lead in soil is only evaluated using direct contact SLs. Lead exceeded the MTCA Method A Unrestricted Land Use CUL (which is a direct contact SL) and the Ecological SL based on the WAC 173-340-7493 plant soil indicator concentration at numerous locations within the Landfill Area. The highest lead concentration, 679 mg/kg, occurred at location HA-X. Location HA-01F had a lead concentration of 27.4 mg/kg, which only exceeded the Human Health SL. Based on this, lead is considered a soil COC in the Landfill Area.
- Nickel exceeded the Ecological SL based on the WAC 173-340-7493 plant soil indicator concentration adjusted for natural background of 38 mg/kg in 3 Landfill Area samples. Landfill cover materials represented by sample DU-2 had a nickel concentration of 40.7 mg/kg. Sample location HA-01C in the 0.0 to 0.5 ft bgs interval had the highest nickel concentration in the Landfill Area, 61.2 mg/kg. Sample location SB-18 representative of native soil beneath the landfill waste prism also had a concentration of 50.2 mg/kg. Based on this, nickel is considered a soil COC in the Landfill Area.
- Zinc exceeded the MTCA Method B Protective of Groundwater, Saturated (300 mg/kg) and Protective of Groundwater to Surface Water, Saturated CUL adjusted for natural background (86 mg/kg) and the WAC 173-340-7493 plant (86 mg/kg), soil biota (200 mg/kg), and wildlife (360 mg/kg) soil indicator concentrations in 20 Landfill Area samples. Zinc was detected up to 14,000 mg/kg at HA-01D in the 0.0 to 0.5 ft bgs interval compared to 977 mg/kg under the waste prism at SB-18. The highest zinc concentrations in HA-01 samples were identified on the eastern side of the toe of the landfill at locations HA-01C and HA-01D, likely because of the presence of significant wastes in the sampling area. Additionally, zinc (and other metals) may be discharged as a component of leachate via a low-lying pathway present in the area and binding to soil at nearby and downgradient wetland locations. Based on this, zinc is considered a soil COC in the Landfill Area.

The metals screening results for the Landfill Area indicate that arsenic, cadmium, chromium, copper, iron, lead, nickel, and zinc should be retained as Landfill Area soil COCs. Note that samples from the bounding locations HA-01Aa, HA-01Ab, and HA-02G did not exceed the SLs for lead and zinc, the two COCs analyzed at these locations. HA-X exceeded the Human Health and Ecological SLs for lead and zinc.

8.3.1.3.3 Wetland Area Soil

Sample results for metals in Wetland Area soils are presented in Table 8-4. In the Wetland Area, metals concentrations are generally consistent with, or lower than, those covering (DU-02) or in native soils beneath the landfill waste prism (SB-18). Hexavalent chromium, selenium, and thallium were not detected in any Wetland Area samples, although the DLs for these metals were sometimes elevated above the SLs because of dilution of the samples at the laboratory (Table 8-4). Barium, chromium, and vanadium are present in the Wetland Area at concentrations below natural background (Ecology, 1994; USGS, 2013) (Tables 7-4 and 7-5).

As discussed in Section 7.3, secondary human health direct contact and ecological screenings were performed on Wetland Area soil concentrations. The secondary human health direct contact screening (Table 7-4) demonstrates that direct contact Human Health risks posed by metals in the Wetland Area are limited to cobalt and lead. The secondary ecological screening (Table 7-5) showed that the 95th percentile UCL for arsenic, cadmium, cobalt, and nickel were below their most stringent Ecological SL and should not be part of the evaluation moving forward, and only copper, lead, and zinc were retained as wetland metal Ecological COCs.

Results by depth and SL basis (Human Health and Ecological) are shown in Figures 8-3a through 8-3d (lead) and 8-4a through 8-4f (zinc), with locations on transects HA-02 (excluding HA-02G) through HA-07 corresponding to Wetland Area sampling locations. Figures 8-5a and 8-5b show an overlay of surface soil lead and zinc isoconcentration contours binned into Human Health and Ecological SL groups to help clarify their distributions in the Wetland Area. Note that not all locations on these transects used for these figures fall within the delineated wetland and some bounding samples represent sloped areas above the wetland along the base of the bluff (HA-02G), the toe of the landfill (HA-01 transect), or flank of the landfill (HA-X). In total, 90 Wetland Area soil samples were analyzed for metals with most samples being run for lead and zinc and other samples getting a more comprehensive suite of metals assessed (Table 8-4). The following is a summary of the Wetland Area soil testing results for metal COCs identified in Section 7.3:

- Arsenic exceeded the MTCA Method A and B CULs and the WAC 173-340-7493 plant soil indicator concentration in one Wetland Area sample, HA-02E, 0 to 0.5 ft bgs (12.5 mg/kg). This exceedance occurred in isolation in the Wetland Area. The 95th percentile UCL for arsenic in the Wetland Area is 4.642 mg/kg, below natural background of 7 mg/kg (Tables 7-4 and 7-5). Because of this, arsenic is not considered a soil COC in the Wetland Area.
- Cadmium slightly exceeded the Ecological SL based on the WAC 173-340-7493 plant soil indicator concentration (4 mg/kg) in two Wetland Area samples, HA-02C (4.51 mg/kg) and HA-02D (5.03 mg/kg). The 95th percentile UCL for cadmium in the Wetland Area is 1.68 mg/kg below the Ecological SL (Table 7-5). Because of this, cadmium is not considered a soil COC in the Wetland Area.
- Chromium was not above Human Health or Ecological SLs in the Wetland Area. Based on this, chromium is not considered a soil COC in the Wetland Area.
- Hexavalent chromium was not detected in Wetland Area soils, and is not retained as a Wetland Area soil COC. However, hexavalent chromium was detected in the dissolved fraction of Wetland Area surface water below SLs. These detections are further discussed in Section 8.3.1.1, and are not thought to be due to Site impacts. Based on these factors, hexavalent chromium is not considered a soil COC in the Wetland Area.

- Cobalt exceeded the MTCA Method B Direct Contact, Non-Cancer CUL, and the WAC 173-340-7493 plant soil indicator concentration in one Wetland Area sample HA-02E, 0 to 0.5 ft bgs (82.3 mg/kg). The 95th percentile UCL for cobalt in the Wetland Area is 12.3 mg/kg below natural background 29.19 mg/kg (Table 7-5). The single Human Health SL exceedance is more than two times the Human Health SL of 29.19 mg/kg. However, this exceedance occurred in isolation and no other cobalt exceedances were identified anywhere within the Site. Because of this, cobalt is not considered a soil COC in the Wetland Area.
- Copper exceeded the WAC 173-340-7493 plant and soil biota soil indicator concentrations in eight Wetland Area samples and was evaluated as part of the TEE. Copper impacts in the Wetland Area are concentrated near the landfill in samples from transect HA-02 from 0 to 2.0 ft bgs. The 95th percentile UCL for copper in the Wetland Area is 68.57 mg/kg, which is above its Ecological SL (Table 7-4). However, copper did not exceed the Human Health Direct Contact SL of 3,200 mg/kg in Wetland Area soil, and the TEE SL of 208 mg/kg was not exceeded in any Wetland Area soil. In addition, there were no exceedances in surface water in the Wetland Area, and the only groundwater exceedances in the Wetland Area were for total copper. Based on these factors, copper is not considered a soil Human Health or Ecological COC in the Wetland Area.
- Iron was not evaluated in soil at the Site. However, iron was identified as a groundwater COC (Section 8.3.1.2). Because of this, and the fact that the wastes present at the Site are likely high in iron, it should be considered a soil COC for the purposes of the Wetland Area cleanup.
- Lead exceeded the MTCA Method B Protective of Groundwater to Surface Water, Saturated CULs and the WAC 173-340-7493 plant, soil biota, and wildlife soil indicator concentrations. Lead concentrations vary across the Wetland Area, with concentrations ranging from 5.20 mg/kg at HA-03C in the 0.5 to 1.0 ft bgs interval to 501 mg/kg at HA-06D in the 0.0 to 0.5 ft bgs interval. Lead concentrations do not appear to decline with distance from the landfill and have an erratic pattern (Figures 8-3a through 8-3d), indicating they may not be the result of landfill impacts. The widely varying concentrations of lead dispersed across the Wetland Area may be related to firearms use distributing lead shot and/or bullets throughout the area over time (Figure 4-4; Appendix A). This is demonstrated by elevated lead concentrations extending up the slope west of the waste prism along the western edge just outside of the landfill waste and Wetland Area boundaries (HA-X). Indications of shotgun and high caliber rifle use were noted through shell casings found across the top of the landfill (Appendix A). The lead distribution pattern aligns with a conceptual lead fallout zone based on an approximate range of shotgun ammunition when fired from the top of the landfill (approximately 250 yards), with the assumption that lead fallout could land anywhere in the Site between the top of the landfill and this approximate range. Commercial shooting ranges have been shown to contain lead concentrations in their soils well above background levels related to lead shot and dust, as recognized in EPA's guidance on best management practices (BMPs) on lead in shooting ranges (Hardinson et al., 2004; Bannon et al., 2009; EPA, 2005). Additionally, use of borrow pit soil as landfill cover material may have furthered the presence of lead in the Wetland Area because the borrow pit area was also used for firearm shooting and impacts from landfill cover may have migrated to the Wetland Area (Section 5.2). However, lead does not exceed its SL established via TEE WOE in any wetland soil samples (reference). Based on this, lead is not considered an Ecological soil COC in the Wetland Area.

  In the Wetland Area, lead had a 95th percentile UCL (110.9 mg/kg) below the most stringent direct contact SL (250 mg/kg; MTCA Method A) however, the maximum detected concentration was 501 mg/kg just over two times the direct contact SL WAC 170-340-740(7)(e)(i) (Table 7-5). Only four Wetland Area samples exceeded the MTCA Method A direct contact SL for lead. These areas are isolated from the Landfill Area by portions of the Wetland Area with lower concentrations. The unrestricted land use scenario (residential) that these MTCA Method A direct contact SLs were developed for indicates the need for the most protective CULs based on child exposure scenarios. This scenario is not representative of the reasonable maximum exposure of the current or future recreational use cases for the Site WAC 173-340-708(3). In addition, there were no lead exceedances in the dissolved fraction of groundwater or surface water in the Wetland Area. For these reasons, the slight two times exceedance for lead at one location within the Wetland Area does not pose a significant direct contact human health risk and is not considered a Human Health direct contact COC in soil.

- Nickel exceeded the WAC 173-340-7493 plant soil indicator concentration set to natural background (38 mg/kg) in two Wetland Area samples near the landfill HA-02C, 0 to 0.5 ft bgs (51.4 mg/kg) and HA-02D, 0 to 0.5 ft bgs (47.3 mg/kg). The 95th percentile UCL for nickel in the Wetland Area is 18.63mg/kg which is below natural background 38 mg/kg (Table 7-4). Because of this, nickel is not considered a soil COC in the Wetland Area.
- Zinc exceeded the MTCA Method B Protective of Groundwater, Saturated and Protective of Groundwater to Surface Water, Saturated CULs and the WAC 173-340-7493 plant, soil biota, and wildlife soil indicator concentrations. Approximately 250 to 300 ft from the toe of the landfill, near the farthest extents of the sampling effort, zinc was detected at up to 1,990 mg/kg at location HA-06I and 1,910 mg/kg at location HA-07I but was lower than concentrations identified in sampling locations closer to the landfill toe. The source of zinc is likely to be from landfill wastes such as tires and galvanized metals that have leached dissolved zinc into solution (Rhodes et al., 2012). This dissolved zinc may have mobilized along flow paths in the Wetland Area where sorption to soils then occurs and the zinc is rendered immobile (HHS, 2005). This indicates that more mobile metals such as zinc may be transported a reasonable distance from the landfill, but concentrations decrease with distance. The highest zinc concentrations were identified on the eastern side of the Wetland Area, indicating zinc is likely mobilizing as a dissolved metal in surface water pathways originating from leaching from the landfill through a preferential flow pathway present in this area and redepositing in soil downgradient of the landfill. Additionally, tire waste and galvanized metal, which are known to contain zinc (HHS, 2005), are scattered well beyond the toe of the landfill in the Wetland Area, especially along the eastern side of the wetlands. These wastes may be contributing to dissolved zinc mobilizing and rebinding with soil further downgradient. Figures 8-4a through 8-4f show the zinc distribution throughout the Wetland Area by depth and SL basis. Based on this, zinc is considered a soil COC in the Wetland Area.

As TEE evaluation results suggest that levels of copper, lead, and zinc are protective of terrestrial Ecological receptors (see Section 8.4), the only soil metal COCs to be retained in the Wetland Area are iron and zinc for the protection of groundwater and surface water.

8.3.2 Volatile Organic Compounds

VOCs were analyzed as COPCs in surface water, groundwater, and soil using EPA Method 8260D. In surface water the only VOC detected was naphthalene. In groundwater naphthalene and toluene were detected. In soil tetrachloroethylene (PCE) and naphthalene were detected in native materials beneath the waste prism at location SB-18. All of these detections were below the relevant Human Health and Ecological SLs. The following sections present the analytical and screening results for VOCs by media.

8.3.2.1 Surface Water

VOC analyses were conducted on 19 surface water samples. Analytical results are shown in Table 8-5. VOCs were not detected in any surface water samples analyzed via EPA Method 8260D.

Upward adjustment of applicable Human Health SLs to the PQLs was required for 12 VOCs in surface water. Most of the SLs that were upward adjusted to the PQLs are for the evaluation of risk via water and organism consumption scenarios. These scenarios are more conservative than warranted for the Site's current use because no known subsistence fishing or routine consumption of surface waters is occurring within it. All the

VOCs that required upward adjustment of SLs were not detected. These compounds are identified by a lack of color fill in the far-right columns in Tables 7-1a and 7-1b. VOCs that were not detected but that had PQLs below the applicable SLs are not considered Site surface water COCs. VOCs that were not detected but that had PQLs below the applicable SLs are not considered Site surface water COCs. The 12 VOCs that had PQL-based SLs and were not detected via EPA Method 8260D generally had PQLs consistent with the Practical Quantitation Limits (PQLs) from the QAPP (Appendix B of the RIWP [GSI, 2021a]). Because of this, VOCs are not retained as COCs for surface water at the Site (Table 8-5).

8.3.2.2 Groundwater

VOC analyses were conducted on the six groundwater samples (PZ-01 through PZ-05) collected in February 2022 and one sample (GW-01) collected before the RI in January 2021 from the landfill waste prism. Toluene was the only VOC detected in groundwater. The detected concentration of toluene of 0.640 µg/L occurred at location PZ-03 at the toe of the landfill (Table 8-6). The toluene concentration was orders of magnitude below its Human Health and Ecological SLs. PCE and its degradation by-products were not detected in any groundwater samples.

Upward adjustment of applicable Human Health SLs to the PQLs was required for 17 VOCs in groundwater. Most of the SLs that were upward adjusted to the PQLs are for the evaluation of risk via water and organism consumption scenarios. These scenarios are more conservative than warranted for the Site's current use because no known consumption of groundwater is occurring within it. All of the VOCs that required upward adjustment of SLs were not detected. These compounds are identified by a lack of color fill in the far-right columns in Tables 7-2a and 7-2b. VOCs that were not detected but that had PQLs below the applicable SLs are not considered Site groundwater COCs. The 17 VOCs that had PQL-based SLs and were not detected via EPA Method 8260D generally had PQLs that were consistent with the PQLs from the QAPP (Appendix B of the RIWP [GSI, 2021a]). Because of this, VOCs are not retained as COCs for groundwater at the Site (Table 8-6).

8.3.2.3 Soil

VOC analysis was conducted on 7 soil samples. These samples were collected from the former borrow pit (DU-1), Landfill Area cover materials (DU-2), native soil immediately below the landfill waste prism (SB-18-9-10), toe-of-landfill transect composite (HA-01), and in the Wetland Area transect composites HA-02 and HA-03 (Table 8-7). PCE was the only VOC detected in soil. This detection occurred at location SB-18-9-10 (0.0601 mg/kg) and is orders of magnitude below the Human Health SL of 480 mg/kg. No PCE degradation by-products (e.g., trichloroethene, cis-1,2-dichloroethylene [DCE], trans-DCE, and vinyl chloride) were detected in any of the soil samples analyzed.

Upward adjustment of applicable Human Health SLs to the PQLs was required for two VOCs (1,2,3-trichloropropane and dibromochloropropane) in soil. The SLs that were upward adjusted to the PQLs are for the MTCA Method B Direct Contact, Cancer scenario. This scenario is more conservative than warranted for the Site because there is not frequent repeated human use that could lead to dermal contact with soils and the regular ingestion of soils is not occurring. These VOCs that required upward adjustment of SLs were not detected. These compounds are identified by a lack of color fill in the far-right columns in Tables 7-3a and
7-3b. Those VOCs that were not detected but that had PQLs above the applicable SLs are not considered Site soil COCs. However, because there is the potential for two VOCs (1,2,3-trichloropropane and dibromochloropropane) and select other sample-specific VOCs with elevated DLs to be present at or above their Human Health SLs, Site soil may need to be further assessed during the cleanup and/or post-cleanup monitoring.

8.3.3 Semi-Volatile Organic Compounds

SVOCs were analyzed as COPCs in surface water, groundwater, and soil using EPA Method 8270E. The analytical results for SVOCs are discussed below. SVOCs were not detected above SLs in any surface water or groundwater samples (Tables 8-8 and 8-9, respectively). In soil pentachlorophenol (PCP) and total cPAHs were detected above their Human Health SLs (Table 8-10). The following sections present the analytical and screening results for SVOCs by media.

8.3.3.1 Surface Water

SVOCs were analyzed in 19 surface water samples. Only three SVOCs were detected in any of these samples (Table 8-8):

- Benzyl alcohol (SE-01, 0.106 µg/L)
- Diethyl phthalate (SW-04, 0.215 µg/L)
- Naphthalene (SW-05, 0.0192 µg/L)

Benzyl alcohol does not have Human Health or Ecological SLs. Diethyl phthalate and naphthalene were both orders of magnitude below their Human Health SLs. Additionally, because no individual PAHs were found to be above SLs in surface water, the evaluation of soil PAHs can be limited to the direct contact CULs for the total cPAH mixture represented as BaP Toxic Equivalent Quotients (TEQ) consistent with WAC 173-340-708(8)(e).

Upward adjustment of applicable Human Health SLs to the PQLs was required for several SVOCs in surface water. Most of the SLs that were upward adjusted to the PQLs are for the evaluation of risk via water and organism consumption scenarios. These scenarios are more conservative than warranted for the Site's current use because no known subsistence fishing or routine consumption of surface waters is occurring within it or likely to occur on it in the future. Some of these SVOCs that required upward adjustment of SLs were not detected. These compounds are identified by a lack of color fill in the far-right columns in Tables 7-1a and 7-1b. Those SVOCs that were not detected but that had PQLs below the applicable SLs are not considered Site surface water COCs. The SVOCs that had PQL-based SLs and were not detected via EPA Method 8270E had DLs that were consistent with the PQLs from the QAPP (Appendix B of the RIWP [GSI, 2021a]). Because of this, SVOCs are not retained as COCs for surface water at the Site (Table 8-8).

8.3.3.2 Groundwater

SVOCs were analyzed in 11 groundwater samples collected from five Site piezometers in 2021. These samples were analyzed for a limited PAH suite. In 2021 before the RI a single groundwater sample was collected at GW-01 in the landfill waste prism and was run for the full SVOC suite. Because no individual PAHs were found to be above SLs in groundwater the evaluation of soil PAHs can be limited to the direct contact CULs for the total cPAH mixture represented as BaP TEQ consistent with WAC 173-340-708(8)(e).

The only three SVOCs were detected in groundwater (Table 8-9):

- Fluorene (PZ-05, 0.0187 µg/L)
- Naphthalene (PZ-05, 0.343 µg/L)
- Phenanthrene (PZ-02, 0.0228 µg/L)

Phenanthrene does not have Human Health or Ecological SLs. Fluorene and naphthalene were both orders of magnitude below their Human Health SLs. Additionally, because no individual PAHs were found to be above SLs in groundwater the evaluation of soil PAHs can be limited to the direct contact CULs for the total cPAH mixture represented as BaP TEQ consistent with WAC 173-340-708(8)(e).

Upward adjustment of applicable Human Health SLs to the PQLs was required for several SVOCs in groundwater. Most of the SLs that were upward adjusted to the PQLs are for the evaluation of risk via water and organism consumption scenarios. These scenarios are likely more conservative than warranted for the Site's current use because no known subsistence fishing or routine consumption of groundwater is occurring within it or likely to occur on it in the future. Some of these SVOCs that required upward adjustment of SLs were not detected. These compounds are identified by a lack of color fill in the far-right columns in Tables 7-2a and 7-2b. Those SVOCs that were not detected but that had PQLs below the applicable SLs are not considered Site groundwater COCs. Because no SVOCs were found above SLs, and they were rarely detected, SVOCs are not thought to be impacting groundwater at the Site (Table 8-9). The SVOCs that had PQL-based SLs and were not detected via EPA Method 8270E had PQLs that were consistent with the PQLs from the QAPP (Appendix B of the RIWP [GSI, 2021a]). Because of this, SVOCs are not retained as COCs for groundwater at the Site (Table 8-9).

8.3.3.3 Soil

Soil samples from six locations were analyzed for SVOCs in September 2021. These detected SVOCs include the following (not including individual cPAHs) (Table 8-10):

- 3&4-Methylphenol (coelution) (HA-03, 0 to 0.5 ft bgs interval, 0.198 mg/kg)
- Anthracene (DU-01, borrow pit, 0.0700 mg/kg)
- Benzoic acid (HA-03, 0 to 0.5 ft bgs interval, 7.73 mg/kg)
- Butyl benzyl phthalate (BBP) (HA-01 composite, 1.99 mg/kg)
- Fluoranthene (DU-02, 0.215 mg/kg, and H-01 composite, 0.242 mg/kg)
- Naphthalene (HA-01 composite, 0.265 mg/kg)
- Pentachlorophenol (9 to 10 ft bgs grab sample from SB-18, 3.16 mg/kg)
- Phenanthrene (DU-01, borrow pit, 0.245 mg/kg; DU-02, 0.173 mg/kg; HA-01 composite, 0.397 mg/kg)
- Phenol (HA-01 composite, 0.179 mg/kg; HA-02 composite, 0.0860 mg/kg; HA-03 composite, 0.169 mg/kg)
- Pyrene (DU-01, borrow pit, 1.01 mg/kg; DU-02, 0.321 mg/kg; HA-01 composite, 0.173 mg/kg; HA-02 composite, 0.0551 mg/kg)
- Total PAHs (DU-01, borrow pit, 1.37 mg/kg; DU-02, 0.306 mg/kg; HA-01 composite, 0.144 mg/kg; HA-02 composite, 0.0817 mg/kg)

Most of the detected compounds that had Human Health or Ecological SLs (3&4-Methylphenol coelution, anthracene, benzoic acid, BBP, fluoranthene, naphthalene, phenanthrene, phenol, pyrene) were orders of magnitude below their respective SLs. PCP was detected in only one sample from the landfill waste prism, SB-18-9-10 (3.16 mg/kg), which had concentrations above the Human Health SL based on the MTCA Method B Direct Contact, Cancer CUL (2.5 mg/kg) and Ecological SL (3 mg/kg) based on the WAC 173-340-7493 plant soil indicator concentration. There is currently no potential for direct contact with human receptors or ecological receptors at this sample location. However, because of this detection, PCP is considered a Landfill Area soil COC. PCP is not considered a Wetland Area soil COC.

Total cPAHs as a mixture were detected in four samples from the borrow pit (DU-01), Landfill Area (DU-02 and HA-01 composite), and Wetland Area (HA-02 composite). Only two samples exceeded the Human Health SL based on the MTCA Method B Direct Contact, Cancer CUL (0.19 mg/kg). The first total PAH sample that exceeded the Human Health SL is from the former borrow pit location DU-01 (1.37 mg/kg) and the second is from location DU-02 (0.306 mg/kg), which represents cover materials in the Landfill Area. Both of these samples also and Human Health SL exceedances for BaP which serves as the basis for the total cPAH SL and is considered redundant. Therefore, total cPAHs are considered a soil COC for the Landfill Area. Total cPAHs are not considered a Wetland Area soil COC because there were no detections above the relevant Human Health or Ecological SLs. Note that individual cPAH compounds are not included or discussed in this section because no individual PAHs were found to be above SLs in groundwater.

Upward adjustment of applicable Human Health SLs to the PQL was required for three SVOCs (2,6-dinitrotoluene, N-nitrosodimethylamine, N-nitrosodi-n-propylamine) in soil. Most of the SLs that were upward adjusted to the PQL are for the MTCA Method B, Direct Contact, Cancer scenario. This scenario is more conservative than warranted for the Site because there is not frequent repeated human use that could lead to dermal contact with soils and the regular ingestion of soils is not occurring. The SVOCs that required upward adjustment of SLs were not detected. These compounds are identified by a lack of color fill in the far-right columns in Tables 7-3a and 7-3b. Those SVOCs that were not detected but that had PQLs below the applicable SLs are not considered Site soil COCs. However, because there is the potential for three SVOCs (2,6-dinitrotoluene, N-nitrosodimethylamine, N-nitrosodi-n-propylamine) and select other sample specific SVOCs with elevated DLs to be present at or above their Human Health SLs, Site soil may need to be further assessed during the cleanup and/or post-cleanup monitoring.

8.3.4 Polychlorinated Biphenyls

PCBs were analyzed as COPCs in surface water and soil only. No detectable concentrations of PCBs were found in surface water (Table 8-11); therefore, because of the low mobility and solubility of PCBs, these compounds were not analyzed in groundwater. Analytical results showed that select PCB Aroclors were present in Landfill Area cover soils (DU-2) and soil samples near the toe of the landfill only. No detections in soil samples exceeded Human Health or Ecological SLs (Table 8-12). The following sections present the analytical and screening results for PCBs by media.

8.3.4.1 Surface Water

Three surface water samples were analyzed for PCBs. Total PCBs were not detected in any of the three surface water locations sampled (Table 8-11).

Upward adjustment of applicable Human Health or Ecological SLs to the PQL was required for Total PCBs (PQL for Total PCBs is set at the highest reported PQL of all reported Aroclors). The SLs that were upward adjusted to the PQL are for the evaluation of risk via water and organism consumption (Total PCBs) and the MTCA Method B, Cancer scenario. These scenarios are more conservative than warranted for the Site's current use because no known subsistence fishing or routine consumption of groundwater is occurring within it or likely to occur on it in the future. Total PCBs were not detected, as identified by a lack of color fill in the far-right column in Tables 7-1a and 7-1b. PCB Aroclors were not detected via EPA Method 8082A and had PQLs that were consistent with the PQLs from the QAPP (Appendix B of the RIWP [GSI, 2021a]). Because of this, PCBs are not retained as COCs for surface water at the Site (Table 8-11).

8.3.4.2 Groundwater

PCBs were not COPCs in groundwater because of their physical and chemical properties. Therefore, PCBs were not evaluated in groundwater and are not considered Site groundwater COCs. However, whether PCBs are impacting Site groundwater may need to be confirmed during post-cleanup monitoring.

8.3.4.3 Soil

Seven soil samples collected in September 2021 were analyzed for PCB Aroclors. PCBs were not detected and were below the Human Health and Ecological SLs in the former borrow pit (DU-01), native soil beneath the landfill waste prism (SB-18), and in the Wetland Area composites from HA-02 and HA-03. Detected concentrations of Aroclors 1254 and 1260, and thereby total PCB concentrations were below the Human Health and Ecological SLs landfill surface cover (DU-02) and the sample from the transect composite at the toe of the landfill (HA-01) (Table 8-12). Those PCB compounds that were not detected but that had PQLs below the applicable SLs are not considered Site soil COCs.

PCBs were not found in Site surface water, and they do not typically migrate significant distances from their source locations because of their tendency to adsorb to soil. Therefore, the low soil concentrations found at the Site present a low risk to groundwater unless transported by non-aqueous-phase liquid plumes (HHS, 2000). Based on the lack of Human Health and Ecological SL exceedances and the CSM for the Site, PCBs are not considered a landfill or Wetland Area soil COC.

8.3.5 Total Petroleum Hydrocarbons

Several surface water and groundwater samples contained detectable TPH concentrations (Tables 8-13 and 8-14), but none of these samples had detections that exceeded Human Health or Ecological SLs. Soil samples were collected for TPH analysis from the off-site borrow pit area (DU-01), the Landfill Area (DU-02, and SB-18), the toe of the landfill (HA-01), and the first four Wetland Area soil transects (HA-02 through HA-05). Analytical results show that gasoline-range (GRO) compounds were detected above the Human Health SL at all analyzed composite sample locations except HA-05. Both the Human Health and the Ecological SLs were exceeded in one soil sample at HA-03 (Table 8-15). TPH-DRO/ORO, which is screened as the sum of DRO and ORO (Ecology, 2016) (see Section 8.2.3.1), was detected at all analyzed composite sample locations, and the Ecological SLs were exceeded in five samples (including SB-18 from the base of the waste prism).

8.3.5.1 Surface Water

TPH analyses were conducted on 13 surface water samples. GRO and select aliphatic and aromatic hydrocarbon ranges were detected. No detections exceeded their Human Health or Ecological SLs[6] (Table 8-13). Because of these results, TPH analytes and mixtures are not considered Site surface water COCs.

8.3.5.2 Groundwater

TPH analyses were conducted on 11 groundwater samples collected from all five Site piezometers in November of 2021 and February 2022. Only select EPHs were detected. No detections exceeded their Human Health or Ecological SLs.[7] However, benzene, ethylbenzene, and methyl tertbutyl ether as reported via NWVPH had elevated DLs that exceeded their respective Human Health and Ecological SLs (Table 8-14). These compounds are identified by a lack of color fill in the far-right columns in Tables 7-2a and 7-2b. These compounds were not detected and are not impacting Site groundwater based on their results under the more sensitive EPA Method 8260D for VOCs (Table 8-6). Because of this, TPH analytes and mixtures are not considered Site groundwater COCs.

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[6] The surface water Ecological SL for DRO is based on weathered DRO.
[7] The groundwater Human Health SLs are based on GRO with benzene being present (GRO) and heavy oils (ORO). The groundwater Ecological SL for DRO is based on weathered DRO.

8.3.5.3 Soil

TPH analyses were conducted on 24 soil samples. Between the two TPH methods, GRO detections in soil above the Human Health SL of 30 mg/kg based on the MTCA Method A Unrestricted Land Use scenario were found in five samples representing four locations (Table 8-15)[8]:

- Surface soils at the toe of the Landfill Area, represented by the HA-01 composite sample (61.9 mg/kg)
- Wetland Area surface soil (0 to 0.5 ft bgs) composite samples along transects HA-02 (52.8 mg/kg), HA-03 (56.5 and 141 mg/kg [duplicate]), and HA-04 (95.0 mg/kg).

The Ecological SL (100 mg/kg) was only exceeded in a duplicate surface sample at HA-03 (141 mg/kg, Wetland Area). All other TPH-GRO detections are well below the Ecological SL, and the average TPH-GRO concentration in Wetland Area soil (using one half the DL for non-detects) is 25 mg/kg. Because of this, TPH-GRO is not considered an Ecological risk in Wetland Area soil. Several other TPH compounds and hydrocarbon ranges were detected, but they did not exceed the SLs. Because of the Human Health SL exceedances, TPH-GRO is considered a soil COC in the Landfill and Wetland Areas.

DRO and ORO were also detected in most of the analyzed samples. Detection of TPH-DRO/RRO (the sum of DRO and RRO) above the Ecological SL of 200 mg/kg, based on the Soil Ecological Indicator for soil biota, were found in five samples representing the following areas:

- Subsurface soil at the toe of the Landfill Area, represented by the HA-01 composite sample at 0.5 to 1.0 ft bgs (279 mg/kg)
- Native soil at the base of the landfill waste prism, represented by SB-18 at 9.0 to 10.0 ft bgs (864 mg/kg).
- Wetland Area surface (HA-03, HA-04) and subsurface (HA-03) soil with concentrations ranging from 345 to 616 mg/kg.

Several other TPH compounds and hydrocarbon ranges were detected, but they did not exceed the SLs, and all other TPH-DRO/ORO detections are below the Ecological SL. Because of the above detections, TPH-DRO/ORO is considered an Ecological COC in both Landfill Area soil and Wetland Area soil.

8.3.6 Polybrominated Diphenyl Ethers

PBDEs were analyzed in surface water and groundwater as COPCs because of concerns related to concentrations found elsewhere in the Nisqually River watershed. Low levels of PBDEs were detected in both surface water and groundwater samples. For the purposes of this evaluation, Total PBDEs were calculated by including 100 percent of resulting concentrations for detections and one half of the DL for non-detects in the summation. Using this approach, PBDE congener mixtures and Total PBDEs were all orders of magnitude below Human Health and Ecological SLs. Results for surface water and groundwater samples are presented in Tables 8-16 and 8-17, respectively. PBDEs were not analyzed in soils. A discussion of the PBDE sampling results by media is presented in the following sections.

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[8] The soil GRO Human Health SL is based on benzene being present in GRO.

8.3.6.1 Surface Water

Nineteen surface water samples were analyzed for PBDEs between 2021 and 2022. PBDEs were detected in all samples except for the six collected in January 2021, which had elevated DLs. All detections and non-detects were at concentrations below the relevant Human Health SL. Congener BDE-47 was detected in all samples from September 2021 and in all samples from 2022 and ranged from 6.17 to 16.4 pg/L (Table 8-16). Summations of OctaBDE (including BDE-153, -128/154, and -183/176) also had concentrations orders of magnitude below their Human Health SLs. Because PBDE concentrations in surface water are below SLs, PBDEs are not considered a Site surface water COC.

8.3.6.2 Groundwater

Analysis of PBDEs was conducted on seven groundwater samples collected from GW-01 in 2021 before the RI and piezometers PZ-01 through PZ-05 in February 2022. PBDE congeners were detected at concentrations up to 1,710 pg/L for BDE-209 at PZ-01, and results for the Total PentaBDE summation went up to 2,434 pg/L. All PBDE concentrations were below their Human Health and Ecological SLs (Table 8-17). Summations (assuming 100 percent of potential individual congeners contribute to PBDE mixtures) for PentaBDE and OctaBDE are orders of magnitude lower than their SLs. Based on the low levels of PBDE concentrations detected in groundwater, PBDEs are not considered a Site groundwater COC.

8.3.6.3 Soil

PBDEs were not analyzed in soils, based on the initial questions that were related to the surface water pathway to the Mashel River, which includes surface water and the potential for groundwater to discharge to surface waters.

8.4 Terrestrial Ecological Evaluation Results

The results of the TEE are presented in Appendix D. Figure 4-5 shows the “impacted” and “reference (non-impacted)” locations evaluated in the TEE. This Site-specific TEE evaluation was performed to better estimate if metals and other co-located COPCs in soil within the Wetland Area of the Site may pose unacceptable risks to ecological receptors. Several findings related to the ecological condition of the wetlands were identified in the TEE:

- Plant species were largely native, with no visual evidence of plant stress. Mean plant community diversity and relative abundance metrics are similar in reference (non-impacted) and impacted areas.
- Plant diversity and relative abundance in the canopy was not adversely influenced by copper, lead, and zinc concentrations. Species richness, or number of species, was highest at the location with the highest zinc soil concentrations.
- Plant community characteristics based on ground cover (diversity and abundance) were not adversely influenced by copper, lead, and zinc concentrations. The evaluation noted a positive correlation between plant community characteristics of ground cover and concentrations of lead in soil; however, the TEE states that it is unlikely that high lead levels in soil promote plant diversity and abundance.
- Earthworms and potworms, both terrestrial species, were found in more than 70 and 30 percent of sample pits, respectively. Results indicated that there was no difference in abundance or adverse effects on the ecological community because of lead and zinc in soil.
- Numerous terrestrial and avian species such as Steller’s jay, raccoons, black-tailed deer, coyote, black bear, Cooper’s hawk, and Douglas squirrels were identified by the wildlife cameras. These species all appeared healthy and vital, and the behaviors observed appeared normal.

The TEE concludes that there is a low probability that elevated concentrations of copper, lead, and zinc in Wetland Area soils at the Site are causing adverse effects to terrestrial ecological receptors. In addition, there were no indicators of poor plant or wildlife health. Based on these findings, Site-specific pCULs for copper, lead, and zinc are proposed at protective levels based on the WOE evaluation and are presented in Tables 7-3b and 8-18. The application of these pCULs as SLs eliminates the consideration of copper and lead as Wetland Area soil COCs. These concentrations are defined as the Ecological pCULs for the associated metals within the Wetland Area of the Site but not the Landfill Area. Additionally, the TEE addresses the presence of other COCs in the Wetland Area through its finding of no adverse effects though additional COCs with Wetland Area exceedances, such as select SVOCs, TPH-DRO/ORO, and TPH-GRO, were not analyzed in discrete samples associated with specific TEE locations.

8.5 Contaminants of Concern

Based on the screening of COPCs, a set of COCs were identified for each media evaluated (surface water, groundwater, and soil). These COCs were identified by reviewing Human Health and Ecological SL exceedances for COPCs that were detected, as well as the Site CSM and COPC specific findings. The COCs identified in the following sections may continue to be monitored in surface water, groundwater, and soil after the RA is complete. Because of the unique setting of the Wetland Area, the TEE was conducted, and a WOE approach was used to determine Site-specific pCULs for the protection of terrestrial ecological receptors exclusively for the Wetland Area soils.

In addition, COPCs that were not detected, and that required elevation of the relevant SLs to the PQLs, may not be completely excluded as COPCs if the PQLs deviate from the QAPP. These compounds can be identified through a lack of green highlighting in the rightmost columns of Tables 7-1a, 7-1b, 7-2a, 7-2b, 7-3a, and 7-3b, and include PCBs, VOCs, and SVOCs (all analyzed matrices, Human Health and/or Ecological); thallium (groundwater, Human Health); hexavalent chromium (soil, Human Health). However, only hexavalent chromium is causing exceedances of Human Health or Ecological SLs in groundwater or surface water. These analytes will be tested per the QAPP and evaluated during the cleanup but will not be considered as COCs for the purpose of established cleanup alternatives. The potential risks to Human Health or Ecological risks are limited to direct contact pathway. All cleanup alternatives will be able to address this pathway.

8.5.1 Surface Water

Through the screening process, surface water COPCs that exceeded Human Health and/or Ecological SLs in areas where landfill impacts may be present were retained as COCs if there was not a technical basis for their exclusion. The following COCs have been identified for Site (Landfill and Wetland Areas) surface water:

- **Metals:**
  - Hexavalent chromium
  - Zinc

8.5.2 Groundwater

Through the screening process, groundwater COPCs that exceeded Human Health and/or Ecological SLs in areas where landfill impacts may be present were retained as COCs if there was not a technical basis for their exclusion. The following COCs have been identified for Site (Landfill and Wetland Areas) groundwater:

- **Metals:**
  - Hexavalent chromium
  - Iron
  - Zinc

8.5.3 Soil

Soil COCs have been identified for both the Landfill and Wetland Areas based on the screening conducted on analytical results. Through the screening process, COPCs that exceeded Human Health and/or Ecological SLs in areas where landfill impacts may be present were retained as COCs if there was not a technical basis for their exclusion. The following sections summarize the soil COCs identified for the Landfill and Wetland Areas.

8.5.3.1 Landfill Area

The lists below detail the COCs identified for soil in the Landfill Area through the screening process:

- **Metals:**
  - Arsenic
  - Cadmium
  - Chromium
  - Copper
  - Iron (not analyzed in Site soil, but iron is included because of groundwater SL exceedances in Landfill Area wells)
  - Lead
  - Nickel
  - Zinc
- **SVOCs:**
  - PCP
  - Total cPAHs
- **TPH:**
  - DRO/ORO
  - GRO

8.5.3.2 Wetland Area

The lists below detail the COCs identified for soil in the Wetland Area through the screening process:

- **Metals:**
  - Iron (not analyzed in Site soil, but iron is included because of groundwater SL exceedances in Wetland Area wells)
  - Zinc

- **TPH:**
  - DRO/ORO
  - GRO

As previously discussed in Section 7.3, Table 7-5 provides a comparison of the most stringent Human Health direct contact SLs (Method B Cancer, Method B Non-Cancer, or Method A unrestricted use) against the maximum detected result and the 95th percentile UCL for Wetland Area soils. Appendix F contains documentation supporting the derivation of the 95th percentile UCL for Wetland Area metal COCs. This comparison demonstrates that no SVOCs exceeded the direct contact SLs. TPH-GRO exceeded the direct contact SL in the composite samples from transects HA-02, HA-03, and HA-04 (Table 8-15). TPH-DRO/ORO exceeded the Ecological SL, based on the Soil Ecological Indicator for soil biota, in the composite samples from transects HA-03 and HA-04. However, based on the TEE results, these concentrations are not thought to be harming the ecological conditions (Section 8.4).

8.6 Geotechnical Investigation Results

Geotechnical sampling conducted as part of the RI was described in Section 4.2.1.2 and the results are presented in this section. Sample B-1 was analyzed for Atterberg limits and found to contain organic, dense clays and silts at 20 ft bgs, which is likely native soil. Particle size analyses were conducted on samples collected from B-1 at 25 ft bgs, SB-10 at 25 ft bgs, SB-14 at 5 ft bgs, and SB-17 at 40 ft bgs. This evaluation found a high proportion of sand in materials underlying the landfill waste. Recommendations for the excavation of the landfill include excavating loose material to dense, silty sand till (where possible), creating a base of free draining granular fill and drainpipes to prevent a buildup of pore pressure, using WSDOT-approved borrow materials (also tested clean) as cover, and excavating soft peat soils and backfilling with dense silty sand or Mashel formation where necessary to meet grade in the Wetland Area. The geotechnical report is presented in Appendix E.

8.7 Geophysical Results

The geophysical survey (Section 4.2.2.5) indicated that the waste prism at the middle of the landfill is approximately 20 to 30 ft thick and thins to approximately 6 ft thick at its upslope edges. Based on the existing landfill profile and natural grade of nearby slopes, the lower portion of the waste prism is likely a similar thickness. Figures 8-6a and 8-6b provide the results from the seismic data profiles. Low wave compression signals represented by blue are thought to be indicative of anthropogenic disturbance and waste. Using these data, a three-dimensional depiction of the landfill waste prism thickness was developed (Figure 8-7). This depiction shows wastes approximately 31 ft thick in the center portions of the landfill footprint below where the slope steepens. Along the lowest seismic line perpendicular to the slope the waste thickness tapers off at the edges. Near the upper portions of the landfill thinner waste deposits are present. The geophysical report is presented in Appendix G.

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9 Proposed Cleanup Levels and Points of Compliance

In accordance with MTCA regulations (WAC 173-340), Site-specific pCULs for surface water, groundwater, and soil COCs were developed based on applicable receptors and exposure pathways. The POCs are the locations and media where Site pCULs identified in Sections 9.1 and 9.2 must be attained. The proposed POCs for the Site have been identified in accordance with the regulatory requirements contained within WAC 173-340-720 through 173-340-740.

9.1 Cleanup Levels

The soil pCULs were developed for both the Landfill Area and Wetland Area separately to account for the differences in their pathways based on the CSM and the findings of the TEE WOE that was completed in the Wetland Area. Soil pCULs from the TEE WOE work that are applicable to the Wetland Area only are presented in Table 8-18. The pCULs for each media by Site area are summarized in the following sections and in Table 9-1.

9.1.1 Surface Water

Tables 7-1a and 7-1b summarize the Human Health and Ecological surface water SLs, respectively, and Table 9-1 shows the surface water pCULs for the Site. These pCULs are limited to hexavalent chromium and zinc. The source of these pCULs is the Ecology CLARC database (Ecology, 2023) and Section 304 of the Clean Water Act. For protection of aquatic life, the lowest applicable freshwater criteria (chronic or acute) from these sources was used as the pCUL.

9.1.2 Groundwater

Tables 7-2a and 7-2b summarize the Human Health and Ecological groundwater SLs, respectively, and Table 9-1 identifies the groundwater pCULs for the Site. These pCULs are limited to hexavalent chromium, iron, and zinc. The MTCA Method B Cancer (hexavalent chromium), MTCA Method B Potable Groundwater criteria (iron), and the WAC 173-201A-240 freshwater chronic criteria for aquatic life are proposed as pCULs. The source of the listed pCULs is MTCA's CLARC database (Ecology, 2023).

9.1.3 Soil

Soil pCULs for the Landfill and Wetland Areas of the Site differ because of the different metals found to be present above SLs, and because the Site-specific TEE WOE evaluation resulted in proposed adjusted SLs for copper, lead, and zinc in the Wetland Area. Tables 7-3a and 7-3b summarize the Human Health and Ecological soil SLs, respectively, and Table 9-1 identifies the area-specific pCUL for the Site. The derivation of pCULs for these two areas are discussed separately below.

9.1.3.1 Landfill Area

The source of most of the numeric SLs in Tables 7-3a and 7-3b are based on the MTCA CULs and Risk Calculation (CLARC) database (Ecology, 2023) and WAC 173-340-7493, Table 749-3. Because of iron's presence in groundwater above its MTCA Method B pCUL based on the Potable Groundwater Cleanup Level, an iron pCUL for soil should be implemented in the Landfill Area. This pCUL is based on the MTCA Method B Protective of Groundwater, Saturated CUL (7.6 mg/kg) adjusted to the natural background concentration of iron (42,100 mg/kg). The soil pCULs identified in Table 9-1 are intended to be protective of Human Health and Ecological receptors and are based on a future unrestricted use scenario for the Landfill Area. In general, among the Human Health and Ecological SLs, the lower, more protective value was selected as the pCUL. The pCULs for arsenic, chromium, iron, nickel, and zinc were set to their natural background concentrations, which may not be representative of Site conditions before landfilling. The pCUL for lead is based on the Soil Ecological Indicator for plants; this is because lead in Landfill Area soil is only evaluated based on direct contact risk for Human Health, and the Soil Ecological Indicator for plants CUL is lower than the Method A Unrestricted Land Use Human Health SL. The pCUL for copper is based on Soil Ecological Indicator for soil biota; this is because copper in Landfill Area soil is only evaluated based on direct contact risk for Human Health, and the Soil Ecological Indicator for soil biota CUL is lower than the Method B Direct Contact, Non-Cancer Human Health SL. The pCUL for cadmium is based on the Soil Ecological Indicator for plants.

9.1.3.2 Wetland Area

The TEE WOE evaluation work conducted in the Wetland Area (Sections 4.2.6 and 8.5, Appendix D) provides a basis for developing revised Ecological pCULs based on Site-specific conditions for copper, lead, and zinc. For the Human Health scenario and all other constituents, the pCUL is based on MTCA Human Health and Ecological SLs representative of active pathways. The only COCs identified in wetland soil are zinc, iron, TPH-DRO/ORO, and TPH-GRO. Iron was not sampled in Wetland Area soil but is retained as a COC because of groundwater exceedances in the Wetland Area. Metals in the Wetland Area sampling locations are all equal to or less than their pCULs. TPH-DRO/ORO and TPH-GRO are above their pCULs and will need to be addressed through the RA. The pCULs for the Wetland Area are presented in Table 9-1 and are protective of Human Health and Ecological receptors.

9.2 Air

Adverse impacts to air quality related to Site COCs are not anticipated. Therefore, pCULs for airborne contaminants are not proposed.

9.3 Points of Compliance

Two types of POCs were considered for the different media at the Site:

- **Standard POC.** A standard POC is generally defined by the media for the entirety of the site. Unless a site qualifies for a conditional POC, CULs must be met at the standard POC for each media (soil, groundwater, and surface water).
- **Conditional POC.** Where it can be demonstrated under WAC 173-340-350 through 173-340-390 that it is not practicable to meet the pCUL throughout the Site within a reasonable restoration time frame, Ecology may approve a conditional POC established as close as practicable to the source of hazardous substances and generally not extending beyond the Property boundary. Where a conditional POC is proposed, it is necessary to demonstrate that all practicable methods of treatment are or will be used in the site cleanup.

The POCs proposed for surface water, groundwater, and soil at the Site are discussed in the following sections.

9.3.1 Surface Water

A standard POC is proposed for surface water. Per WAC 173-340-730(6)(a), the POC for surface water "shall be at the point or points at which hazardous substances are released to surface waters of the state." Per WAC 173-201A-020, "Surface waters of the state includes lakes, rivers, ponds, streams, inland waters, saltwater, wetlands and all other surface waters and water courses within the jurisdiction of the state of Washington." Per these requirements, the standard POC for surface water will be established within the Wetland Area, which integrates spring and seep flows from the Landfill Area. The surface water POC is where the surface water pCULs identified in Section 9.3 (Table 9-1) must be attained, consistent with WAC 173-340-730(6). Locations where surface water runoff concentrates along the flow path to the Mashel River downgradient of Landfill and Wetland Area impacts (Figures 3-3 and 3-4) will be identified. This POC will be representative of sitewide surface water impacts and will allow for repeated measurements at the same location so long as flow is present.

9.3.2 Groundwater

For groundwater, a standard POC shall be established throughout the Site from the uppermost level of the saturated zone extending vertically to the lowest depth that could potentially be affected. The groundwater POC is established where the groundwater pCULs identified in Section 9.2 (Table 9-1) must be attained, consistent with WAC 173-340-720(8). Iron in groundwater exceeded SLs in both the Landfill Area (PZ-01, PZ-02) and the Wetland Area (PZ-03, PZ-04), and zinc only exceeded SLs in the Landfill Area (GW-01). However, monitoring wells located in the Wetland Area are immediately downgradient of the Landfill Area and therefore reflect landfill-contaminated groundwater. Therefore, groundwater standard POC monitoring locations are proposed beneath the landfill and immediately downgradient of the toe of the landfill on the boundary of the Wetland Area, which will represent the portions of the aquifer where Site impacts are most likely to be observed.

9.3.3 Soil

A standard POC is proposed for soil in both the Landfill and Wetland Areas. The POC for soil is based on the human exposure via direct contact and ecological considerations based on the TEE. The CULs must be met in soils throughout the Site from the ground surface to 15 ft bgs for human exposure, 6 ft bgs for ecological exposure, and the entire soil column for the protection of groundwater. This is where the soil pCULs identified in Section 9.1.2 (Table 9-1) must be attained, consistent with WAC 173-340-740(6). The Wetland Area pCULs include an area-specific value developed through the TEE (Section 8.4) for zinc.

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FEASIBILITY STUDY

The second section of this report is the FS, in which the proposed remedial alternatives are described and considered against the goals and limitations of the project. The RAOs and ARARs are established, applicable remedial technologies are identified, and four remedial alternatives (two for the Landfill Area and two for the Wetland Area) are proposed. These alternatives are evaluated against the threshold requirements (per WAC 173-340-360(2)(a)) and using a DCA. Based on the objectives, requirements, and evaluations conducted, a proposed remedial alternative is presented for further consideration by Ecology.

10 Remedial Action Objectives and Requirements

This section establishes the RAOs and ARARs that will be used in the FS.

10.1 Remedial Action Objectives

Based on the CSM (Section 5) and the RI results (Section 8), the primary RAO is to protect human health and the environment by eliminating unacceptable exposures for potential future park visitors, occupational workers, and ecological receptors. Other RAOs include the following:

- Soil and Solid Waste
  - Eliminate exposure to waste and contaminants for human receptors through removal, isolation, administrative controls, and natural attenuation.
  - Control or eliminate erosion of waste and impacted soil from the landfill.
  - Control unacceptable risk to ecological receptors in direct contact with soil.
  - Control or eliminate impacts from waste and contaminated soil to groundwater and surface water.
- Groundwater
  - Provide for beneficial use of groundwater post-RA or within a reasonable restoration time frame.
  - Prevent impacted groundwater (if identified in post-RA sampling) from impacting surface water resources.
- Surface Water
  - Provide for beneficial use of surface water post-RA or within a reasonable restoration time frame.
  - Control, treat, and/or eliminate leachate generation from landfill waste.

In addition, the cleanup action must include any planned future uses of the Site and any habitat restoration or resource recovery goals.

10.2 Applicable or Relevant and Appropriate Requirements

Cleanup actions conducted under MTCA must comply with applicable state and federal laws. Applicable state and federal laws include legally applicable requirements and those requirements that Ecology determines to be relevant and appropriate as described in WAC 173-340-710, which are referred to as ARARs. ARARs typically fall into three categories: chemical-specific, location-specific, and action-specific. The ARARs potentially applicable to each RA alternative were evaluated and are discussed below and summarized in Table 10-1. The alternatives evaluated in this FS comply with the intent of these laws and statutes and are protective of human health and the environment.

Cleanup actions conducted under MTCA under an agreed order are exempt from the procedural requirements of certain state and federal laws (i.e., RCW chapters 70A.15, 70A.205, 70A.300, 77.55, 90.48, and 90.58) and the procedural requirements of any laws requiring or authorizing local government permits or approvals for the RA. However, the cleanup must comply with the substantive provisions of the laws, permit requirements, or approvals pursuant to such laws (RCW 70A-305-090).

10.2.1 Chemical-Specific Applicable or Relevant and Appropriate Requirements

Chemical-specific ARARs set health or risk-based concentrations in environmental media (i.e., soil, groundwater, and surface water) for specific hazardous substances, pollutants, or contaminants. Chemical-specific ARARs will be referenced to determine whether proposed RA options are protective of human health and the environment based on chemical concentrations in landfill media.

10.2.2 Location-Specific Applicable or Relevant and Appropriate Requirements

Location-specific ARARs set restrictions on activities within geographic areas with potential impacts to wildlife, habitat, biota, fish, and cultural resources specific to the Site's location.

10.2.3 Action-Specific Applicable or Relevant and Appropriate Requirements

Potential action-specific ARARs set controls or restrictions on particular types of activities included in the selected remedial alternative. Action-specific ARARs are used to indicate how selected remedial technologies can be applied to the Site (i.e., waste disposal, excavation, grading). They also indicate specific requirements for the Landfill and Wetland Areas.

11 Identification of Applicable Remedial Alternatives

In accordance with WAC 173-340-350(8)(b)(i) and (ii), an initial screening of remedial alternative technologies was completed. Multiple alternatives were evaluated, including consideration of the characteristics and complexity of the Site, current Site conditions, and physical constraints. In accordance with applicable MTCA criteria, the evaluation included at least one permanent alternative and one alternative with a standard POC. Any alternatives that allow waste or contaminated soil to be left in place will require a standard POC, as described in Section 9.5. The following types of alternatives and technologies were eliminated from further analysis in the initial screening:

- Alternatives or technologies that clearly do not meet the minimum selection requirements in WAC 173-340-360, including alternatives with disproportionate costs in relation to the benefits.
- Alternatives or technologies that are not technically possible to implement on the Site.
- "No action" alternatives that do not involve any RA at the Site.

The remaining alternatives and process options were determined to be applicable to the Site and were identified for further evaluation. The initial screening of these alternatives is summarized below.

11.1 Institutional Controls

Institutional controls (ICs) are defined in WAC 173-349-440 as "measures undertaken to limit or prohibit activities that may interfere with the integrity of an interim action or cleanup action or that may result in exposure to hazardous substances at a site." ICs are intended to facilitate long-term protection of human health and the environment. These may be physical, legal, or administrative tools to ensure that hazardous waste left in place at the completion of the RA does not pose a risk to human health. ICs include preventing certain uses of a property, installation of barriers (such as signage, fencing, or legal land-use restrictions), and defining the required maintenance of these controls. If complete waste removal does not occur and/or contaminants remain above pCULs after RA, long-term maintenance such as inspections, repairs, and educational programs or advisories may be required. ICs are implementable and may be effective as an element of a permanent RA. ICs are retained for further analysis as an element of the retained alternatives.

11.2 Engineering Controls

Engineering controls (ECs) are physical measures that are designed to prevent or minimize exposure to contamination remaining on the Site. For the landfill, if no waste removal or only partial waste removal occurred, ECs can be effective tools for ensuring the long-term protection of human health and the environment. Example ECs include capping of the landfill using impermeable geotextiles or other barriers to prevent downward percolation of precipitation from contacting landfill waste, and leachate collection to prevent contaminant contact with soil and groundwater beyond the toe of the landfill. For the Wetland Area, this could include capping of elevated metals concentrations in soil and collection of leachates at the toe of the landfill to prevent impacting the Wetland Area. ECs are implementable and are retained for further analysis of alternatives where waste is not fully removed.

11.3 Waste Removal

Waste removal to the maximum extent practicable would ensure the long-term protection of human health and the environment at the Site because the contaminant source would be removed. Waste removal may be combined with soil removal, and all material removal options would need to be combined with permitted off-site disposal. Soil removal and off-site disposal options are described below. This alternative is retained for further analysis and serves as a permanent alternative baseline against which other alternatives are evaluated, to determine whether the RAs selected are permanent to the maximum extent practicable.

11.4 Soil Removal

Contaminated soil removal to the maximum extent practicable would result in a permanent protective solution with no ICs because the contaminated material would be removed. However, removal actions must be balanced against disruptions to the environment and any disproportionate costs in comparison to benefits. Soil removal would need to be combined with permitted off-site disposal. The soil removal alternative is retained for further analysis and serves as a permanent alternative baseline against which other alternatives are evaluated, to determine whether the RAs selected are permanent to the maximum extent practicable.

11.5 Off-Site Disposal

This technology is combined with soil and/or excavation alternatives and is effective in protecting human health and the environment at the Site for the long term. Near-site and off-site disposal options were considered and are presented in the Eatonville Landfill – Explanation of Engineering Level Cost Evaluation for Landfill Closure Memorandum (GSI, 2021b). The borrow pit is located near the Site on Nisqually State Park property; however, moving waste from the current location to the borrow pit presents a number of logistical and regulatory challenges. In addition to the regulatory requirements, disposal at the borrow pit would likely require support for and the purchase of additional property from State Parks to properly construct a new landfill. Near-site disposal options were not carried forward.

Off-site disposal to an existing Resource Conservation and Recovery Act (RCRA) Subtitle D landfill remains an option. Off-site disposal would require waste characterization (1) in accordance with local, state, and federal requirements before transport and disposal; and (2) that non-Subtitle D waste be segregated from the municipal wastes before landfilling. Waste streams would be segregated on-site at the top of the landfill or potentially using the adjacent borrow pit area, and these separated waste streams would be disposed of in accordance with regulatory requirements. At a minimum, segregation is anticipated to include tires, recyclable metals, and green waste. Tires require special disposal authorization from most receiving facilities, green waste can be composted or staged for State Parks use, and recyclable metals would be delivered to a recycling facility. Off-site disposal of landfill waste and contaminated soil to the maximum extent practicable is carried forward as a viable remedial technology.

11.6 In Situ Treatment

Treatment options for groundwater and surface water are available and could reduce or remove contaminants in water before discharging beyond the toe of the landfill. However, water treatment alone would not address the source of contaminants (landfill waste and impacted soil) and would not meet the RAOs for the project. Water treatment may be considered to augment primary remedial technologies, but options for directly treating the landfill waste prism and Wetland Area soils are generally not viable. The exceptions to this are TPH-DRO/ORO and TPH-GRO, which may be remediated using natural attenuation mechanisms such as biological and chemical degradation, as both hydrocarbon ranges are shown to readily degrade naturally in soils and groundwaters (Lahvis et al., 1999; Nishiwaki et al., 2018; Kao et al., 2006; Kao and Prosser, 2001; Kampbell et al., 2001; Boopathy, 2004; ITRC, 2018; EPA, 1999; Eriksson et al., 1998; Ledezma-Villanueva et al., 2016).

Active treatment of groundwater, surface water, and/or leachate is not readily implementable at the Site, as the Site is remote, located on or accessed by steep grades, and would potentially require water collection at multiple seepage locations. In addition, a limited footprint is available for placement of a treatment system. Therefore, active treatment is not carried forward as a viable technology.

Passive in situ leachate treatment options, such as permeable reactive barriers or filtration of discharge through active media, are available and may be effective as a lower cost and less complex technology to remove contaminants from leachate before discharge than active treatment. This alternative would be expected to treat all COCs present in the leachate. Therefore, passive in situ treatment is carried forward in this evaluation.

11.7 Evaluation and Selection of Representative Technologies

Based on the initial screening, the following representative technologies are retained for further remedial alternative analysis:

- ICs
- ECs (landfill cap)
- Waste removal to the maximum extent practicable
- Impacted soil removal
- Off-site disposal of waste and impacted soil
- Monitored natural attenuation (MNA) of TPH-DRO/ORO and TPH-GRO in Wetland Area soil
- Passive in situ water treatment

The execution of the RA will require a combination of the technologies under consideration in use across the Site. These combinations are presented as RA alternatives in Section 12.

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12 Remedial Action Alternatives

This section provides a description of the RA alternatives under consideration at the Site. Based on discussions with Site stakeholders and interested parties, including Ecology, Weyerhaeuser, the Town, State Parks, and the Nisqually Indian Tribe, and considering Site-specific conditions and regulatory requirements, the Landfill and Wetland Areas will be evaluated as separate RAs. Two RA alternatives each were developed for the Landfill and Wetland Areas. The Landfill and Wetland Areas subject to the development of remedial alternatives are generally defined by the results of the screening process applied to media in the different Site areas presented in Section 6. Figure 12-1 shows the refined Site areas (Landfill and Wetland) used to develop the RA alternatives. All RA alternatives were developed with consideration for public concerns, including vulnerable populations and overburdened communities, per WAC 173-340-360 (3)(f)(vii).

For the Landfill Area, Alternative 1A (Section 12.2.1) includes full waste removal (including discrete waste that has migrated into the Wetland Area and a 0.04-acre area along the path of the spring [Figure 12-1]) and impacted soil (within the landfill footprint) removal, followed by re-grading and restoration. Impacted soil removal within the landfill footprint also includes removal of 0.3 acres of soil from the overlapping inferred wetlands within the Landfill Area and 0.05 acres of soil from the wetland lobe at the southern border of the Landfill Area (Figure 12-1). This alternative would include removal of discrete wastes that have migrated into the Wetland Area. Alternative 1B (Section 12.2.2) includes partial waste removal (including discrete waste that has migrated into 0.6 acres of the Wetland Area [Figure 12-1]), re-grading of the remaining waste, and isolation of remaining waste (capping). Note that based on the data screening results, the Landfill Area subject to RA does not include HA-01Aa, HA-01Ab, and HA-02G. The extent of the Landfill Area along its southern boundary with the Wetland Area is modified by adding a south-extending lobe to account for the high concentrations of zinc in surface soil shown on Figure 8-4b. By including the area between the HA-01 and the HA-02 transects in the vicinity of HA-01D and HA-02D as part of the Landfill Area RA, the Site-specific pCULs for the Wetland Area can be adhered to because concentrations at HA-02D are below the Wetland Area pCULs. The extents of the landfill RA area are shown on Figure 12-1.

For the Wetland Area, Alternative 2A (Section 12.3.1) includes removal of contaminated soil above the Wetland Area pCULs. Alternative 2B (Section 12.3.2) assumes isolation of impacted soil for the protection of human health through implementation of ICs, and the reduction of TPH-DRO/ORO and TPH-GRO concentrations through natural attenuation processes; no soil removal is required for ecological purposes (based on the pCULs for the wetlands). Table 12-1 summarizes the alternatives. The Wetland Area subject to RA includes all locations on transects HA-02 through HA-07 (except for HA-02G). The extents of the wetland RA area are shown on Figure 12-1.

12.1 Common Elements for Landfill and Wetland Area Alternatives

Cleanup action Alternatives 1A/1B and 2A/2B would include common elements that are necessary, regardless of the remedy selected. The descriptions of the two alternatives do not necessarily include these common elements; however, the specific costs for the common elements are included in the estimates and are listed below:

- Meeting substantive requirements of any permitting in accordance with RCW 70A-30-090, which will include consultation with USACE and Ecology.
- Confirmation sampling of the limits of excavation.
- Temporary and final permanent erosion and sedimentation controls.
- Removal of discrete wastes that have migrated into the Wetland Area along with remove of landfill wastes.

- Site restoration.
- Closure reporting.
- Installation of one or more monitoring wells into the Vashon Formation underlying the landfill waste prisms footprint post-RA and eventual removal.
- Installation of two or more monitoring wells at the toe of the landfill and eventual removal of wells upon restoration completion.
- Identifying locations where surface water runoff concentrates along the flow path to the Mashel River downgradient of Landfill and Wetland Area impacts
- Restrictions on the use of groundwater and surface water through the implementation of ICs for human consumption and exposure until CULs are met.
- Compliance monitoring and reporting (assumes up to quarterly sampling the first year following completion, followed by 2 years of semi-annual monitoring, and annual monitoring for Years 4 and 5 following completion).
- Five-year periodic reviews, as required by Ecology pursuant to WAC 173-340-420.

12.2 Landfill Area Alternatives

The following sections present remedial Alternatives 1A and 1B for the Landfill Area.

12.2.1 Alternative 1A: Waste and Impacted Soil Removal to the Maximum Practicable Extents

Alternative 1A represents the most comprehensive RA alternative to address the contaminant source and impacted soil within the estimated extents of the landfill waste prism (Figure 12-2 and Table 12-1). Alternative 1A consists of:

- Clearing vegetation to allow for Site access.
- Improving the access road for material hauling and restoration activities.
- Development of a material separation/processing and loadout area at the former borrow pit or above the landfill.
- Temporarily re-directing spring discharge on the west edge of the landfill to limit impacts from construction-related runoff during removal activities.
- Full removal of approximately 21,500 CY of solid waste and up to 1,800 CY of impacted soil (removed to the maximum extent practicable from the waste prism and up to 1 ft of soil removal below the waste prism, or as otherwise necessary to remove impacted soil above pCULs) via excavation. The excavated soil and solid waste above CULs will be transported, as required, and disposed at regulated solid waste landfill and recycling waste facilities in accordance with all applicable laws. This estimate is based on multiple lines of evidence, including the land survey (Section 4.2.2.6), results of the geotechnical investigation (Section 8.6), and the geophysical survey (Section 8.7). These lines of evidence have uncertainty associated with them because of access challenges and the geophysical survey best represents conditions immediately below the seismic lines. Additionally, the depth and extent of soil impacts beneath the waste prism is not known at this time because of access constraints.
- The depth of the impacted soil is uncertain because of difficulty accessing soil below the waste prism. Leave surface sampling will be performed post-waste removal and contaminated soil will be removed to

below pCULs. It is assumed there will likely be limited soil removal at the waste prism and native soil interface (less than 1 ft in most places).

- Removal of discrete landfill solid wastes that have migrated into the Wetland Area. Ecology and the USACE will be consulted during the remedial design phase to ensure that impacts to wetlands are considered during removal and BMPs are integrated into the design.
- Targeted soil removal in the vicinity of the HA-X sampling location in the ravine on the northwest side of the landfill (this location is outside of the landfill waste prism and Wetland Area).
- Stabilizing the landfill footprint and transition edges of the hillslope through slope reduction and benching. Slope reductions/benching would generate excess clean material (potentially 6,000 to 9,000 CY) that would be used for grading and habitat restoration and any excess material would be stockpiled.
- Restoration/revegetation of disturbed areas.
- Installing monitoring wells in the center of the landfill waste prism and at the toe of the landfill for compliance monitoring at the frequency specified in Section 12.1.

Removal of impacted soils from the landfill and waste from the Landfill and Wetland Areas through excavation eliminates future risk to human health and the environment in the Landfill Area, because the selected pCULs represent the most conservative CULs considered for active pathways, or represent the background concentration of COCs. This removal action is also expected to eliminate the primary original, and likely ongoing, source of contamination to the Wetland Area. Alternative 1A assumes that waste materials would be accepted by the LRI Landfill in Puyallup, Washington, or an alternative Subtitle D landfill identified during final design, and no waste materials would be designated as “hazardous” (i.e., requiring Subtitle C landfill disposal). Green waste (i.e., vegetation), tires, and large metal debris would require special disposal.

12.2.1.1 Removal of Waste to the Maximum Extent Practicable

Full removal of landfill waste to the maximum extent practicable is a stepwise process consisting of:

- Mobilization and staging construction equipment at the Site and potentially at the borrow pit area (or a similar open area).
- Clearing and grubbing of vegetative material within the work area. Removed vegetation would be hauled to a green waste recycler, stockpiled for future use, or reused in restoration activities.
- Preparing the borrow pit area located on Nisqually State Park property or an area to be used as a material processing and staging area, including construction trailer placement, material and supply staging, and installation of a liner and a sacrificial protective cover layer for material processing. This will require coordination with State Parks, unless all work can be performed within the limits of the Property, which is unlikely because of the limited available space outside of the active work area.
- Waste removal via excavation and disposal beginning from the top of the slope and working down-slope using standard construction equipment.
- Low-impact and/or hand removal of tires and other wastes that have migrated beyond the toe of the landfill into the Wetland Area over time.
- Building of temporary access roads or tiered benches along the excavated face of the landfill as removal proceeds down-slope for the purposes of loading waste into haul trucks and installing the groundwater POC at the completion of waste and soil removal.
- Moving waste to the on-site staging area where waste streams would be segregated into the following types before off-site disposal at an approved facility: municipal solid waste, and green waste. If identified

during removal, additional segregation may include universal waste (commonly recycled wastes with special management provisions [e.g., batteries], hazardous waste [i.e., asbestos, drums], and recyclables).

- Removal and disposal of impacted soil at the waste interface, where encountered, to meet pCULs. Confirmation sampling of the final cut surface will ensure that soil concentrations below pCULs are achieved.

After removal of waste to the maximum extent practicable and any impacted soil (in the Landfill Area only) below the waste is complete, the clean soils would be shaped to form a slope no steeper than 2H:1V, with benches where necessary. The final slope angle and determination of bench locations would consider the RI geotechnical investigation (Appendix E), ARARs, and further design analyses. Based on preliminary evaluations of the anticipated waste removal, a slope of 2H:1V would require excavation of clean soil beyond the removal of the waste prism and impacted soils below the waste prism. Clean soil and any larger rocks or boulders would be segregated and staged separate from waste and impacted soil materials. If loose sand or gravel is observed at the final subgrade surface, this material may require removal and replacement with stockpiled clean materials that meets geotechnical requirements. If insufficient structural clean fill is available, base course (such as crushed rock) can be imported or a 2.5H:1V maximum slope would be established. However, this is not anticipated to be required. This alternative assumes the stockpiled clean soil would be reused as fill or temporary road base course, where needed.

In this alternative, an access road would be maintained from the top to the toe of the landfill, or a series of tiered benches would be established for use in support of Site inspections and POC monitoring well installation, development, and future abandonment purposes. One of the temporary waste removal access roads may be improved for long-term use or a new road can be developed, or foot trails may be established to connect the tiered benches. It is currently assumed that two or three 15 ft wide benches would be constructed for geotechnical stability, releasing accumulated water in the hillslope soil, erosion control, and access to the toe of the landfill slope (Figure 12-2).

Following waste removal to the maximum practicable extents, removal of impacted soil beneath the footprint of the landfills waste prism based on results of leave surface sampling, and re-grading of the hill slope, restoration and wetland mitigation activities (as necessary) would be performed. The FS assumes the restoration and mitigation activities would include:

- Removal of invasive species near the disturbed soil boundary.
- Placement of topsoil to allow for plant establishment and growth.
- Placement of erosion control matting and straw wattles across all disturbed areas.
- Hydroseeding with a native grass mix with species selection based on discussion with State Parks.
- Select tree or shrub planting with species selection based on discussion with State Parks.
- Placement of large woody debris for both erosion control and habitat establishment.
- Wetland restoration and planting plan, if any impacts to the wetlands occur during removal activities.
- Wetland mitigation, where any loss of habitat is required in support of construction.
- Re-grading of the west ravine where the spring discharges, including installing a rock-lined channel or down-pipe with dissipators at the discharge to prevent undercutting and eroding the hillslope face.

Implementation of Alternative 1A provides an avenue to immediately and permanently address the landfill wastes and impacted soil in the Landfill Area in a way that removes contaminated media from the Site, minimizes long-term maintenance needs for the Property, and allows for a transfer of ownership to State Parks with minimal future restrictions on the Property. Post-construction inspections and monitoring would be completed to ensure proper slope construction and maintenance of vegetative cover (including invasive species monitoring). Inspections would include observations of erosion and the health of the vegetative cover and would be completed in conjunction with compliance monitoring for 5 years following completion. Compliance monitoring is assumed to be quarterly sampling for the first year following completion, followed by 2 years of semi-annual monitoring and then 2 years of annual monitoring. Longer monitoring periods may be needed if cleanup levels are not met, or as required by Ecology.

12.2.2 Alternative 1B: Partial Waste and Soil Removal and Capping

Alternative 1B assumes that the landfill is required to continue to comply with minimum functional standards presented in WAC 173-300 because the alternative leaves remaining waste in the original location and it would not be regulated under the Criteria for Municipal Solid Waste Landfill regulations (WAC 173-351). The alternative is shown and described in Figures 12-3a and 12-3b, and Table 12-1.

This approach, similar to Alternative 1A, would include removal of landfill waste and impacted soil via excavation, but rather than full removal to the maximum extents practicable, only approximately 12,000 CY of solid waste would be removed and disposed of off-site. Most of the removed waste would be sourced from the top of the slope to result in a final constructed slope of 2H:1V slope (with benches where required). Impacted soil underlying the removed waste would be removed to approximately 1 ft and confirmation sampling conducted to ensure that pCULs are met. This alternative would require the toe of the slope to be pushed out into the Wetland Area. This alternative would also include removal of landfill wastes that have migrated into the Wetland Area. To ensure that impacts to wetlands are addressed in the final design and mitigation approaches are agreed to, Ecology and the USACE will be consulted during the remedial design phase. Any exposed impacted soil at the waste interface, based on leave surface sampling, would be removed and used in the bedding layer for the underside of the liner system. Figure 12-3a shows this alternative. Waste removal would proceed in the same manner as described above for Alternative 1A (Section 12.2.1).

Any waste retained on Site would be regraded, as needed, compacted, and capped to prevent direct exposure and surface water infiltration (Figures 12-3a and 12-3b). The engineered cap would consist of screened on-site clean fill (and impacted soil, if found) to cover the remaining waste and would provide a smooth liner subgrade surface before installing the 60-mil high-density polyethylene liner. The landfill cap would require the installation of anchoring trenches around the perimeter of remaining waste. Trenches at the top and the toe of the cap would be installed into native soil, while the remainder of the perimeter anchor trench could be installed within engineered fill, if necessary. Anchor trenches would incorporate drainage features. Over the liner, the cap would consist of a geocomposite layer covered with a screened on-site sand or angular gravel fill for drainage, followed by screened on-site clean fill and topsoil at the surface to allow for a vegetation growth layer. The horizontal benches would have a 12- to 18-inch-thick layer of fill gravel installed to the surface so that vehicular traffic can continue to use the benches as access roads for long-term maintenance and landfill inspections if roads are utilized. The benches would contain drainage channels to quickly shed surface water runoff off the landfill face. Additionally, surface water collection trenches and conveyance would be required at the top and along the sides of the cap to collect and divert surface water away from the cap. Surface water would be diverted to the ravine northwest of the cap to the extent practical. Figure 12-3a shows these features of Alternative 1B.

At the toe of the remaining landfill waste, an earthen buttress system would be required to prevent movement over time, and a groundwater collection trench would be required below the liner system to collect, treat, and divert groundwater to prevent hydraulic buildup under the liner (Figure 12-3b). Treated groundwater would be discharged to the northwest towards the ravine. The collection trench would incorporate a permeable reactive barrier using treatment methods such as a customizable reagent (i.e., a metal binding/fixing or similar) to remove dissolved metals in the groundwater and leachate before discharge. The collection trench would be designed below the liner system and, as such, reactive barrier media is not anticipated to be replaced in the future. End of pipe treatment of leachate discharge would be the contingency measure required if the reactive barrier media were exhausted over time and continued treatment were required.

Following partial waste removal, waste capping, and re-grading the hill slope, restoration activities would be performed. The FS assumes this includes:

- Removal of invasive species near the disturbed soil boundary.
- Placement of erosion control matting and straw wattles across all disturbed final surfaces.
- Hydroseeding with a non-invasive rapid growth grass mix with species selection based on discussion with State Parks.
- Wetland restoration and planting plan, if any impacts to wetlands occur during removal of waste that has migrated beyond the landfill toe or during buttress placement.
- Re-grading of the west ravine where the spring discharges, including a rock-lined channel or down-pipe with dissipators at the discharge to prevent undercutting and eroding the hillslope face.
- Potential wetland mitigation if the wetlands on Site are defined as jurisdictional wetlands by USACE, where any loss of habitat is required in support of construction.

Alternative 1B would result in long-term ICs with an Environmental Covenant requiring ongoing maintenance and inspections and access limitations to prevent disturbance to the remediated Site, including:

- Management of the leachate collection system, as required.
- Maintenance of surface drainage channels and ditches.
- Irrigation of grass cover until establishment, as required based on season.
- Periodic inspections of the landfill soil and vegetative cover.
- Maintenance repairs to the landfill surface, as necessary.
- Groundwater monitoring well installation for compliance monitoring after the completion of the RA.

Inspections are assumed to occur for 20 years or less if stability of the landfill cover allows for discontinuing regular inspections and Ecology determines groundwater and leachate monitoring can cease because of adequate attenuation within a reasonable restoration time frame (approximately 10 years). Inspections would be completed in coordination with compliance monitoring plans. Long-term monitoring of the groundwater downgradient of the landfill and groundwater discharge to the ravine would be required to confirm that the cap is successful at isolating the remaining waste and that the treatment trench has effective ICs. Five-year reviews would be required with this alternative until the ICs can be removed.

12.3 Wetland Area Remedial Action Alternatives

The following sections present remedial Alternatives 2A and 2B for the Wetland Area.

12.3.1 Alternative 2A: Full Impacted Soil Removal

Alternative 2A would consist of full removal of 1.05 acres of impacted Wetland Area soils above the Human Health Direct Contact CULs (Section 8.5) and vegetation removal to allow for soil removal activities (Figure 12-2 and Table 12-1). This would involve clearing the densely vegetated trees, brushes, and other plants within the impacted Wetland Area, as well as removal of any landfill waste that have migrated to the Wetland Area. Following clearing and grubbing activities, approximately 3,400 CY of Wetland Area soils impacted by TPH-DRO/ORO and TPH-GRO at depths of up to approximately 2 ft bgs will be removed from the

Wetland Area and disposed of in a regulated solid waste landfill. After soil removal, confirmation sampling will be conducted to ensure that pCULs are attained. Following confirmation, clean, wetland-compatible fill will be placed back to the original grade, and restoration within the Wetland Area will occur (Figure 12-2). This will include any required mitigation of impacts to the ecological community within excavated areas. Alternative 2A assumes that impacted soil materials would be accepted by the LRI Landfill in Puyallup, Washington, or an alternative Subtitle D landfill identified during final design (without adding dewatering amendments because of dewatering of the wetland before removal). No waste materials would be designated as “hazardous” (i.e., requiring Subtitle C landfill disposal).

Full removal of Wetland Area soils would consist of:

- Confirming the status of the wetlands as jurisdictional by the USACE and/or waters of the State by Ecology and obtaining/extending any permits required based on this determination.
- Construction of access “finger roads” through the Wetland Area using clean fill to allow low ground pressure construction equipment to track beyond the toe of the landfill or use of swamp excavators to track over low-bearing pressure subgrade materials.
- Re-routing of the spring around the construction area would be required to minimize soil and temporary backfill saturation during work periods. Additionally, active dewatering of the wetlands with sumps and dewatering systems may be required in and around the work area and decanting or dewatering of soil may be required before off-haul.
- Clearing of vegetative material by certified arborists with expertise in the removal of middle-aged (approximately 50- to 75-year-old) trees, as well as dense wetland brush and plants. This removal will likely require specialized equipment.
- Clearing and grubbing of vegetative material within the work area, sufficient to allow for soil removal to proceed. Grubbed vegetation would be (1) off-hauled to a green waste recycler, if elevated metals concentrations are not identified in the vegetation and the materials are free of impacted soil; (2) off-hauled to a Subtitle D landfill when separation from impacted soil is not feasible; (3) stockpiled for future use, if elevated metals concentrations are not identified in the vegetation and the materials; or (4) reused in restoration activities, except for any root wads containing soil with elevated metals concentrations.
- Soil removal and disposal beginning at the farthest extents of soil impacts above pCULs is found and pulling back towards the toe of the landfill as removal occurs. Excavation would be performed with low-ground pressure excavators, long-reach excavators, “swamp excavators,” or a combination of equipment/approaches based on soil bearing pressures and access. Soil would be loaded into haul trucks for transport. As soil is removed, confirmation sampling at the excavation limits would be conducted using field screening techniques (i.e., field portable X-ray fluorescence on air-dried samples). After a clean bottom surface is defined, clean wetlands-compatible fill would be imported to return the Wetland Area to its original grade. The access roads would then be pulled back and soil removal would continue in this stepwise manner until reaching the toe of the landfill. At all times, separation between clean backfill materials and impacted soil must be maintained.
- Impacted soil staged in the borrow pit or other area would be loaded into trucks for disposal at the selected landfill.

Temporary erosion control measures for the wetlands would include silt fencing at the downgradient construction boundary and treating any dewatering discharges from sumps or dewatering systems in contact with impacted soil before returning these waters to the wetlands beyond the project limits. It is anticipated that limited erosion control measures will be needed during the construction work activities as the grade within the Wetland Area is relatively flat. Vegetation removed within wetlands would require re-establishment at the completion of the construction activities, in compliance with USACE and other permit requirements and in coordination with Ecology, State Parks, and WDFW. A Biological Opinion may be required to support the Joint Aquatic Resources Permit Application and to dictate construction BMPs and protective measures. All federal permits must be obtained for this alternative to be implemented.

Implementation of Alternative 2A requires ICs to restrict the use of Site groundwater and surface waters until their pCULs can be achieved. No ICs that limit direct contact with soils in the Wetland Area of the Site are needed. This alternative provides an avenue to address the Wetland Area in a manner that removes future liabilities, and limits future maintenance, while allowing for a transfer of ownership to State Parks with limited restrictions placed on the Property. In this alternative, post-construction inspections and monitoring are limited to ensuring that vegetation re-establishment is successful and ensuring that any trees or shrubs that die are replaced. These inspections would be completed in conjunction with compliance monitoring, which is assumed to be conducted annually for the first 5 years post-RA. However, because of the density of healthy vegetation in the wetlands and anticipated age of currently established trees, full re-establishment of vegetation and ecological life to its pre-remediation state is anticipated to take approximately 50 years based on the age of the trees present.

Alternative 2A would result in the removal of impacted soil from the Wetland Area, eliminating soil exceeding the most conservative direct contact Human Health CULs (MTCA Method A, Unrestricted Land Use or Method B, Direct Contact [Cancer or Non-Cancer]) and allowing for unrestricted use of the Wetland Area.

12.3.2 Alternative 2B: Natural Attenuation and Institutional Controls

As indicated in Section 12.2, selective waste removal within the Wetland Area would occur as part of either Alternative 1A or 1B for the Landfill Area. Under Alternative 2B, the primary method of compliance with cleanup standards would be isolation of TPH-GRO–impacted soil from human contact through use of ICs and natural attenuation of iron (if present above pCULs), zinc, TPH-DRO/ORO, and TPH-GRO within a reasonable restoration time frame (Figure 12-3a and Table 12-1). The Wetland Area has a presence of healthy flora, which provide a natural protective cover over soils, minimize erosional processes with a well-established root mass and canopy, and which is well understood to stabilize contaminants such as metals through natural biological processes (Yan et al., 2020; Bhat et al., 2022).

Based on the findings of the TEE indicating the contaminant levels in Wetland Area soils do not pose a risk to ecological receptors, impacted soil removal above pCULs within the Wetland Area would not be performed under Alternative 2B. The risks to human health were evaluated in the comparison of Direct Contact SLs to the maximum and 95th percentile UCL results in Wetland Area soils, and TPH-GRO is the only contaminant exceeding the SL (Table 8-18). Therefore, human contact with this contaminant may need to be controlled through the implementation of ICs to limit human access to, and direct contact with, soil in the Wetland Area with TPH-GRO concentrations above direct contact CULs until it naturally attenuates to concentrations below the pCUL. This TPH-GRO will naturally attenuate over time through physical and chemical degradation processes after the landfill source is removed, as the compounds in gasoline are readily biodegraded (Lahvis et al., 1999; Nishiwaki et al., 2018; Kao et al., 2006). Natural attenuation of gasoline has been favorably demonstrated through research (Kao and Prosser, 2001; Kampbell et al., 2001), and MNA and has been accepted for use as a remedial technology at petroleum spill cleanup sites when concentrations are low (i.e., Pacific Northwest National Laboratory, 2001; Wisconsin Department of Natural Resources, 2004; EPA, 1999). An IC for protecting public health to exposure risks posed by TPH-GRO through transect HA-04 will be needed until natural attenuation processes have reduced TPH-GRO concentrations below the pCUL.

In addition, the presence of TPH-DRO/ORO in Wetland Area soils above the pCUL are not thought to be impacting the ecological condition of the Wetland Area based on the results of the TEE (Section 8.4). However, concentrations of TPH-DRO/ORO will need to be monitored until natural attenuation processes have reduced TPH-DRO/ORO concentrations below the pCUL. These processes are also supported in research (Boopathy, 2004; Eriksson et al., 1998; Ledezma-Villanueva et al., 2016) and in petroleum cleanup guidance (ITRC, 2018; EPA, 1999).

Surface water and groundwater impacts at the Site from iron, hexavalent chromium, and zinc would largely be addressed by the actions identified in Alternatives 1A or 1B for the Landfill Area. These actions would remove or isolate the source of metals impacting surface water and groundwater that are associated with metal debris, tires, and other wastes present throughout the Landfill Area and in the Wetland Area. Impacts to soil from metals in the portions of the Wetland Area most distant from the landfill are not thought to be a source for surface water as evidenced by the lack of SL exceedances identified at monitoring locations (SW-07, 10, 11, and 14) associated with those areas during the RI/FS (Table 8-2). Groundwater impacts beneath the Wetland Area are also thought to be less significant than those associated with the landfill source area based on the CSM. Because of this, groundwater monitoring done during the RI and as part of the post-remedial action compliance monitoring will serve as a conservative point of reference for the evaluation of Site groundwater conditions.

Monitoring would be performed following landfill waste removal to ensure surface water in the wetlands has not been impacted by COCs found in surface waters near the toe of the landfill and that areas of previous surface water impact have been eliminated through source removal activities. Natural attenuation processes are an element of Alternative 2B and include bioturbation, biological degradation, physical degradation, and phytoextraction (e.g., contaminant uptake and removal, and destruction of organic contaminants) processes. These natural attenuation processes would be expected to result in recovery and achieving pCULs for TPH-DRO/ORO and TPH-GRO in less than 10 years and the further reduction of metals concentrations below CULs in Wetland Area soil overtime. Concentrations on TPH-DRO/ORO and TPH-GRO will be evaluated as part of an MNA program. When concentrations of TPH-GRO drop below the pCUL, access restriction ICs may be removed. Because Alternative 2B would meet the provisions of WAC 173-340-740(6)(f)(i-vi), it would meet MTCA standards for a final remedy by achieving CULs at the standard POC in a reasonable restoration time frame.

It is assumed that removal of waste materials and removal of distributed waste debris within the Wetland Area (Alternative 1A or 1B), and leachate controls (if Alternative 1B is chosen) would prevent continued impacts to the Wetland Area. Remaining metals concentrations above pCULs in the Wetland Area soils would not impact ecological receptors per the Site-specific TEE findings, do not pose a direct contact risk to humans (Section 8.4.1), and do not pose a risk to surface waters based on sampling performed to date, which shows concentrations of metals in surface waters beyond the point of landfill leaching being below their SLs.

Alternative 2B may require ICs to be implemented to limit activities that would allow for direct contact with soils impacted by TPH-GRO until the pCUL is met through natural attenuation processes, and restrict the use of groundwater for consumption. These ICs, if needed, may include signs, fencing, or deed restrictions to prohibit access into the Wetland Area up to transect HA-04 by humans and minimize contact with TPH-GRO, which is a direct contact risk. This direct contact risk posed by TPH-GRO will resolve over time as the concentrations of TPH-GRO naturally attenuate (Kao and Prosser, 2001; Kampbell et al., 2001; Lahvis et al., 1999; Nishiwaki et al., 2018; Kao et al., 2006). In addition, natural attenuation time frames for gasoline-range hydrocarbons are generally short (within a decade; USGS, 2003). Following the Property transfer to State Parks, a ban on shooting will be enforceable under their ownership (WAC 352-32-120). A minimal long-term operations and maintenance budget would be required to maintain ICs in perpetuity or until concentrations are sampled and found to be below unrestricted use Human Health SLs for TPH-GRO in the future and to confirm that concentrations of TPH-DRO/ORO have drop below the pCUL.

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13 Remedial Action Alternative Evaluation Criteria

This section provides descriptions of the MTCA requirements and detailed evaluation criteria used to determine the efficacy of the assembled alternatives.

13.1 Threshold and Other Requirements

RAs performed under MTCA must meet a set of minimum requirements, or threshold requirements. Per WAC 173-340-360(2)(a), alternatives that do not meet the threshold requirements are not considered viable RA alternatives. The threshold requirements are as follows:

- **Protect Human Health and the Environment.** Consider the degree to which an alternative meets MTCA cleanup standards, the degree to which the remedy is permanent, and the short-term risk associated with implementing the remedy.
- **Comply with Cleanup Standards.** For an alternative to be considered viable, the RA alternative must comply with cleanup standards, including the CULs (Sections 9.1 through 9.4), POCs (Section 9.5), and ARARs (Section 10.2).
- **Comply with Applicable State and Federal Laws.** RAs under MTCA must comply with applicable state and federal laws deemed relevant as discussed in Section 10.2.
- **Provide for Compliance Monitoring.** Per WAC 173-340-410, compliance monitoring can include protection, performance, or conformational monitoring. For remedies that propose on-site disposal, isolation of contaminated soils from human contact, or natural attenuation as the selected RA for all or a portion of a site, a long-term monitoring plan is required.

Per WAC 173-340-360(2)(b), selected actions that fulfill the threshold requirements must also meet other requirements:

- **Use Permanent Solutions to the Maximum Extent Practicable.** To determine whether a cleanup action uses permanent solutions to the maximum extent practicable, the DCA process shall be used (Section 13.2).
- **Provide for a Reasonable Restoration Time Frame.** Per WAC 173-340-360(4), RAs should provide for a reasonable restoration timeline considering factors such as:
    - Potential risks posed by the Site to human health and the environment.
    - Practicability of achieving a shorter restoration time frame.
    - Current use of the Site, surrounding areas, and associated resources that are, or may be, affected by releases from the Site.
    - Potential future use of the Site, surrounding areas, and associated resources that are, or may be, affected by releases from the Site.
    - Availability of alternative water supplies.
    - Likely effectiveness and reliability of ICs.
    - Ability to control and monitor migration of hazardous substances from the Site.
    - Toxicity of hazardous substances at the Site.
    - Natural processes that reduce concentrations of hazardous substances and have been documented to occur at the Site or under similar Site conditions.
- **Consider Public Concerns and Tribal Rights.** Public concerns and Tribal rights shall be considered through the public notice and participation process described in WAC 173-340-600. The consultation process will afford affected Tribes and members of the public the opportunity to comment on the selected RA.

13.2 Disproportionate Cost Analysis Ranking Criteria

The MTCA FS process calls for comparing the costs and benefits of alternatives and selecting the alternative with incremental costs that are proportionate to the incremental benefits using the DCA Ranking Criteria. The DCA is used to define the RA alternatives that are considered permanent to the maximum extent practicable. Table 13-1 summarizes the DCA. As outlined in WAC 173-340-360(3), MTCA provides a methodology that uses the criteria listed below:

- **Protectiveness.** The overall protectiveness of a RA alternative is evaluated on the basis of several factors: overall protectiveness of human health and the environment, including the degree to which existing risks are reduced; time required to reduce the risk at the Site and attain cleanup standards; on-site and off-site risks resulting from implementing the alternative; and improvement of the overall environmental quality.
- **Permanence.** MTCA specifies that when selecting a RA alternative, preference will be given to actions that are "permanent solutions to the maximum extent practicable." Evaluation criteria include the degree to which the alternative permanently reduces the toxicity, mobility, or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment processes, and the characteristics and quantity of treatment residuals generated.
- **Cost.** Costs associated with implementing a RA alternative include design, construction, long-term monitoring, agency oversight, ICs, the net present value of any long-term costs, and agency oversight. Long-term costs include operation and maintenance costs, monitoring costs, equipment replacement costs, and the cost of maintaining ICs. Unit costs were developed using construction cost estimates provided by relevant vendors and contractors, review of actual costs incurred from past remediation projects, EPA and Interstate Technology and Regulatory Council guidance documents, and professional judgment (Appendix H).
- **Long-Term Effectiveness.** Long-term effectiveness is the degree of certainty that the RA alternative will be successful in maintaining compliance with cleanup standards during the long-term performance of the RA, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes. MTCA provides a guide for ranking the long-term effectiveness of several types of technologies. MTCA ranks technologies in descending order as follows:
    - Reuse or recycling
    - Detoxification
    - Immobilization or solidification
    - Disposal in an engineered, lined, and monitored facility
    - On-site isolation with attendant ECs
    - ICs and monitoring
- **Management of Short-Term Risks.** The risk to human health and the environment associated with the RA alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks.
- **Implementability.** The ability of the RA alternative to be implemented, including consideration of whether the alternative is technically possible; availability of necessary off-site facilities, services, and materials; administrative and regulatory requirements; scheduling; size; complexity; monitoring requirement; access for construction operations and monitoring; and integration with existing facility operations and

other current or potential RAs. It also includes administrative factors associated with permitting and completing the cleanup.

- **Consideration of Public Concerns and Tribal Rights.** As outlined in WAC 173-340-600, public participation is an integral part of Ecology's responsibilities under MTCA. Public involvement is ensured through various avenues, including public notices, a site register, and public meetings. Specific notice requirements must be followed for, among others, off-property conditional POCs and pCULs for groundwater flowing into nearby surface water. In addition, Tribal rights and interests, and concerns of overburdened communities and vulnerable populations, must be considered both when determining and when weighting each of the five benefit criteria (protectiveness, permanence, long-term effectiveness, management of short-term risks, and implementability). Consideration will be given as to whether the community has concerns regarding the RA alternative and, if so, the extent to which the alternative addresses those concerns. This process includes concerns from individuals, community groups, local governments, Tribes, federal and state agencies, or any other organization that may have an interest in or knowledge of the Site. The consultation process will afford affected Tribes and members of the public the opportunity to comment on the RI/FS and selected RA.

13.3 Evaluation of Alternatives

This section provides an evaluation and comparative analysis of each RA alternative for the Landfill and Wetland Areas using the threshold requirements outlined in Section 13.1. Tables 12-1 and 13-1 provide the RA alternative evaluation details and DCA scoring parameters.

13.3.1 Landfill Area Alternatives

The evaluation of threshold and other requirements, and the DCA for Landfill Area Alternatives 1A and 1B are presented in the following sections and in Tables 12-1 and 13-1.

13.3.1.1 Threshold and Other Requirements Evaluation

Both landfill RA alternatives meet the threshold requirements of WAC 173-340-360(2), as listed below and shown in Table 13-1:

- **Protection of Human Health and the Environment.** Alternatives 1A and 1B would both prevent or control identified risks to human health and the environment. Alternative 1A would accomplish this permanently by removing source material, which in turn would prevent any potential future release of contaminants. Alternative 1B would accomplish this through a combination of partial waste removal, re-grading and capping of remaining waste, limiting infiltration contacting the remaining landfill waste through capping, and control of leachate generated. Alternative 1B would require long-term monitoring and potential future maintenance to ensure protection of the environment is maintained over perpetuity.
- **Compliance with Cleanup Standards.** Both RA alternatives are expected to meet cleanup standards for the Landfill Area. CULs for the landfill would be used to guide the RA and are required to be maintained in perpetuity if source materials remain (Alternative 1B). Both alternatives would require installation of deeper downgradient wells to ensure groundwater was not impacted by landfill materials and, if impacts to groundwater are detected or partial waste removal is selected, monitoring over time. Alternative 1B would result in a final cleanup approach that would require ongoing inspections and monitoring to ensure that wastes remain capped, and leachate is controlled or discharged at concentrations below CULs to protect soil, surface water, and groundwater resources. Alternative 1A would allow for a much shorter restoration time frame as all waste to the maximum extent practicable would be removed. The Alternative 1A estimated restoration time frame is immediate, while it is likely 10 years for Alternative 1B

(the scenarios will need to be modeled for a true time frame estimate). In either scenario, contaminant concentrations in groundwater will begin to decrease immediately upon completion of RA.

- **Compliance with Applicable State and Federal Regulations.** Both RA alternatives are expected to comply with applicable ARARs. For Alternative 1B, this assumes re-grading and capping of waste does not trigger compliance with current landfilling regulations and leachate can be discharged into the Wetland Area post-treatment. Alternatives 1A and 1B also impact the delineated and inferred wetlands, which are assumed to be jurisdictional. If permanent loss of a portion of the wetlands occurs because of remedial activities, mitigation measures would be required.
- **Provision for Compliance Monitoring.** Both alternatives include compliance monitoring of groundwater to verify compliance with cleanup standards, and Alternative 1B would require compliance monitoring of leachate.
- **Use Permanent Solutions to the Maximum Extent Practicable.** Alternative 1A provides the most permanent solution through the removal of waste and impacted soil within the landfill footprint to the maximum practicable extents.
- **Reasonable Restoration Time Frame.** Both RA alternatives would restore the Site in a reasonable time frame. Alternative 1A would require post-remediation groundwater sampling to confirm no impacts to groundwater. Alternative 1B would require additional long-term monitoring and 5-year reviews to confirm the performance of the cap indefinitely or until Ecology approves discontinuation of 5-year reviews (assumed to occur for 25 years minimally). It is assumed for the FS that COC concentrations in impacted soils within the Wetland Area would all be below CULs within 10 years.
- **Consider Public Concerns and Tribal Rights.** In addition to the input from the Nisqually Indian Tribe and State Parks wherein a preference for Alternative 1A was provided, public concerns shall be considered through the public notice and participation process described in WAC 173-340-600, including the public review and comment period for this RI/FS and the draft CAP. The Tribal Consultation process will provide the opportunity for meaningful participation for the affected Tribes to review and comment on the cleanup action. Public concerns are also considered within the DCA discussed below.

13.3.1.2 Disproportionate Cost Analysis Evaluation

The DCA is used to define the RA alternatives that are considered permanent to the maximum extent practicable. For each landfill RA alternative, the overall relative benefit was determined on the basis of the sum of weighted scores for each DCA criterion (Table 13-1). An evaluation of these criteria and specific considerations related to Alternatives 1A and 1B are discussed further below:

- **Protectiveness.** Both alternatives are protective and would meet cleanup standards post-construction, but Alternative 1A is more protective than Alternative 1B as full removal of landfill wastes eliminates future risk of re-exposure or generation of uncontrolled leachate. Further, as Alternative 1B would leave some waste in place, leachate would continue to be generated that would require treatment and monitoring over time. Both alternatives address higher potential seepage and flow rates that may occur due to climate change through stormwater and surface water management and slope laybacks. In addition, the Landfill Area is elevated above the estimated 100-year flood plain (Figure 3-3 and EPA, 2023). Alternative 1B may also be less protective of the environment in the case of increased runoff or landslide events triggered as a result of climate change, as the in-place material would also be at risk of exhumation. This in turn would increase the risk to overburdened communities and vulnerable populations who use the Site or may encounter impacted Site media or biota that have accumulated contaminants associated with the Site. As such, overall risks to human health and the environment are reduced to the greatest extent by Alternative 1A.

- **Permanence.** Both alternatives are permanent solutions to addressing exposure and uncontrolled waste releases but Alternative 1A represents a "permanent cleanup action" through complete removal of waste and impacted soil. Alternative 1B has the potential to result in future releases, such as if maintenance is not conducted on the landfill cap, failure of the cap occurs, leachate is discharged above cleanup standards without monitoring and contingency control measures, or landslide events take place. Alternative 1A is also more resilient to climate change, as all Landfill Area soil contamination would be removed from the Site and no buried contamination would exist that could be exhumed through flooding and erosional events. Therefore, Alternative 1A is considered a more permanent solution.
- **Cost.** Alternative 1A has a higher cost, but the cost differential for performing full waste and impacted soil removal versus partial waste removal is relatively small (Appendix H). This is because the partial waste removal Alternative 1B is much more difficult to implement and requires on-going cover maintenance and passive treatment of leachate. This on-going maintenance may be required more frequently, and therefore will be more costly, if precipitation rates, and therefore runoff volumes, increase due to climate change.
- **Long-term Effectiveness.** Alternative 1A has higher long-term effectiveness as the waste is removed and, therefore, would permanently be able to meet cleanup standards and removes potential residual risk. Alternative 1B is reliant on on-site isolation of remaining waste through capping, maintenance, monitoring, and ICs. Operation and maintenance, and monitoring/IC approaches are the lowest two ranked preferences by MTCA for controlling contaminants over the long term. In addition, Alternative 1A has the long-term benefit of being more resilient to the future impacts of climate change expected to be observed at the Site, as discussed in Section 3.3, per WAC 173-340-360 (5)(d)(iii)(A)(III). The erosional effects of severe storms and increased seepage rates brought about by increased precipitation have the potential to expose contaminated soil or leachate under the Alternative 1B scenario after the remedy is implemented. Both alternatives propose reworking the Landfill Area slope from roughly 1H:1V to no more than 2H:1V, which would protect either remedy against landslides. However, the presence of large and unstable waste materials left in place could lead to slope instability for Alternative 1B.
- **Management of Short-term Risks.** Alternative 1A would result in higher short-term risk despite being more protective and effective because of the increased volume of waste that requires removal. The increased volume of waste that must be handled could lead to higher risk from construction-related accidents, contaminant exposure potential, and highway accidents during material off-hauling. However, Alternative 1B has similar challenges as Alternative 1A, but with lower waste volumes, and results in increased construction challenges related to trying to work across wastes left in place rather than removing all waste as construction proceeds down the slope of the landfill.
- **Technical and Administrative Implementability.** Alternative 1A would be the most feasible alternative to implement technically and administratively. Alternative 1B would be significantly more challenging to implement as non-uniform and poorly compressible waste left in place needs to be shaped and compacted to the extent possible before installing a cap that must protect the waste from re-exposure over time. This is further complicated by the cap being installed on a steep slope grade. It would be difficult to place the cap and even more challenging to properly anchor the cap edges in place. Finally, ensuring that cover material can be placed over the cap that would not result in landslides in the future but would continue to be usable for future cap maintenance through installation of service roads would require complex geotechnical considerations. Separately from the re-grading and capping, as the landfill would not have a bottom liner, groundwater and infiltrating surface water outside the capping areas would have a potential to continually rewet waste over time, an issue that may be exacerbated by increasing storm intensity due to climate change, requiring a leachate collection and treatment system before discharge. However, an active treatment system would require long-term maintenance and an associated funding stream. As such, Alterative 1B proposes a passive treatment approach using reactive media but the design would have to include a contingency in case the reactive media eventually became

spent and CULs were exceeded at a later time. From an administrative standpoint, Alternative 1B is also more challenging as a major assumption to the alternative is that the landfill would remain grandfathered into its current regulatory framework and remediation would not be required to comply with current landfill regulations, and this assumption may not hold.

- **Consideration of Public Concerns and Tribal Rights.** While the general public has not had an opportunity to weigh in on the RA alternatives, State Parks and the Nisqually Indian Tribe have indicated a preference for the selection of Alterative 1A. It is also reasonable to assume that the public would also prefer restoration of public park spaces to natural conditions through removal of the landfill materials from the park. The Tribal Consultation process will provide the opportunity for meaningful participation for the affected Tribes to review and comment on the cleanup action.

For each criterion, the alternative was scored on a scale of 1 to 5 based on the degree to which the alternative meets that criterion. A score of 1 indicates that the alternative poorly meets the criterion, and a score of 5 indicates that the alternative provides the highest benefit for that criterion. The average Environmental Benefit Scores for Alternatives 1A and 1B are 4.7 and 3.4, respectively. The Probable Cost for Alternative 1A is $12.3 million, and the Probable Cost for Alternative 1B is $10.8 million (Appendix H). Using the ratio of these numbers (Environmental Benefit Score: Probable Cost) to determine a final benefit score, Table 13-1 ranks the two remedial alternatives. Alternative 1A provides a higher ratio of benefit to cost, indicating that it is permanent to the maximum extent practicable, and, more importantly, that Alternative 1A is being selected as the preferred alternative, despite the higher cost, because it is a permanent and protective cleanup action.

13.3.2 Wetland Area Alternatives

The evaluation of threshold and other requirements, and the DCA for the Wetland Area Alternatives 2A and 2B are presented in the following sections and in Tables 12-1 and 13-1.

13.3.2.1 Threshold and Other Requirements Evaluation

Both RA alternatives presented meet the threshold requirements of WAC 173-340-360(2), as listed below:

- **Protection of Human Health and the Environment.** Both RA alternatives consider control of identified risks to human health and the environment. Alternative 2A would accomplish this by removing contaminated material and restoring or mitigating impacts to the wetlands. Alternative 2B would protect human health and the environment through the isolation of impacted soils from human contact, natural attenuation of TPH-DRO/ORO and TPH-GRO, ICs, waste debris removal (under Alternative 1A or 1B), and protection of the existing wetland ecosystem while monitoring for the migration of contaminants via the surface water pathway and natural attenuation of TPH-DRO/ORO and TPH-GRO.
- **Compliance with Cleanup Standards.** Both RA alternatives are expected to meet Site cleanup standards, but Alternative 2B would require the Site-specific pCULs developed through the TEE to be adopted for the constituents evaluated in the TEE (copper, lead, and zinc). MTCA standard SLs and/or Site-specific CULs are applied to each remedial alternative during the restoration time frame. Alternative 2B would result in an approach that requires isolation of TPH-GRO–impacted soils to limit human exposure, MNA of TPH-DRO/ORO and TPH-GRO until CULs are met, use of ICs until TPH-GRO direct contact risks are resolved, deterring unauthorized shooting within the Property that could continue to add metals to the soils, ongoing verification that the surface water and groundwater pathways are not active.
- **Compliance with Applicable State and Federal Regulations.** Both RA alternatives are expected to comply with applicable ARARs. For Alternative 2A, this assumes removal of contaminated soil will trigger additional regulatory requirements related to wetlands disturbance, which would trigger additional permitting requirements, restoration/mitigation needs, and BMPs as determined in consultation with

Ecology and USACE. For Alternative 2B, this assumes Site-specific proposed TEE Ecological CUL is adopted for zinc.

- **Provision for Compliance Monitoring.** Both Alternatives 1B and 2B would require additional ongoing compliance monitoring for downstream transport of COCs by surface waters and groundwaters over time. Alternative 2B would rely on ICs and MNA for treatment of TPH-DRO/ORO and TPH-GRO until concentrations fall below the pCULs.
- **Reasonable Restoration Time Frame.** While Alternative 2A would remove contaminants immediately, significant habitat degradation would occur and an extended time frame (approximately 50 years for full vegetation regrowth) would be required to allow for plant regrowth, soil biota to re-establish, and wildlife to return. Whether the wetland ecosystem present would ever return to its current form is uncertain, as large and old stands of trees are present. A changing climate may also prevent the ecosystem from recovering to its current form. Alternative 2B would rely on the removal of waste in the wetlands under Alternatives 1A and 1B to reduce Wetland Area impacts and limit the migration of COCs to downstream receptors via surface waters post-RA, assuming removal or control of the source of COC impacts (landfill waste, uncontrolled leachate, and/or indiscriminate sport shooting). Alternative 2B would also avoid loss of a critical wetland ecosystem that has been shown to be free of adverse effects to the ecological communities present. Both Wetland Area alternatives would require monitoring and 5-year reviews to confirm the performance and compliance of the selected alternative.
- **Consider Public Concerns and Tribal Rights.** Public concerns and Tribal rights shall be considered through the public notice and participation process described in WAC 173-340-600 including the public review and comment period for this RI/FS and the draft CAP. The consultation process will afford affected Tribes and the public the opportunity to comment on the selected RA. Public concerns and Tribal rights are also considered within the DCA discussed below.

13.3.2.2 Disproportionate Cost Analysis Evaluation

The DCA is used to evaluate the RA alternatives that are considered permanent to the maximum extent practicable. For each Wetland Area RA alternative, the overall relative benefit was determined on the basis of the sum of weighted scores for each DCA criterion. As outlined in Section 13.2, these criteria include protectiveness, permanence, long-term effectiveness, management of short-term risks, technical and administrative implementability, and consideration of public concerns and specific considerations related to the Wetland Area Alternatives 2A and 2B are discussed further below:

- **Protectiveness.** Alternative 2B is more protective than Alternative 2A based on the following:
  - ***The degree existing risks are reduced:*** For both alternatives, risks are reduced through different methods. For Alternative 2A, risk reduction is through removal of soil with elevated COCs and wastes in the Wetland Area (Alternatives 1A and 1B). For Alternative 2B, risk reduction occurs for human receptors by isolation from exposure using ICs and removal of wastes in the Wetland Area (Alternatives 1A and 1B). As ecological receptors do not appear impacted by the elevated COC concentrations in soil based on the TEE WOE approach, reduction in human chemical exposure risk via soil isolation would not alter ecological conditions within the wetlands. However, the habitat damages that would occur because of the removal of soil under Alternative 2A would result in significant impact.
  - ***Time required to reduce risk and obtain cleanup standards:*** Both alternatives result in risk reduction for human receptors after remediation is implemented. However, the time to achieve CULs for Alternative 2A is immediate, whereas the approach used under Alternative 2B may require a longer restoration time frame and will leave soils in place that are above the Soil Ecological Indicator soil biota SL for TPH-DRO/ORO and MTCA Method A Unrestricted Land Use SL for TPH-GRO. However, these soils will be isolated and are not causing adverse effects to ecological communities as shown

through the TEE WOE evaluation, and the TPH-DRO/ORO and TPH-GRO concentrations will naturally attenuate over time (less than a decade), eliminating risk in the Wetland Area (Kao and Prosser, 2001; Kampbell et al., 2001; Boopathy, 2004; Eriksson et al., 1998; Ledezma-Villanueva et al., 2016).

- ***On- and off-site risk resulting from implementing the remedy:*** Active removal of COC-impacted soils in Alternative 2A creates a potential to result in surface water and soil impacts during remediation that could migrate off-site and must be controlled. In addition, handling of soil by workers creates a potential exposure risk during construction. Finally, significant habitat destruction will occur with Alternative 2A, resulting in significant damage to local biota; and while habitat restoration may be performed, re-establishment of a localized functional ecosystem will take decades. In practicality, the wetland impacts may need to be mitigated via off-site credits, and the Wetland Area removal footprint would never fully be restored. Climate impacts may also prevent the wetland from fully recovering and re-establishing. Because Alternative 2B does not propose removal of habitat or handling of impacted soils, there is no increased on- or off-site risk with implementing this alternative and removal of wastes will reduce metals and hydrocarbon concentrations and associated risk over time. In addition to the removal of wastes, natural attenuation of residual hydrocarbons in the form of TPH-GRO will occur in the Wetland Area further reducing risks and allowing for the eventual removal of any use restrictions placed on the area.
- ***Improvement to the overall environmental quality:*** The Wetland Area below the toe of the landfill is a high-functioning habitat with no observable environmental impacts to ecological receptors. Assuming landfill waste is contained or removed above the toe of the landfill and in the Wetland Area, leachate is eliminated or treated, and shooting is prevented, ongoing impacts to the Wetland Area will be eliminated, and recovery will proceed. Removal of soil under Alternative 2A results in loss of functioning habitat for a period that would take decades to recover to its current state. This prolonged recovery period would negatively impact overall environmental quality in the short-term with limited overall benefits to the long-term. The current wetland environment also serves as a buffer zone between the Landfill Area and the Mashel River that may make the entire area and remedy more resilient to flooding (EPA, 2006; Ecology, 2015). The net environmental benefit is greater for Alternative 2B because impacted soils would be isolated, experience no disturbance, and the wetland ecosystem would naturally attenuate over a shorter time period than it would take for the wetland habitat to recover in the soil removal alternative (Alternative 2A).

- **Permanence.** Both alternatives would be permanent solutions to addressing exposure, but Alternative 2A represents the most "permanent cleanup action" based on the following:
  - ***Degree to which the alternative permanently reduces the toxicity, mobility or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances:*** Alternative 2A permanently reduces the volume of COC-impacted soils through complete removal and disposal in an engineered landfill, while Alternative 2B reduces toxicity and mobility over time through natural attenuation, and source removal/control under Alternatives 1A and 1B. As such, Alternative 2A has a higher degree of permanence under this criterion.
  - ***Reduction or elimination of hazardous substance releases and sources of releases:*** Sources of releases are eliminated through removal of landfill waste materials under preferred Alternative 1A. Elimination of potential secondary sources (soil impacted by the landfill in the Wetland Area) under Alternative 2A is more permanent in the short term. However, under Alternative 2B, these impacts to the Wetland Area would be reduced or eliminated after Alternative 1A or 1B is implemented, resulting in an equal reduction in releases.
  - ***Degree of irreversibility of waste treatment process:*** Alternative 2A is irreversible as soil is removed from the Wetland Area. Alternative 2B relies in part on processes which have the possibility, albeit low, of altering chemical transformation of metals occurring if significant pH changes within the wetland soils happen. This hypothetical transformation may result in more mobile and bioavailable

forms of metals being present in the Wetland Area, which could occur with a changing climate and increased movement of surface water. Naturally occurring dispersion and biological transformation/degradation, and chemical degradation processes that have a high likelihood of occurring under Alternative 2B would not be reversible. When the considerations are combined, Alternative 2A has a higher degree of irreversibility but it has been determined that current COC concentrations in Wetland Area soil are not impacting ecological communities.

- ***Characteristics and quantity of treatment residuals generated:*** Neither option would create treatment residuals that present a toxicity or mobility risk.

- **Cost.** Alternative 2B has a significantly lower cost ($83,600) than Alternative 2A ($2.65 million), as a soil removal action within the Wetland Area would be challenging because of the soft soil conditions, dense vegetation and trees, steep access slopes to haul soil out of the Wetland Area, significant habitat removal, which would be required before remedy implementation, and the degree of restoration/mitigation required (Appendix H). Restoration efforts would also likely be more costly for Alternative 2A if climate change has the effect of slowing or complicating wetland habitat recovery.

- **Long-term Effectiveness.** Alternatives 2A and 2B have approximately equal long-term effectiveness based on the below factors. However, MTCA factors do not take into account impacts on the existing established habitat in the wetlands or impacts on ecological communities during the habitat re-establishment period. The long-term effectiveness factors considered include:
  - ***Degree of certainty that the alternative will be successful:*** Alternative 2A is more certain in that removal processes permanently eliminate impacted soils, but the viability of restoring the wetlands habitat is uncertain. For Alternative 2B, the benefits of impacted soil isolation with source removal and natural attenuation are well understood and have been effectively used at a variety of cleanup sites, including landfills with significantly higher concentrations of contaminants (USGS, 2003). Ongoing monitoring of surface water will allow for adaptive management of the remedy over time, if necessary.
  - ***Reliability of the alternative during the period of time hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels:*** As human receptors are highly unlikely to come into contact with the Wetland Area soil and no adverse effects were seen in ecological receptors, Alternative 2B is a reliable alternative to address elevated COCs contained in soil, assuming that Alternative 1A or 1B is implemented. Alternative 2A would achieve pCULs at the completion of remediation.
  - ***Magnitude of residual risk with the alternative in place:*** As a result of the challenging access to the Wetland Area and no observed ecological effects, the residual risk to receptors in isolated, COC-impacted soil under Alternative 2B is extremely low, even if ICs are not properly maintained over time. Alternative 2A would not result in residual chemical risk but results in ecological habitat degradation and the potential for elevated short-term release of COCs because of active disturbance.
  - ***Effectiveness of controls required to manage treatment residues or remaining wastes:*** For Alternative 2B, isolation of contaminated soils with ICs and natural attenuation are well-established with low maintenance costs. Alternative 2A would require significant habitat restoration/mitigation, which would also allow for monitoring for effective habitat re-establishment and the ability to adapt to habitat recovery issues identified.

- **Management of Short-Term Risks.** Alternative 2A would result in significant short-term risks related to handling of contaminated soil, impacts to a jurisdictional wetland, and removal of a healthy and established ecosystem. Further, soil removal can lead to higher risks of off-site migration of soils with elevated metal concentrations if they become entrained in surface water runoff, potential for construction-related accidents during soil removal and import of clean wetland soils and monitoring well drilling (especially because of the steep slopes and limited access to the Wetland Area of the Site), and soil contaminant exposure potential to workers. Alternative 2B would not disturb the current habitat or excavate soil (beyond the waste removal extents), there are no short-term risks from current site conditions, although the same short-term risks of Alternative 2A related to monitoring well drilling in the wetlands would apply.

- **Technical and Administrative Implementability.** Alterative 2A would have significantly more technical implementability challenges as a result of a variety of factors, including:
  - Extensive clearing of trees and vegetation in a Wetland Area with soft substrate and determining an effective method to haul removed vegetation to the top of the landfill slope.
  - Excavation of soft soil materials in an area with no current access means building "finger roads" with geogrids and competent base material to allow equipment to track over the wetlands or through the use of swamp excavators if there is competent subgrade at a shallow depth below the soft surface materials.
  - Dewatering the Wetland Area and bypass pumping incoming water, to the extent practicable to improve construction efficiency. This may be complicated by increased seepage rates and sheet flows that are expected to occur due to climate change.
  - Work in the Wetland Area would require additional state and federal permitting and consultation requirements and mitigation needs, leading to an extensive review and negotiation process and an uncertain final design condition.
  - Long-term monitoring and maintenance would be required to ensure habitat recovery is proceeding and plant replacement occurs when losses happen.
  - Removal of the habitat and attempts to re-establish a thriving ecological community equivalent to what currently exists may take years to decades and will require ongoing maintenance to ensure establishment of plant, shrubs, and forbs and avoid invasive species dominating the replanted area. Re-establishment of habitat also may not be possible in the area due to the effects of climate change.
- **Consideration of Public Concerns and Tribal Rights.** While the general public has not had an opportunity to weigh in on the RA alternatives (the Nisqually Indian Tribe has had this opportunity), it is anticipated that the public would be concerned about the destruction of a high-quality wetland ecosystem to accomplish removal while recognizing that long-term protection of surface water and groundwater resources must be demonstrated with compliance monitoring for the no soil removal alternative. As noted in Section 5.3.1, the census tracts adjacent to the Site and the Nisqually Indian Tribe's census tract do not contain vulnerable populations and overburdened communities. The Nisqually Indian Tribe relies more heavily on the Nisqually River to which the Mashel River is a tributary than do the surrounding communities, and they could be disproportionately impacted by the RA. However, it is unlikely that any of the proposed remedial alternatives will have a disproportionate effect on this community, as the Site is on private property and is not easily accessible, and accessible surface water (the Mashel River) is not being impacted.

Alternative 2A also has significant administrative implementability challenges related to the scale of impacts to the jurisdictional wetlands. Further, construction would have to comply with the substantive requirements of the stormwater construction general permit, which will be more challenging to implement in the Wetland Area than would be in the Landfill Area and may limit the work window for construction to prevent off-site impacts from construction activities. Additional requirements and ARAR implications would also be evaluated if Ecology selects Alternative 2A.

Alternative 2B proposes no active soil removal and rather relies on natural attenuation and waste removal under Alternatives 1A/1B to achieve a reasonable restoration time frame. This alternative would require ICs for Human Health receptors exposure to TPH-GRO impacted soil and iron and zinc impacted groundwater, monitored natural attenuation to address TPH-DRO/ORO in soil, monitoring of the surface water and groundwater pathways, and 5-year reviews to ensure that soil impacts shown to have no adverse effect on biota are not migrating off Site via the surface water or groundwater pathways, and ecological communities remain healthy.

For each criterion above, the alternative was scored on a scale of 1 to 5 based on the degree to which the alternative meets that criterion. A score of 1 indicates that the alternative poorly meets the criterion and a score of 5 indicates that the alternative provides the highest benefit for that criterion. The average Environmental Benefit Score for Alternative 2A is 3.1 and for Alternative 2B is 3.6. The Probable Cost for Alternative 2A is $2.65 million and the Probable Cost for Alternative 2B is $83,600 (Appendix H). Using the ratio of these numbers (Environmental Benefit Score: Probable Cost) to determine a final benefit score, Table 13-1 ranks the two Wetland Area RA alternatives. Alternative 2B provides a higher benefit and a significantly lower cost, resulting in a significantly higher benefit ratio. Alternative 2A is not favored because of its disproportionate cost, the administrative complexity of removal within a likely jurisdictional wetland, the limited reduction of risk to likely receptors, and habitat impacts; Alternative 2B is considered permanent to the maximum extent practicable, limits impacts to the existing ecosystem, and is the preferred alternative for the Wetland Area.

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14 Preferred Remedial Action Alternative

Based on the RI results presented in Section 8 and the evaluation of FS alternatives in Section 13.3, **Alternative 1A (Landfill Area: Waste and Impacted Soil Removal to the Maximum Practicable Extents)** and **Alternative 2B (Wetland Area: Natural Attenuation and Institutional Controls)** were selected as the preferred RA alternatives for the Site (Figure 14-1). This combination of alternatives meets all of the MTCA threshold and other requirements outlined in Section 13.1 and was determined to be permanent to the maximum extent practicable through the DCA process. This set of alternatives would remove contaminant sources, while minimally impacting fragile wetland ecosystems, would include ongoing monitoring to ensure that restoration is achieved across the Site, and would require the use of ICs to remove Human Health exposure risks to Wetland Area soils with TPH-GRO and groundwaters with iron and zinc. In summary, the principal remedial components and benefits of the proposed combined RA of Alternatives 1A/2B (Sections 12.2.1 and 12.3.2) are:

- All waste (in the Landfill and Wetland Areas) and impacted soils beneath the waste prism exceeding pCULs in the Landfill Area would be excavated and disposed of at an off-site facility permitted to receive such waste, which would immediately eliminate the source of downstream contamination, the source of leachate to the Wetland Area, and the potential for erosion and high-precipitation events to move contaminants. In addition, the removal of soil in the zinc lobe at the toe of the landfill may also help in eliminating zinc exceedances in surface water at SE-02/SW-12 at the toe of the landfill.
- The remaining slope would be cut back, as needed, to a final slope angle of approximately 2H:1V and a service access road would be installed to allow for installation and future removal of central waste prism and downgradient POC monitoring wells. The more gradual slope will help to limit erosion and the erosive impacts of floods or high-precipitation events, which will become more likely due to climate change.
- The final cut surface would be covered with topsoil, erosion control material to prevent erosion, and restoration plantings to allow the area to recover and be restored to a natural environment similar to surrounding park land. This would also make the Site and the remedy more resilient to increased rainfall and sheet flow caused by climate change.
- Landfill waste that has migrated to the ravine and Wetland Area beyond the extent of the landfill would be removed and disposed of at an off-site facility, similar to the waste from the major waste prism.
- Soil with elevated COC concentrations in the Wetland Area beyond the toe of landfill, which have been determined to have no adverse effect on terrestrial ecological receptors and pose a limited threat to human health, would remain in place to preserve the existing and well-functioning wetland ecosystem present. Concentrations of TPH-DRO/ORO would need to be evaluated over time to ensure that natural attenuation is occurring and that concentrations recover to levels below the pCUL.
- A Wetland Area IC would be established that consists of land use restrictions filed with the County and signage warning the public to avoid direct contact with Wetland Area soil. This IC may be lifted when TPH-GRO concentrations attenuate below the CUL.
- Sitewide ICs to restrict the use of groundwater for human consumption would be implemented. These ICs may be lifted when iron and zinc concentrations fall below the CUL. However, groundwater use may be still restricted due to the chromium (VI) exceedance, which is located upgradient of the landfill.
- Compliance monitoring to be conducted includes:
  - Leave surface sampling in the Landfill Area post-removal of wastes and impacted soils to ensure that impacts have been addressed.
  - Groundwater monitoring to ensure no residual impacts to the groundwater aquifer or local surface water is occurring from the contamination that originated from the uncontrolled landfill waste.
  - Surface water monitoring to ensure that Wetland Area soil impacts and seepage from the landfill are not migrating to surface waters above CULs.

  - If cleanup and/or post-cleanup groundwater and/or surface monitoring results indicate that COCs are migrating to surface waters, further evaluation will be conducted if required by Ecology.
  - Ensuring that ICs are being maintained, and habitat restoration is proceeding on the slope. Routine observations would be made to inspect for erosion and the health of the vegetative cover providing erosion control.
- Landfill source material would be permanently removed, satisfying the concerns of the public, Site stakeholders, and sovereign nations, in addition to providing more access for the public within Nisqually State Park while restoring the health of the wetland and minimizing future impacts to the ecosystem.

Selection of this preferred RA alternative is subject to Ecology approval and public comment, pending public review of this RI/FS and CAP. The final RA will be implemented in accordance with the CAP after it is approved.

15 Stakeholder Engagement and Public Participation

Ecology continues to engage with stakeholders and the sovereign nation of the Nisqually Indian Tribe. Routine project meetings are held between Ecology, the PLPs, Washington State Parks, and the Nisqually Tribe, and stakeholders and the Tribe are both engaged in frequent project updates and can directly engage in the RI/FS and cleanup planning, design, and implementation.

Public notice and opportunity for comment will be provided for the RI/FS, as required in WAC 173-340-600(13). In addition to participation requirements to engage with the general public, MTCA requires Ecology to initiate meaningful engagement with affected Indian tribes before initiating a remedial investigation or an interim action at a site, and maintain meaningful engagement with Indian tribes throughout the cleanup process. MTCA's goal is for Ecology to provide Indian tribes with timely information, effective communication, continuous opportunities for collaboration and, when necessary, government-to-government consultation, as it determines is appropriate for each site (WAC 173-340-620(1)).

Ecology will seek to engage affected Indian tribes during the cleanup process whenever it provides the public an opportunity to comment. The engagement will be in addition to and independent of any public participation process (WAC 173-340-620(4)). Ecology will engage Indian tribes before seeking public comment and to provide up to 60 days for tribal engagement instead of the 30 days typically provided for public comment. In accordance with MTCA, the documents used to make the decisions discussed in this RI/FS are on file in the administrative record for the Site and are listed in Section 6. The administrative record for the Site is available for public review by contacting the Cleanup Site Manager, Sam Meng, at the Southwest Region of Ecology's Toxics Cleanup Program (300 Desmond Dr SE, Lacey, Washington 98503).

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Tables

Table 3-1. Groundwater Elevations

Well Identification	TOC Elevation (ft NAVD 88)	Ground Surface Elevation (ft NAVD 88)	Screened Interval (ft below TOC)	Date Measured	Depth to Water (ft below TOC)	Depth to Water (ft bgs)	Groundwater Elevation (ft NAVD 88)
GW-01[1]	NA	592.15	NA	01/21/2021	1.00	1.00	592.15
PZ-01	725.67	722.77	91.9–101.9	11/17/2021	78.20	75.30	647.47
				02/04/2022	79.19	76.29	646.48
PZ-02	726.72	726.15	89.57–99.57	11/17/2021	76.62	76.05	650.10
				02/04/2022	79.48	78.91	647.24
PZ-03	592.91	589.50	5.24–6.24	11/17/2021	3.77	0.36	589.14
				02/03/2022	4.01	0.60	588.90
PZ-04	583.48	580.51	5.31–6.31	11/17/2021	3.57	0.60	579.91
				02/03/2022	3.75	0.78	579.73
PZ-05	725.84	722.77	21.07–31.07	11/17/2021	28.30	25.23	697.54
				02/04/2022	25.88	22.81	699.96

Notes

[1] Sample collected from shallow groundwater below top 0.5 feet of soil.

bgs = below ground surface

ft = foot or feet

NA = not applicable

NAVD 88 = North American Vertical Datum of 1988

TOC = top of casing

Table 4-1. Groundwater and Surface Water Field Parameters

Sample ID	Sample ID Alias	Matrix	Date Measured	pH (unitless)	Temperature (°C)[1]	Oxidation Reduction Potential (mV)[1]	Conductivity (µS/cm)[1]	Dissolved Oxygen (mg/L)[1]	Turbidity (NTUs)[1]	Ferrous Iron (mg/L)[2]
GW-01	—	Groundwater -- Wetland	01/11/2021	7.63	7.71	213.7	825	7.38	17	—
PZ-01	—	Groundwater - Upgradient	11/17/2021[3]	7.35	8.50	-421	238	2.88	102	—
			02/04/2022	7.16	8.80	-51.0	182	0.240	216	1.50
PZ-02	—	Groundwater - Upgradient	11/17/2021	7.17	9.50	-217	196	2.54	788	—
			02/04/2022	7.20	8.70	-75.7	174	0.230	8.04	2.50
PZ-05	—	Groundwater - Upgradient	11/17/2021	Well not sampled due to insufficient water.						
			02/04/2022	6.55	8.70	101	98.4	7.77	4.62	0.00
PZ-03	—	Groundwater - Wetland	11/17/2021	6.76	9.00	13.8	107.1	0.360	13.0	—
			02/03/2022	6.80	7.60	-38.0	97.5	3.17	—	0.750
PZ-04	—	Groundwater - Wetland	11/17/2021	6.69	9.30	-14.4	236	1.19	35.7	—
			02/03/2022	6.79	7.70	-65.0	276	0.820	—	5.75
SE-01 and SE-101	Co-located with SW-09	Surface Water - Seep	1/11/2021	6.79	9.0	202	104.0	11.33[2]	1.94	—
SE-02	Co-located with SW-12	Surface Water - Seep	1/11/2021	6.8	7.7	178	630.0	3.14[2]	0.64	—
SW-01	—	Surface Water - Seep	1/12/2021	7.95	8.4	215	87.0	12.2[2]	4.31	—
SW-02	Co-located with SW-09	Surface Water - Seep	1/12/2021	8.07	9.1	173	81.0	11.46[2]	2.64	—
SW-03	—	Surface Water - Seep	1/12/2021	6.92	9.1	188	52.0	10.45[2]	1.47	—
SPRING	SPRING-2, SW-03, SW-06, SW-13	Surface Water - Spring	9/16/2021	6.32	9.74	69.4	97.0	—	0.540	—
			2/2/2022	6.99	8.80	151	93.0	7.75	0.890	—
SW-04	—	Surface Water	9/16/2021	6.96	10.3	125	94.0	—	16.2	—
SW-05	—	Surface Water	9/16/2021	7.20	10.0	98.7	97.0	—	0.850	—
SW-07	—	Surface Water	2/2/2022	7.43	6.40	168	86.4	8.03	1.94	0.00
SW-08	SEEP-2	Surface Water - Ephemeral Stream	2/2/2022	7.90	8.30	154	88.4	9.21	1.32	0.00
SW-09	Co-located with SE-01 and SW-02	Surface Water - Ephemeral Stream	2/2/2022	7.86	7.70	157	87.5	9.10	7.97	0.00
SW-10	—	Surface Water	2/2/2022	7.55	6.10	159	342	8.14	1.32	0.00
SW-11	—	Surface Water	2/2/2022	7.54	6.90	43.7	104	8.45	1.12	0.00
SW-12	Co-located with SE-02	Surface Water	2/2/2022	7.04	8.20	135	944	7.93	0.760	0.00
SW-14	—	Surface Water - Ephemeral Stream	2/4/2022	7.45	6.40	139	90.6	8.46	2.52	0.00

Notes

[1] Direct-Read Instrument (YSI 556).

[2] Measured using a Hach® field kit.

[3] Pump overheated after pumping 3 gallons. Parameter stabilization was not fully achieved before low-flow sampling.

— = not applicable/not collected

°C = degrees Celsius

µS/cm = microsiemens per centimeter

mg/L = milligrams per liter

mV = millivolts

NTU = Nephelometric Turbidity Unit

Table 4-2. Soil Gas Field Measurements

Location	Date	Depth (ft bgs)	Oxygen (O_2) (%)[1]	Carbon Dioxide (CO_2) (%)[1]	Methane (CH_4) (%)[1]	Lower Explosive Limit (LEL) (%)[1]	Carbon Monoxide (CO) (ppm)[1]	Hydrogen Sulfide (H_2S) (ppm)[1]	Hydrogen (H_2) (ppm)[1]
SB-16	09/16/2021	8–12	15.2	4.1	0.1	3.0	—	—	—
SB-18	09/16/2021	5–9	18.0	3.9	0.1	2.0	—	—	—
SB-19	09/16/2021	5–9	—	—	0.1	3.0	54	0	"low"

Notes

[1] Direct-Read Instrument (Landtec Gem).

— = not applicable/not collected

bgs = below ground surface

ft = foot or feet

ppm = parts per million

Table 7-1a. Human Health Surface Water Screening Levels

Compound	MTCA: MTCA Method B WAC 173-340-730[1] Non-Cancer	MTCA: MTCA Method B WAC 173-340-730[1] Cancer	ARAR: Criteria for Consumption of Water & Organisms, WAC 173-201A-240[2]	ARAR: Criteria for Consumption of Water & Organism, CWA 304[3]	ARAR: Human Health Criteria, Consumption of Water+Organism, 40 CFR 131.45[4]	Natural Background[5]	PQL	Maximum Detection Above the Detection Limit
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Miscellaneous								
pH	–	–	–	5 to 9	–	–	–	6.32/8.07
Metals (6020B, E218.6)								
Antimony	1,000	–	12	5.6	6	–	1	0.575
Arsenic	18	0.098	10	0.018	0.018	4.9	1	1.66
Barium	–	–	–	1,000	–	–	1	382
Beryllium	270	–	–	–	–	–	0.2	ND
Cadmium	41	–	–	–	–	–	0.2	0.349
Chromium[6]	240,000	–	–	–	–	–	1	ND
Hexavalent Chromium	490	0.13	–	–	–	–	0.02	0.31
Copper	2,900	–	1,300	1,300	–	–	2	10.5
Iron	–	–	–	1,000	–	–	50	301
Nickel[7]	1,100	–	150	610	80	–	2	3.47
Selenium	2,700	–	120	170	60	–	1	ND
Silver	26,000	–	–	–	–	–	0.2	ND
Thallium[8]	0.22	–	0.24	0.24	–	–	0.2	ND
Zinc	17,000	–	2,300	7,400	1,000	–	4	205
PCBs (8082A)								
Total PCBs[9]	–	0.0001	0.00017	0.000064	0.000007	–	0.0943	–
Total Petroleum Hydrocarbons (NWTPH-Gx, NWTPH-Dx, NWVPH, NWEPH)								
Naphthalene	4,900	–	–	–	–	–	40	0.0192
Benzene	2,000	23	0.44	0.58	–	–	20	ND
Ethylbenzene	6,900	–	200	68	29	–	25	ND
Toluene	19,000	–	180	57	72	–	25	ND
VOCs (8260D)[10]								
1,1,1-Trichloroethane	930,000	–	47,000	10,000	20,000	–	0.4	ND
1,1,2,2-Tetrachloroethane	10,000	6.5	0.12	0.2	0.1	–	0.5	ND
1,1,2-Trichloroethane	2,300	25	0.44	0.55	0.35	–	0.5	ND
1,1-Dichloroethene	23,000	–	1,200	300	700	–	0.4	ND
1,2,4-Trichlorobenzene	230	2	0.12	0.071	0.036	–	2	ND
1,2-Dichlorobenzene	4,200	–	2,000	1,000	700	–	0.5	ND
1,2-Dichloroethane	13,000	59	9.3	9.9	8.9	–	0.4	ND
1,2-Dichloropropane	25,000	43	0.71	0.9	–	–	0.5	ND
1,3-Dichlorobenzene	–	–	13	7	2	–	0.5	ND
1,4-Dichlorobenzene	3,300	22	460	300	200	–	0.5	ND
Acrylonitrile	3,500	0.4	0.019	0.061	–	–	2	ND
Benzene	2,000	23	0.44	0.58	–	–	0.2	ND
Bromodichloromethane	14,000	28	0.77	0.95	0.73	–	1	ND
Bromoform	14,000	220	5.8	7	4.6	–	1	ND
Bromomethane	970	–	520	100	300	–	5	ND
Carbon tetrachloride	550	4.9	0.2	0.4	–	–	1	ND
Chlorobenzene	5,000	–	380	100	100	–	0.5	ND
Chloroform	6,900	56	260	60	100	–	1	ND
cis-1,3-Dichloropropene[11]	41,000	34	0.24	0.27	0.22	–	1	ND
Dibromochloromethane	14,000	21	0.65	0.8	0.6	–	1	ND
Ethylbenzene	6,900	–	200	68	29	–	0.5	ND
Hexachlorobutadiene	930	30	0.69	0.01	0.01	–	5	ND
Methylene Chloride	17,000	590	16	20	10	–	10	ND
Naphthalene	4,900	–	–	–	–	–	2	0.0192
Tetrachloroethene	500	100	4.9	10	2.4	–	0.4	ND
Toluene	19,000	–	180	57	72	–	1	ND
trans-1,2-Dichloroethene	33000	–	600	100	200	–	0.4	ND
trans-1,3-Dichloropropene[11]	41,000	34	0.24	0.27	0.22	–	1	ND
Trichloroethene	120	4.9	0.38	0.6	0.3	–	0.4	ND
Vinyl Chloride	6,600	3.7	0.02	0.022	–	–	0.4	ND

Table 7-1a. Human Health Surface Water Screening Levels

Compound	MTCA Method B WAC 173-340-730[1]		ARAR			Natural Background[5]	PQL	Maximum Detection Above the Detection Limit
	Non-Cancer	Cancer	Criteria for Consumption of Water & Organisms, WAC 173-201A-240[2]	Criteria for Consumption of Water & Organism, CWA 304[3]	Human Health Criteria, Consumption of Water+Organism, 40 CFR 131.45[4]			
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
SVOCs (8270E)[10]								
1,2,4-Trichlorobenzene	230	2	0.12	0.071	0.036	—	0.0467	ND
1,2-Dichlorobenzene	4,200	—	2,000	1,000	700	—	0.0467	ND
1,3-Dichlorobenzene	—	—	13	7	2	—	0.0467	ND
1,4-Dichlorobenzene	3,300	22	460	300	200	—	0.0467	ND
2,4,5-Trichlorophenol	—	—	—	300	—	—	0.0935	ND
2,4,6-Trichlorophenol	17	3.9	0.25	1.5	—	—	0.0935	ND
2,4-Dichlorophenol	190	—	25	10	10	—	0.0935	ND
2,4-Dimethylphenol	550	—	85	100	—	—	0.0935	ND
2,4-Dinitrophenol	3,500	—	60	10	30	—	0.467	ND
2,4-Dinitrotoluene	1,400	5.5	0.039	0.049	—	—	0.187	ND
2-Chlorophenol	97	—	15	30	—	—	0.0935	ND
2-Chloronaphthalene	1,000	—	170	800	100	—	0.0187	ND
3,3'-Dichlorobenzidine	—	0.046	0.0031	0.049	—	—	0.935	ND
4,6-Dinitro-O-Cresol	—	—	7.1	2	3	—	0.467	ND
4-Chloro-3-methylphenol	—	—	36	500	—	—	0.187	ND
Acenaphthene	640	—	110	70	30	—	0.0187	ND
Anthracene	26,000	—	3,100	300	100	—	0.0187	ND
Benzo(a)anthracene	—	—	0.014	0.0012	0.00016	—	0.0166	ND
Benzo(a)pyrene	26	0.035	0.0014	0.00012	0.000016	—	0.0166	ND
Benzo(b)fluoranthene	—	—	0.014	0.0012	0.00016	—	0.0166	ND
Benzo(k)fluoranthene	—	—	0.014	0.012	0.0016	—	0.0166	ND
Bis(2-chloro-1-methylethyl) ether	42,000	37	—	200	400	—	0.0467	ND
Bis(2-chloroethyl)ether	—	0.85	0.02	0.03	—	—	0.0467	ND
Bis(2-ethylhexyl)phthalate	400	3.6	0.23	0.32	0.045	—	0.374	ND
Butyl benzyl phthalate	1,300	8.2	0.56	0.1	0.013	—	0.374	ND
Chrysene	—	—	1.4	0.12	0.016	—	0.0166	ND
Dibenzo(a,h)anthracene	—	—	0.0014	0.00012	0.000016	—	0.0166	ND
Dibutyl phthalate	2,900	—	450	20	8	—	0.374	ND
Diethyl phthalate	28,000	—	4,200	600	200	—	0.374	0.215
Dimethyl phthalate	—	—	92,000	2,000	600	—	0.374	ND
Fluoranthene	90	—	16	20	6	—	0.0187	ND
Fluorene	3,500	—	420	50	10	—	0.0187	ND
Hexachlorobenzene	0.24	0.00047	0.000051	0.000079	0.000005	—	0.0187	ND
Hexachlorobutadiene	930	30	0.69	0.01	0.01	—	0.0467	ND
Hexachlorocyclopentadiene	3,600	—	150	4	1	—	0.0935	ND
Hexachloroethane	21	1.9	0.11	0.1	0.02	—	0.0467	ND
Indeno(1,2,3-cd)pyrene	—	—	0.014	0.0012	0.00016	—	0.0166	ND
Isophorone	120,000	1,600	27	34	—	—	0.0467	ND
Naphthalene	4,900	—	—	—	—	—	0.0374	0.0192
Nitrobenzene	1,800	—	55	10	30	—	0.187	ND
N-Nitrosodimethylamine	800	0.8	0.00065	0.00069	—	—	0.0467	ND
N-Nitrosodi-n-propylamine	—	0.82	0.0044	0.005	—	—	0.0467	ND
N-Nitrosodiphenylamine	—	9.7	0.62	3.3	—	—	0.0467	ND
Pentachlorophenol	1,200	1.5	0.046	0.03	0.002	—	0.187	ND
Phenol	560,000	—	18,000	4,000	9,000	—	0.374	ND
Pyrene	2,600	—	310	20	8	—	0.0187	ND
Total cPAHs[12]	26	0.035	0.0014	0.00012	0.000016	—	0.0166	ND
PBDEs (1614)								
Units	pg/L	pg/L	pg/L	pg/L			pg/L	pg/L
BDE-99[13]	32,000	—	—	—	—	—	99	7.99
BDE-209[13]	5,700,000,000	2,900,000,000	—	—	—	—	495	ND
OctaBDE (BDE-153, -128/154, -183/176)[13]	2,400,000,000	—	—	—	—	—	198	5.93

Notes

Selected surface water human health screening level.

Screening level exceedance.

No screening level exceedance.

Analytes with no available screening levels are not shown.

Several analytes are on the reported analyte lists for more than one method (i.e., naphthalene is reported in the VOC, TPH, and SVOC methods).
Maximum detections are shown regardless of method, and minimum PQLs are based on the individual method.

1 Washington State Department of Ecology (Ecology), Model Toxics Control Act (MTCA) Cleanup Amendments, Cleanup Levels and Risk Calculation (CLARC) Master Table, May 2023 (Revised January 2023).

2 Washington State Legislature, Water Quality Standards for Surface Waters of the State of Washington, WAC 173-201A-240, Table 240.

3 United States Environmental Protection Agency, National Recommended Water Quality Criteria - Human Health Criteria Table. Clean Water Act, Section 304.

4 Human Health Criteria for Washington, consumption of water plus organism, 40 CFR 131.45, Table 1

5 Ecology, Natural Background Groundwater Arsenic Concentrations in Washington State. January 2022.

6 Human health screening level listed is for Cr(III).

7 Human health screening levels listed are for nickel soluble salts.

8 Human health screening levels listed are for thallium soluble salts.

9 Listed PQL is for the highest of the minimum PQLs of the constituents used in the summation of Total PCBs.

10 Protective values for benzene, ethylbenzene, toluene, xylenes (BTEX) and diesel- and gasoline-range organics are from the Washington State Department of Ecology Implementation Memo #23.

11 Human health screening levels listed are for 1,3-dichloropropene.

12 Human health screening levels listed are for benzo(a)pyrene. Listed PQL is for the highest of the minimum PQLs of the constituents used in the summation of Total cPAHs.

13 Listed PQL is for the highest of the minimum PQLs of the constituents used in the summation of each PBDE group.

— = not available or not applicable

µg/L = micrograms per liter

CWA = Clean Water Act

ARAR = applicable or relevant and appropriate requirements

cPAH = carcinogenic polycyclic aromatic hydrocarbons

MTCA = Model Toxics Control Act

ND = not detected

PBDE = Polybrominated Diphenyl Ether

PCB = polychlorinated biphenyls

pg/L = picograms per liter

PQL = practical quantitation limit

SVOCs = Semivolatile organic compounds

VOCs = Volatile organic compounds

WAC = Washington Administrative Code

Table 7-1b. Ecological Surface Water Screening Levels

Compound	ARARs				Natural Background[3]	PQL	Maximum Detection Above the Detection Limit
	Aquatic Life Criteria - Fresh Water, WAC 173-201A-240[1]		Freshwater Aquatic Life Criteria, CWA[2]				
	Chronic	Acute	Chronic	Acute			
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Miscellaneous							
pH	6.5 to 8.5	—	6.5 to 9	—		—	6.32/8.07
Metals (6020B, E218.6)							
Arsenic	190	360	150	340	4.9	1	1.66
Cadmium	1	3.7	0.72	1.8	—	0.2	0.349
Chromium[4]	180	550	74	570	—	1	ND
Hexavalent Chromium	10	15	11	16	—	0.02	0.13
Copper	11	17	—	—	—	2	10.5
Iron	—	—	1,000	—	—	50	301
Lead	2.5	65	2.5	65	—	0.2	7.32
Nickel[5]	160	1,400	52	470	—	2	3.47
Selenium	5	20	—	—	—	1	ND
Silver	—	3.4	—	3.2	—	0.2	ND
Zinc	100	110	120	120	—	4	205
PCBs (8082A)							
Total PCBs[6]	0.014	2	0.014	—	—	0.0943	ND
Total Petroleum Hydrocarbons (NWTPH-Gx, NWTPH-Dx, NWVPH, NWEPH) [7]							
Benzene	10	—	—	—	—	20	ND
Ethylbenzene	12	—	—	—	—	25	ND
M,P-Xylene	57	—	—	—	—	40	ND
O-Xylene	57	—	—	—	—	20	ND
Toluene	53	—	—	—	—	25	ND
Diesel Range Organics (DRO) + Residual Range Organics (RRO)[8,9]	3,000	—	—	—	—	—	ND
Gasoline Range Organics (GRO)[8]	1,000	—	—	—	—	79.3	256
Total Xylenes[10]	57	—	—	—	—	40	ND
VOCs (8260D) [7]							
Benzene	10	—	—	—	—	0.2	ND
Ethylbenzene	12	—	—	—	—	0.5	ND
M,P-Xylene	57	—	—	—	—	1	ND
O-Xylene	57	—	—	—	—	0.5	ND
Toluene	53	—	—	—	—	1	ND
Total Xylenes[10]	57	—	—	—	—	1	ND
SVOCs (8270E)							
Pentachlorophenol	13	20	15	19	—	0.187	ND

Notes

Selected surface water ecological screening level.

Screening level exceedance.

No screening level exceedance.

Analytes with no available screening levels are not shown.

Several analytes are on the reported analyte lists for more than one method (i.e., naphthalene is reported in the VOC, TPH, and SVOC methods).
Maximum detections are shown regardless of method, and minimum PQLs are based on the individual method.

[1] Washington State Legislature, Water Quality Standards for Surface Waters of the State of Washington, WAC 173-201A-240.

[2] National Recommended Water Quality Criteria - Aquatic Life Criteria Table, Clean Water Act Section 304

[3] Ecology, Natural Background Groundwater Arsenic Concentrations in Washington State. January 2022.

[4] Ecological screening levels listed are for Cr(III) except where noted.

[5] Ecological screening levels listed are for nickel soluble salts.

[6] Listed PQL is for the highest of the minimum PQLs of the constituents used in the summation of Total PCBs.

[7] Protective values for benzene, ethylbenzene, toluene, xylenes (BTEX) and diesel- and gasoline-range organics are from the Washington State Department of Ecology Implementation Memo #23.

[8] The following summations were performed on TPH data:

1. GRO values for methods NWVPH and NVEPH were calculated by summing BTEX (benzene, toluene, ethylbenzene, xylenes), methyl tertbutyl ether, naphthalene, and hydrocarbons with between 4 and 10 carbon atoms.
2. DRO values for methods NWVPH and NWEPH were calculated by summing hydrocarbons with between 10 and 25 carbon atoms.
3. ORO values for methods NWVPH and NWEPH were calculated by summing hydrocarbons with more than 25 carbon atoms.

[9] As this summation spans two analytical methods, a PQL is not indicated.

[10] Listed PQL is for the highest of the minimum PQL of the constituents used in the summation of Total Xylenes.

— = not available or not applicable

µg/L = micrograms per liter

ND = not detected

PCB = polychlorinated biphenyls

PQL = practical quantitation limit

SVOCs = Semivolatile organic compounds

TPH = total petroleum hydrocarbons

VOCs = Volatile organic compounds

WAC = Washington Administrative Code

Table 7-2a. Human Health Groundwater Screening Levels

Compound	MTCA				ARAR				Natural Background[6]	PQL	Maximum Detection Above the Detection Limit
	MTCA Method A, WAC 173-340-720, Table 720-1[1]	MTCA Method B, WAC 173-340-720[1]			Washington State MCL and SMCL, WAC 246-290-310[2]	Criteria for Consumption of Water & Organism, CWA 304[3]	Criteria for Consumption of Water & Organisms, WAC 173-201A-240[4]	Human Health Criteria, Consumption of Water+Organism, 40 CFR 131.45[5]			
		Non-Cancer	Cancer	Potable Groundwater Cleanup Level							
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Miscellaneous											
pH	–	–	–	–	–	5 to 9	–	–	–	–	6.55 to 7.35
Metals (6020B, E218.6)											
Antimony	–	6.4	–	6	6	5.6	12	6	–	1	1.49
Arsenic	5	4.8	0.058	5	10	0.018	10	0.018	4.9	1	2.53
Barium	–	3,200	–	2,000	2,000	1,000	–	–	–	1	55.1
Beryllium	–	32	–	4	4	–	–	–	–	0.2	0.327
Cadmium	5	8	–	5	5	–	–	–	–	0.2	0.285
Chromium[7]	50/100[a]	24,000[b]	–	24,000	100	–	–	–	–	1	7.4
Chromium, Hexavalent	50	48	0.046	0.0461	–	–	–	–	–	0.02	0.12
Cobalt	–	4.8	–	4.8	–	–	–	–	–	1	3.42
Copper	–	640	–	640	1,300	1,300	1,300	–	–	2	15.4
Iron	–	11,000	–	300	300	–	–	–	–	50	9,320
Lead	15	–	–	15	15	–	–	–	–	0.2	2.58
Nickel[8]	–	320	–	320	–	610	150	80	–	2	6.82
Selenium	–	80	–	50	50	170	120	60	–	1	1.27
Silver	–	80	–	80	100	–	–	–	–	0.2	ND
Thallium[9]	–	0.16	–	0.16	2	0.24	0.24	–	–	0.2	ND
Vanadium	–	80	–	80	–	–	–	–	–	2	10.5
Zinc	–	4,800	–	4,800	5,000	7,400	2,300	1,000	–	4	580
Total Petroleum Hydrocarbons (NWTPH-Gx, NWTPH-Dx, NWVPH, NWEPH)											
Naphthalene	160	160	–	160	–	–	–	–	–	40	0.343
Benzene	5	32	0.8	5	5	0.58	0.44	–	–	20	ND
Ethylbenzene	700	800	–	700	700	68	200	29	–	25	ND
Toluene	1,000	640	–	640	1,000	57	180	72	–	25	0.64
o-Xylene	–	1,600	–	1,600	–	–	–	–	–	20	ND
m,p-Xylene[10]	–	1,600	–	1,600	–	–	–	–	–	40	ND
Methyl tert-butyl ether	20	–	24	24.3	–	–	–	–	–	25	ND
Diesel Range Organics (DRO) + Residual Range Organics (RRO)[11,12]	500	–	–	–	–	–	–	–	–	–	316
Gasoline Range Organics (GRO)[11]	800	–	–	–	–	–	–	–	–	79.4	123
Total Xylenes[13]	1,000	1,600	–	1,600	10,000	–	–	–	–	40	ND
VOCs (8260D)											
1,1,1,2-Tetrachloroethane	–	240	1.7	1.68	–	–	–	–	–	0.4	ND
1,1,1-Trichloroethane	200	16,000	–	200	200	10,000	47,000	20,000	–	0.4	ND
1,1,2,2-Tetrachloroethane	–	160	0.22	0.219	–	0.2	0.12	0.1	–	0.5	ND
1,1,2-Trichloroethane	–	32	0.77	3	5	0.55	0.44	0.35	–	0.5	ND
1,1-Dichloroethane	–	1,600	7.7	7.68	–	–	–	–	–	0.4	ND
1,1-Dichloroethene	–	400	–	7	7	300	1,200	700	–	0.4	ND
1,2,3-Trichlorobenzene	–	6.4	–	6.4	–	–	–	–	–	2	ND
1,2,3-Trichloropropane	–	32	0.00038	0.00038	–	–	–	–	–	1	ND
1,2,4-Trichlorobenzene	–	80	1.5	15.1	70	0.071	0.12	0.036	–	2	ND
1,2,4-Trimethylbenzene	–	80	–	80	–	–	–	–	–	1	ND
1,2-Dichlorobenzene	–	720	–	600	600	1,000	2,000	700	–	0.5	ND
1,2-Dichloroethane	5	48	0.48	4.81	5	9.9	9.3	8.9	–	0.4	ND
1,2-Dichloropropane	–	320	1.2	5	5	0.9	0.71	–	–	0.5	ND
1,3,5-Trimethylbenzene	–	80	–	80	–	–	–	–	–	1	ND
1,3-Dichlorobenzene	–	–	–	–	–	7	13	2		0.5	ND
1,3-Dichloropropane	–	160	–	160	–	–	0.24	–	–	1	ND
1,4-Dichlorobenzene	–	560	8.1	75	75	300	460	200	–	0.5	ND
2-Chlorotoluene	–	160	–	160	–	–	–	–	–	1	ND
2-Hexanone	–	40	–	40	–	–	–	–	–	10	ND
4-Chlorotoluene	–	160	–	160	–	–	–	–	–	1	ND
Acetone	–	7,200	–	7,200	–	–	–	–	–	20	ND
Acrylonitrile	–	320	0.081	0.081	–	0.061	0.019	–	–	2	ND
Benzene	5	32	0.8	5	5	0.58	0.44	–	–	0.2	ND
Bromobenzene	–	64	–	64	–	–	–	–	–	0.5	ND
Bromodichloromethane	–	160	0.71	7.06	80	0.95	0.77	0.73	–	1	ND
Bromoform	–	160	5.5	55.38	80	7	5.8	4.6	–	1	ND
Bromomethane	–	11	–	11.2	–	100	520	300	–	5	ND
Carbon disulfide	–	800	–	800	–	–	–	–	–	10	ND
Carbon tetrachloride	–	32	0.63	5	5	0.4	0.2	–	–	1	ND
Chlorobenzene	–	160	–	100	100	100	380	100	–	0.5	ND
Chloroform	–	80	1.4	14.11	80	60	260	100	–	1	ND
cis-1,2-Dichloroethene	–	16	–	16	70	–	–	–	–	0.4	ND
cis-1,3-Dichloropropene	–	240	0.44	0.4375	–	0.27	0.24	0.22	–	1	ND
Dibromochloromethane	–	160	0.52	5.21	80	0.8	0.65	0.6	–	1	ND
Dibromochloropropane	–	1.6	0.014	0.144	0.2	–	–	–	–	5	ND
Dibromomethane	–	80	–	80	–	–	–	–	–	1	ND
Dichlorodifluoromethane	–	1,600	–	1,600	–	–	–	–	–	1	ND
Ethylbenzene	700	800	–	700	700	68	200	29	–	0.5	ND
Ethylene dibromide	0.01	72	0.022	0.05	0.05	–	–	–	–	0.5	ND
Hexachlorobutadiene	–	8	0.56	0.561	–	0.01	0.69	0.01	–	5	ND
Isopropylbenzene	–	800	–	–	800	–	–	–	–	1	ND
m,p-Xylene[10]	–	1,600	–	1,600	–	–	–	–	–	1	ND
Methyl ethyl ketone	–	4,800	–	4,800	–	–	–	–	–	10	ND
Methyl isobutyl ketone	–	640	–	640	–	–	–	–	–	10	ND
Methyl tert-butyl ether	20	–	24	24.3	–	–	–	–	–	1	ND
Methylene Chloride	5	48	5.8	5	5	20	16	10	–	10	ND
Naphthalene	160	160	–	160	–	–	–	–	–	2	0.343
n-Butylbenzene	–	400	–	400	–	–	–	–	–	1	ND
n-Propylbenzene	–	800	–	800	–	–	–	–	–	0.5	ND
o-Xylene	–	1,600	–	1,600	–	–	–	–	–	0.5	ND
sec-Butylbenzene	–	800	–	800	–	–	–	–	–	1	ND
Styrene	–	1,600	–	100	100	–	–	–	–	1	ND
tert-Butylbenzene	–	800	–	800	–	–	–	–	–	1	ND
Tetrachloroethene	5	48	21	5	5	10	4.9	2.4	–	0.4	ND
Toluene	1,000	640	–	640	1000	57	180	72	–	1	0.64
trans-1,2-Dichloroethene	–	160	–	100	100	100	600	200	–	0.4	ND
trans-1,3-Dichloropropene	–	240	0.44	0.4375	–	0.27	0.24	0.22	–	1	ND
Trichloroethene	5	4	0.54	4	5	0.6	0.38	0.3	–	0.4	ND
Trichlorofluoromethane	–	2,400	–	2,400	–	–	–	–	–	2	ND
Vinyl Acetate	–	8,000	–	8,000	–	–	–	–	–	10	ND
Vinyl Chloride	0.2	24	0.029	0.291666667	2	0.022	0.02	–	–	0.4	ND
Total Xylenes[13]	1,000	1,600	–	1,600	10,000	–	–	–	–	1	ND

Table 7-2a. Human Health Groundwater Screening Levels

Compound	MTCA				ARAR				Natural Background[6]	PQL	Maximum Detection Above the Detection Limit
	MTCA Method A, WAC 173-340-720, Table 720-1[1]	MTCA Method B, WAC 173-340-720[1]			Washington State MCL and SMCL, WAC 246-290-310[2]	Criteria for Consumption of Water & Organism, CWA 304[3]	Criteria for Consumption of Water & Organisms, WAC 173-201A-240[4]	Human Health Criteria, Consumption of Water+Organism, 40 CFR 131.45[5]			
		Non-Cancer	Cancer	Potable Groundwater Cleanup Level							
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
SVOCs (8270E)											
1,2,4-Trichlorobenzene	–	80	1.5	15.1	70	0.071	0.12	0.036	–	0.0485	ND
1,2-Dichlorobenzene	–	720	–	600	600	1,000	2,000	700	–	0.0485	ND
1,2-Dinitrobenzene	–	1.6	–	1.6	–	–	–	–	–	0.485	ND
1,3-Dichlorobenzene	–	–	–	–	–	7	13	2	–	0.0485	ND
1,3-Dinitrobenzene	–	1.6	–	1.6	–	–	–	–	–	0.485	ND
1,4-Dichlorobenzene	–	560	8.1	75	75	300	460	200	–	0.0485	ND
1,4-Dinitrobenzene	–	1.6	–	1.6	–	–	–	–	–	0.485	ND
1-Methylnaphthalene	–	560	–	1.51	–	–	–	–	–	0.0388	ND
2,3,4,6-Tetrachlorophenol	–	480	–	480	–	–	–	–	–	0.0971	ND
2,4,5-Trichlorophenol	–	1,600	–	1,600	–	300	–	–	–	0.0971	ND
2,4,6-Trichlorophenol	–	16	8	7.95	–	1.5	0.25	–	–	0.0971	ND
2,4-Dichlorophenol	–	48	–	48	–	10	25	10	–	0.0971	ND
2,4-Dimethylphenol	–	320	–	320	–	100	85	–	–	0.0971	ND
2,4-Dinitrophenol	–	32	–	32	–	10	60	30	–	0.485	ND
2,4-Dinitrotoluene	–	32	0.28	0.282	–	0.049	0.039	–	–	0.194	ND
2,6-Dinitrotoluene	–	4.8	0.058	0.0583	–	–	–	–	–	0.194	ND
2-Chloronaphthalene	–	640	–	640	–	800	170	100	–	0.0194	ND
2-Chlorophenol	–	40	–	40	–	30	15	–	–	0.0971	ND
2-Methylnaphthalene	–	32	–	32	–	–	–	–	–	0.0388	ND
2-Methylphenol	–	800	–	800	–	–	–	–	–	0.0485	ND
2-Nitroaniline	–	160	–	160	–	–	–	–	–	0.388	ND
3&4-Methylphenol Coelution[14]	–	800	–	800	–	–	–	–	–	0.0485	ND
3,3'-Dichlorobenzidine	–	–	0.19	0.194	–	0.049	0.0031	–	–	0.971	ND
4,6-Dinitro-O-cresol	–	1.3	–	1.28	–	2	7.1	3	–	0.485	ND
4-Chloro-3-methylphenol	–	1,600	–	1,600	–	500	36	–	–	0.194	ND
4-Chloroaniline	–	64	0.44	0.438	–	–	–	–	–	0.0485	ND
4-Nitroaniline	–	64	4.4	0.438	–	–	–	–	–	0.388	ND
Acenaphthene	–	480	–	480	–	70	110	30	–	0.0194	ND
Aniline	–	110	15	15.4	–	–	–	–	–	0.0971	ND
Anthracene	–	2,400	–	2,400	–	300	3,100	100	–	0.0194	ND
Azobenzene	–	–	0.4	0.398	–	–	–	–	–	0.0485	ND
Benzo(a)anthracene	–	–	–	–	–	0.0012	0.014	0.00016	–	0.0176	ND
Benzo(a)pyrene	0.1	4.8	0.023	0.2	0.2	0.00012	0.0014	0.000016	–	0.0176	ND
Benzo(b)fluoranthene	–	–	–	–	–	0.0012	0.014	0.00016	–	0.0176	ND
Benzo(k)fluoranthene	–	–	–	–	–	0.012	0.014	0.0016	–	0.0176	ND
Benzoic Acid	–	64,000	–	64,000	–	–	–	–	–	2.43	ND
Benzyl alcohol	–	1,600	–	1,600	–	–	–	–	–	0.194	ND
Bis(2-chloro-1-methylethyl) ether	–	320	0.63	0.625	–	200	–	400	–	0.0485	ND
Bis(2-chloroethoxy)methane	–	48	–	48	–	–	–	–	–	0.0485	ND
Bis(2-chloroethyl) ether	–	–	0.04	0.0398	–	–	0.02	–	–	0.0485	ND
Bis(2-ethylhexyl) phthalate	–	320	6.3	6	6	0.32	0.23	0.045	–	0.388	ND
Butyl benzyl phthalate	–	3,200	46	46.1	–	0.1	0.56	0.013	–	0.388	ND
Chrysene	–	–	–	–	–	0.12	1.4	0.016	–	0.0176	ND
Di(2-ethylhexyl)adipate	–	9,600	73	400	400	–	–	–	–	0.485	ND
Dibenz(a,h)anthracene	–	–	–	–	–	0.00012	0.0014	0.000016	–	0.0176	ND
Dibenzofuran	–	8	–	8	–	–	–	–	–	0.0194	ND
Dibutyl phthalate	–	1,600	–	1,600	–	20	450	8	–	0.388	ND
Diethyl phthalate	–	13,000	–	12,800	–	600	4,200	200	–	0.388	ND
Dimethyl phthalate	–	–	–	–	–	2000	92,000	600	–	0.388	ND
Di-n-octyl phthalate	–	160	–	160	–	–	–	–	–	0.388	ND
Fluoranthene	–	640	–	640	–	20	16	6	–	0.0194	ND
Fluorene	–	320	–	320	–	50	420	10	–	0.0194	0.0187
Hexachlorobenzene	–	6.4	0.027	0.273	1	0.000079	0.000051	0.000005	–	0.0194	ND
Hexachlorobutadiene	–	8	0.56	0.561	–	0.01	0.69	0.01	–	0.0485	ND
Hexachlorocyclopentadiene	–	48	–	48	50	4	150	1	–	0.0971	ND
Hexachloroethane	–	5.6	1.1	1.09	–	0.1	0.11	0.02	–	0.0485	ND
Indeno(1,2,3-cd)pyrene	–	–	–	–	–	0.0012	0.014	0.00016	–	0.0176	ND
Isophorone	–	3,200	92	92.1	–	34	27	–	–	0.0485	ND
Naphthalene	160	160	–	160	–	–	–	–	–	0.0388	0.343
Nitrobenzene	–	16	–	16	–	10	55	30	–	0.194	ND
N-Nitrosodimethylamine	–	0.064	0.00023	0.000226	–	0.00069	0.00065	–	–	0.0485	ND
N-Nitrosodi-n-propylamine	–	–	0.013	0.0125	–	0.005	0.0044	–	–	0.0485	ND
N-Nitrosodiphenylamine	–	–	18	17.9	–	3.3	0.62	–	–	0.0485	ND
Pentachlorophenol	–	80	0.22	1	1	0.03	0.046	0.002	–	0.19	ND
Phenol	–	4,800	–	4,800	–	4,000	18,000	9,000	–	0.388	ND
Pyrene	–	240	–	240	–	20	310	8	–	0.0194	ND
Pyridine	–	8	–	8	–	–	–	–	–	0.194	ND
Total cPAHs[15]	0.1	4.8	0.023	0.2	0.2	–	0.0014	–	–	0.0166	ND
PBDEs											
Units	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L		pg/L	pg/L	pg/L	pg/L
BDE-47	–	1,600,000	–	1,600,000	–	–	–	–	–	109	923
BDE-99	–	1,600,000	–	1,600,000	–	–	–	–	–	109	1,080
BDE-153	–	3,200,000	–	–	–	–	–	–	–	109	95.1
BDE-209	–	110,000,000	130,000,000	112,000,000	–	–	–	–	–	545	1,710
OctaBDE (BDE-153, -128/154, -183/176)[16]	–	48,000,000	–	48,000,000	–	–	–	–	–	218	202
PentaBDE (BDE-47, -99, -100, -153, -128/154)[16]	–	16,000,000	–	16,000,000	–	–	–	–	–	218	2,434

Notes

Selected groundwater human health screening level.

Screening level exceedance.

No screening level exceedance.

Analytes with no available screening levels are not shown.

Several analytes are on the reported analyte lists for more than one method (i.e., naphthalene is reported in the VOC, TPH, and SVOC methods).

Maximum detections are shown regardless of method, and minimum PQLs are based on the individual method.

[1] Washington State Department of Ecology (Ecology), Model Toxics Control Act (MTCA) Cleanup Amendments, Cleanup Levels and Risk Calculation (CLARC) Master Table, May 2023 (Revised January 2023).

[2] Washington State Maximum Contaminant Levels, WAC 246-290-310

[3] United States Environmental Protection Agency, National Recommended Water Quality Criteria - Human Health Criteria Table. Clean Water Act, Section 304.

[4] Washington State Legislature, Water Quality Standards for Surface Waters of the State of Washington, WAC 173-201A-240, Table 240.

[5] Human Health Criteria for Washington, consumption of water plus organism, 40 CFR 131.45, Table 1

[6] Ecology, Natural Background Groundwater Arsenic Concentrations in Washington State. For the Toxics Cleanup Program, Washington State Department of Ecology. January 2022.

[7] Human health screening levels and PQL listed are for Total Cr except where noted.

[8] Human health screening levels listed are for nickel soluble salts except where noted.

[9] Human health screening levels listed are for thallium soluble salts except where noted.

[10] Human health screening levels listed are for m-Xylene except where noted.

[11] The following summations were performed on TPH data:

1. GRO values for methods NWVPH and NVEPH were calculated by summing BTEX (benzene, toluene, ethylbenzene, xylenes), methyl tertbutyl ether, naphthalene, and hydrocarbons with between 4 and 10 carbon atoms.
2. DRO values for methods NWVPH and NWEPH were calculated by summing hydrocarbons with between 10 and 25 carbon atoms.
3. ORO values for methods NWVPH and NWEPH were calculated by summing hydrocarbons with more than 25 carbon atoms.

[12] As this summation spans two analytical methods, a PQL is not indicated.

[13] Listed PQL is for the highest of the minimum PQLs of the constituents used in the summation of Total Xylenes.

[14] Human health screening levels listed are for 3-methylphenol except where noted, as its screening levels are more conservative than those for 4-methylphenol.

[15] Human health screening levels listed are for benzo(a)pyrene. Listed PQL is for the highest of the minimum PQLs of the constituents used in the summation of Total cPAHs.

[16] Listed PQL is for the highest PQL of the constituents used in the summation of each PBDE group.

[a] 50 µg/L assumes that a portion of the chromium is hexavalent. If all the chromium is trivalent, then the Method A number is 100 µg/L.

[b] Human health screening level listed is for Cr(III).

– = not available or not applicable

µg/L = micrograms per liter

ARAR = applicable or relevant and appropriate requirement

cPAH = carcinogenic polycyclic aromatic hydrocarbon

MCL = Maximum Contaminant Level

MTCA = Model Toxics Control Act

ND = not detected

PBDE = Polybrominated Diphenyl Ether (equivalent to BDE)

PCB = polychlorinated biphenyl

pg/L = picograms per liter

pH = potential hydrogen

PQL = practical quantitation limit

SMCL = Secondary Maximum Contaminant Level

SVOCs = semivolatile organic compound

TPH = total petroleum hydrocarbons

USEPA = U.S. Environmental Protection Agency

VOC = volatile organic compound

WAC = Washington Administrative Code

Table 7-2b. Ecological Groundwater Screening Levels

Compound	ARARs				Natural Background[3]	PQL	Maximum Detection Above the Detection Limit
	Aquatic Life Criteria - Fresh Water, WAC 173-201A-240[1]		Freshwater Aquatic Life Criteria, CWA[2]				
	Chronic	Acute	Chronic	Acute			
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Miscellaneous							
pH	6.5 to 8.5	—	6.5 to 9	—	—	—	7.63
Metals (6020B, E218.6)							
Arsenic	190	360	150	340	4.9	1	2.53
Cadmium	1	3.7	0.72	1.8	—	0.2	0.285
Chromium[4]	180	550	74	570	—	1	7.4
Chromium, Hexavalent	10	15	11	16	—	0.02	0.12
Copper	11	17	—	—	—	2	15.4
Iron	—	—	1,000	—	—	50	9,320
Lead	2.5	65	2.5	65	—	0.2	2.58
Nickel[5]	160	1,400	52	470	—	2	6.82
Selenium	5	20	—	—	—	1	1.27
Silver	—	3.4	—	3.2	—	0.2	ND
Zinc	100	110	120	120	—	4	580
Total Petroleum Hydrocarbons (NWTPH-Gx, NWTPH-Dx, NWVPH, NWEPH)[6]							
Benzene	10	—	—	—	—	20	ND
Ethylbenzene	12	—	—	—	—	25	ND
M,P-Xylene	57	—	—	—	—	40	ND
O-Xylene	57	—	—	—	—	20	ND
Toluene	53	—	—	—	—	25	0.64
Diesel Range Organics (DRO) + Residual Range Organics (RRO)[7,8]	3,000	—	—	—	—	—	316
Gasoline Range Organics (GRO)[7]	1,000	—	—	—	—	79.4	123
Total Xylenes	57	—	—	—	—	40	ND
VOCs (8260D)[6]							
Benzene	10	—	—	—	—	0.2	ND
Ethylbenzene	12	—	—	—	—	0.5	ND
M,P-Xylene	57	—	—	—	—	1	ND
O-Xylene	57	—	—	—	—	0.5	ND
Toluene	53	—	—	—	—	1	0.64
Total Xylenes	57	—	—	—	—	1	ND
SVOCs (8270E)							
Pentachlorophenol	13	20	15	19	—	0.19	ND

Notes

Selected groundwater ecological screening level.

Screening level exceedance.

No screening level exceedance.

Analytes with no available screening levels are not shown.

Several analytes are on the reported analyte lists for more than one method (i.e., naphthalene is reported in the VOC, TPH, and SVOC methods). Maximum detections are shown regardless of method, and minimum PQLs are based on the individual method.

[1] Washington State Legislature, Water Quality Standards for Surface Waters of the State of Washington, WAC 173-201A-240, Table 240.

[2] National Recommended Water Quality Criteria - Aquatic Life Criteria Table, Clean Water Act Section 304

[3] Ecology, Natural Background Groundwater Arsenic Concentrations in Washington State. January 2022.

[4] Ecological screening levels listed are for Cr(III) except where noted. Listed PQL is for Total Chromium.

[5] Ecological screening levels listed are for nickel soluble salts except where noted.

[6] Protective values for benzene, ethylbenzene, toluene, xylenes (BTEX) and diesel- and gasoline-range organics are from the Washington State Department of Ecology Implementation Memo #23.

[7] The following summations were performed on TPH data:

1. GRO values for methods NWVPH and NVEPH were calculated by summing BTEX (benzene, toluene, ethylbenzene, xylenes), methyl tertbutyl ether, naphthalene, and hydrocarbons with between 4 and 10 carbon atoms.
2. DRO values for methods NWVPH and NWEPH were calculated by summing hydrocarbons with between 10 and 25 carbon atoms.
3. ORO values for methods NWVPH and NWEPH were calculated by summing hydrocarbons with more than 25 carbon atoms.

[8] As this summation spans two analytical methods, a PQL is not indicated.

— = not available or not applicable

µg/L = micrograms per liter

ND = not detected

PQL = practical quantitation limit

SVOCs = Semivolatile organic compounds

TPH = total petroleum hydrocarbons

VOCs = Volatile organic compounds

Table 7-3a. Human Health Soil Screening Levels

Compound	Human Health					Natural Background		PQL	Maximum Detection Above the Detection Limit
	MTCA Method A, WAC 173-340-740[1]	MTCA Method B, WAC 173-340-740[1]							
	Unrestricted Land Use	Direct Contact, Non-Cancer	Direct Contact, Cancer	Protective of Groundwater, Saturated	Protective of Groundwater to Surface Water, Saturated	Statewide 90th%[2]	USGS 2014 Top 5 cm 90% UTL / 90% Coverage[3]		
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Metals (6020B, E218.6)									
Arsenic	20	24	0.67	0.15	0.15	7	–	1	30.5
Barium	–	16,000	–	83	41	–	780.4	1	265
Beryllium	–	160	–	3.2	220	2	–	0.2	0.57
Cadmium	2	80	–	0.035	0.005	1	–	0.2	10.9
Chromium[4]	2,000	120,000	–	24,000	74	42	–	1	45
Chromium, Hexavalent	19	240	0.38	0.00089	0.025	–	–	2.06	ND
Cobalt	–	24	–	0.22	–	–	29.19	1	82.3
Copper	–	3,200	–	14	0.25	36	–	2	208
Iron[5]	–	56,000	–	7.6	25	42,100	–	–	–
Lead	250	–	–	150	25	17	–	0.2	6,000
Nickel[6]	–	1,600	–	21	3.4	38	–	2	61.2
Selenium	–	400	–	0.26	0.026	–	0.611	1	ND
Thallium[7]	–	0.8	–	0.011	0.016	–	0.374	0.2	0.185
Vanadium	–	400	–	80	–	–	243.9	2	56.1
Zinc	–	24,000	–	300	6.2	86	–	4	14,000
PCBs (8082A)									
Aroclor 1016	–	5.6	14	0.06	0.00032	–	–	0.01	ND
Aroclor 1254	–	1.6	0.5	0.0029	0.000014	–	–	0.01	0.0704
Aroclor 1260	–	–	0.5	0.018	–	–	–	0.01	0.0319
Total PCBs[8]	1	–	0.5	0.017	0.0000006	–	–	0.01	0.144
Total Petroleum Hydrocarbons (NWTPH-Gx, NWTPH-Dx, NWVPH, NWEPH)									
Benzene	0.03	320	18	0.0017	0.00015	–	–	0.643	ND
Ethylbenzene	6	8,000	–	0.34	0.0059	–	–	1.82	ND
m,p-Xylene[9]	–	16,000	–	0.77	–	–	–	1.07	ND
Methyl tert-butyl ether	0.1	–	560	0.0072	–	–	–	1.18	ND
Naphthalene	5	1,600	–	0.24	7.3	–	–	2.79	0.265
o-Xylene	–	16,000	–	0.84	–	–	–	0.536	ND
Toluene	7	6,400	–	0.27	0.023	–	–	0.536	ND
Diesel Range Organics (DRO) + Residual Range Organics (RRO)[10,11]	2,000	–	–	–	–	–	–	–	864
Gasoline Range Organics (GRO)[10]	30	–	–	–	–	–	–	12.4	141
VOCs (8260D)									
1,1,1,2-Tetrachloroethane	–	2,400	38	0.00063	–	–	–	0.0272	ND
1,1,1-Trichloroethane	2.00	160,000	–	0.084	4.2	–	–	0.0272	ND
1,1,2,2-Tetrachloroethane	–	1,600	5	0.00008	0.000037	–	–	0.0544	ND
1,1,2-Trichloroethane	–	320	18	0.0011	0.00013	–	–	0.0272	ND
1,1-Dichloroethane	–	16,000	180	0.0026	–	–	–	0.0272	ND
1,1-Dichloroethene	–	4,000	–	0.0025	0.11	–	–	0.0272	ND
1,2,3-Trichlorobenzene	–	64	–	0.011	–	–	–	0.272	ND
1,2,3-Trichloropropane	–	320	0.0063	0.00000015	–	–	–	0.0544	ND
1,2,4-Trichlorobenzene	–	800	34	0.029	0.00007	–	–	0.272	ND
1,2,4-Trimethylbenzene	–	800	–	0.072	–	–	–	0.0544	ND
1,2-Dichlorobenzene	–	7,200	–	0.4	0.47	–	–	0.0272	ND
1,2-Dichloroethane	–	480	11	0.0016	0.0029	–	–	0.0272	ND
1,2-Dichloropropane	–	3,200	27	0.0017	0.00024	–	–	0.0272	ND
1,3,5-Trimethylbenzene	–	800	–	0.071	–	–	–	0.0544	ND
1,3-Dichloropropane	–	1,600	–	0.057	–	–	–	0.0544	ND
1,4-Dichlorobenzene	–	5,600	190	0.068	0.18	–	–	0.0272	ND
2-Chlorotoluene	–	1,600	–	0.11	–	–	–	0.0544	ND
2-Hexanone	–	400	–	0.012	–	–	–	0.544	ND
4-Chlorotoluene	–	1,600	–	0.11	–	–	–	0.0544	ND
Acetone	–	72,000	–	2.1	–	–	–	1.09	ND
Acrylonitrile	–	3,200	1.9	0.000024	0.0000056	–	–	0.109	ND
Benzene	0.03	320	18	0.0017	0.00015	–	–	0.0109	ND
Bromobenzene	–	640	–	0.033	–	–	–	0.0272	ND
Bromodichloromethane	–	1,600	16	0.0022	0.00023	–	–	0.0544	ND
Bromoform	–	1,600	130	0.023	0.0019	–	–	0.109	ND
Bromomethane	–	110	–	0.0033	0.03	–	–	0.544	ND
Carbon disulfide	–	8,000	–	0.25	–	–	–	0.544	ND
Carbon tetrachloride	–	320	14	0.0022	0.000088	–	–	0.0544	ND
Chlorobenzene	–	1,600	–	0.051	0.051	–	–	0.0272	ND
Chloroform	–	800	32	0.0048	0.02	–	–	0.0544	ND
cis-1,2-Dichloroethene	–	160	–	0.0052	–	–	–	0.0272	ND
cis-1,3-Dichloropropene[12]	–	2,400	10	0.00014	0.000069	–	–	0.0544	ND
Dibromochloromethane	–	1,600	12	0.0017	0.00019	–	–	0.109	ND
Dibromochloropropane	–	16	0.23	0.000058	–	–	–	0.272	ND
Dibromomethane	–	800	–	0.025	–	–	–	0.0544	ND
Dichlorodifluoromethane	–	16,000	–	0.53	–	–	–	0.109	ND
Ethylbenzene	6	8,000	–	0.34	0.0059	–	–	0.0272	ND
Ethylene dibromide	0.005	720	0.5	0.000018	–	–	–	0.0544	ND
Hexachlorobutadiene	–	80	13	0.00063	0.000011	–	–	0.109	ND
Isopropylbenzene	–	8,000	–	0.79	–	–	–	0.0544	ND
m,p-Xylene	–	16,000	–	0.77	–	–	–	0.0544	ND
Methyl ethyl ketone	–	48,000	–	1.4	–	–	–	0.544	ND
Methyl isobutyl ketone	–	6,400	–	0.19	–	–	–	0.544	ND
Methyl tert-butyl ether	0.1	–	560	0.0072	–	–	–	0.0544	ND
Methylene Chloride	0.02	480	94	0.0015	0.003	–	–	0.544	ND
Naphthalene	5	1,600	–	0.24	7.3	–	–	0.109	0.265
n-Butylbenzene	–	4,000	–	0.71	–	–	–	0.0544	ND
n-Propylbenzene	–	8,000	–	0.88	–	–	–	0.0272	ND
o-Xylene	–	16,000	–	0.84	–	–	–	0.0272	ND
sec-Butylbenzene	–	8,000	–	1.3	–	–	–	0.0544	ND
Styrene	–	16,000	–	0.12	–	–	–	0.0544	ND
tert-Butylbenzene	–	8,000	–	1	–	–	–	0.0544	ND
Tetrachloroethene	0.05	480	480	0.0028	0.0013	–	–	0.0272	0.0601
Toluene	7.00	6,400	–	0.27	0.023	–	–	0.0544	ND
trans-1,2-Dichloroethene	–	1,600	–	0.032	0.032	–	–	0.0272	ND
trans-1,3-Dichloropropene[12]	–	2,400	10	0.00014	0.000069	–	–	0.0544	ND
Trichloroethene	0.03	40	12	0.0015	0.00011	–	–	0.0272	ND
Trichlorofluoromethane	–	24,000	–	0.79	–	–	–	0.109	ND
Vinyl Chloride	–	240	0.67	0.00009	0.0000062	–	–	0.0272	ND
Total Xylenes[13]	9	16,000	–	0.83	0.03	–	–	0.05	ND

Table 7-3a. Human Health Soil Screening Levels

Compound	Human Health					Natural Background		PQL	Maximum Detection Above the Detection Limit
	MTCA Method A, WAC 173-340-740[1]	MTCA Method B, WAC 173-340-740[1]							
	Unrestricted Land Use	Direct Contact, Non-Cancer	Direct Contact, Cancer	Protective of Groundwater, Saturated	Protective of Groundwater to Surface Water, Saturated	Statewide 90th%[2]	USGS 2014 Top 5 cm 90% UTL / 90% Coverage[3]		
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
SVOCs (8270E)									
1,2,4-Trichlorobenzene	–	800	34	0.029	0.00007	–	–	0.214	ND
1,2-Dichlorobenzene	–	7,200	–	0.4	0.47	–	–	0.214	ND
1,2-Dinitrobenzene	–	8	–	0.001	–	–	–	2.14	ND
1,3-Dinitrobenzene	–	8	–	0.001	–	–	–	2.14	ND
1,4-Dichlorobenzene	–	5,600	190	0.068	0.18	–	–	0.214	ND
1,4-Dinitrobenzene	–	8	–	0.001	–	–	–	2.14	ND
1-Methylnaphthalene	–	5600	34	0.0042	–	–	–	0.171	ND
2,3,4,6-Tetrachlorophenol	–	2,400	–	0.27	–	–	–	0.427	ND
2,4,5-Trichlorophenol	–	8,000	–	3	0.57	–	–	0.427	ND
2,4,6-Trichlorophenol	–	80	91	0.0053	0.00017	–	–	0.427	ND
2,4-Dichlorophenol	–	240	–	0.021	0.0043	–	–	0.427	ND
2,4-Dimethylphenol	–	1,600	–	0.25	0.066	–	–	0.427	ND
2,4-Dinitrophenol	–	160	–	0.0092	0.0029	–	–	2.14	ND
2,4-Dinitrotoluene	–	160	3.2	0.00024	0.000034	–	–	0.858	ND
2,6-Dinitrotoluene	–	24	0.67	0.000051	–	–	–	0.858	ND
2-Chloronaphthalene	–	6,400	–	1.8	0.28	–	–	0.0858	ND
2-Chlorophenol	–	400	–	0.027	0.01	–	–	0.427	ND
2-Methylnaphthalene	–	320	–	0.088	–	–	–	0.171	ND
2-Methylphenol	–	4,000	–	0.47	–	–	–	0.214	ND
2-Nitroaniline	–	800	–	0.064	–	–	–	1.71	ND
3&4-Methylphenol Coelution[14]	–	4,000	–	0.47	–	–	–	0.214	0.198
3,3'-Dichlorobenzidine	–	–	2.2	0.00068	0.000011	–	–	1.71	ND
4,6-Dinitro-O-cresol	–	6	–	0.0013	0.0021	–	–	2.14	ND
4-Chloro-3-methylphenol	–	8,000	–	1.2	0.028	–	–	0.858	ND
4-Chloroaniline	–	320	5	0.00017	–	–	–	0.214	ND
4-Nitroaniline	–	320	50	0.0017	–	–	–	1.71	ND
Acenaphthene	–	4,800	–	2.5	0.16	–	–	0.0858	ND
Aniline	–	560	180	0.0055	–	–	–	0.427	ND
Anthracene	–	24,000	–	57	2.4	–	–	0.0858	0.07
Azobenzene	–	–	9.1	0.0016	–	–	–	0.214	ND
Benzo(a)pyrene	0.1	24	0.19	0.19	0.000016	–	–	0.128	1.05
Benzoic Acid	–	320,000	–	18	–	–	–	10.7	7.73
Benzyl alcohol	–	8,000	–	0.49	–	–	–	0.427	ND
Bis(2-chloro-1-methylethyl)ether	–	3,200	14	0.00023	0.074	–	–	0.214	ND
Bis(2-chloroethoxy)methane	–	240	–	0.014	–	–	–	0.214	ND
Bis(2-chloroethyl)ether	–	–	0.91	0.000014	0.0000073	–	–	0.214	ND
Bis(2-ethylhexyl)phthalate	–	1,600	71	0.67	0.005	–	–	1.28	ND
Butyl benzyl phthalate	–	16,000	530	0.65	0.00018	–	–	0.858	1.99
Di(2-ethylhexyl)adipate	–	48,000	830	15	–	–	–	2.14	ND
Dibenzofuran	–	80	–	0.076	–	–	–	0.0858	ND
Dibutyl phthalate	–	8,000	–	3	0.015	–	–	0.858	ND
Diethyl phthalate	–	64,000	–	4.7	0.074	–	–	0.858	ND
Di-n-octyl phthalate	–	800	–	23	–	–	–	0.858	ND
Fluoranthene	–	3,200	–	32	0.3	–	–	0.0858	0.695
Fluorene	–	3,200	–	2.6	0.08	–	–	0.0858	ND
Hexachlorobenzene	–	64	0.63	0.022	0.0000004	–	–	0.0858	ND
Hexachlorobutadiene	–	80	13	0.00063	0.000011	–	–	0.214	ND
Hexachlorocyclopentadiene	–	480	–	0.081	0.0017	–	–	0.427	ND
Hexachloroethane	–	56	25	0.00053	0.0000097	–	–	0.214	ND
Isophorone	–	16,000	1,100	0.032	0.0095	–	–	0.214	ND
Naphthalene	5	1,600	–	0.24	7.3	–	–	0.171	0.265
Nitrobenzene	–	160	–	0.0065	0.0041	–	–	0.858	ND
N-Nitrosodimethylamine	–	0.64	0.0037	0.00000007	0.0000002	–	–	0.214	ND
N-Nitrosodi-n-propylamine	–	–	0.14	0.000007	0.0000025	–	–	0.214	ND
N-Nitrosodiphenylamine	–	–	200	0.052	0.0018	–	–	0.214	ND
Pentachlorophenol	–	400	2.5	0.00088	0.0000018	–	–	0.858	3.16
Phenol	–	24,000	–	2.3	1.9	–	–	0.171	0.179
Pyrene	–	2,400	–	16	0.55	–	–	0.0858	1.01
Pyridine	–	80	–	0.0029	–	–	–	0.427	ND
Total cPAHs[15]	0.1	24	0.19	0.19	0.000016	–	–	0.004	1.37

Notes

Selected soil human health screening level.

Screening level exceedance.

No screening level exceedance.

Screening levels not applicable based on results of prior pre-screenings.

Analytes with no available screening levels are not shown.

Several analytes are on the reported analyte lists for more than one method (i.e., naphthalene is reported in the VOC, TPH, and SVOC methods).
Maximum detections are shown regardless of method, and minimum PQLs are based on the individual method.

[1] Washington State Department of Ecology (Ecology), Model Toxics Control Act (MTCA) Cleanup Amendments, Cleanup Levels and Risk Calculation (CLARC) Master Table, May 2023 (Revised January 2023).

[2] Ecology, Natural Background Soil Metals Concentrations in Washington State (Table 1, State Wide Values), October 1994.

[3] USGS, Geochemical and Mineralogical Data for Soils of the Conterminous United States, U.S. Geological Survey and U.S. Department of Interior. Data Series 801. 2013.

[4] Human health screening levels listed are for Cr(III) except where noted. Listed PQL is for total chromium.

[5] Iron was not analyzed in soils but is listed because it was identified as a COPC during the surface water and groundwater pre-screening evaluations.

[6] Human health screening levels listed are for nickel soluble salts except where noted.

[7] Human health screening levels listed are for thallium soluble salts except where noted.

[8] Listed PQL is for the highest of the minimum PQLs of the constituents used in the summation of Total PCBs.

[9] Human health screening levels listed are for m-Xylene except where noted, as its screening levels are more conservative than those for o-Xylene.

[10] The following summations were performed on TPH data:

1. GRO values for methods NWVPH and NVEPH were calculated by summing BTEX (benzene, toluene, ethylbenzene, xylenes), methyl tertbutyl ether, naphthalene, and hydrocarbons with between 4 and 10 carbon atoms.
2. DRO values for methods NWVPH and NWEPH were calculated by summing hydrocarbons with between 10 and 25 carbon atoms.
3. ORO values for methods NWVPH and NWEPH were calculated by summing hydrocarbons with more than 25 carbon atoms.

[11] As this summation spans two analytical methods, a PQL is not indicated.

[12] Human health screening levels listed are for 1,3-dichloropropene, mixture of isomers, except where noted.

[13] Listed PQL is for the highest of the minimum PQLs of the constituents used in the summation of Total Xylenes.

[14] Human health screening levels listed are for 3-methylphenol, as its screening levels are more conservative than those for 4-methylphenol. Listed PQL is for 3&4 methylphenol coelution.

[15] Human health screening levels listed are for benzo(a)pyrene. Listed PQL is for the highest of the minimum PQLs of the constituents used in the summation of Total cPAHs.

– = not available or not applicable

cPAHs = carcinogenic polycyclic aromatic hydrocarbons

mg/kg = milligrams per kilogram

MTCA = Model Toxics Control Act

PCB = polychlorinated biphenyls

PQL = practical quantitation limit

SVOC = semivolatile organic compound

USGS = U.S. Geological Survey

UTL = Upper Tolerance Limit

VOC = volatile organic compound

WAC = Washington Administrative Code

Table 7-3b. Ecological Soil Screening Levels

Compound	Ecological: WAC 173-340-7493, Table 749-3 Soil Ecological Indicator[1]			Natural Background		Terrestrial Ecological Evaluation pCUL *Wetland Soil Only*[4]	PQL	Maximum Detection Above the Detection Limit
	Plants	Soil Biota	Wildlife	Statewide 90th %[2]	USGS 2014 Top 5 cm 90% UTL/90% Coverage[3]			
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Metals (6020B, E218.6)								
Arsenic[5]	10	60	132	7	–	–	1	30.5
Barium	500	–	102	–	780.4	–	1	265
Beryllium	10	–	–	2	–	–	0.2	0.57
Cadmium	4	20	14	1	–	–	0.2	10.9
Chromium	42	42	67	42	–	–	1	45
Cobalt	20	–	–	–	29.19	–	1	82.3
Copper	100	50	217	36	–	208	2	208
Lead	50	500	118	17	–	501	0.2	6,000
Nickel	30	200	980	38	–	–	2	61.2
Selenium	1	70	0.3	–	0.611	–	1	ND
Thallium	1	–	–	–	0.374	–	0.2	0.185
Vanadium	2	–	–	–	243.9	–	2	56.1
Zinc	86	200	360	86	–	5,480	4	14,000
PCBs (8082A)								
Total PCBs[6]	40	–	0.65	–	–	–	0.0096	0.144
Total Petroleum Hydrocarbons (NWTPH-Gx, NWTPH-Dx, NWVPH, NWEPH)								
Toluene	200	–	–	–	–	–	0.536	ND
Diesel Range Organics (DRO) + Residual Range Organics (RRO)[7,8]	–	200	6,000	–	–	–	18.1	864
Gasoline Range Organics (GRO)[7]	–	100	5,000	–	–	–	18.1	141
VOCs (8260D)								
1,2,3-Trichlorobenzene	–	20	–	–	–	–	0.272	ND
1,2,4-Trichlorobenzene	–	20	–	–	–	–	0.272	ND
1,2-Dichloropropane	–	700	–	–	–	–	0.0272	ND
1,4-Dichlorobenzene	–	20	–	–	–	–	0.0272	ND
Chlorobenzene	–	40	–	–	–	–	0.0272	ND
Styrene	300	–	–	–	–	–	0.0544	ND
Toluene	200	–	–	–	–	–	0.0544	ND
SVOCs (8270E)								
1,2,4-Trichlorobenzene	–	20	–	–	–	–	0.214	ND
1,4-Dichlorobenzene	–	20	–	–	–	–	0.214	ND
2,4,5-Trichlorophenol	4	9	–	–	–	–	0.427	ND
2,4,6-Trichlorophenol	–	10	–	–	–	–	0.427	ND
2,4-Dinitrophenol	20	–	–	–	–	–	2.14	ND
4-Nitrophenol	–	7	–	–	–	–	0.858	ND
Acenaphthene	20	–	–	–	–	–	0.0858	ND
Benzo(a)pyrene	–	–	12	–	–	–	0.128	1.05
Dibutyl phthalate	200	–	–	–	–	–	0.858	ND
Diethyl phthalate	100	–	–	–	–	–	0.858	ND
Dimethyl phthalate	–	200	–	–	–	–	0.858	ND
Fluorene	–	30	–	–	–	–	0.0858	ND
Hexachlorobenzene	–	–	17	–	–	–	0.0858	ND
Hexachlorocyclopentadiene	10	–	–	–	–	–	0.427	ND
Nitrobenzene	–	40	–	–	–	–	0.858	ND
N-Nitrosodiphenylamine	–	20	–	–	–	–	0.214	ND
Pentachlorophenol	3	6	4.5	–	–	–	0.858	3.16
Phenol	70	30	–	–	–	–	0.171	0.179
Total cPAHs[9]	–	–	12	–	–	–	0.128	1.37

Notes

Selected soil ecological screening level.
Terrestrial ecological evaluation pCUL.
Screening level exceedance.
No screening level exceedance.

Analytes with no available screening levels are not shown.

Several analytes are on the reported analyte lists for more than one method (i.e., naphthalene is reported in the VOC, TPH, and SVOC methods).
Maximum detections are shown regardless of method, and minimum PQLs are based on the individual method.

[1] Washington Administrative Code (WAC) 173-340-900 Table 749-3, Ecological Indicator Soil Concentrations for Protection of Terrestrial Plants and Animals.

[2] Ecology, Natural Background Soil Metals Concentrations in Washington State (Table 1, State Wide Values), October 1994.

[3] USGS, Geochemical and Mineralogical Data for Soils of the Conterminous United States, U.S. Geological Survey and U.S. Department of the Interior. Data Series 801. 2013.

[4] See the Weight of Evidence Based Terrestrial Ecological Evaluation, Appendix G of this document.

[5] Ecological screening levels listed are for As(V).

[6] Listed PQL is for the highest of the minimum PQL of the constituents used in the summation of Total PCBs.

[7] Listed PQL is for the highest of the minimum PQLs of the constituents used in the following summations:
1. GRO values for methods NWVPH and NVEPH were calculated by summing BTEX (benzene, toluene, ethylbenzene, xylenes), methyl tertbutyl ether, naphthalene, and hydrocarbons with between 4 and 10 carbon atoms.
2. DRO values for methods NWVPH and NWEPH were calculated by summing hydrocarbons with between 10 and 25 carbon atoms.
3. ORO values for methods NWVPH and NWEPH were calculated by summing hydrocarbons with more than 25 carbon atoms.

[8] As this summation spans two analytical methods, a PQL is not indicated.

[9] Ecological screening levels listed are for benzo(a)pyrene. Listed PQL is for the highest of the minimum PQLs of the constituents used in the summation of Total cPAHs.

– = not available or not applicable
cPAHs = carcinogenic polycyclic aromatic hydrocarbons
mg/kg = milligrams per kilogram
MTCA = Model Toxics Control Act
PCB = polychlorinated biphenyls
pCUL = Proposed cleanup level
PQL = Practical Quantitation Limit
SVOCs = Semivolatile organic compounds
TPH = total petroleum hydrocarbons
USGS = U.S. Geological Survey
UTL = Upper Tolerance Limit
VOCs = Volatile organic compounds
WAC = Washington Administrative Code

Table 7-4. Wetland Area Secondary Screening – Direct Contact

COPCs	Distribution[1]	Units	Number of Wetland Area Samples[2]	Number of Detections	Max Location	Max Concentration Depth Interval (ft)	Max Concentration in Wetland Area (mg/kg)	Natural Background (mg/kg)	Wetland Area Data 95% UCL (mg/kg)	Human Health Direct Contact SL (mg/kg)[3]
Arsenic	Normal	mg/kg	25	21	HA-02E	0-0.5	12.5	7[4]	4.642	7[6]
Barium	Normal	mg/kg	25	25	HA-02D	0-0.5	116	780.4[5]	79.72	16,000
Beryllium	Normal	mg/kg	25	4	HA-02C	0-0.5	0.57	2[4]	0.334	160
Cadmium	Normal	mg/kg	25	18	HA-02D	0-0.5	5.03	1[4]	1.68	80
Chromium	Normal	mg/kg	25	25	HA-03A	0-0.5	26.1	42[4]	16.47	120,000
Hexavalent Chromium	–	mg/kg	25	25	–	–	ND	–	ND	2.06[7]
Cobalt	Normal	mg/kg	25	21	HA-02E	0-0.5	82.3	29.19[5]	12.3	24
Copper	Normal	mg/kg	25	25	HA-02C	0-0.5	208	36[4]	68.57	3,200
Lead	Gamma	mg/kg	80	80	HA-06D	0-0.5	501	17[4]	110.9	250[8]
Nickel	Normal	mg/kg	25	20	HA-02C	0-0.5	51.4	38[4]	18.63	1,600
Vanadium	Normal	mg/kg	25	25	HA-03A	0-0.5	55.3	243.9[5]	34.1	400
Selenium	–	mg/kg	25	0	–	–	ND	0.611[5]	ND	0.8
Thallium	–	mg/kg	25	0	–	–	ND	0.374[5]	ND	400
Zinc	Normal	mg/kg	90	90	HA-02D	0.5-1.0	5,420	86[4]	889.3	24,000
Total cPAHs	–	mg/kg	3	1	HA-02 Composite	0-0.5	0.0817	–	–	0.19
TPH-GRO	–	mg/kg	14	1	HA-03 Composite (duplicate)	0-0.5	141	–	–	30

Notes

Max detection is greater than 2 times the direct contact screening level.

Retained as a Human Health Direct Contact COC.

Screening factor that eliminates consideration as a COC.

[1] Distribution is calculated when at least 6 values are available and cannot be calculated when no detects are available.

[2] All discrete samples from the Wetland Area that includes transects HA-02 through HA-07.

[3] MTCA Method B, WAC 173-340 Direct Contact, non-Cancer, Eq. 740-1, except where noted.

[4] Washington Department of Ecology 90th percentile Statewide background value.

[5] USGS 2013 top 5 cm in mixed forest setting 90% Upper Tolerance Limit (UTL)/90% Coverage.

[6] Based on natural background.

[7] Based on the PQL (above the cancer direct contact criteria).

[8] MTCA Method A unrestricted land use

– = not analyzed or not applicable

ft = foot or feet

mg/kg = milligrams per kilogram

J = estimate

ND = Non Detect

SL = screening level

UCL = upper confidence limit

UTL = upper tolerance limit

Table 7-5. Wetland Area Secondary Screening - Metals

Metal	Distribution	Units	Number of Wetland Area Samples[1]	Number of Detections	Max Location	Max Concentration Depth Interval (ft)	Max Concentration in Wetland Area (mg/kg)	Natural Background (mg/kg)	Wetland Area Data 95% UCL (mg/kg)	Most Stringent Ecological SL (mg/kg)[4]
Arsenic	Normal	mg/kg	25	21	HA-02E	0-0.5	12.5	7[2]	4.642	10
Barium	Normal	mg/kg	25	25	HA-02D	0-0.5	116	780.4[3]	79.72	780.4
Beryllium	Normal	mg/kg	25	4	HA-02C	0-0.5	0.57	2[2]	0.334	10
Cadmium	Normal	mg/kg	25	18	HA-02D	0-0.5	5.03	1[2]	1.68	4
Chromium	Normal	mg/kg	25	25	HA-03A	0-0.5	26.1	42[2]	16.47	42
Cobalt	Normal	mg/kg	25	21	HA-02E	0-0.5	82.3	29.19[3]	12.3	29.19
Copper	Normal	mg/kg	25	25	HA-02C	0-0.5	208	36[2]	68.57	50
Lead	Gamma	mg/kg	80	80	HA-06D	0-0.5	501	17[2]	110.9	50
Nickel	Normal	mg/kg	25	20	HA-02C	0-0.5	51.4	38[2]	18.63	38
Selenium	—	mg/kg	25	0	—	—	ND	0.611[3]	ND	1
Thallium	—	mg/kg	25	0	—	—	ND	0.374[3]	ND	1
Vanadium	Normal	mg/kg	25	25	HA-03A	0-0.5	55.3	243.9[3]	34.1	243.9
Zinc	Normal	mg/kg	90	90	HA-02D	0.5-1.0	5,420	86[2]	889.3	86

Notes

Retained as a wetland metal Ecological COC.

Screening factor that eliminates consideration as a COC.

[1] All discrete samples from the Wetland Area that includes transects HA-02 through HA-07.

[2] Washington Department of Ecology 90th percentile Statewide background value.

[3] USGS 2013 top 5 cm in mixed forest setting 90th percentile Upper Tolerance Limit (UTL)/90th percentile Coverage.

[4] See Table 7-3b for the evaluated soil ecological screening levels.

— = not available or not applicable

ft = foot or feet

mg/kg = milligrams per kilogram

ND = Non Detect

SL = screening level

UCL = upper confidence limit

UTL = upper tolerance limit

Table 8-1. Miscellaneous Groundwater and Surface Water Analyses

Screening Criteria				Ferrous Iron	Alkalinity, Bicarbonate (as CaCO3)	Alkalinity, Carbonate (as CaCO3)	Alkalinity, Hydroxide (as CaCO3)	Alkalinity, Total (as CaCO3)	Ammonia (as N)	Hardness (as CaCO3)	Total Hardness
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L
Groundwater Screening Levels											
Human Health				–	–	–	–	–	–	–	–
Ecological				–	–	–	–	–	–	–	–
PQL				–	20	20	20	20	0.02	15.4	6,000
Location	Area	Date	Sample Type								
Upgradient Spring (Surface Water) and Upgradient Piezometers (Groundwater)											
PZ-01	Landfill	2/4/2022	Primary	1.5	94.8	20.0 U	20.0 U	94.8	0.01000 U	–	–
PZ-02	Landfill	2/4/2022	Primary	2.5	80.8	20.0 U	20.0 U	80.8	0.01000 U	–	–
	Landfill	2/4/2022	Duplicate	–	79.2	20.0 U	20.0 U	79.2	0.01000 U	–	–
PZ-05	Landfill	2/4/2022	Primary	<0.5	38.7	20.0 U	20.0 U	38.7	0.01000 U	–	–
SW-03	Spring	1/12/2021	Primary	–	–	–	–	–	–	31.1	20,800
SW-06	Spring	9/16/2021	Primary	–	–	–	–	–	–	–	–
	Spring	9/16/2021	Duplicate	–	–	–	–	–	–	–	–
SW-13	Spring	2/2/2022	Primary	–	37.5	20.0 U	20.0 U	37.5	0.0150 J	–	–
Former Landfill											
GW-01	Landfill	1/12/2021	Primary	–	–	–	–	–	–	456	369,556
SW-05	Landfill	9/16/2021	Primary	–	–	–	–	–	–	–	–
Wetland											
PZ-03	Wetland	2/3/2022	Primary	0.75	40.0	20.0 U	20.0 U	40.0	0.0420	–	–
PZ-04	Wetland	2/3/2022	Primary	5.75	64.5	20.0 U	20.0 U	64.5	0.223	–	–
SE-01	Wetland	1/11/2021	Primary	–	–	–	–	–	–	42.0	29,714
	Wetland	1/11/2021	Duplicate	–	–	–	–	–	–	41.0	28,965
SE-02	Wetland	1/11/2021	Primary	–	–	–	–	–	–	380	279,664
SW-01	Wetland	1/12/2021	Primary	–	–	–	–	–	–	35.4	23,697
SW-02	Wetland	1/12/2021	Primary	–	–	–	–	–	–	32.7	21,849
SW-04	Wetland	9/16/2021	Primary	–	–	–	–	–	–	–	–
SW-07	Wetland	2/2/2022	Primary	<0.5	32.8	20.0 U	20.0 U	32.8	0.0140 J	–	–
SW-08	Wetland	2/2/2022	Primary	<0.5	37.3	20.0 U	20.0 U	37.3	0.0170 J	–	–
SW-09	Wetland	2/2/2022	Primary	<0.5	35.5	20.0 U	20.0 U	35.5	0.0110 J	–	–
	Wetland	2/2/2022	Duplicate	–	35.8	20.0 U	20.0 U	35.8	0.01000 U	–	–
SW-10	Wetland	2/2/2022	Primary	<0.5	63.7	20.0 U	20.0 U	63.7	0.0300	–	–
SW-11	Wetland	2/2/2022	Primary	<0.5	36.8	20.0 U	20.0 U	36.8	0.0400	–	–
SW-12	Wetland	2/2/2022	Primary	<0.5	130	20.0 U	20.0 U	130	0.0860	–	–
SW-14	Wetland	2/4/2022	Primary	<0.5	38.2	20.0 U	20.0 U	38.2	0.01000 U	–	–

Table 8-1. Miscellaneous Groundwater and Surface Water Analyses

Screening Criteria				Nitrate (as N)	Nitrate/Nitrite (as N)	Nitrite (as N)	Sulfate	Total Organic Carbon	Ethane	Ethene	Methane
				mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels											
Human Health				—	—	—	—	—	—	—	—
Ecological				—	—	—	—	—	—	—	—
PQL				0.25	0.5	0.25	1	1	1	1	1
Location	**Area**	**Date**	**Sample Type**								
Upgradient Spring (Surface Water) and Upgradient Piezometers (Groundwater)											
PZ-01	Landfill	2/4/2022	Primary	0.125 U	0.500 U	0.125 U	**6.90**	1.00 U	**1.50**	**0.800 J**	**3.10**
PZ-02	Landfill	2/4/2022	Primary	0.125 U	0.500 U	0.125 U	**9.08**	1.00 U	**0.0690 J**	**0.0610 J**	0.410 U
	Landfill	2/4/2022	Duplicate	0.125 UJ	0.500 UJ	0.125 UJ	**9.08**	1.00 U	0.0570 U	0.0500 U	0.410 U
PZ-05	Landfill	2/4/2022	Primary	**0.328**	0.500 U	0.125 U	**3.24**	**1.62**	**0.580 J**	**0.370 J**	**0.970 J**
SW-03	Spring	1/12/2021	Primary	—	**0.346**	—	—	—	—	—	—
SW-06	Spring	9/16/2021	Primary	—	—	—	—	**1.18 J**	—	—	—
	Spring	9/16/2021	Duplicate	—	—	—	—	**1.18 J**	—	—	—
SW-13	Spring	2/2/2022	Primary	**0.236 J**	0.500 UJ	0.125 UJ	**3.58**	**1.73**	0.0570 U	0.0500 U	0.410 U
Former Landfill											
GW-01	Landfill	1/12/2021	Primary	—	**5.99**	—	—	—	—	—	—
SW-05	Landfill	9/16/2021	Primary	—	—	—	—	**1.29 J**	—	—	—
Wetland											
PZ-03	Wetland	2/3/2022	Primary	0.125 UJ	0.500 UJ	0.125 UJ	**3.42**	**2.66**	0.0570 U	0.0500 U	**300**
PZ-04	Wetland	2/3/2022	Primary	0.125 UJ	0.500 UJ	0.125 UJ	**38.4**	**2.83**	0.0570 U	0.0500 U	**24.0**
SE-01	Wetland	1/11/2021	Primary	—	**0.459**	—	—	—	—	—	—
	Wetland	1/11/2021	Duplicate	—	**0.454**	—	—	—	—	—	—
SE-02	Wetland	1/11/2021	Primary	—	**3.76**	—	—	—	—	—	—
SW-01	Wetland	1/12/2021	Primary	—	**0.812**	—	—	—	—	—	—
SW-02	Wetland	1/12/2021	Primary	—	**0.303**	—	—	—	—	—	—
SW-04	Wetland	9/16/2021	Primary	—	—	—	—	**2.03**	—	—	—
SW-07	Wetland	2/2/2022	Primary	**0.164 J**	0.500 UJ	0.125 UJ	**2.39**	**2.87**	0.0570 U	0.0500 U	**0.990 J**
SW-08	Wetland	2/2/2022	Primary	**0.217 J**	0.500 UJ	0.125 UJ	**2.39**	**1.70**	0.0570 U	0.0500 U	0.410 U
SW-09	Wetland	2/2/2022	Primary	**0.202 J**	0.500 UJ	0.125 UJ	**2.55**	**1.95**	0.0570 U	0.0500 U	0.410 U
	Wetland	2/2/2022	Duplicate	**0.203 J**	0.500 UJ	0.125 UJ	**2.59**	**1.84**	0.0570 U	0.0500 U	0.410 U
SW-10	Wetland	2/2/2022	Primary	**0.669 J**	**0.669 J**	0.125 UJ	**118**	**3.74**	0.0570 U	0.0500 U	**0.710 J**
SW-11	Wetland	2/2/2022	Primary	**0.237 J**	0.500 UJ	0.125 UJ	**8.41**	**2.80**	0.0570 U	0.0500 U	**0.510 J**
SW-12	Wetland	2/2/2022	Primary	**4.33 J**	**4.33 J**	0.125 UJ	**487**	**3.46**	0.0570 U	0.0500 U	0.410 U
SW-14	Wetland	2/4/2022	Primary	**0.221 J**	0.500 U	0.125 U	**3.26**	**1.99**	0.0570 U	0.0500 U	**1.30**

Table 8-1. Miscellaneous Groundwater and Surface Water Analyses

Notes

BOLD = detection

— = not available or not applicable

µg/L = micrograms per liter

$CaCO_3$ = calcium carbonate

J = estimate

mg/L = milligrams per liter

N = nitrogen

PQL = practical quantitation limit

SL = screening level

U = non-detect at method detection limit

Table 8-2. Surface Water Results for Metals

Screening Criteria				pH	Antimony		Arsenic		Barium		Beryllium	
				Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
				SU	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels												
Human Health				5.0 to 9.0	5.6	5.6	4.9[a]	4.9[a]	1,000	1,000	270	270
Ecological				6.5 to 8.5	–	–	150	150	–	–	–	–
Natural Background				–	–	–	4.9	4.9	–	–	–	–
PQL				–	1	1	1	1	1	1	0.2	0.2
Location	Area	Date	Sample Type									
Upgradient Spring												
SW-03	Spring	1/12/2021	Primary	6.92	0.500 U	0.500 U	0.500 U	0.500 U	2.18	1.83	0.100 U	0.100 U
SW-06	Spring	9/16/2021	Primary	6.32	–	–	0.500 U	0.500 U	2.01	1.95	0.100 U	0.100 U
			Duplicate	6.32	–	–	0.500 U	0.500 U	1.96 J	1.86	0.100 U	0.100 U
SW-13	Spring	2/2/2022	Primary	6.99	–	–	0.500 U	0.500 U	2.22 U	2.39 J+	0.100 U	0.100 U
Landfill Area												
SW-05	Landfill	9/16/2021	Primary	7.20	–	–	0.500 U	0.500 U	5.19	5.09	0.100 U	0.100 U
Wetland Area												
SE-01	Wetland	1/11/2021	Primary	6.79	0.500 U	0.500 U	0.500 U	0.500 U	6.61	5.73	0.100 U	0.100 U
			Duplicate	6.79	0.500 U	0.500 U	0.500 U	0.500 U	6.77	5.64	0.100 U	0.100 U
SE-02	Wetland	1/11/2021	Primary	6.80	0.575 J	0.500 U	1.66	1.01	382	36.6	0.100 U	0.100 U
SW-01	Wetland	1/12/2021	Primary	7.95	0.500 U	0.500 U	0.500 U	0.500 U	7.32	6.33	0.100 U	0.100 U
SW-02	Wetland	1/12/2021	Primary	8.07	0.500 U	0.500 U	0.500 U	0.500 U	5.22	3.78	0.100 U	0.100 U
SW-04	Wetland	9/16/2021	Primary	6.96	–	–	0.500 U	0.500 U	3.71	3.77	0.100 U	0.100 U
SW-07	Wetland	2/2/2022	Primary	7.43	–	–	0.500 U	0.500 U	3.76	3.62	0.100 U	0.100 U
SW-08	Wetland	2/2/2022	Primary	7.90	–	–	0.500 U	0.500 U	2.89 U	2.73 J+	0.100 U	0.100 U
SW-09	Wetland	2/2/2022	Primary	7.86	–	–	0.500 U	0.500 U	5.07	3.17	0.100 U	0.100 U
			Duplicate	7.86	–	–	0.500 U	0.500 U	3.66	3.12	0.100 U	0.100 U
SW-10	Wetland	2/2/2022	Primary	7.55	–	–	0.500 U	0.500 U	26.7	26.9	0.100 U	0.100 U
SW-11	Wetland	2/2/2022	Primary	7.54	–	–	0.500 U	0.500 U	8.93	8.06	0.100 U	0.100 U
SW-12	Wetland	2/2/2022	Primary	7.04	–	–	0.864 J	0.909 J	52.4	56.0	0.107 U	0.100 U
SW-14	Wetland	2/4/2022	Primary	7.45	–	–	0.500 U	0.500 U	5.24	5.50	0.100 U	0.100 U

Table 8-2. Surface Water Results for Metals

Screening Criteria				Cadmium		Chromium		Chromium, Hexavalent		Cobalt		Copper	
				Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels													
Human Health				41	41	240,000	240,000	0.13	0.13	–	–	1,300	1,300
Ecological				0.72	0.72	74	74	10	10	–	–	11	11
Natural Background				–	–	–	–	–	–	–	–	–	–
PQL				0.2	0.2	1	1	0.02	0.02	1	1	2	2
Location	Area	Date	Sample Type										
Upgradient Spring													
SW-03	Spring	1/12/2021	Primary	0.100 U	0.100 U	0.500 U	0.500 U	–	–	0.500 U	0.500 U	1.00 U	1.00 U
SW-06	Spring	9/16/2021	Primary	0.100 U	0.100 U	1.00 U	1.00 U	**0.310**	**0.310**	0.500 U	0.500 U	1.00 U	1.00 U
			Duplicate	0.100 U	0.100 U	1.00 U	1.00 U	**0.310**	**0.310**	0.500 U	0.500 U	1.00 U	1.00 U
SW-13	Spring	2/2/2022	Primary	0.100 U	0.100 U	1.00 U	1.00 U	–	**0.120 J+**	0.500 U	0.500 U	1.00 U	1.00 U
Landfill Area													
SW-05	Landfill	9/16/2021	Primary	0.100 U	0.100 U	1.00 U	1.00 U	**0.140**	**0.140**	0.500 U	0.500 U	**2.85**	**1.61 J**
Wetland Area													
SE-01	Wetland	1/11/2021	Primary	**0.128 J**	0.100 U	0.500 U	0.500 U	–	–	0.500 U	0.500 U	**3.79**	**1.65 J**
			Duplicate	**0.128 J**	0.100 U	0.500 U	0.500 U	–	–	0.500 U	0.500 U	**5.24**	**1.66 J**
SE-02	Wetland	1/11/2021	Primary	**0.159 J**	**0.103 J**	0.500 U	0.500 U	–	–	**0.624 J**	0.500 U	**10.5**	**1.94 J**
SW-01	Wetland	1/12/2021	Primary	0.100 U	0.100 U	0.500 U	0.500 U	–	–	0.500 U	0.500 U	**2.19**	**1.70 J**
SW-02	Wetland	1/12/2021	Primary	0.100 U	0.100 U	0.500 U	0.500 U	–	–	0.500 U	0.500 U	**2.90**	1.00 U
SW-04	Wetland	9/16/2021	Primary	0.100 U	0.100 U	1.00 U	1.00 U	**0.0520**	**0.0570**	0.500 U	0.500 U	**1.24 J**	**1.10 J**
SW-07	Wetland	2/2/2022	Primary	0.100 U	0.100 U	1.00 U	1.00 U	–	**0.100 J+**	0.500 U	0.500 U	1.00 U	1.00 U
SW-08	Wetland	2/2/2022	Primary	0.100 U	0.100 U	1.00 U	1.00 U	–	**0.130 J+**	0.500 U	0.500 U	**1.59 J**	1.00 U
SW-09	Wetland	2/2/2022	Primary	0.100 U	0.100 U	1.00 U	1.00 U	–	**0.100 J+**	0.500 U	0.500 U	**4.85**	1.00 U
			Duplicate	0.100 U	0.100 U	1.00 U	1.00 U	–	**0.0890 J+**	0.500 U	0.500 U	**2.40**	1.00 U
SW-10	Wetland	2/2/2022	Primary	0.100 U	0.100 U	1.00 U	1.00 U	–	0.0270 U	0.500 U	0.500 U	1.00 U	1.00 U
SW-11	Wetland	2/2/2022	Primary	0.100 U	0.100 U	1.00 U	1.00 U	–	**0.0900 J+**	0.500 U	0.500 U	**1.83 J**	1.00 U
SW-12	Wetland	2/2/2022	Primary	**0.349 J**	**0.117 J**	1.07 U	1.00 U	–	0.0290 U	0.536 U	0.500 U	**1.55 J**	**1.24 J**
SW-14	Wetland	2/4/2022	Primary	0.100 U	0.100 U	1.00 U	1.00 U	–	**0.110 J+**	0.500 U	0.500 U	**3.48**	**2.00**

Table 8-2. Surface Water Results for Metals

Screening Criteria				Iron		Lead		Nickel		Selenium		Silver	
				Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels													
Human Health				1,000	1,000	–	–	80	80	60	60	26,000	26,000
Ecological				1,000	1,000	2.5	2.5	52	52	5	5	3.2	3.2
Natural Background				–	–	–	–	–	–	–	–	–	–
PQL				50	50	0.2	0.2	2	2	1	1	0.2	0.2
Location	Area	Date	Sample Type										
Upgradient Spring													
SW-03	Spring	1/12/2021	Primary	–	–	0.100 U	0.100 U	1.00 U	1.00 U	0.500 U	0.500 U	0.100 U	0.100 U
SW-06	Spring	9/16/2021	Primary	–	–	0.110 U	0.100 U	1.00 U	1.00 U	0.500 U	0.500 U	–	–
			Duplicate	–	–	0.110 U	0.100 U	1.00 U	1.00 U	0.500 U	0.500 U	–	–
SW-13	Spring	2/2/2022	Primary	25.0 U	25.0 U	0.110 U	0.100 U	1.00 U	1.00 U	0.500 U	0.500 U	–	–
Landfill Area													
SW-05	Landfill	9/16/2021	Primary	–	–	**1.17**	**0.107 J**	1.00 U	1.00 U	0.500 U	0.500 U	–	–
Wetland Area													
SE-01	Wetland	1/11/2021	Primary	–	–	**1.55 J**	0.100 U	1.00 U	1.00 U	0.500 U	0.500 U	0.100 U	0.100 U
			Duplicate	–	–	**3.27 J**	0.100 U	1.00 U	1.00 U	0.500 U	0.500 U	0.100 U	0.100 U
SE-02	Wetland	1/11/2021	Primary	–	–	**7.32**	**0.182 J**	**1.61 J**	1.00 U	0.500 U	0.500 U	0.100 U	0.100 U
SW-01	Wetland	1/12/2021	Primary	–	–	**1.08**	**0.493**	1.00 U	1.00 U	0.500 U	0.500 U	0.100 U	0.100 U
SW-02	Wetland	1/12/2021	Primary	–	–	**2.59**	**0.103 J**	1.00 U	1.00 U	0.500 U	0.500 U	0.100 U	0.100 U
SW-04	Wetland	9/16/2021	Primary	–	–	**0.437**	0.100 U	1.00 U	1.00 U	0.500 U	0.500 U	–	–
SW-07	Wetland	2/2/2022	Primary	**80.3**	**30.0 J**	**0.303**	0.100 U	1.00 U	1.00 U	0.500 U	0.500 U	–	–
SW-08	Wetland	2/2/2022	Primary	**38.4 J**	25.0 U	**0.549**	0.100 U	1.00 U	1.00 U	0.500 U	0.500 U	–	–
SW-09	Wetland	2/2/2022	Primary	**301 J**	25.0 U	**4.39**	0.100 U	**1.22 J**	1.00 U	0.500 U	0.500 U	–	–
			Duplicate	**120 J**	25.0 U	**1.93**	0.100 U	1.00 U	1.00 U	0.500 U	0.500 U	–	–
SW-10	Wetland	2/2/2022	Primary	**149**	**33.2 J**	**0.145 J**	0.100 U	**3.47**	1.00 U	0.500 U	0.500 U	–	–
SW-11	Wetland	2/2/2022	Primary	**289**	25.0 U	**1.31**	0.100 U	**1.56 J**	**1.17 J**	0.500 U	0.500 U	–	–
SW-12	Wetland	2/2/2022	Primary	26.8 U	25.0 U	0.118 U	0.100 U	**1.27 J**	**1.13 J**	0.536 U	0.500 U	–	–
SW-14	Wetland	2/4/2022	Primary	**197**	**25.4 J**	**2.45**	**0.429**	1.00 U	**1.46 J**	0.500 U	0.500 U	–	–

Table 8-2. Surface Water Results for Metals

Screening Criteria				Thallium		Vanadium		Zinc		Calcium	Magnesium	Total Hardness
				Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total	Total
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels												
Human Health				0.22	0.22	–	–	1,000	1,000	–	–	–
Ecological				–	–	–	–	100	100	–	–	–
Natural Background				–	–	–	–	–	–	–	–	–
PQL				0.2	0.2	2	2	4	4	600	100	600
Location	Area	Date	Sample Type									
Upgradient Spring												
SW-03	Spring	1/12/2021	Primary	0.100 U	0.100 U	1.02 J	1.14 J	4.00	2.00 U	8,330	2,510	20,800
SW-06	Spring	9/16/2021	Primary	0.100 U	0.100 U	1.67 J	1.99 J	2.00 U	2.00 U	–	–	–
			Duplicate	0.100 U	0.100 U	1.72 J	2.01	2.00 U	2.00 U	–	–	–
SW-13	Spring	2/2/2022	Primary	0.100 U	0.100 U	1.11 J	1.75 J	2.00 U	2.00 U	–	–	–
Landfill Area												
SW-05	Landfill	9/16/2021	Primary	0.100 U	0.100 U	1.31 J	1.55 J	43.7	41.1	–	–	–
Wetland Area												
SE-01	Wetland	1/11/2021	Primary	0.100 U	0.100 U	1.00 U	1.00 U	50.4	41.1	11,900	3,010	29,714
			Duplicate	0.100 U	0.100 U	1.00 U	1.00 U	59.6	43.8	11,600	2,900	28,965
SE-02	Wetland	1/11/2021	Primary	0.100 U	0.100 U	5.95	2.46	205	134	112,000	24,500	279,664
SW-01	Wetland	1/12/2021	Primary	0.100 U	0.100 U	2.21	1.91 J	42.0	35.2	9,490	2,850	23,697
SW-02	Wetland	1/12/2021	Primary	0.100 U	0.100 U	1.03 J	1.00 U	62.4	36.8	8,750	2,640	21,849
SW-04	Wetland	9/16/2021	Primary	0.100 U	0.100 U	1.31 J	1.84 J	33.9	34.4	–	–	–
SW-07	Wetland	2/2/2022	Primary	0.100 U	0.100 U	1.01 J	1.98 J	3.95 J	3.73 J	–	–	–
SW-08	Wetland	2/2/2022	Primary	0.100 U	0.100 U	1.00 U	1.84 J	6.58	6.11	–	–	–
SW-09	Wetland	2/2/2022	Primary	0.100 U	0.100 U	1.36 J	1.83 J	37.9	12.1	–	–	–
			Duplicate	0.100 U	0.100 U	1.00 U	1.89 J	20.1	14.0	–	–	–
SW-10	Wetland	2/2/2022	Primary	0.100 U	0.100 U	1.00 U	1.21 J	93.9	90.3	–	–	–
SW-11	Wetland	2/2/2022	Primary	0.100 U	0.100 U	1.00 U	1.45 J	65.5	49.0	–	–	–
SW-12	Wetland	2/2/2022	Primary	0.107 U	0.100 U	2.63	3.17	135	137	–	–	–
SW-14	Wetland	2/4/2022	Primary	0.100 U	0.100 U	1.16 J	1.73 J	44.6	30.4	–	–	–

Table 8-2. Surface Water Results for Metals

Notes

Exceeds the Human Health SL.

Exceeds the Ecological SL.

Total and dissolved metals analysis by EPA Method 6020B. Hexavalent chromium analyses by EPA Method 218.6.

Samples SW-06 (09/16/2021) and SW-13 (2/2/2022) are from the same location.

[a] Screening level is based on natural background

BOLD = detection

— = not analyzed or not available

µg/L = micrograms per liter

EPA = U.S. Environmental Protection Agency

J = estimate

J+/- = the result is biased high or low

PQL = practical quantitation limit

SL = screening level

U = non-detect

Table 8-3. Groundwater Results for Metals

Screening Criteria				pH	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium		Chromium, Hexavalent		Cobalt		Copper	
				Total	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
				SU	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels																						
Human Health				5 to 9	5.6	5.6	4.9[a]	4.9[a]	1,000	1,000	4	4	5	5	100	100	0.046	0.046	4.8	4.8	640	640
Ecological				6.5 to 8.5	–	–	150	150	–	–	–	–	0.72	0.72	74	74	10	10	–	–	11	11
Natural Background				–	–	–	4.9	4.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PQL				–	1	1	1	1	2	2	0.2	0.2	0.2	0.2	2	2	0.02	0.02	1	1	2	2
Location	Area	Date	Sample Type																			
Upgradient Piezometers																						
PZ-01	Landfill	11/17/2021	Primary	7.35	–	–	1.98	1.39	41.8	18.8	0.327	0.113 J	0.100 U	0.100 U	7.09	1.25 J	0.0120 J	0.00790 U	3.42	1.61	15.4	4.20
	Landfill	2/4/2022	Primary	7.16	–	–	1.96	1.05	43.0	12.1	0.240	0.100 U	0.100 U	0.100 U	7.40	1.00 U	–	0.00790 U	2.82	0.751 J	13.9	1.00 U
PZ-02	Landfill	11/17/2021	Primary	7.17	–	–	2.53	2.11	49.3	34.4	0.102 J	0.100 U	0.100 U	0.100 U	4.67	1.00 U	–	–	1.37	0.500 U	8.48	1.00 U
			Duplicate	7.17	–	–	2.50	2.04	51.1	34.6	0.100 U	0.100 U	0.100 U	0.100 U	3.98	1.00 U	0.00790 U	0.00790 U	1.31	0.500 U	8.26	1.06 J
	Landfill	2/4/2022	Primary	7.20	–	–	1.54	1.41	40.0	35.7	0.100 U	0.100 U	0.100 U	0.100 U	1.66 J	1.00 U	–	0.00790 U	0.500 U	0.500 U	2.02	1.00 U
			Duplicate	7.20	–	–	1.66	1.51	38.1	35.9	0.100 U	0.100 U	0.100 U	0.100 U	1.06 J	1.00 U	–	0.00790 U	0.500 U	0.500 U	1.08 J	1.00 U
PZ-05	Landfill	11/17/2021	Primary	–	–	–	0.609 J	0.500 U	33.9	28.2	0.100 U	0.100 U	0.100 U	0.100 U	1.07 J	1.00 U	–	0.0920	1.19	0.862 J	3.15	2.38
	Landfill	2/4/2022	Primary	6.55	–	–	0.500 U	0.500 U	3.86	3.04	0.100 U	0.100 U	0.100 U	0.100 U	1.00 U	1.00 U	–	0.120 J+	0.500 U	0.500 U	1.12 J	1.00 U
Landfill Area																						
GW-01	Landfill	1/12/2021	Primary	7.63	1.49	1.47	0.500 U	0.500 U	55.1	51.7	0.100 U	0.100 U	0.285	0.283	0.500 U	0.500 U	–	–	0.500 U	0.500 U	2.07	1.58 J
Wetland Area																						
PZ-03	Wetland	11/17/2021	Primary	6.76	–	–	0.602 J	0.591 J	7.01	5.26	0.100 U	0.100 U	0.100 U	0.100 U	1.00 U	1.00 U	0.0350	0.00790 U	0.541 J	0.500 U	1.00 U	1.00 U
	Wetland	2/3/2022	Primary	6.80	–	–	0.500 U	0.500 U	5.45	4.52	0.100 U	0.100 U	0.100 U	0.100 U	1.00 U	1.00 U	–	0.00790 U	0.500 U	0.500 U	1.00 U	1.00 U
PZ-04	Wetland	11/17/2021	Primary	6.69	–	–	2.18	1.94	28.9	23.6	0.100 U	0.100 U	0.100 U	0.100 U	1.40 J	1.00 U	0.00790 U	0.00790 U	1.01	0.810 J	2.59	1.00 U
	Wetland	2/3/2022	Primary	6.79	–	–	0.500 U	0.500 U	22.2	21.6	0.100 U	0.100 U	0.100 U	0.100 U	1.00 U	1.00 U	–	0.00790 U	0.611 J	0.500 U	1.14 J	1.00 U

Table 8-3. Groundwater Results for Metals

Screening Criteria				Iron		Lead		Nickel		Selenium		Silver		Thallium		Vanadium		Zinc		Calcium	Magnesium	Total Hardness
				Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Total	Total
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels																						
Human Health				300	300	15	15	80	80	50	50	80	80	0.2	0.2	80	80	1,000	1,000	–	–	–
Ecological				1,000	1,000	2.5	2.5	52	52	5	5	3.2	3.2	–	–	–	–	100	100	–	–	–
Natural Background				–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PQL				50	50	0.2	0.2	2	2	1	1	0.2	0.2	0.2[b]	0.2[b]	2	2	4	4	–	–	–
Location	Area	Date	Sample Type																			
Upgradient Piezometers																						
PZ-01	Landfill	11/17/2021	Primary	–	–	2.58	0.547	6.75	1.90 J	1.27	1.24	–	–	0.100 U	0.100 U	10.1	2.44	15.8	3.92 J	–	–	–
	Landfill	2/4/2022	Primary	7,010	1,200	2.15	0.100 U	6.82	1.24 J	0.628 J	0.500 U	–	–	0.100 U	0.100 U	10.5	1.00 U	15.1	2.00 U	–	–	–
PZ-02	Landfill	11/17/2021	Primary	–	–	1.29	0.374	3.30	1.00 U	0.500 U	0.500 U	–	–	0.100 U	0.100 U	5.32	1.34 J	9.67	2.00 U	–	–	–
			Duplicate	–	–	1.10	0.135 J	3.16	1.00 U	0.500 U	0.500 U	–	–	0.100 U	0.100 U	5.87	1.42 J	8.02	2.00 U	–	–	–
	Landfill	2/4/2022	Primary	3,650	3,240	0.315	0.100 U	1.45 J	1.00 U	0.500 U	0.500 U	–	–	0.100 U	0.100 U	1.19 J	1.00 U	2.71 J	2.36 J	–	–	–
			Duplicate	3,570	3,220	0.178 J	0.100 U	1.12 J	1.00 U	0.500 U	0.500 U	–	–	0.100 U	0.100 U	1.00 U	1.22 J	2.00 U	2.00 U	–	–	–
PZ-05	Landfill	11/17/2021	Primary	–	–	0.460	0.100 U	2.66	1.95 J	0.500 U	0.500 U	–	–	0.100 U	0.100 U	1.98 J	1.00 U	25.9	20.2	–	–	–
	Landfill	2/4/2022	Primary	192	25.0 U	0.110 U	0.100 U	1.19 J	1.00 U	0.500 U	0.500 U	–	–	0.100 U	0.100 U	1.00 U	1.61 J	2.60 J	2.00 U	–	–	–
Landfill Area																						
GW-01	Landfill	1/12/2021	Primary	–	–	0.564	0.100 U	2.39	1.81 J	0.500 U	0.500 U	0.100 U	0.100 U	0.100 U	0.100 U	2.35	1.51 J	580	547	148,000	21,000	86,478
Wetland Area																						
PZ-03	Wetland	11/17/2021	Primary	–	–	0.596	0.166 J	1.00 U	1.00 U	0.500 U	0.500 U	–	–	0.100 U	0.100 U	1.12 J	1.18 J	7.95	4.32	–	–	–
	Wetland	2/3/2022	Primary	1,190	684	0.264	0.100 U	1.00 U	1.00 U	0.500 U	0.500 U	–	–	0.100 U	0.100 U	1.00 U	1.33 J	4.88	3.41 J	–	–	–
PZ-04	Wetland	11/17/2021	Primary	–	–	0.703	0.313	1.42 J	1.00 U	0.500 U	0.500 U	–	–	0.100 U	0.100 U	4.30	2.63	16.4	15.0	–	–	–
	Wetland	2/3/2022	Primary	5,780	9,320	0.160 J	0.100 U	1.16 J	1.00 U	0.500 U	0.500 U	–	–	0.100 U	0.100 U	1.42 J	1.44 J	34.2	3.67 J	–	–	–

Table 8-3. Groundwater Results for Metals

Notes

Exceeds the Human Health SL.

Exceeds the Ecological SL.

Exceeds both the Human Health and Ecological SL

Total and dissolved metals analysis by EPA Method 6020B. Hexavalent chromium analyses by EPA Method 218.6.

BOLD = detection

[a] Screening level is based on natural background

[b] Screening level is based on the minimum PQL.

— = not analyzed or not available

µg/L = micrograms per liter

EPA = U.S. Environmental Protection Agency

J = estimate

J+/- = the result is biased high or low

pH = potential hydrogen

PQL = practical quantitation limit

SL = screening level

U = non-detect

Table 8-4. Soil Results for Metals

Screening Criteria						Arsenic	Barium	Beryllium	Cadmium	Chromium	Chromium, Hexavalent	Cobalt	Copper	Lead	Nickel	Selenium	Thallium	Vanadium	Zinc	Total Organic Carbon
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																				
Human Health						7[a]	16,000	160	80	120,000	2.06[b]	24	3,200	25	1,600	400	0.8	400	86[a]	–
Ecological						10	780.4[a]	10	4	42[a]	–	29.19[a]	50	50	38[a]	1	1	243.9[a]	86[a]	–
Terrestrial Ecological Evaluation pCUL						–	–	–	–	–	–	–	208	501	–	–	–	–	5,480	–
Natural Background						7	780.4	2	1	42	–	29.19	36	17	38	0.611	0.374	243.9	86	–
PQL						1	1	0.2	0.2	1	2.06	1	2	0.2	2	1	0.2	2	4	200
Location	Area	Date	Sample Type	Method	Depth (ft)															
Former Borrow Pit																				
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	17.7	70.3	0.259	0.264	28.6	1.03 UJ	10.9	125	6,000	26.4	0.499 U	0.185 J	56.1	132	11,000 J
Landfill Area																				
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	6.75	104	0.291	1.58	34.4	2.08 UJ	11.8	90.8	197	40.7	0.500 U	0.100 J	48.1	436	41,000 J
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	4.20	70.4	1.26 U	2.44	12.4	4.90 UJ	7.08	125	131	17.9	1.26 U	0.253 U	20.3	3,750	150,000 J
	Landfill	2/4/2022	Primary	Composite	0.5-1.0	3.44	67.9	0.216 J	1.20	12.7	2.06 U	3.80	48.2	83.8	10.6	1.05 U	0.211 U	21.7	1,050	–
	Landfill	2/4/2022	Primary	Composite	1.0-2.0	3.23	55.4	0.200 J	0.931	11.6	1.94 U	4.45	38.7	50.1	11.1	0.944 U	0.189 U	26.7	789	–
HA-01A	Landfill	2/3/2022	Primary	Grab	0.0-0.5	3.15	41.8	0.228 J	0.847	12.9	2.99 UJ	6.34	86.9 J+	149	16.2	0.808 U	0.162 U	26.1	389 J-	–
	Landfill	2/3/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	338 J	–	–	–	–	663 J	–
	Landfill	2/3/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	268	–
HA-01Aa	Landfill	8/11/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	12.6	–	–	–	–	32.7	–
HA-01Ab	Landfill	8/11/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	20.9	–	–	–	–	37.7	–
HA-01B	Landfill	2/3/2022	Primary	Grab	0.0-0.5	7.79 J	100.0 J	0.407 UJ	3.41 J	20.3 J	7.87 UJ	8.70 J	133 J	168 J	25.8 J	2.04 UJ	0.407 UJ	27.3 J	1,790 J	–
	Landfill	2/3/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	155 J	–	–	–	–	2,670 J	–
	Landfill	2/3/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	528	–
HA-01C	Landfill	2/4/2022	Primary	Grab	0.0-0.5	4.73 J	265 J	0.918 UJ	10.9 J	17.6 J	17.0 UJ	10.1 J	166 J	283 J	61.2 J	4.59 UJ	0.918 UJ	26.8 J	5,780 J	–
	Landfill	2/4/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	111	–	–	–	–	3,930	–
	Landfill	2/4/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	681	–
HA-01D	Landfill	2/4/2022	Primary	Grab	0.0-0.5	10.5 J	169 J	0.394 UJ	6.33 J	20.5 J	8.72 UJ	17.8 J	140 J	325 J	37.7 J	1.97 UJ	0.394 UJ	21.1 J	14,000 J	–
	Landfill	2/4/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	11.8	–	–	–	–	912	–
	Landfill	2/4/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	467	–
HA-01E	Landfill	2/4/2022	Primary	Grab	0.0-0.5	1.70	44.8	0.174 J	0.167 J	5.39	2.72 U	3.55	15.4	17.2	2.50 J	0.674 U	0.135 U	15.0	110	–
	Landfill	2/4/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	20.7	–	–	–	–	95.3	–
	Landfill	2/4/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	73.3	–
HA-01F	Landfill	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	27.4	–	–	–	–	35.3	–
HA-02G	Landfill	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	7.65	–	–	–	–	33.8	–
HA-X	Landfill	8/11/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	679	–	–	–	–	104	–
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	30.5	150	0.652 U	2.31	45.0	2.32 U	13.8	164	260	50.2	0.652 U	0.130 U	27.2	977	64,000
Wetland Area																				
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	5.08	63.5	1.59 U	0.988	12.9	6.35 U	5.71	43.0	57.5	14.9	1.59 U	0.319 U	22.6	2,490	110,000
	Wetland	2/3/2022	Primary	Composite	1.0-2.0	4.65	82.3	0.443 J	0.387 J	13.4	6.31 U	4.84	42.0	14.8	12.1	1.54 U	0.308 U	49.3	405	–
	Wetland	2/3/2022	Primary	Composite	0.5-1.0	5.43 J	101 J	0.454 UJ	1.88 J	15.3 J	4.73 UJ	6.42 J	66.8 J	86.0 J	20.2 J	2.27 UJ	0.454 UJ	45.5 J	3,620 J	–
	Wetland	2/3/2022	Duplicate	Composite	0.5-1.0	5.25 J	98.4 J	0.519 UJ	0.946 J	16.4 J	4.77 UJ	7.16 J	67.4 J	86.2 J	20.8 J	2.60 UJ	0.519 UJ	50.4 J	3,640 J	–
	Wetland	2/3/2022	Duplicate	Composite	1.0-2.0	6.30 J	104 J	0.570 J	0.651 J	18.2 J	6.60 UJ	5.18 J	53.7 J	24.6 J	15.6 J	1.63 UJ	0.327 UJ	55.3 J	384 J	–
HA-02A	Wetland	2/3/2022	Primary	Grab	0.0-0.5	1.90 J	51.1 J	0.378 UJ	0.398 J	8.93 J	7.13 UJ	2.59 J	29.5 J	38.5 J	3.78 UJ	1.89 UJ	0.378 UJ	19.3 J	75.5 J	–
	Wetland	2/3/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	57.5 J	–	–	–	–	90.1 J	–
	Wetland	2/3/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	47.6	–
HA-02Aa	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	6.34	–	–	–	–	31.6	–
HA-02Ab	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	9.63	–	–	–	–	32.1	–
HA-02B	Wetland	2/3/2022	Primary	Grab	0.0-0.5	3.10	51.3	0.303 J	0.738	15.6	5.63 UJ	4.64	44.0	86.6	13.6	1.51 U	0.303 U	23.3	486	–
	Wetland	2/3/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	48.6 J	–	–	–	–	537 J	–
	Wetland	2/3/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	286	–
HA-02C	Wetland	2/3/2022	Primary	Grab	0.0-0.5	4.25 UJ	81.6 J	0.850 UJ	4.51 J	18.3 J	16.7 UJ	5.52 J	208 J	172 J	51.4 J	4.25 UJ	0.850 UJ	29.5 J	1,940 J	–
	Wetland	2/3/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	158 J	–	–	–	–	2,520 J	–
	Wetland	2/3/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	142	–

Table 8-4. Soil Results for Metals

Location	Area	Date	Sample Type	Method	Depth (ft)	Arsenic	Barium	Beryllium	Cadmium	Chromium	Chromium, Hexavalent	Cobalt	Copper	Lead	Nickel	Selenium	Thallium	Vanadium	Zinc	Total Organic Carbon
Screening Criteria						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																				
Human Health						7[a]	16,000	160	80	120,000	2.06[b]	24	3,200	25	1,600	400	0.8	400	86[a]	–
Ecological						10	780.4[a]	10	4	42[a]	–	29.19[a]	50	50	38[a]	1	1	243.9[a]	86[a]	–
Terrestrial Ecological Evaluation pCUL						–	–	–	–	–	–	–	208	501	–	–	–	–	5,480	–
Natural Background						7	780.4	2	1	42	–	29.19	36	17	38	0.611	0.374	243.9	86	–
PQL						1	1	0.2	0.2	1	2.06	1	2	0.2	2	1	0.2	2	4	200
HA-02D	Wetland	2/3/2022	Primary	Grab	0.0-0.5	6.01 J	116 J	0.747 UJ	5.03 J	10.1 J	14.7 UJ	6.37 J	61.1 J	163 J	47.3 J	3.73 UJ	0.747 UJ	21.2 J	3,420 J	–
	Wetland	2/3/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	60.1 J	–	–	–	–	5,420 J	–
	Wetland	2/3/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	613 J	–
HA-02E	Wetland	2/3/2022	Primary	Grab	0.0-0.5	12.5 J	102 J	0.426 UJ	1.23 J	15.6 J	7.78 UJ	82.3 J	182 J	80.4 J	22.9 J	2.13 UJ	0.426 UJ	28.4 J	4,170 J	–
	Wetland	2/3/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	15.2 J	–	–	–	–	4,290 J	–
	Wetland	2/3/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	418	–
HA-02F	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	25.7	–	–	–	–	39.9	–
	Wetland	8/9/2022	Duplicate	Grab	0.0-0.5	–	–	–	–	–	–	–	–	27.8	–	–	–	–	41.2	–
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	4.37 J	57.8 J	2.02 UJ	0.805 J	11.7 J	8.24 UJ	2.60 J	28.9 J	58.1 J	10.6 J	2.02 UJ	0.405 UJ	31.0 J	400 J	180,000 J
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	3.99 J	60.2 J	2.10 UJ	1.66 J	11.0 J	8.32 UJ	2.43 J	29.9 J	65.5 J	9.92 J	2.10 UJ	0.420 UJ	32.8 J	701 J	240,000 J
	Wetland	2/3/2022	Primary	Composite	0.5-1.0	3.97 J	97.5 J	0.455 UJ	0.795 J	18.8 J	8.65 UJ	5.54 J	52.8 J	121 J	18.5 J	2.28 UJ	0.455 UJ	45.7 J	571 J	–
	Wetland	2/3/2022	Primary	Composite	1.0-2.0	1.43 J	43.4	0.228 U	0.228 U	9.59	4.28 U	1.82 J	13.4	5.01	6.17	1.14 U	0.228 U	27.4	93.5	–
HA-03A	Wetland	2/3/2022	Primary	Grab	0.0-0.5	4.83 J	111 J	0.561 J	2.02 J	26.1 J	10.6 UJ	5.32 J	123 J	247 J	25.3 J	2.72 UJ	0.543 UJ	38.8 J	380 J	–
	Wetland	2/3/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	273 J	–	–	–	–	325	–
	Wetland	2/3/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	58.0	–
HA-03Aa	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	52.9	–	–	–	–	29.9	–
HA-03Ab	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	79.7	–	–	–	–	11.3	–
HA-03B	Wetland	2/3/2022	Primary	Grab	0.0-0.5	2.68 J	56.1 J	0.361 UJ	0.361 UJ	9.67 J	6.84 UJ	2.40 J	21.2 J	88.9 J	3.61 UJ	1.81 UJ	0.361 UJ	23.3 J	107 J	–
	Wetland	2/3/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	35.2	–	–	–	–	76.8	–
	Wetland	2/3/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	20.3	–
HA-03C	Wetland	2/1/2022	Primary	Grab	0.0-0.5	3.41 UJ	66.8 J	0.683 UJ	1.37 J	12.7 J	13.1 UJ	3.41 UJ	27.3 J	278 J	6.83 UJ	3.41 UJ	0.683 UJ	22.0 J	909 J	–
	Wetland	2/1/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	5.20	–	–	–	–	36.9	–
	Wetland	2/1/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	21.3	–
HA-03D	Wetland	2/3/2022	Primary	Grab	0.0-0.5	3.87 UJ	58.0 J	0.775 UJ	1.55 J	6.21 J	14.9 UJ	3.87 UJ	28.9 J	141 J	7.75 UJ	3.87 UJ	0.775 UJ	22.9 J	2,310 J	–
	Wetland	2/3/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	40.4 J	–	–	–	–	3,070 J	–
	Wetland	2/3/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	593	–
HA-03E	Wetland	2/3/2022	Primary	Grab	0.0-0.5	4.07 UJ	65.3 J	0.814 UJ	3.66 J	4.41 J	16.1 UJ	4.07 UJ	33.7 J	62.3 J	8.14 UJ	4.07 UJ	0.814 UJ	16.5 J	3,600 J	–
	Wetland	2/3/2022	Primary	Grab	0.5-1.0	–	–	–	–	–	–	–	–	16.7 J	–	–	–	–	1,560 J	–
	Wetland	2/3/2022	Primary	Grab	1.0-2.0	–	–	–	–	–	–	–	–	–	–	–	–	–	1,190 J	–
HA-03F	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	55.5	–	–	–	–	40.3	–
HA-03G	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	12.0	–	–	–	–	31.6	–
HA-04	Wetland	2/1/2022	Primary	Composite	0.0-0.5	4.40 J	59.6 J	0.727 UJ	0.727 UJ	8.26 J	12.9 UJ	3.63 UJ	24.1 J	256 J	8.26 J	3.63 UJ	0.727 UJ	17.6 J	592 J	–
	Wetland	2/1/2022	Primary	Composite	0.5-1.0	2.00 J	68.0	0.289 U	0.289 U	15.7	5.85 U	2.24 J	17.8	10.3	10.2	1.44 U	0.289 U	29.7	86.6	–
	Wetland	2/1/2022	Primary	Composite	1.0-2.0	1.19 J	40.0	0.188 U	0.188 U	9.23	3.83 U	2.10	10.6	3.29	7.14	0.941 U	0.188 U	19.3	52.6	–
HA-04A	Wetland	2/1/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	94.0 J	–	–	–	–	200 J	–
HA-04Aa	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	8.00	–	–	–	–	37.8	–
HA-04Ab	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	31.0 J	–	–	–	–	30.0 J	–
HA-04B	Wetland	2/1/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	199 J	–	–	–	–	26.4 J	–
HA-04C	Wetland	2/1/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	169 J	–	–	–	–	204 J	–
HA-04D	Wetland	2/1/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	109 J	–	–	–	–	185 J	–
HA-04E	Wetland	2/1/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	52.2 J	–	–	–	–	1,400 J	–
HA-04F	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	10.2	–	–	–	–	18.9	–
HA-04G	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	10.3	–	–	–	–	24.7	–

Table 8-4. Soil Results for Metals

Screening Criteria						Arsenic	Barium	Beryllium	Cadmium	Chromium	Chromium, Hexavalent	Cobalt	Copper	Lead	Nickel	Selenium	Thallium	Vanadium	Zinc	Total Organic Carbon
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																				
Human Health						7[a]	16,000	160	80	120,000	2.06[b]	24	3,200	25	1,600	400	0.8	400	86[a]	–
Ecological						10	780.4[a]	10	4	42[a]	–	29.19[a]	50	50	38[a]	1	1	243.9[a]	86[a]	–
Terrestrial Ecological Evaluation pCUL						–	–	–	–	–	–	–	208	501	–	–	–	–	5,480	–
Natural Background						7	780.4	2	1	42	–	29.19	36	17	38	0.611	0.374	243.9	86	–
PQL						1	1	0.2	0.2	1	2.06	1	2	0.2	2	1	0.2	2	4	200
Location	Area	Date	Sample Type	Method	Depth (ft)															
HA-05	Wetland	2/1/2022	Primary	Composite	0.0-0.5	2.82 J	46.9 J	0.376 UJ	0.393 J	11.6 J	7.63 UJ	2.11 J	16.0 J	118 J	7.38 J	1.88 UJ	0.376 UJ	25.4 J	88.7 J	–
	Wetland	2/1/2022	Primary	Composite	0.5-1.0	2.95 J	67.3	0.313 U	0.313 U	13.1	6.24 U	2.92 J	17.4	26.8	8.87	1.56 U	0.313 U	32.3	51.2	–
	Wetland	2/1/2022	Primary	Composite	1.0-2.0	1.25 J	45.4	0.262 J	0.189 U	11.4	3.79 U	2.23	13.7	7.51	6.12	0.947 U	0.189 U	28.4	20.3	–
HA-05A	Wetland	2/1/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	373	–	–	–	–	59.4	–
HA-05Aa	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	163	–	–	–	–	26.4	–
HA-05Ab	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	102	–	–	–	–	16.2	–
	Wetland	8/10/2022	Duplicate	Grab	0.0-0.5	–	–	–	–	–	–	–	–	137	–	–	–	–	19.6	–
HA-05B	Wetland	2/1/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	120	–	–	–	–	43.9	–
HA-05C	Wetland	2/1/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	179 J	–	–	–	–	78.7 J	–
HA-05D	Wetland	2/1/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	55.2 J	–	–	–	–	723 J	–
HA-05E	Wetland	2/1/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	87.7	–	–	–	–	10.1	–
HA-05F	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	31.7 J	–	–	–	–	733 J	–
HA-05G	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	15.8 J	–	–	–	–	65.8 J	–
HA-06A	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	176	–	–	–	–	36.2	–
HA-06B	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	194	–	–	–	–	19.8	–
HA-06C	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	214 J	–	–	–	–	60.8 J	–
HA-06D	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	501 J	–	–	–	–	410 J	–
HA-06E	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	38.5 J	–	–	–	–	291 J	–
HA-06F	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	32.6	–	–	–	–	20.1	–
HA-06G	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	49.5	–	–	–	–	19.0	–
HA-06H	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	16.8	–	–	–	–	24.8	–
HA-06I	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	47.6 J	–	–	–	–	1,990 J	–
HA-07A	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	66.5	–	–	–	–	38.9	–
HA-07B	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	143 J	–	–	–	–	45.5 J	–
HA-07C	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	112 J	–	–	–	–	32.5 J	–
HA-07D	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	223 J	–	–	–	–	192 J	–
HA-07E	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	197 J	–	–	–	–	548 J	–
HA-07F	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	48.0	–	–	–	–	16.8	–
HA-07G	Wetland	8/10/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	9.31	–	–	–	–	19.4	–
HA-07H	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	57.2	–	–	–	–	24.5	–
HA-07I	Wetland	8/9/2022	Primary	Grab	0.0-0.5	–	–	–	–	–	–	–	–	40.1 J	–	–	–	–	1,910 J	–

Table 8-4. Soil Results for Metals

Notes

Exceeds the Human Health SL.

Exceeds the Ecological SL.

Exceeds both the Human Health and Ecological SLs.

Total metals analyses by EPA Method 6020B. Hexavalent chromium analyses by EPA Method 7196A.

BOLD = detection

[a] Screening level is based on natural background

[b] Screening level is based on the PQL.

— = not analyzed or not available

EPA = U.S. Environmental Protection Agency

ft = foot or feet

ISM = incremental sampling methodology

J = estimate

mg/kg = milligrams per kilogram

pCUL = proposed cleanup level

PQL = practical quantitation limit

U = non-detect at method detection limit

UJ = non-detect, and the value is an estimate

Table 8-5. Surface Water Results for VOCs

Screening Criteria				GSI Total Xylenes (U=1/2) 2020	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trimethylbenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene	1,3-Dichloropropane	2,2-Dichloropropane	2-Chlorotoluene	2-Hexanone	4-Chlorotoluene	Acetone	Acrylonitrile	Benzene	Bromobenzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dibromochloromethane	Dibromochloropropane	Dibromomethane
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels																																										
Human Health				—	—	10,000	0.5[a]	0.5[a]	—	300	—	—	—	—	8.9	0.71	—	2	—	—	—	—	—	—	2[a]	0.44	—	—	1[a]	4.6	100	—	1[a]	100	—	56	—	—	1[a]	—	—	—
Ecological				57	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PQL				—	0.4	0.4	0.5	0.5	0.4	0.4	1	2	1	1	0.4	0.5	1	0.5	1	1	1	10	1	20	2	0.2	0.5	1	1	1	5	10	1	0.5	5	1	5	0.4	1	1	5	1
Location	Area	Date	Sample Type																																							
Upgradient Spring																																										
SW-03	Spring	1/12/2021	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	10.0 U	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	5.00 UJ-	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-06	Spring	9/16/2021	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	10.0 U	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
	Spring	9/16/2021	Duplicate	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	10.0 U	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-13	Spring	2/2/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
Landfill Area																																										
SW-05	Landfill	9/16/2021	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	10.0 U	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
Wetland Area																																										
SE-01	Wetland	1/11/2021	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	10.0 U	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	5.00 UJ-	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
	Wetland	1/11/2021	Duplicate	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	10.0 U	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	5.00 UJ-	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SE-02	Wetland	1/11/2021	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	10.0 U	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	5.00 UJ-	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-01	Wetland	1/12/2021	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	10.0 U	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	5.00 UJ-	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-02	Wetland	1/12/2021	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	10.0 U	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	5.00 UJ-	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-04	Wetland	9/16/2021	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	10.0 U	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-07	Wetland	2/2/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-08	Wetland	2/2/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-09	Wetland	2/2/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
	Wetland	2/2/2022	Duplicate	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-10	Wetland	2/2/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.400 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-11	Wetland	2/2/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-12	Wetland	2/2/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U
SW-14	Wetland	2/4/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U

Table 8-5. Surface Water Results for VOCs

Screening Criteria				Dichlorodifluoromethane	Ethylbenzene	Ethylene dibromide	Isopropylbenzene	M,P-Xylene	Methyl ethyl ketone	Methyl Isobutyl Ketone	Methyl tert-butyl ether	Methylene chloride	n-Butylbenzene	n-Propylbenzene	O-Xylene	p-Isopropyltoluene	sec-Butylbenzene	Styrene	tert-Butylbenzene	Tetrachloroethene	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichloroethene	Trichlorofluoromethane	Vinyl acetate	Vinyl chloride	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,4-Dichlorobenzene	Hexachlorobutadiene	Naphthalene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels																																
Human Health				–	29	–	–	–	–	–	–	10[a]	–	–	–	–	–	–	–	2.4	57	100	1[a]	0.4[a]	–	–	0.4[a]	2[a]	700	22	5[a]	4,900
Ecological				–	12	–	–	57	–	–	–	–	–	–	57	–	–	–	–	–	53	–	–	–	–	–	–	–	–	–	–	–
PQL				1	0.5	0.5	1	1	10	10	1	10	1	0.5	0.5	1	1	1	1	0.4	1	0.4	1	0.4	2	10	0.4	2	0.5	0.5	5	2
Location	Area	Date	Sample Type																													
Upgradient Spring																																
SW-03	Spring	1/12/2021	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	5.00 U	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
SW-06	Spring	9/16/2021	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	5.00 U	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	2.00 U
	Spring	9/16/2021	Duplicate	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	5.00 U	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	2.00 U
SW-13	Spring	2/2/2022	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	–	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
Landfill Area																																
SW-05	Landfill	9/16/2021	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	5.00 U	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	2.00 U
Wetland Area																																
SE-01	Wetland	1/11/2021	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	5.00 U	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
	Wetland	1/11/2021	Duplicate	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	5.00 U	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
SE-02	Wetland	1/11/2021	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	5.00 U	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
SW-01	Wetland	1/12/2021	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	5.00 U	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
SW-02	Wetland	1/12/2021	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	5.00 U	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
SW-04	Wetland	9/16/2021	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	5.00 U	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	2.00 U
SW-07	Wetland	2/2/2022	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	–	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
SW-08	Wetland	2/2/2022	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	–	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
SW-09	Wetland	2/2/2022	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	–	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
	Wetland	2/2/2022	Duplicate	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	–	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
SW-10	Wetland	2/2/2022	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	–	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
SW-11	Wetland	2/2/2022	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	–	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
SW-12	Wetland	2/2/2022	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	–	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
SW-14	Wetland	2/4/2022	Primary	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U	0.500 U	0.200 U	1.00 U	–	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U

Table 8-5. Surface Water Results for VOCs

Notes

VOC analyses by EPA Method 8260D.

Total xylenes were calculated by summing m,p- and o-xylenes and include undetected values at one half the detection limit.

Samples SW-06 (09/16/2021) and SW-13 (2/2/2022) are from the same location.

Some analytes are reported multiple times by different analytical methods. In this case, only the analysis with the lowest PQL is used in the data screening process. See also Tables 7-1a-b.

[a] Screening level is based on the PQL.

BOLD = detection

— = not analyzed or not available

µg/L = micrograms per liter

EPA = U.S. Environmental Protection Agency

J = estimate

J+/- = the result is biased high or low

PQL = practical quantitation limit

U = non-detect

UJ = non-detect, and the value is an estimate

VOC = volatile organic compound

Table 8-6. Groundwater Results for VOCs

Screening Criteria				GSI Total Xylenes (U=1/2) 2020	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trimethylbenzene	1,2-Dichloroethane	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene	1,3-Dichloropropane	2,2-Dichloropropane	2-Chlorotoluene	2-Hexanone	4-Chlorotoluene	Acetone	Acrylonitrile	Benzene	Bromobenzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane	Carbon disulfide
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels																																
Human Health				1,600	1.68	200	0.5[a]	0.5[a]	7.68	7	—	6.4	1[a]	80	0.48	0.9	80	2	1[a]	—	160	40	160	7,200	2[a]	0.44	64	—	1[a]	4.6	11	800
Ecological				57	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—	—	—	—	—	—
PQL				—	0.4	0.4	0.5	0.5	0.4	0.4	1	2	1	1	0.4	0.5	1	0.5	1	1	1	10	1	20	2	0.2	0.5	1	1	1	5	10
Location	Area	Date	Sample Type																													
Upgradient Piezometers																																
PZ-01	Landfill	2/4/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U
PZ-02	Landfill	2/4/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U
	Landfill	2/4/2022	Duplicate	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U
PZ-05	Landfill	2/4/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U
Landfill Area																																
GW-01	Landfill	1/12/2021	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	10.0 U	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U
Wetland Area																																
PZ-03	Wetland	2/3/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U
PZ-04	Wetland	2/3/2022	Primary	0.375 U	0.200 U	0.200 U	0.250 U	0.250 U	0.200 U	0.200 U	0.500 U	1.00 U	0.500 U	0.500 U	0.200 U	0.250 U	0.500 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	0.500 U	20.0 UJ	1.00 U	0.100 U	0.250 U	0.500 U	0.500 U	0.500 U	5.00 U	5.00 U

Table 8-6. Groundwater Results for VOCs

Screening Criteria				Carbon tetrachloride	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dibromochloromethane	Dibromochloropropane	Dibromomethane	Dichlorodifluoromethane	Ethylbenzene	Ethylene dibromide	Isopropylbenzene	M,P-Xylene	Methyl ethyl ketone	Methyl Isobutyl Ketone	Methyl tert-butyl ether	Methylene chloride	n-Butylbenzene	n-Propylbenzene	O-Xylene	p-Isopropyltoluene	sec-Butylbenzene	Styrene	tert-Butylbenzene	Tetrachloroethene	Toluene	trans-1,2-Dichloroethene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels																																
Human Health				1[a]	100	—	1.4	—	16	1[a]	1[a]	5[a]	80	1,600	29	0.5[a]	800	1,600	4,800	640	24	10[a]	400	800	1,600	—	800	100	800	2.4	57	100
Ecological				—	—	—	—	—	—	—	—	—	—	—	12	—	—	57	—	—	—	—	—	—	57	—	—	—	—	—	53	—
PQL				1	0.5	5	1	5	0.4	1	1	5	1	1	0.5	0.5	1	1	10	10	1	10	1	0.5	0.5	1	1	1	1	0.4	1	0.4
Location	Area	Date	Sample Type																													
Upgradient Piezometers																																
PZ-01	Landfill	2/4/2022	Primary	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U
PZ-02	Landfill	2/4/2022	Primary	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U
	Landfill	2/4/2022	Duplicate	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U
PZ-05	Landfill	2/4/2022	Primary	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U
Landfill Area																																
GW-01	Landfill	1/12/2021	Primary	0.500 U	0.250 U	5.00 U	0.500 U	5.00 UJ-	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U
Wetland Area																																
PZ-03	Wetland	2/3/2022	Primary	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	**0.640 J**	0.200 U
PZ-04	Wetland	2/3/2022	Primary	0.500 U	0.250 U	5.00 U	0.500 U	2.50 U	0.200 U	0.500 U	0.500 U	2.50 U	0.500 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	5.00 U	5.00 U	0.500 U	5.00 U	0.500 U	0.250 U	0.250 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 U	0.500 U	0.200 U

Table 8-6. Groundwater Results for VOCs

Screening Criteria				trans-1,3-Dichloropropene	Trichloroethene	Trichlorofluoromethane	Vinyl acetate	Vinyl chloride	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,4-Dichlorobenzene	Hexachlorobutadiene	Naphthalene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels													
Human Health				1[a]	0.4[a]	2,400	8,000	0.4[a]	2[a]	600	8.1	5[a]	160
Ecological				—	—	—	—	—	—	—	—	—	—
PQL				1	0.4	2	10	0.4	2	0.5	0.5	5	2
Location	Area	Date	Sample Type										
Upgradient Piezometers													
PZ-01	Landfill	2/4/2022	Primary	0.500 U	0.200 U	1.00 U	—	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
PZ-02	Landfill	2/4/2022	Primary	0.500 U	0.200 U	1.00 U	—	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
PZ-02	Landfill	2/4/2022	Duplicate	0.500 U	0.200 U	1.00 U	—	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
PZ-05	Landfill	2/4/2022	Primary	0.500 U	0.200 U	1.00 U	—	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
Landfill Area													
GW-01	Landfill	1/12/2021	Primary	0.500 U	0.200 U	1.00 U	5.00 U	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
Wetland Area													
PZ-03	Wetland	2/3/2022	Primary	0.500 U	0.200 U	1.00 U	—	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U
PZ-04	Wetland	2/3/2022	Primary	0.500 U	0.200 U	1.00 U	—	0.200 U	1.00 U	0.250 U	0.250 U	2.50 U	1.00 U

Table 8-6. Groundwater Results for VOCs

Notes

VOC analyses by EPA Method 8260D.

Total xylenes were calculated by summing m,p- and o-xylenes and include undetected values at one half the detection limit.

Some analytes are reported multiple times by different analytical methods. In this case, only the analysis with the lowest PQL is used in the data screening process. See also Tables 7-2a-b.

[a] Screening level is based on the PQL.

BOLD = detection

— = not analyzed or not available

µg/L = micrograms per liter

EPA = U.S. Environmental Protection Agency

J = estimate

J+/- = the result is biased high or low

PQL = practical quantitation limit

U = non-detect

UJ = non-detect, and the value is an estimate

VOC = volatile organic compound

Table 8-7. Soil Results for VOCs

Screening Criteria						E8260D GSI Total Xylenes (U=1/2) 2020	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trimethylbenzene	1,2-Dichloroethane
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																	
Human Health						16,000	38	160,000	5	18	180	4,000	—	64	0.0544[a]	800	11
Ecological						—	—	—	—	—	—	—	—	20	—	—	—
PQL						—	0.0272	0.0272	0.0544	0.0272	0.0272	0.0272	0.0544	0.272	0.0544	0.0544	0.0272
Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)												
Former Borrow Pit																	
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	0.0204 UJ	0.0136 UJ	0.0136 UJ	0.0272 UJ	0.0136 UJ	0.0136 UJ	0.0136 UJ	0.0272 UJ	0.136 UJ	0.0272 UJ	0.0272 UJ	0.0136 UJ
Landfill Area																	
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	0.0272 U	0.0181 U	0.0181 U	0.0362 U	0.0181 U	0.0181 U	0.0181 U	0.0362 U	0.181 U	0.0362 U	0.0362 U	0.0181 U
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	0.109 UJ	0.0724 UJ	0.0724 UJ	0.145 UJ	0.0724 UJ	0.0724 UJ	0.0724 UJ	0.145 UJ	0.724 UJ	0.145 UJ	0.145 UJ	0.0724 UJ
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	0.0326 U	0.0218 U	0.0218 U	0.0435 U	0.0218 U	0.0218 U	0.0218 U	0.0435 U	0.218 U	0.0435 U	0.0435 U	0.0218 U
Wetland Area																	
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.150 UJ	0.0999 UJ	0.0999 UJ	0.200 UJ	0.0999 UJ	0.0999 UJ	0.0999 UJ	0.200 UJ	0.999 UJ	0.200 UJ	0.200 UJ	0.0999 UJ
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.198 UJ	0.132 UJ	0.132 UJ	0.264 UJ	0.132 UJ	0.132 UJ	0.132 UJ	0.264 UJ	1.32 UJ	0.264 UJ	0.264 UJ	0.132 UJ
HA-03	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.241 UJ	0.161 UJ	0.161 UJ	0.321 UJ	0.161 UJ	0.161 UJ	0.161 UJ	0.321 UJ	1.61 UJ	0.321 UJ	0.321 UJ	0.161 UJ

Screening Criteria						E8260D 1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichloropropane	2,2-Dichloropropane	2-Chlorotoluene	2-Hexanone	4-Chlorotoluene	Acetone	Acrylonitrile	Benzene	Bromobenzene	Bromochloromethane	Bromodichloromethane
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																		
Human Health						27	800	1,600	—	1,600	400	1,600	72,000	1.9	18	640	—	16
Ecological						700	—	—	—	—	—	—	—	—	—	—	—	—
PQL						0.0272	0.0544	0.0544	0.0544	0.0544	0.544	0.0544	1.09	0.109	0.0109	0.0272	0.0544	0.0544
Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)													
Former Borrow Pit																		
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	0.0136 UJ	0.0272 UJ	0.0272 UJ	0.0272 UJ	0.0272 UJ	0.272 UJ	0.0272 UJ	0.544 UJ	0.0544 UJ	0.00544 UJ	0.0136 UJ	0.0272 UJ	0.0272 UJ
Landfill Area																		
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	0.0181 U	0.0362 U	0.0362 U	0.0362 U	0.0362 U	0.362 U	0.0362 U	0.724 U	0.0724 U	0.00724 U	0.0181 U	0.0362 U	0.0362 U
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	0.0724 UJ	0.145 UJ	0.145 UJ	0.145 UJ	0.145 UJ	1.45 UJ	0.145 UJ	2.90 UJ	0.290 UJ	0.0290 UJ	0.0724 UJ	0.145 UJ	0.145 UJ
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	0.0218 U	0.0435 U	0.0435 U	0.0435 U	0.0435 U	0.435 U	0.0435 U	0.871 U	0.0871 U	0.00871 U	0.0218 U	0.0435 U	0.0435 U
Wetland Area																		
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.0999 UJ	0.200 UJ	0.200 UJ	0.200 UJ	0.200 UJ	2.00 UJ	0.200 UJ	4.00 UJ	0.400 UJ	0.0400 UJ	0.0999 UJ	0.200 UJ	0.200 UJ
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.132 UJ	0.264 UJ	0.264 UJ	0.264 UJ	0.264 UJ	2.64 UJ	0.264 UJ	5.29 UJ	0.529 UJ	0.0529 UJ	0.132 UJ	0.264 UJ	0.264 UJ
HA-03	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.161 UJ	0.321 UJ	0.321 UJ	0.321 UJ	0.321 UJ	3.21 UJ	0.321 UJ	6.42 UJ	0.642 UJ	0.0642 UJ	0.161 UJ	0.321 UJ	0.321 UJ

Table 8-7. Soil Results for VOCs

Screening Criteria						E8260D													
						Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chloroethane	Chloroform	Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene	Dibromochloromethane	Dibromochloropropane	Dibromomethane	Dichlorodifluoromethane
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																			
Human Health						130	110	8,000	14	1,600	—	32	—	160	10	12	0.272[a]	800	16,000
Ecological						—	—	—	—	40	—	—	—	—	—	—	—	—	—
PQL						0.109	0.544	0.544	0.0544	0.0272	0.544	0.0544	0.272	0.0272	0.0544	0.109	0.272	0.0544	0.109
Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)														
Former Borrow Pit																			
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	0.0544 UJ	0.544 UJ	0.272 UJ	0.0272 UJ	0.0136 UJ	0.272 UJ	0.0272 UJ	0.136 UJ	0.0136 UJ	0.0272 UJ	0.0544 UJ	0.136 UJ	0.0272 UJ	0.109 UJ-
Landfill Area																			
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	0.0724 U	0.724 U	0.362 U	0.0362 U	0.0181 U	0.362 U	0.0362 U	0.181 U	0.0181 U	0.0362 U	0.0724 U	0.181 U	0.0362 U	0.145 UJ-
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	0.290 UJ	2.90 UJ	1.45 UJ	0.145 UJ	0.0724 UJ	1.45 UJ	0.145 UJ	0.724 UJ	0.0724 UJ	0.145 UJ	0.290 UJ	0.724 UJ	0.145 UJ	0.579 UJ-
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	0.0871 U	0.871 U	0.435 U	0.0435 U	0.0218 U	0.435 U	0.0435 U	0.218 U	0.0218 U	0.0435 U	0.0871 U	0.218 U	0.0435 U	0.174 UJ-
Wetland Area																			
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.400 UJ	4.00 UJ	2.00 UJ	0.200 UJ	0.0999 UJ	2.00 UJ	0.200 UJ	0.999 UJ	0.0999 UJ	0.200 UJ	0.400 UJ	0.999 UJ	0.200 UJ	0.799 UJ-
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.529 UJ	5.29 UJ	2.64 UJ	0.264 UJ	0.132 UJ	2.64 UJ	0.264 UJ	1.32 UJ	0.132 UJ	0.264 UJ	0.529 UJ	1.32 UJ	0.264 UJ	1.06 UJ
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.642 UJ	6.42 UJ	3.21 UJ	0.321 UJ	0.161 UJ	3.21 UJ	0.321 UJ	1.61 UJ	0.161 UJ	0.321 UJ	0.642 UJ	1.61 UJ	0.321 UJ	1.28 UJ

Screening Criteria						E8260D												
						Ethylbenzene	Ethylene dibromide	Isopropylbenzene	M,P-Xylene	Methyl ethyl ketone	Methyl Isobutyl Ketone	Methyl tert-butyl ether	Methylene chloride	n-Butylbenzene	n-Propylbenzene	O-Xylene	p-Isopropyltoluene	sec-Butylbenzene
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																		
Human Health						8,000	0.5	8,000	16,000	48,000	6,400	560	94	4,000	8,000	16,000	—	8,000
Ecological						—	—	—	—	—	—	—	—	—	—	—	—	—
PQL						0.0272	0.0544	0.0544	0.0544	0.544	0.544	0.0544	0.544	0.0544	0.0272	0.0272	0.0544	0.0544
Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)													
Former Borrow Pit																		
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	0.0136 UJ	0.0272 UJ	0.0272 UJ	0.0272 UJ	0.272 UJ	0.272 UJ	0.0272 UJ	0.272 UJ	0.0272 UJ	0.0136 UJ	0.0136 UJ	0.0272 UJ	0.0272 UJ
Landfill Area																		
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	0.0181 U	0.0362 U	0.0362 U	0.0362 U	0.362 U	0.362 U	0.0362 U	0.362 U	0.0362 U	0.0181 U	0.0181 U	0.0362 U	0.0362 U
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	0.0724 UJ	0.145 UJ	0.145 UJ	0.145 UJ	1.45 UJ	1.45 UJ	0.145 UJ	1.45 UJ	0.145 UJ	0.0724 UJ	0.0724 UJ	0.145 UJ	0.145 UJ
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	0.0218 U	0.0435 U	0.0435 U	0.0435 U	0.435 U	0.435 U	0.0435 U	0.435 U	0.0435 U	0.0218 U	0.0218 U	0.0435 U	0.0435 U
Wetland Area																		
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.0999 UJ	0.200 UJ	0.200 UJ	0.200 UJ	2.00 UJ	2.00 UJ	0.200 UJ	2.00 UJ	0.200 UJ	0.0999 UJ	0.0999 UJ	0.200 UJ	0.200 UJ
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.132 UJ	0.264 UJ	0.264 UJ	0.264 UJ	2.64 UJ	2.64 UJ	0.264 UJ	2.64 UJ	0.264 UJ	0.132 UJ	0.132 UJ	0.264 UJ	0.264 UJ
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.161 UJ	0.321 UJ	0.321 UJ	0.321 UJ	3.21 UJ	3.21 UJ	0.321 UJ	3.21 UJ	0.321 UJ	0.161 UJ	0.161 UJ	0.321 UJ	0.321 UJ

Table 8-7. Soil Results for VOCs

Screening Criteria						E8260D Styrene	tert-Butylbenzene	Tetrachloroethene	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Trichloroethene	Trichlorofluoromethane	Vinyl chloride	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Hexachlorobutadiene	Naphthalene
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
					Soil Screening Levels															
					Human Health	16,000	8,000	480	6,400	1,600	10	12	24,000	0.67	34	7,200	–	190	13	1,600
					Ecological	300	–	–	200	–	–	–	–	–	20	–	–	20	–	–
					PQL	0.0544	0.0544	0.0272	0.0544	0.0272	0.0544	0.0272	0.109	0.0272	0.272	0.0272	0.0272	0.0272	0.109	0.109
Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)															
Former Borrow Pit																				
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	0.0272 UJ	0.0272 UJ	0.0136 UJ	0.0272 UJ	0.0136 UJ	0.0272 UJ	0.0136 UJ	0.0544 UJ	0.0136 UJ	0.136 UJ	0.0136 UJ	0.0136 UJ	0.0136 UJ	0.0544 UJ	0.0544 UJ
Landfill Area																				
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	0.0362 U	0.0362 U	0.0181 U	0.0362 U	0.0181 U	0.0362 U	0.0181 U	0.0724 U	0.0181 U	0.181 U	0.0181 U	0.0181 U	0.0181 U	0.0724 U	0.0724 U
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	0.145 UJ	0.145 UJ	0.0724 UJ	0.145 UJ	0.0724 UJ	0.145 UJ	0.0724 UJ	0.290 UJ	0.0724 UJ	0.724 UJ	0.0724 UJ	0.0724 UJ	0.0724 U	0.290 U	0.290 UJ
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	0.0435 U	0.0435 U	**0.0601**	0.0435 U	0.0218 U	0.0435 U	0.0218 U	0.0871 U	0.0218 U	0.218 U	0.0218 U	0.0218 U	0.0218 U	0.0871 U	0.0871 U
Wetland Area																				
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.200 UJ	0.200 UJ	0.0999 UJ	0.200 UJ	0.0999 UJ	0.200 UJ	0.0999 UJ	0.400 UJ	0.0999 UJ	0.999 UJ	0.0999 UJ	0.0999 UJ	0.0999 U	0.400 U	0.400 UJ
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.264 UJ	0.264 UJ	0.132 UJ	0.264 UJ	0.132 UJ	0.264 UJ	0.132 UJ	0.529 UJ	0.132 UJ	1.32 UJ	0.132 UJ	0.132 UJ	0.132 UJ	0.529 UJ	0.529 UJ
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.321 UJ	0.321 UJ	0.161 UJ	0.321 UJ	0.161 UJ	0.321 UJ	0.161 UJ	0.642 UJ	0.161 UJ	1.61 UJ	0.161 UJ	0.161 UJ	0.161 UJ	0.642 UJ	0.642 UJ

Table 8-7. Soil Results for VOCs

Notes

VOC analyses by EPA Method 8260D.

Some analytes are reported multiple times by different analytical methods. In this case, only the analysis with the lowest PQL is used in the data screening process. See also Tables 7-3a-b.

Total xylenes were calculated by summing m,p- and o-xylenes and include undetected values at one half the detection limit.

[a] Screening level is based on the PQL.

— = not analyzed or not available

BOLD = detection

EPA = U.S. Environmental Protection Agency

ft = feet

ft = foot or feet

ISM = incremental sampling methodology

J = estimate

mg/kg = milligrams per kilogram

PQL = practical quantitation limit

QC = quality control

U = non-detect

UJ = non-detect, and the value is an estimate

VOC = volatile organic compound

Table 8-8. Surface Water Results for SVOCs

Screening Criteria				GSI Total cPAH (U=1/2) 2020	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,2-Dinitrobenzene	1,3-Dichlorobenzene	1,3-Dinitrobenzene	1,4-Dichlorobenzene	1,4-Dinitrobenzene	1-Methylnaphthalene	2,3,4,6-Tetrachlorophenol	2,3,5,6-Tetrachlorophenol	2,4,5-Trichlorophenol	2,4,6-Trichlorophenol	2,4-Dichlorophenol	2,4-Dimethylphenol	2,4-Dinitrophenol	2,4-Dinitrotoluene	2,6-Dinitrotoluene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Surface Water Screening Levels																					
Human Health				0.0166	0.0467[a]	700	—	2	—	22	—	—	—	—	300	0.25	10	85	10	0.187[a]	—
Ecological				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PQL				—	0.0467	0.0467	0.467	0.0467	0.467	0.0467	0.467	0.0374	0.0935	0.0935	0.0935	0.0935	0.0935	0.0935	0.467	0.187	0.187
Location	Area	Date	Sample Type																		
Upgradient Spring																					
SW-03	Spring	1/12/2021	Primary	0.0101 U	0.0240 U	0.0240 U	0.240 U	0.0240 U	0.240 U	0.0240 U	0.240 U	0.0192 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.240 U	0.0962 U	0.0962 U
SW-06	Spring	9/16/2021	Primary	0.00998 U	0.0236 U	0.0236 U	0.236 U	0.0236 U	0.236 U	0.0236 U	0.236 U	0.0189 U	0.0472 U	0.0472 U	0.0472 U	0.0472 U	0.0472 U	0.0472 U	0.236 U	0.0943 U	0.0943 U
	Spring	9/16/2021	Duplicate	0.00985 U	0.0234 U	0.0234 U	0.234 U	0.0234 U	0.234 U	0.0234 U	0.234 U	0.0187 U	0.0467 U	0.0467 U	0.0467 U	0.0467 U	0.0467 U	0.0467 U	0.234 U	0.0935 U	0.0935 U
SW-13	Spring	2/2/2022	Primary	0.00639 U	—	—	—	—	—	—	—	0.0338 U	—	—	—	—	—	—	—	—	—
Landfill Area																					
SW-05	Landfill	9/16/2021	Primary	0.0101 U	0.0240 U	0.0240 U	0.240 U	0.0240 U	0.240 U	0.0240 U	0.240 U	0.0192 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.240 U	0.0962 U	0.0962 U
Wetland Area																					
SE-01	Wetland	1/11/2021	Primary	0.0103 U	0.0243 U	0.0243 U	0.243 U	0.0243 U	0.243 U	0.0243 U	0.243 U	0.0194 U	0.0485 U	0.0485 U	0.0485 U	0.0485 U	0.0485 U	0.0485 U	0.243 U	0.0971 U	0.0971 U
	Wetland	1/11/2021	Duplicate	0.0105 U	0.0248 U	0.0248 U	0.248 U	0.0248 U	0.248 U	0.0248 U	0.248 U	0.0198 U	0.0495 U	0.0495 U	0.0495 U	0.0495 U	0.0495 U	0.0495 U	0.248 U	0.0990 U	0.0990 U
SE-02	Wetland	1/11/2021	Primary	0.0101 U	0.0240 U	0.0240 U	0.240 U	0.0240 U	0.240 U	0.0240 U	0.240 U	0.0192 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.240 U	0.0962 U	0.0962 U
SW-01	Wetland	1/12/2021	Primary	0.0110 U	0.0260 U	0.0260 U	0.260 U	0.0260 U	0.260 U	0.0260 U	0.260 U	0.0208 U	0.0521 U	0.0521 U	0.0521 U	0.0521 U	0.0521 U	0.0521 U	0.260 U	0.104 U	0.104 U
SW-02	Wetland	1/12/2021	Primary	0.0105 U	0.0250 U	0.0250 U	0.250 U	0.0250 U	0.250 U	0.0250 U	0.250 U	0.0200 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.250 U	0.100 U	0.100 U
SW-04	Wetland	9/16/2021	Primary	0.0103 U	0.0243 U	0.0243 U	0.243 U	0.0243 U	0.243 U	0.0243 U	0.243 U	0.0194 U	0.0485 U	0.0485 U	0.0485 U	0.0485 U	0.0485 U	0.0485 U	0.243 U	0.0971 U	0.0971 U
SW-07	Wetland	2/2/2022	Primary	0.00664 U	—	—	—	—	—	—	—	0.0352 U	—	—	—	—	—	—	—	—	—
SW-08	Wetland	2/2/2022	Primary	0.00629 U	—	—	—	—	—	—	—	0.0333 U	—	—	—	—	—	—	—	—	—
SW-09	Wetland	2/2/2022	Primary	0.00823 U	—	—	—	—	—	—	—	0.0435 U	—	—	—	—	—	—	—	—	—
	Wetland	2/2/2022	Duplicate	0.00770 U	—	—	—	—	—	—	—	0.0406 U	—	—	—	—	—	—	—	—	—
SW-10	Wetland	2/2/2022	Primary	0.00664 U	—	—	—	—	—	—	—	0.0352 U	—	—	—	—	—	—	—	—	—
SW-11	Wetland	2/2/2022	Primary	0.00628 U	—	—	—	—	—	—	—	0.0333 U	—	—	—	—	—	—	—	—	—
SW-12	Wetland	2/2/2022	Primary	0.00633 U	—	—	—	—	—	—	—	0.0335 U	—	—	—	—	—	—	—	—	—
SW-14	Wetland	2/4/2022	Primary	0.00629 U	—	—	—	—	—	—	—	0.0333 U	—	—	—	—	—	—	—	—	—

Table 8-8. Surface Water Results for SVOCs

Screening Criteria				2-Chloronaphthalene	2-Chlorophenol	2-Methylnaphthalene	2-Methylphenol	2-Nitroaniline	2-Nitrophenol	3&4-Methylphenol Coelution	3,3´-Dichlorobenzidine	3-Nitroaniline	4,6-Dinitro-O-Cresol	4-Bromophenyl phenyl ether	4-Chloro-3-methylphenol	4-Chloroaniline	4-Chlorophenyl phenyl ether	4-Nitroaniline	4-Nitrophenol	Acenaphthene	Acenaphthylene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Surface Water Screening Levels																					
Human Health				100	15	—	—	—	—	—	0.935[a]	—	2	—	36	—	—	—	—	30	—
Ecological				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PQL				0.0187	0.0935	0.0374	0.0467	0.374	0.187	0.0467	0.935	0.374	0.467	0.0467	0.187	0.0467	0.0467	0.374	0.187	0.0187	0.0187
Location	Area	Date	Sample Type																		
Upgradient Spring																					
SW-03	Spring	1/12/2021	Primary	0.00962 U	0.0481 U	0.0192 U	0.0240 U	0.192 U	0.0962 U	0.0240 U	0.481 UJ	0.192 U	0.240 U	0.0240 U	0.0962 U	0.0240 U	0.0240 U	0.192 U	0.0962 U	0.00962 U	0.00962 U
SW-06	Spring	9/16/2021	Primary	0.00943 U	0.0472 U	0.0189 U	0.0236 U	0.189 U	0.0943 U	0.0236 U	0.472 UJ	0.189 UJ	0.236 U	0.0236 U	0.0943 U	0.0236 UJ	0.0236 U	0.189 U	0.0943 U	0.00943 U	0.00943 U
	Spring	9/16/2021	Duplicate	0.00935 U	0.0467 U	0.0187 U	0.0234 U	0.187 U	0.0935 U	0.0234 U	0.467 UJ	0.187 UJ	0.234 U	0.0234 U	0.0935 U	0.0234 UJ	0.0234 U	0.187 U	0.0935 U	0.00935 U	0.00935 U
SW-13	Spring	2/2/2022	Primary	—	—	0.0338 U	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0169 U	0.0169 U
Landfill Area																					
SW-05	Landfill	9/16/2021	Primary	0.00962 U	0.0481 U	0.0192 U	0.0240 U	0.192 U	0.0962 U	0.0240 U	0.481 UJ	0.192 UJ	0.240 U	0.0240 U	0.0962 U	0.0240 UJ	0.0240 U	0.192 U	0.0962 U	0.00962 U	0.00962 U
Wetland Area																					
SE-01	Wetland	1/11/2021	Primary	0.00971 U	0.0485 U	0.0194 U	0.0243 U	0.194 U	0.0971 U	0.0243 U	0.485 UJ	0.194 U	0.243 U	0.0243 U	0.0971 U	0.0243 U	0.0243 U	0.194 U	0.0971 U	0.00971 U	0.00971 U
	Wetland	1/11/2021	Duplicate	0.00990 U	0.0495 U	0.0198 U	0.0248 U	0.198 U	0.0990 U	0.0248 U	0.495 UJ	0.198 U	0.248 U	0.0248 U	0.0990 U	0.0248 U	0.0248 U	0.198 U	0.0990 U	0.00990 U	0.00990 U
SE-02	Wetland	1/11/2021	Primary	0.00962 U	0.0481 U	0.0192 U	0.0240 U	0.192 U	0.0962 U	0.0240 U	0.481 UJ	0.192 U	0.240 U	0.0240 U	0.0962 U	0.0240 U	0.0240 U	0.192 U	0.0962 U	0.00962 U	0.00962 U
SW-01	Wetland	1/12/2021	Primary	0.0104 U	0.0521 U	0.0208 U	0.0260 U	0.208 U	0.104 U	0.0260 U	0.521 UJ	0.208 U	0.260 U	0.0260 U	0.104 U	0.0260 U	0.0260 U	0.208 U	0.104 U	0.0104 U	0.0104 U
SW-02	Wetland	1/12/2021	Primary	0.01000 U	0.0500 U	0.0200 U	0.0250 U	0.200 U	0.100 U	0.0250 U	0.500 UJ	0.200 U	0.250 U	0.0250 U	0.100 U	0.0250 U	0.0250 U	0.200 U	0.100 U	0.01000 U	0.01000 U
SW-04	Wetland	9/16/2021	Primary	0.00971 U	0.0485 U	0.0194 U	0.0243 U	0.194 U	0.0971 U	0.0243 U	0.485 UJ	0.194 UJ	0.243 U	0.0243 U	0.0971 U	0.0243 UJ	0.0243 U	0.194 U	0.0971 U	0.00971 U	0.00971 U
SW-07	Wetland	2/2/2022	Primary	—	—	0.0352 U	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0176 U	0.0176 U
SW-08	Wetland	2/2/2022	Primary	—	—	0.0333 U	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0167 U	0.0167 U
SW-09	Wetland	2/2/2022	Primary	—	—	0.0435 U	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0217 U	0.0217 U
	Wetland	2/2/2022	Duplicate	—	—	0.0406 U	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0203 U	0.0203 U
SW-10	Wetland	2/2/2022	Primary	—	—	0.0352 U	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0176 U	0.0176 U
SW-11	Wetland	2/2/2022	Primary	—	—	0.0333 U	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0166 U	0.0166 U
SW-12	Wetland	2/2/2022	Primary	—	—	0.0335 U	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0168 U	0.0168 U
SW-14	Wetland	2/4/2022	Primary	—	—	0.0333 U	—	—	—	—	—	—	—	—	—	—	—	—	—	0.0167 U	0.0167 U

Table 8-8. Surface Water Results for SVOCs

Location	Area	Date	Sample Type	Aniline	Anthracene	Azobenzene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic acid	Benzyl alcohol	Bis(2-chloro-1-methylethyl) ether	bis(2-Chloroethoxy)methane	bis(2-Chloroethyl) ether	Bis(2-Ethylhexyl) Phthalate	Butyl benzyl phthalate	Carbazole	Chrysene	Di(2-Ethylhexyl)Adipate
Screening Criteria				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Surface Water Screening Levels																					
Human Health				–	100	–	0.0166[a]	0.0166[a]	0.0166[a]	–	0.0166[a]	–	–	37	–	0.0467[a]	0.374[a]	0.374[a]	–	0.0166[a]	–
Ecological				–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PQL				0.0935	0.0187	0.0467	0.0166	0.0166	0.0166	0.0187	0.0166	2.34	0.187	0.0467	0.0467	0.0467	0.374	0.374	0.028	0.0166	0.467
Upgradient Spring																					
SW-03	Spring	1/12/2021	Primary	0.0481 U	0.00962 U	0.0240 U	0.00962 U	0.0144 U	0.0144 U	0.00962 U	0.0144 U	1.20 U	0.0962 U	0.0240 U	0.0240 U	0.0240 U	0.192 U	0.192 U	0.0144 U	0.00962 U	0.240 U
SW-06	Spring	9/16/2021	Primary	0.0472 U	0.00943 U	0.0236 U	0.00943 U	0.0142 U	0.0142 U	0.00943 U	0.0142 U	1.18 U	0.0943 U	0.0236 U	0.0236 U	0.0236 U	0.189 U	0.189 U	0.0142 U	0.00943 U	0.236 U
	Spring	9/16/2021	Duplicate	0.0467 U	0.00935 U	0.0234 U	0.00935 U	0.0140 U	0.0140 U	0.00935 U	0.0140 U	1.17 U	0.0935 U	0.0234 U	0.0234 U	0.0234 U	0.187 U	0.187 U	0.0140 U	0.00935 U	0.467 U
SW-13	Spring	2/2/2022	Primary	–	0.0169 U	–	0.00846 U	0.00846 U	0.00846 U	0.0169 U	0.00846 U	–	–	–	–	–	–	–	0.0169 U	0.00846 U	–
Landfill Area																					
SW-05	Landfill	9/16/2021	Primary	0.0481 U	0.00962 U	0.0240 U	0.00962 U	0.0144 U	0.0144 U	0.00962 U	0.0144 U	1.20 U	0.0962 U	0.0240 U	0.0240 U	0.0240 U	0.192 U	0.192 U	0.0144 U	0.00962 U	0.240 U
Wetland Area																					
SE-01	Wetland	1/11/2021	Primary	0.0485 U	0.00971 U	0.0243 U	0.00971 U	0.0146 U	0.0146 U	0.00971 U	0.0146 U	1.21 U	**0.106 J**	0.0243 U	0.0243 U	0.0243 U	0.194 U	0.194 U	0.0146 U	0.00971 U	0.243 U
	Wetland	1/11/2021	Duplicate	0.0495 U	0.00990 U	0.0248 U	0.00990 U	0.0149 U	0.0149 U	0.00990 U	0.0149 U	1.24 U	0.0990 U	0.0248 U	0.0248 U	0.0248 U	0.198 U	0.198 U	0.0149 U	0.00990 U	0.248 U
SE-02	Wetland	1/11/2021	Primary	0.0481 U	0.00962 U	0.0240 U	0.00962 U	0.0144 U	0.0144 U	0.00962 U	0.0144 U	1.20 U	0.0962 U	0.0240 U	0.0240 U	0.0240 U	0.192 U	0.192 U	0.0144 U	0.00962 U	0.240 U
SW-01	Wetland	1/12/2021	Primary	0.0521 U	0.0104 U	0.0260 U	0.0104 U	0.0156 U	0.0156 U	0.0104 U	0.0156 U	1.30 U	0.104 U	0.0260 U	0.0260 U	0.0260 U	0.208 U	0.208 U	0.0156 U	0.0104 U	0.260 U
SW-02	Wetland	1/12/2021	Primary	0.0500 U	0.01000 U	0.0250 U	0.01000 U	0.0150 U	0.0150 U	0.01000 U	0.0150 U	1.25 U	0.100 U	0.0250 U	0.0250 U	0.0250 U	0.200 U	0.200 U	0.0150 U	0.01000 U	0.250 U
SW-04	Wetland	9/16/2021	Primary	0.0485 U	0.00971 U	0.0243 U	0.00971 U	0.0146 U	0.0146 U	0.00971 U	0.0146 U	1.21 U	0.0971 U	0.0243 U	0.0243 U	0.0243 U	0.194 U	0.194 U	0.0146 U	0.00971 U	0.485 U
SW-07	Wetland	2/2/2022	Primary	–	0.0176 U	–	0.00879 U	0.00879 U	0.00879 U	0.0176 U	0.00879 U	–	–	–	–	–	–	–	0.0176 U	0.00879 U	–
SW-08	Wetland	2/2/2022	Primary	–	0.0167 U	–	0.00833 U	0.00833 U	0.00833 U	0.0167 U	0.00833 U	–	–	–	–	–	–	–	0.0167 U	0.00833 U	–
SW-09	Wetland	2/2/2022	Primary	–	0.0217 U	–	0.0109 U	0.0109 U	0.0109 U	0.0217 U	0.0109 U	–	–	–	–	–	–	–	0.0217 U	0.0109 U	–
	Wetland	2/2/2022	Duplicate	–	0.0203 U	–	0.0102 U	0.0102 U	0.0102 U	0.0203 U	0.0102 U	–	–	–	–	–	–	–	0.0203 U	0.0102 U	–
SW-10	Wetland	2/2/2022	Primary	–	0.0176 U	–	0.00880 U	0.00880 U	0.00880 U	0.0176 U	0.00880 U	–	–	–	–	–	–	–	0.0176 U	0.00880 U	–
SW-11	Wetland	2/2/2022	Primary	–	0.0166 U	–	0.00832 U	0.00832 U	0.00832 U	0.0166 U	0.00832 U	–	–	–	–	–	–	–	0.0166 U	0.00832 U	–
SW-12	Wetland	2/2/2022	Primary	–	0.0168 U	–	0.00838 U	0.00838 U	0.00838 U	0.0168 U	0.00838 U	–	–	–	–	–	–	–	0.0168 U	0.00838 U	–
SW-14	Wetland	2/4/2022	Primary	–	0.0167 U	–	0.00833 U	0.00833 U	0.00833 U	0.0167 U	0.00833 U	–	–	–	–	–	–	–	0.0167 U	0.00833 U	–

Table 8-8. Surface Water Results for SVOCs

Screening Criteria				Dibenz(a,h)anthracene	Dibenzofuran	Dibutyl phthalate	Diethyl phthalate	Dimethyl phthalate	Di-n-octyl phthalate	Fluoranthene	Fluorene	Hexachlorobenzene	Hexachlorobutadiene	Hexachlorocyclopentadiene	Hexachloroethane	Indeno(1,2,3-cd)pyrene	Isophorone	Naphthalene	Nitrobenzene	N-Nitrosodimethylamine	N-Nitrosodi-n-propylamine
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Surface Water Screening Levels																					
Human Health				0.0166[a]	—	8	200	600	—	6	10	0.0187[a]	0.0467[a]	1	0.0467[a]	0.0166[a]	27	4,900	10	0.0467[a]	0.0467[a]
Ecological				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PQL				0.0166	0.0187	0.374	0.374	0.374	0.374	0.0187	0.0187	0.0187	0.0467	0.0935	0.0467	0.0166	0.0467	0.0374	0.187	0.0467	0.0467
Location	Area	Date	Sample Type																		
Upgradient Spring																					
SW-03	Spring	1/12/2021	Primary	0.00962 U	0.00962 U	0.192 U	0.192 U	0.192 U	0.192 U	0.00962 U	0.00962 U	0.00962 U	0.0240 U	0.0481 U	0.0240 U	0.00962 U	0.0240 U	0.0192 U	0.0962 U	0.0240 U	0.0240 U
SW-06	Spring	9/16/2021	Primary	0.00943 U	0.00943 U	0.189 U	0.189 U	0.189 U	0.189 U	0.00943 U	0.00943 U	0.00943 U	0.0236 U	0.0472 U	0.0236 U	0.00943 U	0.0236 U	0.0189 U	0.0943 U	0.0236 U	0.0236 U
	Spring	9/16/2021	Duplicate	0.00935 U	0.00935 U	0.187 U	0.187 U	0.187 U	0.187 U	0.00935 U	0.00935 U	0.00935 U	0.0234 U	0.0467 U	0.0234 U	0.00935 U	0.0234 U	0.0187 U	0.0935 U	0.0234 U	0.0234 U
SW-13	Spring	2/2/2022	Primary	0.00846 U	0.0169 U	—	—	—	—	0.0169 U	0.0169 U	—	—	—	—	0.00846 U	—	0.0338 U	—	—	—
Landfill Area																					
SW-05	Landfill	9/16/2021	Primary	0.00962 U	0.00962 U	0.192 U	0.192 U	0.192 U	0.192 U	0.00962 U	0.00962 U	0.00962 U	0.0240 U	0.0481 U	0.0240 U	0.00962 U	0.0240 U	**0.0192 J**	0.0962 U	0.0240 U	0.0240 U
Wetland Area																					
SE-01	Wetland	1/11/2021	Primary	0.00971 U	0.00971 U	0.194 U	0.194 U	0.194 U	0.194 U	0.00971 U	0.00971 U	0.00971 U	0.0243 U	0.0485 U	0.0243 U	0.00971 U	0.0243 U	0.0194 U	0.0971 U	0.0243 U	0.0243 U
	Wetland	1/11/2021	Duplicate	0.00990 U	0.00990 U	0.198 U	0.198 U	0.198 U	0.198 U	0.00990 U	0.00990 U	0.00990 U	0.0248 U	0.0495 U	0.0248 U	0.00990 U	0.0248 U	0.0198 U	0.0990 U	0.0248 U	0.0248 U
SE-02	Wetland	1/11/2021	Primary	0.00962 U	0.00962 U	0.192 U	0.192 U	0.192 U	0.192 U	0.00962 U	0.00962 U	0.00962 U	0.0240 U	0.0481 U	0.0240 U	0.00962 U	0.0240 U	0.0192 U	0.0962 U	0.0240 U	0.0240 U
SW-01	Wetland	1/12/2021	Primary	0.0104 U	0.0104 U	0.208 U	0.208 U	0.208 U	0.208 U	0.0104 U	0.0104 U	0.0104 U	0.0260 U	0.0521 U	0.0260 U	0.0104 U	0.0260 U	0.0208 U	0.104 U	0.0260 U	0.0260 U
SW-02	Wetland	1/12/2021	Primary	0.01000 U	0.01000 U	0.200 U	0.200 U	0.200 U	0.200 U	0.01000 U	0.01000 U	0.01000 U	0.0250 U	0.0500 U	0.0250 U	0.01000 U	0.0250 U	0.0200 U	0.100 U	0.0250 U	0.0250 U
SW-04	Wetland	9/16/2021	Primary	0.00971 U	0.00971 U	0.194 U	**0.215 J**	0.194 U	0.194 U	0.00971 U	0.00971 U	0.00971 U	0.0243 U	0.0485 U	0.0243 U	0.00971 U	0.0243 U	0.0194 U	0.0971 U	0.0243 U	0.0243 U
SW-07	Wetland	2/2/2022	Primary	0.00879 U	0.0176 U	—	—	—	—	0.0176 U	0.0176 U	—	—	—	—	0.00879 U	—	0.0352 U	—	—	—
SW-08	Wetland	2/2/2022	Primary	0.00833 U	0.0167 U	—	—	—	—	0.0167 U	0.0167 U	—	—	—	—	0.00833 U	—	0.0333 U	—	—	—
SW-09	Wetland	2/2/2022	Primary	0.0109 U	0.0217 U	—	—	—	—	0.0217 U	0.0217 U	—	—	—	—	0.0109 U	—	0.0435 U	—	—	—
	Wetland	2/2/2022	Duplicate	0.0102 U	0.0203 U	—	—	—	—	0.0203 U	0.0203 U	—	—	—	—	0.0102 U	—	0.0406 U	—	—	—
SW-10	Wetland	2/2/2022	Primary	0.00880 U	0.0176 U	—	—	—	—	0.0176 U	0.0176 U	—	—	—	—	0.00880 U	—	0.0352 U	—	—	—
SW-11	Wetland	2/2/2022	Primary	0.00832 U	0.0166 U	—	—	—	—	0.0166 U	0.0166 U	—	—	—	—	0.00832 U	—	0.0333 U	—	—	—
SW-12	Wetland	2/2/2022	Primary	0.00838 U	0.0168 U	—	—	—	—	0.0168 U	0.0168 U	—	—	—	—	0.00838 U	—	0.0335 U	—	—	—
SW-14	Wetland	2/4/2022	Primary	0.00833 U	0.0167 U	—	—	—	—	0.0167 U	0.0167 U	—	—	—	—	0.00833 U	—	0.0333 U	—	—	—

Table 8-8. Surface Water Results for SVOCs

Screening Criteria				N-Nitrosodiphenylamine	Pentachlorophenol	Phenanthrene	Phenol	Pyrene	Pyridine
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Surface Water Screening Levels									
Human Health				0.62	0.187	—	4,000	8	—
Ecological				—	13	—	—	—	—
PQL				0.0467	0.187	0.0187	0.374	0.0187	0.187
Location	Area	Date	Sample Type						
Upgradient Spring									
SW-03	Spring	1/12/2021	Primary	0.0240 U	0.0962 U	0.00962 U	0.192 U	0.00962 U	0.0962 U
SW-06	Spring	9/16/2021	Primary	0.0236 U	0.0943 U	0.00943 U	0.189 U	0.00943 U	0.0943 U
	Spring	9/16/2021	Duplicate	0.0234 U	0.0935 U	0.00935 U	0.187 U	0.00935 U	0.0935 U
SW-13	Spring	2/2/2022	Primary	—	0.0980 U	0.0338 U	—	0.0169 U	—
Landfill Area									
SW-05	Landfill	9/16/2021	Primary	0.0240 U	0.0962 U	0.00962 U	0.192 U	0.00962 U	0.0962 U
Wetland Area									
SE-01	Wetland	1/11/2021	Primary	0.0243 U	0.0971 U	0.00971 U	0.194 U	0.00971 U	0.0971 U
	Wetland	1/11/2021	Duplicate	0.0248 U	0.0990 U	0.00990 U	0.198 U	0.00990 U	0.0990 U
SE-02	Wetland	1/11/2021	Primary	0.0240 U	0.0962 U	0.00962 U	0.192 U	0.00962 U	0.0962 U
SW-01	Wetland	1/12/2021	Primary	0.0260 U	0.104 U	0.0104 U	0.208 U	0.0104 U	0.104 U
SW-02	Wetland	1/12/2021	Primary	0.0250 U	0.100 U	0.01000 U	0.200 U	0.01000 U	0.100 U
SW-04	Wetland	9/16/2021	Primary	0.0243 U	0.0971 U	0.00971 U	0.194 U	0.00971 U	0.0971 U
SW-07	Wetland	2/2/2022	Primary	—	0.104 U	0.0352 U	—	0.0176 U	—
SW-08	Wetland	2/2/2022	Primary	—	0.0962 U	0.0333 U	—	0.0167 U	—
SW-09	Wetland	2/2/2022	Primary	—	0.0980 U	0.0435 U	—	0.0217 U	—
	Wetland	2/2/2022	Duplicate	—	0.0980 U	0.0406 U	—	0.0203 U	—
SW-10	Wetland	2/2/2022	Primary	—	0.0971 U	0.0352 U	—	0.0176 U	—
SW-11	Wetland	2/2/2022	Primary	—	0.0990 U	0.0333 U	—	0.0166 U	—
SW-12	Wetland	2/2/2022	Primary	—	0.0962 U	0.0335 U	—	0.0168 U	—
SW-14	Wetland	2/4/2022	Primary	—	0.0952 U	0.0333 U	—	0.0167 U	—

Table 8-8. Surface Water Results for SVOCs

Notes

SVOC (semivolatile organic compound) analyses by EPA Method 8270E.

Total cPAHs (carcinogenic polycyclic aromatic hydrocarbons) calculated using toxicity equivalency factors (TEFs) and include non-detected values at one half the detection limit.

Samples SW-06 (09/16/2021) and SW-13 (2/2/2022) are from the same location.

[a] Screening level is based on the PQL.

BOLD = detection

— = not analyzed or not available

µg/L = micrograms per liter

EPA = U.S. Environmental Protection Agency

J = estimate

PQL = practical quantitation limit

U = non-detect

UJ = non-detect, and the value is an estimate

Table 8-9. Groundwater Results for SVOCs

Screening Criteria				GSI Total cPAH (U=1/2) 2020	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,2-Dinitrobenzene	1,3-Dichlorobenzene	1,3-Dinitrobenzene	1,4-Dichlorobenzene	1,4-Dinitrobenzene	1-Methylnaphthalene	2,3,4,6-Tetrachlorophenol	2,3,5,6-Tetrachlorophenol	2,4,5-Trichlorophenol	2,4,6-Trichlorophenol	2,4-Dichlorophenol	2,4-Dimethylphenol	2,4-Dinitrophenol	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Chloronaphthalene	2-Chlorophenol	2-Methylnaphthalene	2-Methylphenol	2-Nitroaniline	2-Nitrophenol
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels																											
Human Health				0.0166	0.0485[a]	600	1.6	2	1.6	8.1	1.6	1.51	480	–	300	0.25	10	85	10	0.194[a]	0.194[a]	100	15	32	800	160	–
Ecological				–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PQL				–	0.0485	0.0485	0.485	0.0485	0.485	0.0485	0.485	0.0388	0.0971	0.0971	0.0971	0.0971	0.0971	0.0971	0.485	0.194	0.194	0.0194	0.0971	0.0388	0.0485	0.388	0.194
Location	Area	Date	Sample Type																								
Upgradient Piezometers																											
PZ-01	Landfill	11/17/2021	Primary	0.0120 U	–	–	–	–	–	–	–	0.0227 U	–	–	–	–	–	–	–	–	–	–	–	0.0227 U	–	–	–
	Landfill	2/4/2022	Primary	0.00830 U	–	–	–	–	–	–	–	0.0439 U	–	–	–	–	–	–	–	–	–	–	–	0.0439 U	–	–	–
PZ-02	Landfill	11/17/2021	Primary	0.0119 U	–	–	–	–	–	–	–	0.0225 U	–	–	–	–	–	–	–	–	–	–	–	0.0225 U	–	–	–
	Landfill	11/17/2021	Duplicate	0.0110 U	–	–	–	–	–	–	–	0.0208 U	–	–	–	–	–	–	–	–	–	–	–	0.0208 U	–	–	–
	Landfill	2/4/2022	Primary	0.00717 U	–	–	–	–	–	–	–	0.0380 U	–	–	–	–	–	–	–	–	–	–	–	0.0380 U	–	–	–
	Landfill	2/4/2022	Duplicate	0.00704 U	–	–	–	–	–	–	–	0.0373 U	–	–	–	–	–	–	–	–	–	–	–	0.0373 U	–	–	–
PZ-05	Landfill	2/4/2022	Primary	0.00691 U	–	–	–	–	–	–	–	0.0366 U	–	–	–	–	–	–	–	–	–	–	–	0.0366 U	–	–	–
Landfill Area																											
GW-01	Landfill	1/12/2021	Primary	0.0103 UJ-	0.0243 UJ-	0.0243 UJ-	0.243 UJ-	0.0243 UJ-	0.243 UJ-	0.0243 UJ-	0.243 UJ-	0.0194 UJ-	0.0485 U	0.0485 U	0.0485 U	0.0485 U	0.0485 U	0.0485 U	0.243 U	0.0971 UJ-	0.0971 UJ-	0.00971 UJ-	0.0485 U	0.0194 UJ-	0.0243 U	0.194 UJ-	0.0971 U
Wetland Area																											
PZ-03	Wetland	11/17/2021	Primary	0.0122 U	–	–	–	–	–	–	–	0.0233 U	–	–	–	–	–	–	–	–	–	–	–	0.0233 U	–	–	–
	Wetland	2/3/2022	Primary	0.00664 U	–	–	–	–	–	–	–	0.0352 U	–	–	–	–	–	–	–	–	–	–	–	0.0352 U	–	–	–
PZ-04	Wetland	11/17/2021	Primary	0.0120 U	–	–	–	–	–	–	–	0.0227 U	–	–	–	–	–	–	–	–	–	–	–	0.0227 U	–	–	–
	Wetland	2/3/2022	Primary	0.00861 U	–	–	–	–	–	–	–	0.0457 U	–	–	–	–	–	–	–	–	–	–	–	0.0457 U	–	–	–

Table 8-9. Groundwater Results for SVOCs

Screening Criteria				3&4-Methylphenol Coelution	3,3'-Dichlorobenzidine	3-Nitroaniline	4,6-Dinitro-O-Cresol	4-Bromophenyl phenyl ether	4-Chloro-3-methylphenol	4-Chloroaniline	4-Chlorophenyl phenyl ether	4-Nitroaniline	4-Nitrophenol	Acenaphthene	Acenaphthylene	Aniline	Anthracene	Azobenzene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic acid	Benzyl alcohol	Bis(2-chloro-1-methylethyl) ether
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels																										
Human Health				800	0.971[a]	–	1.28	–	36	0.438	–	0.438	–	30	–	15	100	0.398	0.0176[a]	0.0176[a]	0.0176[a]	–	0.0176[a]	64,000	1,600	0.625
Ecological				–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
PQL				0.0485	0.971	0.388	0.485	0.0485	0.194	0.0485	0.0485	0.388	0.194	0.0194	0.0194	0.0971	0.0194	0.0485	0.0176	0.0176	0.0176	0.0194	0.0176	2.43	0.194	0.0485
Location	Area	Date	Sample Type																							
Upgradient Piezometers																										
PZ-01	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	0.0114 U	0.0114 U	–	0.0114 U	–	0.0114 U	0.0170 U	0.0170 U	0.0114 U	0.0170 U	–	–	–
	Landfill	2/4/2022	Primary	–	–	–	–	–	–	–	–	–	–	0.0219 U	0.0219 U	–	0.0219 U	–	0.0110 U	0.0110 U	0.0110 U	0.0219 U	0.0110 U	–	–	–
PZ-02	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	0.0112 U	0.0112 U	–	0.0112 U	–	0.0112 U	0.0169 U	0.0169 U	0.0112 U	0.0169 U	–	–	–
	Landfill	11/17/2021	Duplicate	–	–	–	–	–	–	–	–	–	–	0.0104 U	0.0104 U	–	0.0104 U	–	0.0104 U	0.0156 U	0.0156 U	0.0104 U	0.0156 U	–	–	–
	Landfill	2/4/2022	Primary	–	–	–	–	–	–	–	–	–	–	0.0190 U	0.0190 U	–	0.0190 U	–	0.00950 U	0.00950 U	0.00950 U	0.0190 U	0.00950 U	–	–	–
	Landfill	2/4/2022	Duplicate	–	–	–	–	–	–	–	–	–	–	0.0187 U	0.0187 U	–	0.0187 U	–	0.00933 U	0.00933 U	0.00933 U	0.0187 U	0.00933 U	–	–	–
PZ-05	Landfill	2/4/2022	Primary	–	–	–	–	–	–	–	–	–	–	0.0183 U	0.0183 U	–	0.0183 U	–	0.00915 U	0.00915 U	0.00915 U	0.0183 U	0.00915 U	–	–	–
Landfill Area																										
GW-01	Landfill	1/12/2021	Primary	0.0243 U	0.485 UJ-	0.194 UJ-	0.243 U	0.0243 UJ-	0.0971 U	0.0243 UJ-	0.0243 UJ-	0.194 UJ-	0.194 U	0.00971 UJ-	0.00971 UJ-	0.0485 UJ-	0.00971 UJ-	0.0243 UJ-	0.00971 UJ-	0.0146 UJ-	0.0146 UJ-	0.00971 UJ-	0.0146 UJ-	1.21 U	0.0971 UJ-	0.0243 UJ-
Wetland Area																										
PZ-03	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	0.0116 U	0.0116 U	–	0.0116 U	–	0.0116 U	0.0174 U	0.0174 U	0.0116 U	0.0174 U	–	–	–
	Wetland	2/3/2022	Primary	–	–	–	–	–	–	–	–	–	–	0.0176 U	0.0176 U	–	0.0176 U	–	0.00880 U	0.00880 U	0.00880 U	0.0176 U	0.00880 U	–	–	–
PZ-04	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	0.0114 U	0.0114 U	–	0.0114 U	–	0.0114 U	0.0170 U	0.0170 U	0.0114 U	0.0170 U	–	–	–
	Wetland	2/3/2022	Primary	–	–	–	–	–	–	–	–	–	–	0.0228 U	0.0228 U	–	0.0228 U	–	0.0114 U	0.0114 U	0.0114 U	0.0228 U	0.0114 U	–	–	–

Table 8-9. Groundwater Results for SVOCs

Screening Criteria				bis(2-Chloroethoxy)methane	bis(2-Chloroethyl) ether	Bis(2-Ethylhexyl) Phthalate	Butyl benzyl phthalate	Carbazole	Chrysene	Di(2-Ethylhexyl)Adipate	Dibenz(a,h)anthracene	Dibenzofuran	Dibutyl phthalate	Diethyl phthalate	Dimethyl phthalate	Di-n-octyl phthalate	Fluoranthene	Fluorene	Hexachlorobenzene	Hexachlorobutadiene	Hexachlorocyclopentadiene	Hexachloroethane	Indeno(1,2,3-cd)pyrene	Isophorone	Naphthalene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels																									
Human Health				48	0.0485[a]	0.388[a]	0.388[a]	—	0.0176[a]	73	0.0176[a]	8	8	200	600	160	6	10	0.0194[a]	0.0485[a]	1	0.0485[a]	0.0176[a]	27	160
Ecological				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PQL				0.0485	0.0485	0.388	0.388	0.0291	0.0176	0.485	0.0176	0.0194	0.388	0.388	0.388	0.388	0.0194	0.0194	0.0194	0.0485	0.0971	0.0485	0.0176	0.0485	0.0388
Location	**Area**	**Date**	**Sample Type**																						
Upgradient Piezometers																									
PZ-01	Landfill	11/17/2021	Primary	—	—	—	—	—	0.0114 U	—	0.0114 U	0.0114 U	—	—	—	—	0.0114 U	0.0114 U	—	—	—	—	0.0114 U	—	0.0227 U
	Landfill	2/4/2022	Primary	—	—	—	—	0.0219 U	0.0110 U	—	0.0110 U	0.0219 U	—	—	—	—	0.0219 U	0.0219 U	—	—	—	—	0.0110 U	—	0.0439 U
PZ-02	Landfill	11/17/2021	Primary	—	—	—	—	—	0.0112 U	—	0.0112 U	0.0112 U	—	—	—	—	0.0112 U	0.0112 U	—	—	—	—	0.0112 U	—	0.0225 U
	Landfill	11/17/2021	Duplicate	—	—	—	—	—	0.0104 U	—	0.0104 U	0.0104 U	—	—	—	—	0.0104 U	0.0104 U	—	—	—	—	0.0104 U	—	0.0208 U
	Landfill	2/4/2022	Primary	—	—	—	—	0.0190 U	0.00950 U	—	0.00950 U	0.0190 U	—	—	—	—	0.0190 U	0.0190 U	—	—	—	—	0.00950 U	—	0.0380 U
	Landfill	2/4/2022	Duplicate	—	—	—	—	0.0187 U	0.00933 U	—	0.00933 U	0.0187 U	—	—	—	—	0.0187 U	0.0187 U	—	—	—	—	0.00933 U	—	0.0373 U
PZ-05	Landfill	2/4/2022	Primary	—	—	—	—	0.0183 U	0.00915 U	—	0.00915 U	0.0183 U	—	—	—	—	0.0183 U	**0.0187 J**	—	—	—	—	0.00915 U	—	**0.343**
Landfill Area																									
GW-01	Landfill	1/12/2021	Primary	0.0243 UJ-	0.0243 UJ-	0.194 UJ-	0.194 UJ-	0.0146 UJ-	0.00971 UJ-	0.243 UJ-	0.00971 UJ-	0.00971 UJ-	0.194 UJ-	0.194 UJ-	0.194 UJ-	0.194 UJ-	0.00971 UJ-	0.00971 UJ-	0.00971 UJ-	0.0243 UJ-	0.0485 UJ-	0.0243 UJ-	0.00971 UJ-	0.0243 UJ-	0.0194 UJ-
Wetland Area																									
PZ-03	Wetland	11/17/2021	Primary	—	—	—	—	—	0.0116 U	—	0.0116 U	0.0116 U	—	—	—	—	0.0116 U	0.0116 U	—	—	—	—	0.0116 U	—	0.0233 U
	Wetland	2/3/2022	Primary	—	—	—	—	0.0176 U	0.00880 U	—	0.00880 U	0.0176 U	—	—	—	—	0.0176 U	0.0176 U	—	—	—	—	0.00880 U	—	0.0352 U
PZ-04	Wetland	11/17/2021	Primary	—	—	—	—	—	0.0114 U	—	0.0114 U	0.0114 U	—	—	—	—	0.0114 U	0.0114 U	—	—	—	—	0.0114 U	—	0.0227 U
	Wetland	2/3/2022	Primary	—	—	—	—	0.0228 U	0.0114 U	—	0.0114 U	0.0228 U	—	—	—	—	0.0228 U	0.0228 U	—	—	—	—	0.0114 U	—	0.0457 U

Table 8-9. Groundwater Results for SVOCs

Screening Criteria				Nitrobenzene	N-Nitrosodimethylamine	N-Nitrosodi-n-propylamine	N-Nitrosodiphenylamine	Pentachlorophenol	Phenanthrene	Phenol	Pyrene	Pyridine
				μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L
Groundwater Screening Levels												
Human Health				10	0.0485[a]	0.0485[a]	0.62	0.19[a]	–	4,000	8	8
Ecological				–	–	–	–	13	–	–	–	–
PQL				0.194	0.0485	0.0485	0.0485	0.19	0.0194	0.388	0.0194	0.194
Location	**Area**	**Date**	**Sample Type**									
Upgradient Piezometers												
PZ-01	Landfill	11/17/2021	Primary	–	–	–	–	–	0.0114 U	–	0.0114 U	–
	Landfill	2/4/2022	Primary	–	–	–	–	0.105 U	0.0439 U	–	0.0219 U	–
PZ-02	Landfill	11/17/2021	Primary	–	–	–	–	–	0.0112 U	–	0.0112 U	–
	Landfill	11/17/2021	Duplicate	–	–	–	–	–	**0.0228**	–	0.0104 U	–
	Landfill	2/4/2022	Primary	–	–	–	–	0.0980 U	0.0380 U	–	0.0190 U	–
	Landfill	2/4/2022	Duplicate	–	–	–	–	0.0952 U	0.0373 U	–	0.0187 U	–
PZ-05	Landfill	2/4/2022	Primary	–	–	–	–	0.0962 U	0.0366 U	–	0.0183 U	–
Landfill Area												
GW-01	Landfill	1/12/2021	Primary	0.0971 UJ-	0.0243 UJ-	0.0243 UJ-	0.0243 UJ-	0.0971 U	0.00971 UJ-	0.194 U	0.00971 UJ-	0.0971 UJ-
Wetland Area												
PZ-03	Wetland	11/17/2021	Primary	–	–	–	–	–	0.0116 U	–	0.0116 U	–
	Wetland	2/3/2022	Primary	–	–	–	–	0.0990 U	0.0352 U	–	0.0176 U	–
PZ-04	Wetland	11/17/2021	Primary	–	–	–	–	–	0.0114 U	–	0.0114 U	–
	Wetland	2/3/2022	Primary	–	–	–	–	0.0990 U	0.0457 U	–	0.0228 U	–

Table 8-9. Groundwater Results for SVOCs

Notes

SVOC (semivolatile organic compound) analyses by EPA Method 8270E.

Total cPAHs (carcinogenic polycyclic aromatic hydrocarbons) calculated using toxicity equivalency factors (TEFs) and include non-detected values at one half the detection limit.

[a] Screening level is based on the PQL.

BOLD = detection

— = not analyzed or not available

μg/L = micrograms per liter

EPA = U.S. Environmental Protection Agency

J = estimate

J+/- = the result is biased high or low

PQL = practical quantitation limit

U = non-detect

UJ = non-detect, and the value is an estimate

Table 8-10. Soil Results for SVOCs

Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)	GSI Total cPAH (U=1/2) 2020 (CALC)	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene	1,2-Dinitrobenzene	1,3-Dichlorobenzene	1,3-Dinitrobenzene	1,4-Dichlorobenzene	1,4-Dinitrobenzene	1-Methylnaphthalene	2,3,4,6-Tetrachlorophenol	2,3,5,6-Tetrachlorophenol	2,4,5-Trichlorophenol
Screening Criteria						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																	
Human Health						0.19	34	7,200	8	–	8	190	8	34	2,400	–	8,000
Ecological						12	20	–	–	–	–	20	–	–	–	–	4
PQL						–	0.214	0.214	2.14	0.214	2.14	0.214	2.14	0.171	0.427	0.427	0.427
Former Borrow Pit																	
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	1.37 J	0.133 UJ	0.133 UJ	1.33 UJ	0.133 UJ	1.33 UJ	0.133 UJ	1.33 UJ	0.107 UJ	0.267 UJ	0.267 UJ	0.267 UJ
Landfill Area																	
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	0.306 J	0.136 UJ	0.136 UJ	1.36 UJ	0.136 UJ	1.36 UJ	0.136 UJ	1.36 UJ	0.109 UJ	0.272 UJ	0.272 UJ	0.272 UJ
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	0.144 J	0.166 U	0.166 U	1.66 U	0.166 U	1.66 U	0.166 UJ	1.66 U	0.133 U	0.333 U	0.333 U	0.333 U
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	0.328 U	0.777 U	0.777 U	7.77 U	0.777 U	7.77 U	0.777 U	7.77 U	0.623 U	1.56 U	1.56 U	1.56 U
Wetland Area																	
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.0817 J	0.107 U	0.107 U	1.07 U	0.107 U	1.07 U	0.107 UJ	1.07 U	0.0858 U	0.214 U	0.214 U	0.214 U
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.0565 UJ	0.134 UJ	0.134 UJ	1.34 UJ	0.134 UJ	1.34 UJ	0.134 UJ	1.34 UJ	0.107 UJ	0.268 UJ	0.268 UJ	0.268 UJ
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.115 UJ	0.272 UJ	0.272 UJ	2.72 UJ	0.272 UJ	2.72 UJ	0.272 UJ	2.72 UJ	0.218 UJ	0.544 UJ	0.544 UJ	0.544 UJ

Table 8-10. Soil Results for SVOCs

Screening Criteria						2,4,6-Trichlorophenol	2,4-Dichlorophenol	2,4-Dimethylphenol	2,4-Dinitrophenol	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Chloronaphthalene	2-Chlorophenol	2-Methylnaphthalene	2-Methylphenol	2-Nitroaniline	2-Nitrophenol
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																	
Human Health						80	240	1,600	160	3.2	0.858[a]	6,400	400	320	4,000	800	–
Ecological						10	–	–	20	–	–	–	–	–	–	–	–
PQL						0.427	0.427	0.427	2.14	0.858	0.858	0.0858	0.427	0.171	0.214	1.71	0.858
Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)												
Former Borrow Pit																	
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	0.267 UJ	0.267 UJ	0.267 UJ	1.33 UJ	0.532 UJ	0.532 UJ	0.0532 UJ	0.267 UJ	0.107 UJ	0.133 UJ	1.07 UJ	0.532 UJ
Landfill Area																	
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	0.272 UJ	0.272 UJ	0.272 UJ	1.36 UJ	0.542 UJ	0.542 UJ	0.0542 UJ	0.272 UJ	0.109 UJ	0.136 UJ	1.09 UJ	0.542 UJ
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	0.333 U	0.333 U	0.333 U	1.66 U	0.663 U	0.663 U	0.0663 U	0.333 U	0.133 U	0.166 U	1.33 U	0.663 U
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	1.56 U	1.56 U	1.56 U	7.77 U	3.10 U	3.10 U	0.310 U	1.56 U	0.623 U	0.777 U	6.23 U	3.10 U
Wetland Area																	
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.214 U	0.214 U	0.214 U	1.07 U	0.427 U	0.427 U	0.0427 U	0.214 U	0.0858 U	0.107 U	0.858 U	0.427 U
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.268 UJ	0.268 UJ	0.268 UJ	1.34 UJ	0.534 UJ	0.534 UJ	0.0534 UJ	0.268 UJ	0.107 UJ	0.134 UJ	1.07 UJ	0.534 UJ
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.544 UJ	0.544 UJ	0.544 UJ	2.72 UJ	1.08 UJ	1.08 UJ	0.108 UJ	0.544 UJ	0.218 UJ	0.272 UJ	2.18 UJ	1.08 UJ

Table 8-10. Soil Results for SVOCs

Screening Criteria						3&4-Methylphenol Coelution	3,3´-Dichlorobenzidine	3-Nitroaniline	4,6-Dinitro-O-Cresol	4-Bromophenyl phenyl ether	4-Chloro-3-methylphenol	4-Chloroaniline	4-Chlorophenyl phenyl ether	4-Nitroaniline	4-Nitrophenol	Acenaphthene	Acenaphthylene
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																	
Human Health						4,000	2.2	–	6	–	8,000	5	–	50	–	4,800	–
Ecological						–	–	–	–	–	–	–	–	–	7	20	–
PQL						0.214	1.71	1.71	2.14	0.214	0.858	0.214	0.214	1.71	0.858	0.0858	0.0858
Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)												
Former Borrow Pit																	
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	0.133 UJ	1.07 UJ	1.07 UJ	1.33 UJ	0.133 UJ	0.532 UJ	0.133 UJ	0.133 UJ	1.07 UJ	0.532 UJ	0.0532 UJ	0.0532 UJ
Landfill Area																	
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	0.136 UJ	1.09 UJ	1.09 UJ	1.36 UJ	0.136 UJ	0.542 UJ	0.136 UJ	0.136 UJ	1.09 UJ	0.542 UJ	0.0542 UJ	0.0542 UJ
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	0.166 U	1.33 UJ	1.33 U	1.66 U	0.166 U	0.663 U	0.166 U	0.166 U	1.33 U	0.663 U	0.0663 U	0.0663 U
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	0.777 U	6.23 UJ	6.23 U	7.77 U	0.777 U	3.10 U	0.777 U	0.777 U	6.23 U	3.10 U	0.310 U	0.310 U
Wetland Area																	
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.107 U	0.858 UJ	0.858 U	1.07 U	0.107 U	0.427 U	0.107 U	0.107 U	0.858 U	0.427 U	0.0427 U	0.0427 U
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.198 J	1.07 UJ	1.07 UJ	1.34 UJ	0.134 UJ	0.534 UJ	0.134 UJ	0.134 UJ	1.07 UJ	0.534 UJ	0.0534 UJ	0.0534 UJ
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.272 UJ	2.18 UJ	2.18 UJ	2.72 UJ	0.272 UJ	1.08 UJ	0.272 UJ	0.272 UJ	2.18 UJ	1.08 UJ	0.108 UJ	0.108 UJ

Table 8-10. Soil Results for SVOCs

Screening Criteria						E8270E											
						Aniline	Anthracene	Azobenzene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Benzoic acid	Benzyl alcohol	Bis(2-chloro-1-methylethyl) ether	bis(2-Chloroethoxy)methane
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
					Soil Screening Levels												
					Human Health	180	24,000	9.1	—	0.19	—	—	—	320,000	8,000	14	240
					Ecological	—	—	—	—	12	—	—	—	—	—	—	—
					PQL	0.427	0.0858	0.214	0.0858	0.128	0.128	0.0858	0.128	10.7	0.427	0.214	0.214
Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)												
Former Borrow Pit																	
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	0.267 UJ	0.0700 J	0.133 UJ	0.738 J	1.05 J	1.13 J	0.844 J	0.367 J	6.68 UJ	0.267 UJ	0.133 UJ	0.133 UJ
Landfill Area																	
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	0.272 UJ	0.0542 UJ	0.136 UJ	0.166 J	0.238 J	0.238 J	0.166 J	0.102 J	6.81 UJ	0.272 UJ	0.136 UJ	0.136 UJ
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	0.333 U	0.0663 U	0.166 U	0.0833 J	0.111 J	0.112 J	0.0739 J	0.0997 U	8.33 U	0.663 U	0.166 U	0.166 U
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	1.56 U	0.310 U	0.777 U	0.310 U	0.466 U	0.466 U	0.310 U	0.466 U	38.9 U	1.56 U	0.777 U	0.777 U
Wetland Area																	
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.427 U	0.0427 U	0.107 U	0.0427 U	0.0687 J	0.0642 U	0.0427 U	0.0642 U	5.36 U	0.214 U	0.107 U	0.107 U
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.268 UJ	0.0534 UJ	0.134 UJ	0.0534 UJ	0.0803 UJ	0.0803 UJ	0.0534 UJ	0.0803 UJ	7.73 J	0.268 UJ	0.134 UJ	0.134 UJ
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.544 UJ	0.108 UJ	0.272 UJ	0.108 UJ	0.163 UJ	0.163 UJ	0.108 UJ	0.163 UJ	13.6 UJ	0.544 UJ	0.272 UJ	0.272 UJ

Table 8-10. Soil Results for SVOCs

Screening Criteria						bis(2-Chloroethyl) ether	Bis(2-Ethylhexyl) Phthalate	Butyl benzyl phthalate	Carbazole	Chrysene	Di(2-Ethylhexyl)Adipate	Dibenz(a,h)anthracene	Dibenzofuran	Dibutyl phthalate	Diethyl phthalate	Dimethyl phthalate	Di-n-octyl phthalate
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																	
Human Health						0.91	71	530	—	—	830	—	80	8,000	64,000	—	800
Ecological						—	—	—	—	—	—	—	—	200	100	200	—
PQL						0.214	1.28	0.858	0.128	0.0858	2.14	0.0858	0.0858	0.858	0.858	0.858	0.858
Location	**Area**	**Date**	**QC Sample Type**	**Grab/Composite**	**Depth (ft)**												
Former Borrow Pit																	
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	0.133 UJ	0.800 UJ	0.532 UJ	0.0800 UJ	**0.944 J**	1.33 UJ	**0.186 J**	0.0532 UJ	0.532 UJ	0.532 UJ	0.532 UJ	0.532 UJ
Landfill Area																	
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	0.136 UJ	0.816 UJ	0.542 UJ	0.0816 UJ	**0.182 J**	1.36 UJ	0.0542 UJ	0.0542 UJ	0.542 UJ	0.542 UJ	0.542 UJ	0.542 UJ
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	0.166 U	0.997 U	**1.99**	0.0997 U	**0.142**	1.66 U	0.0663 U	0.0663 U	0.663 U	0.663 U	0.663 U	0.663 U
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	0.777 U	4.66 U	3.10 U	0.466 U	0.310 U	7.77 U	0.310 U	0.310 U	3.10 U	3.10 U	3.10 U	3.10 U
Wetland Area																	
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.214 U	0.642 U	0.427 U	0.0642 U	0.0427 U	1.07 U	0.0427 U	0.0427 U	0.427 U	0.427 U	0.427 U	0.427 U
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.482 UJ	0.803 UJ	0.534 UJ	0.0803 UJ	0.0534 UJ	1.34 UJ	0.0534 UJ	0.0534 UJ	0.534 UJ	0.534 UJ	0.534 UJ	0.534 UJ
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.571 UJ	1.63 UJ	1.08 UJ	0.163 UJ	0.108 UJ	2.72 UJ	0.108 UJ	0.108 UJ	1.08 UJ	1.08 UJ	1.08 UJ	1.08 UJ

Table 8-10. Soil Results for SVOCs

Screening Criteria						Fluoranthene	Fluorene	Hexachlorobenzene	Hexachlorobutadiene	Hexachlorocyclopentadiene	Hexachloroethane	Indeno(1,2,3-cd)pyrene	Isophorone	Naphthalene	Nitrobenzene	N-Nitrosodimethylamine	N-Nitrosodi-n-propylamine
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																	
Human Health						3,200	3,200	0.63	13	480	25	–	1,100	1,600	160	0.214[a]	0.214[a]
Ecological						–	30	17	–	10	–	–	–	–	40	–	–
PQL						0.0858	0.0858	0.0858	0.214	0.427	0.214	0.0858	0.214	0.171	0.858	0.214	0.214
Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)												
Former Borrow Pit																	
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	**0.695 J**	0.0532 UJ	0.0532 UJ	0.133 UJ	0.267 UJ	0.133 UJ	**0.693 J**	0.133 UJ	0.107 UJ	0.532 UJ	0.133 UJ	0.133 UJ
Landfill Area																	
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	**0.215 J**	0.0542 UJ	0.0542 UJ	0.136 UJ	0.272 UJ	0.136 UJ	**0.133 J**	0.136 UJ	0.109 UJ	0.542 UJ	0.136 UJ	0.136 UJ
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	**0.242**	0.0663 U	0.0663 U	0.166 UJ	0.333 U	0.166 U	0.0663 U	0.166 U	**0.265 J**	0.663 U	0.166 U	0.166 U
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	0.310 U	0.310 U	0.310 U	0.777 U	1.56 U	0.777 U	0.310 U	0.777 U	0.623 U	3.10 U	0.777 U	0.777 U
Wetland Area																	
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.0427 U	0.0427 U	0.0427 U	0.107 UJ	0.214 U	0.107 U	0.0427 U	0.107 U	0.0858 U	0.427 U	0.107 U	0.107 U
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.0534 UJ	0.0534 UJ	0.0534 UJ	0.134 UJ	0.268 UJ	0.134 UJ	0.0534 UJ	0.134 UJ	0.107 UJ	0.534 UJ	0.134 UJ	0.134 UJ
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.108 UJ	0.108 UJ	0.108 UJ	0.272 UJ	0.544 UJ	0.272 UJ	0.108 UJ	0.272 UJ	0.218 UJ	1.08 UJ	0.272 UJ	0.272 UJ

Table 8-10. Soil Results for SVOCs

Screening Criteria						N-Nitrosodiphenylamine	Pentachlorophenol	Phenanthrene	Phenol	Pyrene	Pyridine
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels											
Human Health						200	2.5	–	24,000	2,400	80
Ecological						20	3	–	30	–	–
PQL						0.214	0.858	0.0858	0.171	0.0858	0.427
Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)						
Former Borrow Pit											
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	0.133 UJ	0.532 UJ	**0.245 J**	0.107 UJ	**1.01 J**	0.267 UJ
Landfill Area											
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	0.136 UJ	0.542 UJ	**0.173 J**	0.109 UJ	**0.321 J**	0.272 UJ
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	0.166 U	0.663 U	**0.397 J**	**0.179 J**	**0.173**	0.333 U
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	0.777 U	3.16 J	0.310 U	0.623 U	0.310 U	1.56 U
Wetland Area											
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.107 U	0.427 U	0.0427 U	**0.0860 J**	**0.0551 J**	0.214 U
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.134 UJ	0.534 UJ	0.0534 UJ	**0.169 J**	0.0534 UJ	0.268 UJ
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.272 UJ	1.08 UJ	0.108 UJ	0.218 UJ	0.108 UJ	0.544 UJ

Table 8-10. Soil Results for SVOCs

Notes

Exceeds the Human Health SL.

Exceeds both the Human Health and Ecological SL.

SVOC (semivolatile organic compound) analyses by EPA Method 8270E.

Total cPAHs (carcinogenic polycyclic aromatic hydrocarbons) calculated using toxicity equivalency factors (TEFs) and include non-detected values at one half the detection limit.

[a] Screening level is based on the PQL.

BOLD = detection

— = not analyzed or not available

EPA = U.S. Environmental Protection Agency

ft = feet

J = estimate

mg/kg = milligrams per kilogram

PQL = practical quantitation limit

SL = screening level

U = non-detect

UJ = non-detect, and the value is an estimate

Table 8-11. Surface Water Results for PCBs

Screening Criteria				GSI Total PCB Aroclors (U=1/2) 2020	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Surface Water Screening Levels											
Human Health				0.0943[a]	–	–	–	–	–	–	–
Ecological				0.0943[a]	–	–	–	–	–	–	–
PQL				–	0.0943	0.0943	0.0943	0.0943	0.0943	0.0943	0.0943
Location	Area	Date	Sample Type								
Upgradient Spring											
SW-06	Spring	9/16/2021	Primary	0.189 U	0.0472 U	0.0472 U	0.0472 U	0.0472 U	0.0472 U	0.0943 U	0.0472 U
	Spring	9/16/2021	Duplicate	0.168 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U	0.0481 U
Landfill Area											
SW-05	Landfill	9/16/2021	Primary	0.167 U	0.0476 U	0.0476 U	0.0476 U	0.0476 U	0.0476 U	0.0476 U	0.0476 U
Wetland Area											
SW-04	Wetland	9/16/2021	Primary	0.167 U	0.0476 U	0.0476 U	0.0476 U	0.0476 U	0.0476 U	0.0476 U	0.0476 U

Table 8-11. Surface Water Results for PCBs

Notes

PCB analysis by EPA Method 8082A.

Total PCB concentrations were calculated by summing individual Aroclors and include non-detects at one-half the detection limit.

[a] Screening level is based on the PQL.

— = not analyzed or not available

µg/L = micrograms per liter

EPA = U.S. Environmental Protection Agency

PCB = polychlorinated biphenyl

PQL = practical quantitation limit

U = non-detect

Table 8-12. Soil Results for PCBs

Screening Criteria						GSI Total PCB Aroclors (U=1/2) 2020	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels													
Human Health						0.5	5.6	–	–	–	–	0.5	0.5
Ecological						0.65	–	–	–	–	–	–	–
PQL						–	0.0096	0.0096	0.0096	0.0096	0.0096	0.0096	0.0096
Location	Area	Date	Sample Type	Method	Depth (ft)								
Former Borrow Pit													
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	0.0192 U	0.00480 U	0.00480 U	0.00480 U	0.00480 U	0.00480 U	0.00480 U	0.00960 U
Landfill Area													
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	**0.0860 J**	0.0101 U	0.00505 U	0.0101 U	0.0101 U	0.0172 UJ	0.0556 UJ	**0.0319 NJ**
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	**0.144 J**	0.0245 U	0.0245 U	0.0245 U	0.0245 U	0.0245 U	**0.0704 NJ**	0.0245 U
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	0.0943 UJ	0.0128 UJ	0.0547 UJ	0.0326 UJ	0.0169 UJ	0.0116 U	0.0332 UJ	0.0268 UJ
Wetland Area													
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	0.0553 U	0.0158 U	0.0158 U	0.0158 U	0.0158 U	0.0158 U	0.0158 U	0.0158 U
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	0.0721 UJ	0.0206 UJ	0.0206 UJ	0.0206 UJ	0.0206 UJ	0.0206 UJ	0.0206 UJ	0.0206 UJ
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	0.0721 UJ	0.0206 UJ	0.0206 UJ	0.0206 UJ	0.0206 UJ	0.0206 UJ	0.0206 UJ	0.0206 UJ

Table 8-12. Soil Results for PCBs

Notes

PCB analysis by EPA Method 8082A.

Total PCB concentrations were calculated by summing individual Aroclors and include non-detects at one half the detection limit.

BOLD = detection

— = not analyzed or not available

EPA = U.S. Environmental Protection Agency

ft = feet

ISM = incremental sampling methodology

J = estimate

mg/kg = milligrams per kilogram

NJ = tentatively identified compound, estimated value

PCB = polychlorinated biphenyl

PQL = practical quantitation limit

U = non-detect

UJ = non-detect, and the value is an estimate

Table 8-13. Surface Water Results for TPH

Screening Criteria				Diesel Range Organics	Oil Range Organics	Gasoline Range Organics	GSI Total DRO & RRO (U=1/2) 2020	GSI Total DRO (U=1/2) 2020	GSI Total GRO (U=1/2) 2020	GSI Total ORO (U=1/2) 2020	GSI Total Xylenes NWVPH (U=1/2) 2020	Extractable Petroleum Hydrocarbons, >C8-C10 Aliphatics	Extractable Petroleum Hydrocarbons, >C10-C12 Aliphatics	Extractable Petroleum Hydrocarbons, >C12-C16 Aliphatics	Extractable Petroleum Hydrocarbons, >C16-C21 Aliphatics	Extractable Petroleum Hydrocarbons, >C21-C34 Aliphatics	Extractable Petroleum Hydrocarbons, >C8-C10 Aromatics	Extractable Petroleum Hydrocarbons, >C10-C12 Aromatics	Extractable Petroleum Hydrocarbons, >C12-C16 Aromatics	Extractable Petroleum Hydrocarbons, >C16-C21 Aromatics	Extractable Petroleum Hydrocarbons, >C21-C34 Aromatics	M,P-Xylene	O-Xylene	Methyl tert-butyl ether	Volatile Petroleum Hydrocarbons, >C5-C6 Aliphatics	Volatile Petroleum Hydrocarbons, >C6-C8 Aliphatics	Volatile Petroleum Hydrocarbons, >C8-C10 Aliphatics	Volatile Petroleum Hydrocarbons, >C10-C12 Aliphatics	Volatile Petroleum Hydrocarbons, >C8-C10 Aromatics	Volatile Petroleum Hydrocarbons, >C10-C12 Aromatics	Volatile Petroleum Hydrocarbons, >C12-C13 Aromatics	Benzene	Ethylbenzene	Naphthalene	Toluene
				NWTPH_Dx		NWTPH_Gx	CALC					NWEPH										NWVPH													
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Surface Water Screening Levels																																			
Human Health				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20[a]	29	4,900	57
Ecological				—	—	1,000	3,000	—	1,000	—	57	—	—	—	—	—	—	—	—	—	—	57	57	—	—	—	—	—	—	—	—	20[a]	25[a]	—	53
PQL				190	381	100	—	—	—	—	—	79.3	39.6	39.6	39.6	39.6	79.3	39.6	39.6	39.6	39.6	40	20	25	25	45	20	25	50	20	25	20	25	40	25
Location	**Area**	**Date**	**Sample Type**																																
Upgradient Spring																																			
SW-06	Spring	9/16/2021	Primary	—	—	—	73.9 UJ	49.5 UJ	126 UJ	24.4 U	9.89 U	39.4 UJ	20.6 UJ	9.80 U	14.2 UJ	22.5 U	25.9 U	8.86 U	6.95 U	12.7 U	26.4 U	13.8 U	5.99 U	10.9 U	49.5 U	22.1 U	6.78 U	12.2 U	35.5 U	5.87 U	7.76 U	5.04 U	12.5 U	19.6 U	5.92 U
	Spring	9/16/2021	Duplicate	—	—	—	73.9 UJ	49.4 UJ	**256 J**	24.4 U	9.89 U	**116 J**	20.5 UJ	9.79 U	14.2 UJ	22.5 U	25.9 U	8.85 U	6.94 U	12.7 U	26.4 U	13.8 U	5.99 U	10.9 U	41.9 U	**47.8**	6.78 U	12.2 U	35.5 U	5.87 U	7.76 U	5.04 U	12.5 U	19.6 U	5.92 U
SW-13	Spring	2/2/2022	Primary	99.0 U	198 U	50.0 U	148 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Landfill Area																																			
SW-05	Landfill	9/16/2021	Primary	—	—	—	73.7 UJ	49.4 UJ	**162 J+**	24.3 U	9.89 U	39.3 UJ	20.5 UJ	9.77 U	14.2 UJ	22.4 U	25.8 U	8.83 U	6.92 U	12.7 U	26.3 U	13.8 U	5.99 U	10.9 U	**60.5 J+**	22.1 U	6.78 U	12.2 U	35.5 U	5.87 U	7.76 U	5.04 U	12.5 U	19.6 U	5.92 U
Wetland Area																																			
SW-04	Wetland	9/16/2021	Primary	—	—	—	73.8 UJ	49.4 UJ	**164 J+**	24.4 U	9.89 U	39.3 UJ	20.5 UJ	9.78 U	14.2 UJ	22.4 U	25.9 U	8.84 U	6.93 U	12.7 U	26.4 U	13.8 U	5.99 U	10.9 U	**62.4 J+**	22.1 U	6.78 U	12.2 U	35.5 U	5.87 U	7.76 U	5.04 U	12.5 U	19.6 U	5.92 U
SW-07	Wetland	2/2/2022	Primary	99.0 U	198 U	50.0 U	148 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW-08	Wetland	2/2/2022	Primary	98.0 U	196 U	50.0 U	147 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW-09	Wetland	2/2/2022	Primary	96.2 U	192 U	50.0 U	144 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Wetland	2/2/2022	Duplicate	95.2 U	190 U	50.0 U	143 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW-10	Wetland	2/2/2022	Primary	95.2 U	190 U	50.0 U	143 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW-11	Wetland	2/2/2022	Primary	96.2 U	192 U	50.0 U	144 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW-12	Wetland	2/2/2022	Primary	95.2 U	190 U	50.0 U	143 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW-14	Wetland	2/4/2022	Primary	97.1 U	194 U	50.0 U	146 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 8-13. Surface Water Results for TPH

Notes

September 2021 TPH analysis by Northwest Extractable Petroleum Hydrocarbons (NWEPH) and Northwest Volatile Petroleum Hydrocarbons (NWVPH).

February 2022 TPH analysis by Northwest Total Petroleum Hydrocarbons, Diesel and Gasoline-Range (NWTPH-Dx, NWTPH-Gx).

Some analytes are reported multiple times by different analytical methods. In this case, only the analysis with the lowest PQL is used in the data screening process. See also Tables 7-1a-b.

Samples SW-06 (09/16/2021) and SW-13 (2/2/2022) are from the same location.

The following summations were performed. For all summations, non-detects are included at one half the detection limit.

1. GRO values for the September 2021 event were calculated by summing BTEX (benzene, toluene, ethylbenzene, xylenes), methyl tertbutyl ether, naphthalene, and hydrocarbons with between 4 and 10 carbon atoms.
2. DRO values for the September 2021 event were calculated by summing hydrocarbons with between 10 and 25 carbon atoms.
3. ORO values for the September 2021 event were calculated by summing hydrocarbons with more than 25 carbon atoms.

[a] Screening level is based on the PQL.

BOLD = detection

— = not analyzed or not available

µg/L = micrograms per liter

C## = hydrocarbon with ## number of carbon atoms

DRO = diesel range organics

GRO = gasoline range organics

J = estimate

J+/- = the result is biased high or low

ORO = oil/residual range organics

PQL = practical quantitation limit

TPH = total petroleum hydrocarbons

U = non-detect

UJ = non-detect, and the value is an estimate

Table 8-14. Groundwater Results for TPH

Screening Criteria				NWTPH_Dx		NWTPH_Gx	CALC					NWEPH										NWVPH													
				Diesel Range Organics	Oil Range Organics	Gasoline Range Organics	GSI Total DRO & RRO (U=1/2) 2020	GSI Total DRO (U=1/2) 2020	GSI Total GRO (U=1/2) 2020	GSI Total ORO (U=1/2) 2020	GSI Total Xylenes NWVPH (U=1/2) 2020	Extractable Petroleum Hydrocarbons, >C10-C12 Aliphatics	Extractable Petroleum Hydrocarbons, >C10-C12 Aromatics	Extractable Petroleum Hydrocarbons, >C12-C16 Aliphatics	Extractable Petroleum Hydrocarbons, >C8-C10 Aromatics	Extractable Petroleum Hydrocarbons, >C12-C16 Aromatics	Extractable Petroleum Hydrocarbons, >C16-C21 Aliphatics	Extractable Petroleum Hydrocarbons, >C16-C21 Aromatics	Extractable Petroleum Hydrocarbons, >C21-C34 Aliphatics	Extractable Petroleum Hydrocarbons, >C21-C34 Aromatics	Extractable Petroleum Hydrocarbons, >C8-C10 Aliphatics	Volatile Petroleum Hydrocarbons, >C8-C10 Aromatics	Volatile Petroleum Hydrocarbons, >C10-C12 Aliphatics	Volatile Petroleum Hydrocarbons, >C10-C12 Aromatics	Volatile Petroleum Hydrocarbons, >C12-C13 Aromatics	Volatile Petroleum Hydrocarbons, >C5-C6 Aliphatics	Volatile Petroleum Hydrocarbons, >C6-C8 Aliphatics	Volatile Petroleum Hydrocarbons, >C8-C10 Aliphatics	Benzene	Ethylbenzene	Methyl tert-butyl ether	Naphthalene	Toluene	M,P-Xylene	O-Xylene
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Groundwater Screening Levels																																			
Human Health				—	—	800	500	—	800	—	1,600	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20[a]	29	25[a]	160	57	1,600	1,600
Ecological				—	—	1,000	3,000	—	1,000	—	57	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	20[a]	25[a]	—	—	53	57	57
PQL				189	377	100	—	—	—	—	—	39.7	39.7	39.7	79.4	39.7	39.7	39.7	39.7	39.7	79.4	50	25	20	25	25	45	20	20	25	25	40	25	40	20
Location	Area	Date	Sample Type																																
Upgradient Piezometers																																			
PZ-01	Landfill	11/17/2021	Primary	—	—	—	**84.8 J-**	**60.2 J-**	109 UJ-	24.6 UJ-	9.89 U	20.6 UJ-	8.89 U	9.84 UJ-	26.0 U	6.98 U	14.3 UJ-	**17.0 J**	22.6 UJ-	26.5 U	39.6 UJ-	35.5 U	12.2 U	5.87 U	7.76 U	7.24 U	22.1 U	14.0 U	5.04 U	12.5 U	10.9 U	19.6 U	5.92 U	13.8 U	5.99 U
	Landfill	2/4/2022	Primary	94.3 U	189 U	50.0 U	142 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PZ-02	Landfill	11/17/2021	Primary	—	—	—	73.8 UJ-	49.4 UJ-	109 UJ-	24.4 UJ-	9.89 U	20.5 UJ-	8.84 U	9.78 UJ-	25.9 U	6.93 U	14.2 UJ-	12.7 U	22.4 UJ-	26.4 U	39.3 UJ-	35.5 U	12.2 U	5.87 U	7.76 U	7.24 U	22.1 U	13.5 U	5.04 U	12.5 U	10.9 U	19.6 U	5.92 U	13.8 U	5.99 U
	Landfill	11/17/2021	Duplicate	—	—	—	74.0 UJ-	49.5 UJ-	108 UJ-	24.5 UJ-	9.89 U	20.6 UJ-	8.87 U	9.81 UJ-	26.0 U	6.96 U	14.2 UJ-	12.7 U	22.5 UJ-	26.5 U	39.5 UJ-	35.5 U	12.2 U	5.87 U	7.76 U	7.24 U	22.1 U	12.7 U	5.04 U	12.5 U	10.9 U	19.6 U	5.92 U	13.8 U	5.99 U
	Landfill	2/4/2022	Primary	95.2 U	190 U	50.0 U	143 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Landfill	2/4/2022	Duplicate	97.1 U	194 U	50.0 U	146 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PZ-05	Landfill	2/4/2022	Primary	95.2 U	190 U	50.0 U	143 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Wetland Area																																			
PZ-03	Wetland	11/17/2021	Primary	—	—	—	**316 J-**	**211 J-**	108 UJ-	**105 J-**	9.89 U	20.7 UJ-	8.90 UJ-	9.85 UJ-	26.1 U	6.98 UJ-	14.3 UJ-	**168 J-**	22.6 UJ-	**93.6**	39.6 UJ-	35.5 U	12.2 U	5.87 U	7.76 U	7.24 U	22.1 U	12.7 U	5.04 U	12.5 U	10.9 U	19.6 U	5.92 U	13.8 U	5.99 U
	Wetland	2/3/2022	Primary	96.2 U	192 U	50.0 U	144 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PZ-04	Wetland	11/17/2021	Primary	—	—	—	74.0 UJ-	49.5 UJ-	**123 J-**	24.5 UJ-	9.89 U	20.6 UJ-	8.88 U	9.82 UJ-	**27.4 J**	6.96 U	14.2 UJ-	12.7 U	22.5 UJ-	26.5 U	39.5 UJ-	35.5 U	12.2 U	5.87 U	7.76 U	7.24 U	22.1 U	12.4 U	5.04 U	12.5 U	10.9 U	19.6 U	5.92 U	13.8 U	5.99 U
	Wetland	2/3/2022	Primary	96.2 U	192 U	50.0 U	144 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 8-14. Groundwater Results for TPH

Notes

November 2021 TPH analysis by Northwest Extractable Petroleum Hydrocarbons (NWEPH) and Northwest Volatile Petroleum Hydrocarbons (NWVPH).

February 2022 TPH analysis by Northwest Total Petroleum Hydrocarbons, Diesel and Gasoline-Range (NWTPH-Dx, NWTPH-Gx).

Some analytes are reported multiple times by different analytical methods. In this case, only the analysis with the lowest PQL is used in the data screening process. See also Tables 7-2a-b.

The following summations were performed. For all summations, non-detects are included at one half the detection limit.

1. GRO values for the September 2021 event were calculated by summing BTEX (benzene, toluene, ethylbenzene, xylenes), methyl tertbutyl ether, naphthalene, and hydrocarbons with between 4 and 10 carbon atoms.
2. DRO values for the September 2021 event were calculated by summing hydrocarbons with between 10 and 25 carbon atoms.
3. ORO values for the September 2021 event were calculated by summing hydrocarbons with more than 25 carbon atoms.

[a] Screening level is based on the PQL.

BOLD = detection

— = not analyzed or not available

µg/L = micrograms per liter

C## = hydrocarbon with ## number of carbon atoms

DRO = diesel range organics

ft = feet

GRO = gasoline range organics

J = estimate

J+/- = the result is biased high or low

mg/kg = milligrams per kilogram

ORO = oil/residual range organics

PQL = practical quantitation limit

TPH = total petroleum hydrocarbons

U = non-detect

UJ = non-detect, and the value is an estimate

Table 8-15 Soil Results for TPH

Screening Criteria						NWTPH_Dx		NWTPH_Gx	CALC					NWEPH										NWVPH													
						Diesel Range Organics	Oil Range Organics	Gasoline Range Organics	GSI Total DRO & RRO (U=1/2) 2020	GSI Total DRO (U=1/2) 2020	GSI Total GRO (U=1/2) 2020	GSI Total ORO (U=1/2) 2020	GSI Total Xylenes NWVPH (U=1/2) 2020	Extractable Petroleum Hydrocarbons, >C10-C12 Aliphatics	Extractable Petroleum Hydrocarbons, >C10-C12 Aromatics	Extractable Petroleum Hydrocarbons, >C12-C16 Aliphatics	Extractable Petroleum Hydrocarbons, >C12-C16 Aromatics	Extractable Petroleum Hydrocarbons, >C16-C21 Aliphatics	Extractable Petroleum Hydrocarbons, >C16-C21 Aromatics	Extractable Petroleum Hydrocarbons, >C21-C34 Aliphatics	Extractable Petroleum Hydrocarbons, >C21-C34 Aromatics	Extractable Petroleum Hydrocarbons, >C8-C10 Aliphatics	Extractable Petroleum Hydrocarbons, >C8-C10 Aromatics	Volatile Petroleum Hydrocarbons, >C10-C12 Aliphatics	Volatile Petroleum Hydrocarbons, >C10-C12 Aromatics	Volatile Petroleum Hydrocarbons, >C12-C13 Aromatics	Volatile Petroleum Hydrocarbons, >C5-C6 Aliphatics	Volatile Petroleum Hydrocarbons, >C6-C8 Aliphatics	Volatile Petroleum Hydrocarbons, >C8-C10 Aliphatics	Volatile Petroleum Hydrocarbons, >C8-C10 Aromatics	Benzene	Ethylbenzene	Methyl tert-butyl ether	Naphthalene	Toluene	M,P-Xylene	O-Xylene
						mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soil Screening Levels																																					
Human Health						–	–	30	2,000	–	30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	18	8,000	560	1,600	6,400	16,000	16,000
Ecological						–	–	100	200	–	100	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	200	–	–
PQL						35.4	70.7	12.4	–	–	–	–	–	9.04	9.04	9.04	9.04	9.04	9.04	9.04	9.04	18.1	18.1	0.536	0.536	0.536	2.68	1.61	2.68	3.21	0.643	1.82	1.18	2.79	0.536	1.07	0.536
Location	Area	Date	QC Sample Type	Grab/Composite	Depth (ft)																																
Former Borrow Pit																																					
DU-01	Borrow Pit	9/14/2021	Primary	ISM	0.0-0.5	–	–	–	177 J-	21.6 J-	17.9 J-	155 J	0.275 U	4.11 UJ-	2.92 UJ-	1.75 U	2.01 U	3.50 U	11.9	17.0 J	138	9.05 U	6.24 U	1.87	0.591	0.257 U	3.72	3.34 J-	1.28 U	1.65 U	0.205 U	0.623 U	0.571 U	1.37 U	0.171 U	0.381 U	0.169 U
Landfill Area																																					
DU-02	Landfill	9/15/2021	Primary	ISM	0.0-0.5	–	–	–	43.1 J-	14.5 J-	20.7	28.6	0.366 U	4.54 UJ-	3.23 UJ-	1.94 U	2.22 U	3.86 U	5.13 U	6.21 U	25.5	9.99 U	6.89 U	2.50	1.41	0.342 U	5.44	2.51	1.70 U	2.19 U	0.273 U	0.828 U	0.759 U	1.82 U	0.227 U	0.507 U	0.225 U
HA-01	Landfill	9/14/2021	Primary	Composite	0.0-0.5	–	–	–	55.7 J-	25.6 J-	61.9	30.1	0.982 U	9.69 UJ-	6.88 UJ-	4.13 U	4.74 U	8.24 U	10.9 U	13.2 U	23.5	21.3 U	14.7 U	2.45	0.884 U	0.917 U	14.1	18.3	4.57 U	5.88 U	0.733 U	2.22 U	2.04 U	4.89 U	0.610 U	1.36 U	0.604 U
	Landfill	2/4/2022	Primary	Composite	0.0-0.5	24.5 U	49.1 U	9.46 U	36.8 U	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	Composite	0.5-1.0	20.1 U	269 J+	8.49 U	279 J+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	Composite	1.0-2.0	17.8 U	49.1 J	6.20 U	58.0 J	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SB-18	Landfill	9/16/2021	Primary	Grab	9.0-10.0	–	–	–	864 J-	140 J-	29.3	724	0.508 U	4.90 UJ-	3.48 UJ-	100.0	12.0	4.17 U	17.4	454	270	10.8 U	7.44 U	3.09	1.30	0.474 U	7.51	6.73	2.36 U	3.04 U	0.379 U	1.15 U	1.05 U	2.53 U	0.316 U	0.703 U	0.312 U
Wetland Area																																					
HA-02	Wetland	9/14/2021	Primary	Composite	0.0-0.5	–	–	–	42.6 J-	27.9 J-	52.8	14.7 U	1.07 U	9.62 UJ-	6.84 UJ-	4.10 U	4.70 U	8.19 U	10.9 U	13.2 U	16.1 U	21.2 U	14.6 U	4.78	0.962 U	0.998 U	11.3	11.1	4.97 U	6.40 U	0.797 U	2.42 U	2.22 U	5.32 U	0.664 U	1.48 U	0.657 U
	Wetland	2/3/2022	Primary	Composite	1.0-2.0	30.6 U	71.8 J	12.7 UJ	87.1 J	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	Composite	0.5-1.0	46.8 J	92.4 J	30.6 UJ	139 J	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Duplicate	Composite	0.5-1.0	46.8 UJ	113 J	25.0 UJ	136 J	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Duplicate	Composite	1.0-2.0	31.3 UJ	74.4 J	12.7 UJ	90.1 J	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/4/2022	Duplicate	Composite	0.0-0.5	40.3 UJ	80.6 UJ	20.8 UJ	60.4 UJ	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
HA-03	Wetland	9/13/2021	Primary	Composite	0.0-0.5	–	–	–	140 J-	25.6 UJ-	56.5 J	114 J	1.11 U	7.49 UJ-	10.5 UJ-	5.15 U	4.49 U	11.9 U	8.97 U	14.4 UJ	107 J	16.0 U	23.2 U	0.703 UJ	1.00 U	1.04 UJ	16.0	7.97 J	5.16 U	6.65 U	0.829 U	2.51 U	2.30 U	5.53 U	0.690 U	1.54 U	0.683 U
	Wetland	9/13/2021	Duplicate	Composite	0.0-0.5	–	–	–	616 J-	61.7 J-	141 J-	554 J	1.84 UJ-	13.5 UJ-	9.58 UJ-	5.74 U	6.59 U	11.5 U	15.2 U	291 J	263 J	29.7 U	20.5 U	16.5 J	1.66 U	13.3 J	21.6	72.9 J	8.56 U	11.0 U	1.37 UJ-	4.17 UJ-	3.82 U	9.16 U	1.14 UJ-	2.55 UJ-	1.13 UJ-
	Wetland	2/3/2022	Primary	Composite	0.5-1.0	42.5 UJ	324 J+	21.8 UJ	345 J+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	Composite	1.0-2.0	20.0 U	62.6 J	8.00 UJ	72.6 J	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/4/2022	Primary	Composite	0.0-0.5	52.3 UJ	113 J	30.5 UJ	139 J	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
HA-04	Wetland	2/1/2022	Primary	Composite	0.0-0.5	85.2 J	434 J	95.0 J	519 J	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/1/2022	Primary	Composite	0.5-1.0	29.0 U	108 J	21.5 U	123 J	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/1/2022	Primary	Composite	1.0-2.0	17.7 U	35.4 U	6.31 UJ	26.6 U	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
HA-05	Wetland	2/1/2022	Primary	Composite	0.0-0.5	37.9 UJ	75.8 UJ	21.3 UJ	56.9 UJ	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/1/2022	Primary	Composite	0.5-1.0	30.3 U	60.6 U	16.8 U	45.4 U	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/1/2022	Primary	Composite	1.0-2.0	19.1 U	59.9 J	6.33 UJ	69.5 J	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table 8-15. Soil Results for TPH

Notes

Exceeds the Human Health SL.

Exceeds both the Human Health and Ecological SLs.

September 2021 TPH analysis by Northwest Extractable Petroleum Hydrocarbons (NWEPH) and Northwest Volatile Petroleum Hydrocarbons (NWVPH).

February 2022 TPH analysis by Northwest Total Petroleum Hydrocarbons, Diesel and Gasoline-Range (NWTPH-Dx, NWTPH-Gx).

Some analytes are reported multiple times by different analytical methods. In this case, only the analysis with the lowest PQL is used in the data screening process. See also Tables 7-3a-b.

The following summations were performed. For all summations, non-detects are included at one half the detection limit.

1. GRO values for the September 2021 event were calculated by summing BTEX (benzene, toluene, ethylbenzene, xylenes), methyl tertbutyl ether, naphthalene, and hydrocarbons with between 4 and 10 carbon atoms.
2. DRO values for the September 2021 event were calculated by summing hydrocarbons with between 10 and 25 carbon atoms.
3. ORO values for the September 2021 event were calculated by summing hydrocarbons with more than 25 carbon atoms.

BOLD = detection

— = not analyzed or not available

C## = hydrocarbon with ## number of carbon atoms

J = estimate

J+/- = the result is biased high or low

DRO = diesel range organics

ft = feet

GRO = gasoline range organics

mg/kg = milligrams per kilogram

ORO = oil/residual range organics

PQL = practical quantitation limit

TPH = total petroleum hydrocarbons

U = non-detect

UJ = non-detect, and the value is an estimate

Table 8-16. Surface Water Results for PBDEs

Location	Area	Date	Sample Type	GSI Total OctaBDE (U=1/2) 2020	GSI Total PentaBDE (U=1/2) 2020	BDE-100	BDE-1	BDE-2	BDE-3	BDE-7	BDE-8/11	BDE-10	BDE-12	BDE-13	BDE-15	BDE-17	BDE-25	BDE-28	BDE-28/33	BDE-30	BDE-32	BDE-35/21	BDE-37	BDE-47	BDE-49	BDE-66	BDE-71	BDE-75/51	BDE-77	BDE-79	BDE-85	BDE-99	BDE-105	BDE-116	BDE-118
Screening Criteria				pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L
			Surface Water Screening Levels																																
			Human Health	2,400,000,000	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	32,000	–	–	–
			Ecological	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
			PQL	–	–	99	49.5	49.5	49.5	49.5	99	49.5	49.5	49.5	49.5	49.5	49.5	5,000	99	49.5	49.5	49.5	49.5	99	99	99	99	198	99	99	99	99	99	99	99
Upgradient Spring (Surface Water)																																			
SW-03	Spring	1/12/2021	Primary	5,000 U	12,500 U	5,000 U	–	–	–	–	–	–	–	–	–	5,000 U	–	5,000 U	–	–	–	–	–	5,000 U	5,000 U	–	–	–	–	–	5,000 U	5,000 U	–	–	–
SW-06	Spring	9/16/2021	Primary	**11.1 J+**	**28.4 J+**	**1.31 J**	5.95 U	3.82 U	3.38 U	0.308 U	0.228 U	0.326 U	0.218 U	0.203 U	0.165 U	**0.337 J**	0.267 U	–	**0.813 J+**	0.234 U	0.178 U	0.171 U	0.146 U	**15.1 J+**	0.172 U	0.227 U	0.181 U	0.130 U	0.126 U	0.115 U	3.54 U	7.23 U	4.51 U	5.89 U	3.04 U
SW-06	Spring	9/16/2021	Duplicate	**3.76 J+**	**19.9 J+**	**0.978 J**	7.29 U	4.68 U	4.15 U	0.322 U	0.239 U	0.341 U	0.228 U	0.213 U	0.172 U	**0.439 J+**	0.255 U	–	**1.07 J+**	0.224 U	0.170 U	0.164 U	0.140 U	**15.8 J+**	0.276 U	0.382 U	0.290 U	0.207 U	0.213 U	0.184 U	2.09 U	3.10 U	2.66 U	3.47 U	1.79 U
SW-13	Spring	2/2/2022	Primary	**2.11 J+**	**11.7 J+**	0.543 U	7.14 U	4.60 U	4.07 U	0.344 U	0.249 U	0.363 U	0.235 U	0.215 U	0.179 U	0.155 U	0.218 U	–	**0.342 J+**	0.201 U	0.149 U	0.131 U	0.118 U	**7.53 J+**	**0.251 J+**	0.214 U	0.179 U	0.129 U	**0.158 J+**	0.112 U	1.54 U	**2.84 J**	2.02 U	2.35 U	1.42 U
Landfill Area																																			
SW-05	Landfill	9/16/2021	Primary	**1.08 J+**	**20.7 J+**	**1.13 J+**	6.30 U	4.04 U	3.58 U	0.311 U	0.231 U	0.330 U	0.220 U	0.205 U	**0.714 J+**	**0.222 J+**	0.328 U	–	**1.54 J+**	0.287 U	0.219 U	0.210 U	0.180 U	**16.4 J+**	0.229 U	0.311 U	0.241 U	0.172 U	0.174 U	0.153 U	3.11 U	4.93 U	3.95 U	5.17 U	2.66 U
Wetland Area																																			
SE-01	Wetland	1/11/2021	Primary	10,000 U	25,000 U	10,000 U	–	–	–	–	–	–	–	–	–	10,000 U	–	10,000 U	–	–	–	–	–	10,000 U	10,000 U	–	–	–	–	–	10,000 U	10,000 U	–	–	–
SE-01	Wetland	1/11/2021	Duplicate	10,000 U	25,000 U	10,000 U	–	–	–	–	–	–	–	–	–	10,000 U	–	10,000 U	–	–	–	–	–	10,000 U	10,000 U	–	–	–	–	–	10,000 U	10,000 U	–	–	–
SE-02	Wetland	1/11/2021	Primary	25,000 U	62,500 U	25,000 U	–	–	–	–	–	–	–	–	–	25,000 U	–	25,000 U	–	–	–	–	–	25,000 U	25,000 U	–	–	–	–	–	25,000 U	25,000 U	–	–	–
SW-01	Wetland	1/12/2021	Primary	10,000 U	25,000 U	10,000 U	–	–	–	–	–	–	–	–	–	10,000 U	–	10,000 U	–	–	–	–	–	10,000 U	10,000 U	–	–	–	–	–	10,000 U	10,000 U	–	–	–
SW-02	Wetland	1/12/2021	Primary	25,000 U	62,500 U	25,000 U	–	–	–	–	–	–	–	–	–	25,000 U	–	25,000 U	–	–	–	–	–	25,000 U	25,000 U	–	–	–	–	–	25,000 U	25,000 U	–	–	–
SW-04	Wetland	9/16/2021	Primary	**4.31 J+**	**20.5 J+**	**1.40 J**	7.23 U	4.64 U	4.11 U	0.396 U	0.294 U	0.420 U	0.280 U	0.262 U	**0.252 J+**	**0.511 J**	0.319 U	–	**1.39 J+**	0.279 U	0.213 U	0.204 U	0.175 U	**15.3 J+**	0.422 U	0.575 U	0.444 U	0.317 U	0.321 U	0.282 U	2.90 U	4.18 U	3.68 U	4.82 U	2.49 U
SW-07	Wetland	2/2/2022	Primary	**2.82 J+**	**14.4 J+**	**0.974 J+**	7.86 U	5.07 U	4.48 U	0.331 U	0.239 U	0.350 U	0.226 U	0.207 U	0.172 U	**0.319 J**	0.439 U	–	**0.531 J+**	0.404 U	0.300 U	0.265 U	0.238 U	**7.28 J+**	0.206 U	0.242 U	0.218 U	0.157 U	0.136 U	0.136 U	1.79 U	**4.46 J+**	2.35 U	2.74 U	1.65 U
SW-08	Wetland	2/2/2022	Primary	1.01 U	**14.2 J+**	**1.18 J+**	9.19 U	5.92 U	5.24 U	0.383 U	0.277 U	0.405 U	0.262 U	0.240 U	0.199 U	0.238 U	0.334 U	–	**0.567 J+**	0.308 U	0.228 U	0.202 U	0.181 U	**7.36 J+**	0.277 U	0.304 U	0.294 U	0.211 U	**0.149 J+**	0.183 U	1.38 U	**5.03 J**	1.81 U	2.12 U	1.27 U
SW-09	Wetland	2/2/2022	Primary	**4.58 J+**	**16.7 J+**	**1.41 J+**	8.91 U	5.74 U	5.08 U	0.335 U	0.242 U	0.354 U	0.229 U	0.210 U	0.174 U	0.233 U	0.328 U	–	**0.620 J+**	0.302 U	0.224 U	0.198 U	0.178 U	**7.54 J+**	0.132 U	0.170 U	0.140 U	0.100 U	0.0959 U	0.0870 U	1.65 U	**5.52 J+**	2.16 U	2.52 U	1.52 U
SW-09	Wetland	2/2/2022	Duplicate	**4.13 J+**	**19.4 J+**	**1.27 J+**	7.47 U	4.81 U	4.26 U	0.370 U	0.268 U	0.391 U	0.253 U	0.232 U	0.192 U	**0.333 J+**	0.322 U	–	**1.10 J+**	0.297 U	0.220 U	0.194 U	0.175 U	**11.8 J+**	0.237 U	0.242 U	0.252 U	0.181 U	0.136 U	0.157 U	1.08 U	**4.69 J+**	1.42 U	1.66 U	0.998 U
SW-10	Wetland	2/2/2022	Primary	**5.60 J+**	**20.3 J+**	**1.50 J+**	7.58 U	4.89 U	4.32 U	0.360 U	0.261 U	0.381 U	0.246 U	0.226 U	0.187 U	0.285 U	0.401 U	–	**0.673 J**	0.369 U	0.274 U	0.242 U	0.217 U	**9.30 J+**	0.190 U	0.232 U	0.202 U	0.145 U	0.130 U	0.125 U	1.77 U	**6.65 J+**	2.32 U	2.71 U	1.63 U
SW-11	Wetland	2/2/2022	Primary	**5.17 J+**	**24.1 J+**	**1.86 J+**	9.20 U	5.93 U	5.25 U	0.340 U	0.246 U	0.359 U	0.232 U	0.213 U	0.176 U	0.240 U	0.337 U	–	**0.410 J+**	0.311 U	0.230 U	0.204 U	0.183 U	**11.9 J+**	0.191 U	0.227 U	0.203 U	0.146 U	**0.211 J+**	0.126 U	1.43 U	**7.99 J**	1.87 U	2.18 U	1.31 U
SW-12	Wetland	2/2/2022	Primary	**2.29 J+**	**12.5 J+**	**0.985 J+**	6.93 U	4.47 U	3.95 U	0.359 U	0.260 U	0.380 U	0.246 U	0.225 U	0.187 U	0.268 U	0.377 U	–	**0.455 J+**	0.347 U	0.257 U	0.227 U	0.204 U	**6.17 J+**	0.266 U	0.342 U	0.283 U	0.203 U	0.192 U	0.176 U	1.45 U	**3.94 J**	1.89 U	2.21 U	1.33 U
SW-14	Wetland	2/4/2022	Primary	**2.21 J+**	**14.0 J+**	**1.00 J+**	8.11 U	5.23 U	4.62 U	0.199 U	0.144 U	0.210 U	0.136 U	0.124 U	0.103 U	**0.304 J+**	0.331 U	–	**0.984 J**	0.305 U	0.226 U	0.200 U	0.179 U	**8.13 J+**	0.116 U	0.155 U	0.123 U	0.0887 U	0.0871 U	0.0768 U	1.30 U	**3.45 J**	1.70 U	1.99 U	1.20 U

Table 8-16. Surface Water Results for PBDEs

Screening Criteria				BDE-119/120	BDE-126	BDE-128/154	BDE-138	BDE-139	BDE-140	BDE-148/156/169	BDE-153	BDE-154	BDE-155	BDE-166	BDE-175	BDE-180	BDE-181/177	BDE-183/176	BDE-184	BDE-190/171	BDE-191	BDE-197	BDE-201	BDE-203/200	BDE-204	BDE-205	BDE-206	BDE-207	BDE-208	BDE-209
				pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L
Surface Water Screening Levels																														
Human Health				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2,900,000,000
Ecological				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PQL				198	99	198	99	99	99	198	99	5,000	99	99	198	198	198	198	198	396	198	198	198	198	198	198	495	495	495	495
Location	Area	Date	Sample Type																											
Upgradient Spring (Surface Water)																														
SW-03	Spring	1/12/2021	Primary	—	—	—	5,000 U	—	—	—	5,000 U	5,000 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW-06	Spring	9/16/2021	Primary	**0.649 J+**	2.29 U	**2.47 J**	**0.380 J+**	**1.65 J+**	0.571 U	2.37 U	**5.93 J**	—	0.280 U	2.32 U	0.634 U	1.53 U	1.59 U	**2.67 J+**	0.390 U	1.53 U	1.53 U	1.77 U	2.89 U	3.22 U	2.63 U	6.82 U	8.14 U	4.95 U	4.35 U	145 U
	Spring	9/16/2021	Duplicate	1.59 U	1.35 U	0.928 U	1.59 U	1.08 U	1.18 U	2.84 U	**1.13 J+**	—	0.571 U	2.79 U	1.08 U	2.26 U	2.36 U	**2.17 J+**	0.665 U	2.26 U	2.27 U	3.87 U	5.62 U	7.05 U	5.12 U	14.5 U	10.3 U	7.18 U	6.30 U	198 U
SW-13	Spring	2/2/2022	Primary	**0.726 J+**	0.964 U	0.585 U	0.954 U	**0.837 J**	0.699 U	1.49 U	**0.776 J+**	—	0.358 U	1.40 U	1.16 U	1.27 U	1.26 U	2.08 U	0.888 U	1.32 U	1.40 U	1.22 U	1.94 U	2.03 U	**2.53 J+**	4.15 U	4.83 U	2.50 U	2.34 U	123 U
Landfill Area																														
SW-05	Landfill	9/16/2021	Primary	2.29 U	2.01 U	**0.320 J+**	1.21 U	0.710 U	0.775 U	2.07 U	0.757 U	—	0.373 U	2.13 U	0.884 U	1.80 U	1.87 U	0.766 U	0.544 U	1.80 U	1.80 U	**2.21 J+**	4.34 U	5.18 U	3.95 U	10.4 U	14.8 U	9.14 U	8.02 U	170 U
Wetland Area																														
SE-01	Wetland	1/11/2021	Primary	—	—	—	10,000 U	—	—	—	10,000 U	10,000 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Wetland	1/11/2021	Duplicate	—	—	—	10,000 U	—	—	—	10,000 U	10,000 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SE-02	Wetland	1/11/2021	Primary	—	—	—	25,000 U	—	—	—	25,000 U	25,000 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW-01	Wetland	1/12/2021	Primary	—	—	—	10,000 U	—	—	—	10,000 U	10,000 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW-02	Wetland	1/12/2021	Primary	—	—	—	25,000 U	—	—	—	25,000 U	25,000 U	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
SW-04	Wetland	9/16/2021	Primary	**0.984 J+**	1.87 U	0.962 U	1.66 U	**0.864 J+**	1.26 U	2.85 U	**1.26 J+**	—	0.569 U	2.92 U	0.833 U	3.10 U	3.23 U	**2.57 J**	0.512 U	3.10 U	3.11 U	4.14 U	5.87 U	7.54 U	**2.82 J**	13.3 U	10.4 U	**8.00 J**	**8.39 J**	179 U
SW-07	Wetland	2/2/2022	Primary	1.45 U	1.12 U	**0.632 J+**	1.08 U	**0.980 J+**	0.891 U	1.69 U	**1.09 J+**	—	**0.384 J**	1.58 U	0.639 U	1.02 U	1.01 U	2.20 U	0.490 U	1.06 U	1.13 U	2.07 U	3.28 U	3.45 U	2.97 U	7.26 U	5.66 U	**8.14 J**	3.49 U	107 U
SW-08	Wetland	2/2/2022	Primary	1.18 U	0.867 U	0.580 U	1.03 U	**0.984 J+**	0.696 U	1.73 U	0.689 U	—	0.353 U	1.51 U	0.765 U	1.05 U	1.04 U	0.744 U	0.586 U	1.09 U	1.16 U	1.76 U	2.72 U	2.93 U	2.47 U	5.97 U	4.93 U	**6.25 J+**	2.86 U	95.8 U
SW-09	Wetland	2/2/2022	Primary	1.44 U	1.03 U	0.625 U	0.877 U	**1.36 J+**	0.707 U	1.35 U	**1.92 J+**	—	0.353 U	1.29 U	0.702 U	1.34 U	1.33 U	**2.35 J+**	0.538 U	1.40 U	1.48 U	1.83 U	2.73 U	3.05 U	2.48 U	6.17 U	5.34 U	**6.52 J+**	2.75 U	102 U
	Wetland	2/2/2022	Duplicate	**0.796 J+**	0.679 U	0.484 U	0.952 U	**1.26 J+**	0.591 U	1.49 U	**1.42 J**	—	0.300 U	1.40 U	0.569 U	1.29 U	1.27 U	**2.47 J+**	0.437 U	1.34 U	1.42 U	**1.13 J+**	2.59 U	2.81 U	**1.48 J+**	6.35 U	8.50 U	4.99 U	**5.35 J**	127 U
SW-10	Wetland	2/2/2022	Primary	1.46 U	1.11 U	**0.813 J+**	0.824 U	0.496 U	0.555 U	1.32 U	**2.07 J+**	—	0.298 U	1.21 U	0.811 U	0.912 U	0.904 U	**2.72 J+**	0.622 U	0.950 U	1.01 U	**1.21 J+**	3.83 U	4.04 U	**2.21 J+**	8.29 U	4.90 U	**4.36 J+**	**3.33 J+**	110 U
SW-11	Wetland	2/2/2022	Primary	1.19 U	0.893 U	**1.09 J+**	1.07 U	**0.731 J+**	0.653 U	1.90 U	**1.27 J+**	—	0.336 U	1.57 U	0.716 U	1.16 U	1.15 U	**2.81 J+**	0.549 U	1.21 U	1.28 U	1.83 U	2.94 U	3.05 U	2.67 U	6.24 U	6.12 U	**8.00 J**	3.85 U	92.7 U
SW-12	Wetland	2/2/2022	Primary	1.21 U	0.905 U	0.486 U	0.705 U	**1.07 J+**	0.550 U	1.05 U	**1.13 J+**	—	0.302 U	1.04 U	0.508 U	1.16 U	1.15 U	1.83 U	0.390 U	**0.878 J+**	1.29 U	1.20 U	1.90 U	2.00 U	1.72 U	4.29 U	5.95 U	4.30 U	4.03 U	101 U
SW-14	Wetland	2/4/2022	Primary	**1.13 J+**	0.814 U	0.560 U	1.16 U	**1.89 J**	0.749 U	2.00 U	**1.17 J+**	—	0.333 U	1.71 U	1.26 U	1.26 U	1.25 U	1.52 U	0.966 U	1.32 U	1.40 U	2.89 U	4.53 U	4.82 U	4.10 U	11.7 U	8.78 U	**4.31 J+**	4.71 U	188 U

Table 8-16. Surface Water Results for PBDEs

Notes

PBDE analyses by EPA Method 1614.

Samples SW-06 (09/16/2021) and SW-13 (2/2/2022) are from the same location.

The following summations were performed. For all summations, non-detects are included at one half the detection limit.

1. PentaBDE is a mixture of BDE-47, -99, -100, -153, and -128/154 (1,2).
2. OctaBDE is a mixture of BDE-153, -128/154, and -183/176 (1,2).
3. DecaBDE is equivalent to BDE-209 (2).

BOLD = detection

— = not analyzed or not available

EPA = U.S. Environmental Protection Agency

J = estimate

J+/- = the result is biased high or low

PBDE or BDE = polybrominated diphenyl ether

PQL = practical quantitation limit

U = non-detect

(1) From Toxicological Profile for Polybrominated Diphenyl Ethers (PBDEs), Agency for Toxic Substances and Disease Registry, 2022.

(2) From Technical Fact Sheet - Polybrominated Diphenyl Ethers (PBDEs), EPA 2017.

Table 8-17. Groundwater Results for PBDEs

Screening Criteria				GSI Total OctaBDE (U=1/2) 2020	GSI Total PentaBDE (U=1/2) 2020	BDE-47	BDE-99	BDE-153	BDE-1	BDE-2	BDE-3	BDE-7	BDE-8/11	BDE-10	BDE-12	BDE-13
				pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L
Groundwater Screening Levels																
Human Health				48,000,000	16,000,000	1,600,000	1,600,000	3,200,000	–	–	–	–	–	–	–	–
Ecological				–	–	–	–	–	–	–	–	–	–	–	–	–
PQL				–	–	109	109	109	54.5	54.5	54.5	54.5	109	54.5	54.5	54.5
Location	**Area**	**Date**	**Sample Type**													
Upgradient Piezometers																
PZ-01	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	8.13 J	50.3 J	22.1 J	17.2 J	4.35 J	10.0 U	6.44 U	5.70 U	0.369 U	0.267 U	0.390 U	0.252 U	0.231 U
PZ-02	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	11/17/2021	Duplicate	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	202 J+	2,434 J	923	1,080 J	95.1 J	13.3 U	8.57 U	7.58 U	0.385 U	0.278 U	0.406 U	0.263 U	0.241 U
	Landfill	2/4/2022	Duplicate	7.18 J+	46.2 J+	25.3 J	14.7 J	2.82 J	10.1 U	6.48 U	5.74 U	0.402 U	0.291 U	0.425 U	0.275 U	0.252 U
PZ-05	Landfill	2/4/2022	Primary	6.38 J+	31.3 J	14.7 J	10.6 J	2.83 J	8.72 U	5.62 U	4.97 U	0.313 U	0.226 U	0.331 U	0.214 U	0.196 U
Landfill Area																
GW-01	Landfill	1/12/2021	Primary	10,000 U	25,000 U	10,000 U	10,000 U	10,000 U	–	–	–	–	–	–	–	–
Wetland Area																
PZ-03	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	4.37 J+	27.8 J+	13.3 J+	10.4 J	1.08 U	8.35 U	5.38 U	4.76 U	0.302 U	0.218 U	0.319 U	0.206 U	0.189 U
PZ-04	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	5.88 J+	36.1 J+	18.5 J	11.9 J	1.69 J+	8.41 U	5.42 U	4.79 U	0.344 U	0.249 U	0.363 U	0.235 U	0.216 U

Table 8-17. Groundwater Results for PBDEs

Screening Criteria				BDE-15	BDE-17	BDE-25	BDE-28	BDE-28/33	BDE-30	BDE-32	BDE-35/21	BDE-37	BDE-49	BDE-66	BDE-71	BDE-75/51
				pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L
Groundwater Screening Levels																
Human Health				–	–	–	–	–	–	–	–	–	–	–	–	–
Ecological				–	–	–	–	–	–	–	–	–	–	–	–	–
PQL				54.5	54.5	54.5	10,000	109	54.5	54.5	54.5	54.5	109	109	109	218
Location	Area	Date	Sample Type													
Upgradient Piezometers																
PZ-01	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	0.192 U	0.305 U	0.430 U	–	**1.29 J**	0.396 U	0.293 U	0.259 U	0.233 U	0.302 U	0.352 U	0.320 U	0.230 U
PZ-02	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	11/17/2021	Duplicate	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	0.200 U	**1.80 J**	0.625 U	–	**6.23 J+**	0.575 U	0.426 U	0.377 U	0.339 U	**12.7 J**	**11.0 J**	0.443 U	**4.33 J**
	Landfill	2/4/2022	Duplicate	0.209 U	0.317 U	0.446 U	–	**1.30 J**	0.411 U	0.305 U	0.269 U	0.242 U	**0.693 J+**	0.334 U	0.305 U	0.219 U
PZ-05	Landfill	2/4/2022	Primary	0.162 U	0.239 U	0.336 U	–	**0.729 J**	0.310 U	0.229 U	0.203 U	0.182 U	0.227 U	0.254 U	0.241 U	0.173 U
Landfill Area																
GW-01	Landfill	1/12/2021	Primary	–	10,000 U	–	10,000 U	–	–	–	–	–	10,000 U	–	–	–
Wetland Area																
PZ-03	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	0.157 U	**0.225 J+**	0.292 U	–	**0.696 J+**	0.269 U	0.199 U	0.176 U	0.158 U	0.380 U	0.416 U	0.404 U	0.290 U
PZ-04	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	0.179 U	0.308 U	0.433 U	–	**1.24 J+**	0.399 U	0.295 U	0.261 U	0.235 U	0.216 U	0.255 U	0.229 U	0.164 U

Table 8-17. Groundwater Results for PBDEs

Screening Criteria				BDE-77	BDE-79	BDE-85	BDE-100	BDE-105	BDE-116	BDE-118	BDE-119/120	BDE-126	BDE-128/154	BDE-138	BDE-139	BDE-140
				pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L
Groundwater Screening Levels																
Human Health				–	–	–	–	–	–	–	–	–	–	–	–	–
Ecological				–	–	–	–	–	–	–	–	–	–	–	–	–
PQL				109	109	109	109	109	109	109	218	109	218	109	109	109
Location	Area	Date	Sample Type													
Upgradient Piezometers																
PZ-01	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	0.198 U	0.199 U	3.98 U	**3.90 J**	5.22 U	6.09 U	3.66 U	3.07 U	2.49 U	**2.73 J**	1.90 U	**1.60 J**	1.48 U
PZ-02	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	11/17/2021	Duplicate	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	0.307 U	0.276 U	**55.5 J**	**233 J**	6.68 U	7.80 U	4.69 U	3.93 U	3.19 U	**103 J**	**11.5 J+**	**13.9 J+**	**4.66 J**
	Landfill	2/4/2022	Duplicate	0.188 U	0.190 U	3.63 U	**2.83 J+**	4.76 U	5.55 U	3.34 U	2.91 U	2.27 U	1.10 U	1.78 U	1.22 U	1.37 U
PZ-05	Landfill	2/4/2022	Primary	0.143 U	0.150 U	3.99 U	**2.62 J**	5.23 U	6.10 U	3.67 U	3.48 U	2.50 U	1.12 U	1.64 U	**1.27 J+**	1.33 U
Landfill Area																
GW-01	Landfill	1/12/2021	Primary	–	–	10,000 U	10,000 U	–	–	–	–	–	–	10,000 U	–	–
Wetland Area																
PZ-03	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	0.234 U	0.251 U	3.84 U	**2.27 J+**	5.04 U	5.88 U	3.53 U	3.01 U	2.41 U	**1.34 J+**	1.13 U	0.976 U	1.09 U
PZ-04	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	0.144 U	0.142 U	3.63 U	**2.30 J+**	4.76 U	5.55 U	3.34 U	2.65 U	2.27 U	**1.67 J+**	1.52 U	**1.19 J+**	1.14 U

Table 8-17. Groundwater Results for PBDEs

Screening Criteria				BDE-148/156/169	BDE-154	BDE-155	BDE-166	BDE-175	BDE-180	BDE-181/177	BDE-183/176	BDE-184	BDE-190/171	BDE-191	BDE-197	BDE-201
				pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L
Groundwater Screening Levels																
Human Health				–	–	–	–	–	–	–	–	–	–	–	–	–
Ecological				–	–	–	–	–	–	–	–	–	–	–	–	–
PQL				218	10,000	109	109	218	218	218	218	218	436	218	218	218
Location	Area	Date	Sample Type													
Upgradient Piezometers																
PZ-01	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	3.32 U	–	0.666 U	2.79 U	1.45 U	4.68 U	4.64 U	2.10 U	1.11 U	4.88 U	5.17 U	**5.89 J**	11.8 U
PZ-02	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	11/17/2021	Duplicate	–	–	–	–	–	–	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	6.07 U	–	**4.64 J+**	5.25 U	1.28 U	2.17 U	2.15 U	**4.34 J+**	**1.15 J**	2.26 U	2.40 U	6.84 U	10.8 U
	Landfill	2/4/2022	Duplicate	3.04 U	–	0.689 U	2.61 U	0.611 U	2.75 U	2.73 U	**3.81 J+**	0.468 U	2.87 U	3.05 U	**8.91 J+**	10.9 U
PZ-05	Landfill	2/4/2022	Primary	2.60 U	–	0.689 U	2.42 U	0.670 U	2.21 U	2.19 U	**2.99 J+**	0.514 U	2.30 U	2.44 U	**4.59 J+**	7.59 U
Landfill Area																
GW-01	Landfill	1/12/2021	Primary	–	10,000 U	–	–	–	–	–	–	–	–	–	–	–
Wetland Area																
PZ-03	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	1.91 U	–	0.525 U	1.66 U	0.753 U	1.26 U	1.25 U	**2.49 J+**	0.577 U	1.32 U	1.40 U	**3.52 J+**	9.19 U
PZ-04	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	2.47 U	–	0.533 U	2.23 U	0.867 U	2.28 U	2.26 U	**2.52 J+**	0.665 U	2.37 U	2.52 U	**5.59 J+**	9.73 U

Table 8-17. Groundwater Results for PBDEs

Screening Criteria				BDE-203/200	BDE-204	BDE-205	BDE-206	BDE-207	BDE-208	BDE-209
				pg/L	pg/L	pg/L	pg/L	pg/L	pg/L	pg/L
Groundwater Screening Levels										
Human Health				–	–	–	–	–	–	110,000,000
Ecological				–	–	–	–	–	–	–
PQL				218	218	218	545	545	545	545
Location	Area	Date	Sample Type							
Upgradient Piezometers										
PZ-01	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	13.7 U	16.7 J	29.9 U	44.0 J	33.4 J+	24.2 J+	1,710
PZ-02	Landfill	11/17/2021	Primary	–	–	–	–	–	–	–
	Landfill	11/17/2021	Duplicate	–	–	–	–	–	–	–
	Landfill	2/4/2022	Primary	11.4 U	41.6 J+	24.3 U	14.8 U	8.02 U	7.51 U	255 U
	Landfill	2/4/2022	Duplicate	11.4 U	20.8 J	24.8 U	15.0 U	8.06 U	7.54 U	310 U
PZ-05	Landfill	2/4/2022	Primary	8.43 U	17.0 J+	15.6 U	10.5 U	5.93 U	5.55 U	280 U
Landfill Area										
GW-01	Landfill	1/12/2021	Primary	–	–	–	–	–	–	–
Wetland Area										
PZ-03	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	10.2 U	10.2 J+	20.1 U	7.79 U	7.19 J+	4.22 U	188 U
PZ-04	Wetland	11/17/2021	Primary	–	–	–	–	–	–	–
	Wetland	2/3/2022	Primary	10.6 U	22.8 J+	21.7 U	21.3 U	19.0 J+	10.4 J+	255 U

Table 8-17. Groundwater Results for PBDEs

Notes

PBDE analyses by EPA Method 1614.

The following summations were performed. For all summations, non-detects are included at one half the detection limit.

1. PentaBDE is a mixture of BDE-47, -99, -100, -153, and -128/154 (1,2).
2. OctaBDE is a mixture of BDE-153, -128/154, and -183/176 (1,2).

BOLD = detection

— = not analyzed or not available

EPA = U.S. Environmental Protection Agency

J = estimate

J+/- = the result is biased high or low

PBDE or BDE = polybrominated diphenyl ether

pg/L = picograms per liter

PQL = practical quantitation limit

U = non-detect

(1) From Toxicological Profile for Polybrominated Diphenyl Ethers (PBDEs), Agency for Toxic Substances and Disease Registry, 2022.

(2) From Technical Fact Sheet - Polybrominated Diphenyl Ethers (PBDEs), EPA 2017.

Table 8-18. Terrestrial Ecological Evaluation Weight of Evidence Approach Proposed Cleanup Levels

Metal	TEE WOE Wetland Area Soil pCUL (mg/kg)
Copper	208
Lead	501
Zinc	5,480

Notes

mg/kg = milligrams per kilogram

pCUL = proposed cleanup level

TEE = Terrestrial Ecological Evaluation

WOE = Weight of Evidence

Table 9-1. Proposed Cleanup Levels for Soil, Groundwater, and Surface Water

	Contaminant	Landfill Area Soil pCUL (mg/kg)	Landfill Area Soil Basis	Wetland Area Soil pCUL (mg/kg)	Wetland Area Soil Basis	Groundwater pCUL (µg/L)	Groundwater Basis	Surface Water pCUL (µg/L)	Surface Water Basis
Metals	Arsenic	7	MTCA Method B Direct Contact, Cancer; and Statewide 90th Percentile Natural Background	—	Not a COC	—	Not a COC	—	Not a COC
Metals	Cadmium	4	Soil Ecological Indicator - Plants	—	Not a COC	—	Not a COC	—	Not a COC
Metals	Chromium	42	Soil Ecological Indicator - Plants and Soil Biota, and Statewide 90th Percentile Natural Background	—	Not a COC	—	Not a COC	—	Not a COC
Metals	Copper	50	Soil Ecological Indicator - Soil Biota	—	Not a COC	—	Not a COC	—	Not a COC
Metals	Hexavalent Chromium	—	—	—	—	0.046	MTCA Method B Cancer	0.13	MTCA Method B Cancer
Metals	Iron	42,100	MTCA Method B Protective of Groundwater, Saturated; and Statewide 90th Percentile Natural Background	42,100	MTCA Method B Protective of Groundwater, Saturated; and Statewide 90th Percentile Natural Background	300	MTCA Method B Potable Groundwater Protection	—	Not a COC
Metals	Lead	50	Soil Ecological Indicator, Plants	—	Not a COC	—	Not a COC	—	Not a COC
Metals	Nickel	38	Soil Ecological Indicator - Plants, and Statewide 90th Percentile Natural Background	—	Not a COC	—	Not a COC	—	Not a COC
Metals	Zinc	86	MTCA Method B Protective of Groundwater to Surface Water, Saturated; Soil Ecological Indicator - Plants, and Statewide 90th Percentile Natural Background	5,480	TEE pCUL	100	WAC Criteria for Aquatic Life - Freshwater Chronic	100	WAC Criteria for Aquatic Life - Freshwater Chronic
SVOCs	Pentachlorophenol (PCP)	2.5	MTCA Method B Direct Contact, Cancer	—	Not a COC	—	Not a COC	—	Not a COC
SVOCs	Total cPAHs	0.19	MTCA Method B Direct Contact, Cancer	—	Not a COC	—	Not a COC	—	Not a COC
TPH	Gasoline Range Organics (TPH-GRO)	30	MTCA Method A Unrestricted Land Use	30	MTCA Method A Unrestricted Land Use	—	Not a COC	—	Not a COC
TPH	Diesel/Oil Range Organics (TPH-DRO/ORO)	200	Soil Ecological Indicator - Soil Biota	200	Soil Ecological Indicator - Soil Biota	—	Not a COC	—	Not a COC

Notes

[1] The soil pCUL for iron was set to its natural background concentration to protect the soil to groundwater and groundwater to surface water pathways.

[2] The soil pCUL for nickel in the Landfill Area was set to its natural background concentration to protect plants

[3] The soil pCUL for zinc in the Landfill Area was set to its natural background concentration to protect the soil to groundwater and groundwater to surface water pathways.

— = not available or not applicable
µg/L = micrograms per liter
COC = contaminant of concern
CWA = Clean Water Act
DRO/ORO = diesel and oil range organics
GRO = gasoline range organics
mg/kg = milligrams per kilogram
MTCA = Model Toxics Control Act
NA = screening level is not applicable
PCB = Polychlorinated biphenyl
pCUL = proposed cleanup level
SVOC = semivolatile organic compound
TEE = Terrestrial Ecological Evaluation
TPH = total petroleum hydrocarbon
VOC = volatile organic compound
WAC = Washington Administrative Code

Table 10-1. Summary of Applicable or Relevant and Appropriate Requirements

	Requirement	Citation	Alternative 1 - Landfill Area	Alternative 2 - Wetland Area	Relevant Evaluation/Action to Be Taken
CHEMICAL-SPECIFIC	Federal				
	Federal Water Pollution Control Act (Clean Water Act)	33 USC 1251 et seq.	Applicable	Applicable	Regulates the discharge of contaminants into waters of the United States, including wetlands.
	NPDES Program	40 CFR 122	Applicable	Applicable	Limits the discharge of contaminants into surface waters of the United States.
	Water Quality Standards	40 CFR 131	Applicable	Applicable	Provides guidance for states to establish criteria for discharge of contaminants into state waters.
	Clean Water Act Section 404	33 USC 1344	Applicable	Applicable	Regulates the discharge of dredged and fill material into waters of the United States, including wetlands.
	Safe Drinking Water Act	42 USC 300f et seq.	Relevant and Appropriate	Relevant and Appropriate	Defines MCLs for drinking water.
	National Primary and Secondary Drinking Water Regulations	40 CFR 141, 143	Relevant and Appropriate	Relevant and Appropriate	Establishes contaminant levels in drinking water (primary MCLs are enforceable, secondary MCLs are recommended).
	State				
	Washington Hazardous Waste Cleanup - MTCA	RCW 70A.305, WAC 173-340	Applicable	Applicable	Outlines methodology for establishing and implementing cleanup levels for surface water, groundwater, soil, and sediments.
	Washington State Water Pollution Control Act	RCW 90.48	Applicable	Applicable	Aims to reduce discharge of pollutants to surface waters of the state.
	Water Quality Standards for Surface Waters of the State of Washington	WAC 173-201A	Applicable	Applicable	Establishes water quality standards for contaminants of concern in surface waters of the state.
	Water Quality Standards for Groundwaters of the State of Washington	WAC 173-200	Applicable	Applicable	Establishes water quality standards for contaminants of concern in groundwaters of the state.
	Washington NPDES Permit Program	WAC 173-220	Applicable	Applicable	Limits the discharge of contaminants into surface waters of the United States.
	Washington State Department of Health - Group A Public Water Supplies	WAC 246-290	Applicable	Applicable	Defines basic regulatory requirements and protects the health of consumers using public drinking water supplies.
	Maximum contaminant levels (MCLs) and Secondary MCLs (SMCLs)	WAC 246-290-310	Applicable	Applicable	Defines contaminant levels in drinking water (MCLs are enforceable, SMCLs are recommended).
	Washington Sediment Management Standards	WAC 173-204	Relevant and Appropriate	Relevant and Appropriate	Aims to reduce and ultimately eliminate adverse effects on biological resources and significant threats to human health from surface sediment contamination.
LOCATION-SPECIFIC	Federal				
	National Historic Preservation Act	16 USC 470 et seq.	Relevant and Appropriate	Relevant and Appropriate	Federal legislation for the preservation of historic and archaeological sites.
	NEPA	42 USC 4321 et seq.	Applicable	Applicable	Requires all branches of government to give consideration to the environment prior to undertaking any federal action that affects the environment.
	Wetland Protection Policy/The NEPA Rule	EPA Executive Order 11990	Applicable	Applicable	Requires federal agencies to take action to avoid adversely impacted wetlands wherever possible.
	Clean Water Act Section 404	33 USC 1344	Applicable	Applicable	Regulates permitting requirements for construction projects in wetlands that result in changes in the area's bottom elevation.
	Tribal				
	Nisqually Tribal Code: Environmental and Natural Resources	NTC Title 14	Relevant and Appropriate	Relevant and Appropriate	Criteria for surface water quality on tribal property.
	Cultural Resources	NTC 14.05	Relevant and Appropriate	Relevant and Appropriate	Tribal regulation for procedures in place when cultural resources are discovered or disturbed.
	Local				
	Pierce County Code: Wetlands	Title 18E.30	Applicable	Applicable	County code designed to avoid impacts to wetlands due to development.
	Pierce County Code: Regulated Fish and Wildlife Species and Habitat Conservation Areas	Title 18E.40	Applicable	Applicable	Identifies regulated fish and wildlife species, habitat, and mitigation measures.

Table 10-1. Summary of Applicable or Relevant and Appropriate Requirements

	Requirement	Citation	Alternative 1 - Landfill Area	Alternative 2 - Wetland Area	Relevant Evaluation/Action to Be Taken
ACTION-SPECIFIC	Federal				
	Resource Conservation and Recovery Act	42 USC 6901 et seq.	Applicable	Applicable	Framework for proper management of hazardous and non-hazardous solid waste.
	Identification and Listing of Hazardous Waste; Standards Applicable to Generators of Hazardous Waste; Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities; Land Disposal Restrictions	40 CFR 261, 262, 264, 268	Applicable	Applicable	Solid waste designations and disposal facilities standards.
	Standards Applicable to Transporters of Hazardous Waste	40 CFR 263	Applicable	Applicable	Solid waste transportation requirements.
	Transportation: Hazardous Materials Regulations	49 CFR Subchapter C	Applicable	Applicable	Solid waste transportation requirements.
	General Information, Regulations, and Definitions; Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans; Shippers - General Requirements for Shipments and Packaging	49 CFR 171, 172, 173, 177	Applicable	Applicable	General Information, Regulations, and Definitions; Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans; Shippers
	Federal Endangered Species Act	16 USC 1531 et seq.	Applicable	Applicable	List of threatened and endangered species and requirements for preparing and implementing plans for their recovery.
	Interagency Cooperation - Endangered Species Act of 1973, as Amended	50 CFR 402	Applicable	Applicable	Interagency cooperation to avoid take of listed species and for issuing permits for otherwise prohibited activities; provides for cooperation with states.
	Federal Water Pollution Control Act (Clean Water Act)	33 USC 1251 et seq.	Applicable	Applicable	Establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.
	NPDES	40 CFR 122	Applicable	Applicable	Permit program that addresses water pollution by regulating point source pollution discharging to waters of the United States.
	Water Quality Standards	40 CFR 131	Applicable	Applicable	Provisions of state, territorial, authorized tribal or federal law approved by EPA that describe the desired condition of a water body and the means by which that condition will be protected or achieved.
	Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material	40 CFR 230	Relevant and Appropriate	Relevant and Appropriate	Restore and maintain the chemical, physical, and biological integrity of waters of the United States through the control of discharges of dredged or fill material.
	Federal Clean Air Act	42 USC 7401 et seq.	Relevant and Appropriate	Relevant and Appropriate	Defines EPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer.
	National Primary and Secondary Ambient Air Quality Standards; Standards of Performance for New Stationary Sources; National Emission Standards for Hazardous Air Pollutants; National Emission Standards for Hazardous Air Pollutants for Source Categories	40 CFR 50, 60, 61, 63	Relevant and Appropriate	Relevant and Appropriate	Air pollutant standards.
	Tribal				
	Nisqually Tribal Code: Environmental and Natural Resources	NTC Title 14	Relevant and Appropriate	Relevant and Appropriate	Criteria for surface water quality on tribal property.
	Excavation/Dredging/Filling	NTC 14.06	Relevant and Appropriate	Relevant and Appropriate	Tribal regulation for excavation, dredging, and filling in/on waters/wetlands/shorelines, tribal lands, and steep slopes, as well as use of fill material and access to groundwater.

Table 10-1. Summary of Applicable or Relevant and Appropriate Requirements

	Requirement	Citation	Alternative 1 - Landfill Area	Alternative 2 - Wetland Area	Relevant Evaluation/Action to Be Taken
ACTION-SPECIFIC (continued)	State				
	Washington MTCA	RCW 70.105D, RCW 70A.305, WAC 173-340	Applicable	Applicable	MTCA funds and directs the investigation, cleanup, and prevention of sites that are contaminated by hazardous substances.
	Washington Solid Waste Handling Standards	WAC 173-350	Applicable	Applicable	County governments and local health departments develop solid waste regulations and management plans, while the State's Solid Waste Management program supports local governments with technical assistance and guidance.
	Washington Criteria for Municipal Solid Waste Landfills	WAC 173-351	Applicable	Applicable	Establishes minimum statewide standards for all municipal solid waste landfills.
	Washington Hazardous Waste Management	RCW 70.105, RCW 70A.300	Applicable	Applicable	Establishes statewide framework for the planning, regulation, control, and management of hazardous waste which will prevent land, air, and water pollution and conserve the natural, economic, and energy resources of the state.
	Land Disposal Restrictions	WAC 173-303-140	Applicable	Applicable	Encourages the best management practices for dangerous wastes.
	Treatment, Storage, or Disposal of Dangerous Waste	WAC 173-303-141	Applicable	Applicable	Encourages the best management practices for dangerous wastes.
	State Patrol - Transportation of Hazardous Materials	WAC 446-50	Applicable	Applicable	Regulates the safe transportation of hazardous materials, hazardous waste, and radioactive waste materials upon the public highways
	Washington State Environmental Policy Act (SEPA)	RCW 43.21C, Chapter 197-11 WAC	Applicable	Applicable	Requires evaluation of environmental impacts, alternatives, and mitigation measures (i.e. Environmental Impact Statement as outlined in RCW 43.21C.031).
	Watershed Restoration Project Regulations	RCW 89.08.450-510	Applicable	Applicable	Required permitting for projects involving watershed restoration.
	State Water Pollution Control Act, NPDES Regulations	RCW 90.48, Chapter 173-220 WAC	Relevant and Appropriate	Relevant and Appropriate	Criteria for discharge of pollutants and other wastes into state surface waters.
	Washington Department of Fish and Wildlife Hydraulic Project Approval	RCW 77.55	Relevant and Appropriate	Relevant and Appropriate	Applies to projects near state waters that will use, divert, obstruct, or change the natural flow or bed.
	State Water Code and Water Rights	RCW 90.03, 90.04	Relevant and Appropriate	Relevant and Appropriate	Promotes the use of the public waters in a fashion which provides for obtaining maximum net benefits arising from both diversionary uses of the state's public waters and the retention of waters within streams and lakes in sufficient quantity and quality to protect instream and natural values and rights.
	Protection of Withdrawal Facilities Associated with Groundwater Rights; Water Rights; Protection of Upper Aquifer Zones	WAC 173-150, 152, 154	Relevant and Appropriate	Relevant and Appropriate	Establishes and sets forth the policies, framework, and procedures of the Department of Ecology in regard to the protection of the availability of groundwater as it pertains to the water withdrawal facilities of holders of groundwater rights.
	Solid Waste Standards - Reduction and Recycling	RCW 70.95.215	Applicable	Applicable	Provides framework for separation, recycling, and reduction of waste delivered to a solid waste facility.
	Deputies of Department - State Solid Waste Management Plan - Assistance - Coordination - Tire Recycling	RCW 70.95.260	Applicable	Applicable	Requirements for tire recycling.
	Landfilling Standards	WAC 173-304-460	Applicable	Applicable	Landfill performance standards including prevention of groundwater contaminations and requirements for allowable landfill gas concentrations.
	Minimum Standards for Construction and Maintenance of Wells	WAC 173-160	Applicable	Applicable	Any monitoring wells installed, modified, or removed during the remedial action will comply with these standards.
	Regulation and Licensing of Well Contractors and Operators	WAC 173-162	Applicable	Applicable	Drilling subcontractors will be licensed in accordance with these regulations.
	Local				
	Pierce County Code: Grading	Title 17A.30	Applicable	Applicable	Outlines slope grading, excavation, and fill requirements.
	Excavation Standards; Fill Standards; Soil Engineering -- Stability	Section 010, 020, 030	Applicable	Applicable	Grading and filling completed at the site will be regulated through the County standards.

Notes

CFR = Code of Federal Regulations
EPA = U.S. Environmental Protection Agency
MCL = maximum contaminant level
MTCA = Model Toxics Control Act
NEPA = National Environmental Policy Act
NPDES = National Pollutant Discharge Elimination System
NTC = Nisqually Tribal Code
RCW = Revised Code of Washington
USC = United States Code
WAC = Washington Administrative Code

Table 12-1. Summary of Remedial Alternatives

Alternative	Description	Estimated NPV Costs	Restoration Timeframe
Landfill Area Alternatives			
Alternative 1A: Waste and Impacted Soil Removal to the Maximum Practicable Extents	Alternative 1A assumes full waste and impacted soil removal to the maximum extent practicable and off-site disposal of the approximately 21,500 CY of solid waste and 1,800 CY of impacted soil to a regulated solid waste landfill or recycling waste facilities, where applicable, followed by slope modification (2H:1V) and restoration of the hillside. Wastes present in the Wetland Area beneath the toe of the landfill would also be removed. Alternative 1A assumes that waste materials would be accepted by LRI Landfill (or another Subtitle D landfill) and no waste materials would require disposal at a RCRA Subtitle C landfill disposal (hazardous waste).	$12.3M	Immediately upon completion of the cleanup action (possibly over 2 seasons due to restoration planting schedules), followed by up to 5 years of compliance inspection and monitoring prior to achieving site closure.
Alternative 1B: Partial Waste and Soil Removal and Capping	Alternative 1B consists of partial waste removal from the top of the Landfill Area, slope modification (2H:1V), excavation of impacted soil from the upper portion of the Landfill Area, and capping remaining wastes and impacted soils in-place. Wastes present in the Wetland Area beneath the toe of the Landfill Area would also be removed. This approach assumes up to 12,000 CY of solid waste will be disposed off-site or recycled, as appropriate. Surface water and groundwater drainage features will also be required to protect the cap integrity. Under the cap, a leachate collection trench containing treatment reagents will be required to collect and discharge treated leachate in contact with waste.	$10.8M	Immediately upon completion of the cleanup action, followed by long-term compliance inspection, maintenance, and monitoring (alternative assumes 20 years before no further annual monitoring required).
Wetland Area Alternatives			
Alternative 2A: Full Impacted Soil Removal	Alternative 2A assumes vegetation clearing and removal and off-site disposal of up to 3,400 CYs of metals contaminated soil above human health unrestricted land use criteria and Table 749-3 ecological screening criteria and restoration of affected wetlands extending south from the toe of the Landfill Area. Alternative 2A assumes that organic rich soils and waste materials would be accepted by LRI Landfill and no waste materials would require disposal at a RCRA Subtitle C landfill (hazardous waste). After removal of impacted soil, clean habitat-compatible soils would be imported and habitat restoration would be conducted.	$2.65M	~ 2 to 3 months of construction work after completion of removal activities in the Landfill Area. Work would need to be started in the driest part of the season, requiring work to likely occur in second construction season after landfill removal.
Alternative 2B: Natural Attenuation and Institutional Controls	Alternative 2B assumes natural attenuation of TPH-DRO/ORO and TPH-GRO and recovery post source removal over a reasonable restoration timeframe. Institutional controls would be implemented to limit human health exposures to a limited set of COCs through isolation. Ecological receptors were not observed to be harmed by the metals and other COC concentrations present in the Wetland Area based on the Weight of Evidence Based Terrestrial Ecological Evaluation.	$83,600	Less than 10 years of natural attenuation would reduce TPH-DRO/ORO and TPH-GRO concentrations below the cleanup level. Attainment of the cleanup level will be evaluated through a monitoring program. Once the cleanup level has been achieved institutional control for human use restrictions could be lifted.

Notes

COC = contaminant of concern

CY = cubic yards

M = million

NPV = net present value

RAO = Remedial Action Objective

RCRA = Resource Conservation and Recovery Act

TPH-GRO = total petroleum hydrocarbons gasoline range organics

Table 13-1. Disproportionate Cost Analysis Evaluation

Remedial Alternative	Protectiveness (30%)[1]	Permanence (20%)	Long-Term Effectiveness (20%)	Short-Term Risk Management (10%)	Technical and Administrative Implementability (10%)	Public Concerns (10%)	Probable Benefit / Cost Score [3]	Environmental Benefit Score	Probable Cost (in $1M) [2]
	Relative Ranking - Scored from 1 (lowest) to 5 (highest)								
Landfill Area Alternatives									
Alternative 1A: Waste and Impacted Soil Removal to the Maximum Practicable Extents	This alternative is protective of human health and the environment.	This alternative is permanent as it fully removes the source material and impacted soil below the Landfill Area.	This alternative provides long-term effectiveness. Source waste will be completely removed. There is a potential for residual contaminated groundwater or isolated low-level soil impacts to be present following remediation.	Short-term risks to human health and the environment will be mitigated through BMPs. Increased off-site disposal presents higher potential for accidents and spills during hauling.	This alternative is technically and administratively implementable but all construction removal activities will be challenging and removal approaches will be highly technical due to the steep grades present.	The community and participating parties typically prefer a full removal option. This alternative will also provide for unrestricted access of the Landfill Area footprint to State Parks and most benefits overburdened communities and vulnerable populations.	0.38	4.7	$12.3M
	5	5	5	3	4	5			
Alternative 1B: Partial Waste and Soil Removal and Capping	While waste will remain on the Site, this alternative remains protective of human health and the environment as long as waste remains capped and leachate doesn't discharge contaminants above pCULs. Increased discharge is possible considering likely climate scenarios.	This alternative is considered permanent but has a potential to re-contaminate the Site if the cap were to fail. Cap failure could be influenced by climate-driven landslides and increased stormwater runoff. Cap failure would disproportionally affect overburdened communities and vulnerable populations.	This alternative provides long-term effectiveness, but requires long-term monitoring and maintenance to ensure effectiveness. Groundwater will likely pass through the remaining waste under the cap (no bottom liner), which will require ongoing passive treatment that may be amplified through climate scenarios.	Short-term risks to human health and the environment will be mitigated through BMPs. Reduced off-site disposal volume in comparison to Alternative 1A lowers potential for accidents and spills during hauling. However, partial waste removal only presents increased opportunity for slope failure during regrading/construction operations.	This alternative is technically and administratively implementable; however, long-term maintenance will be required and increased precipitation from climate change has the potential to rewet waste and cause leaching or failure of the encapsulated wastes. This alternative also assumes regrading of waste would not trigger current landfilling requirements.	While this alternative would isolate remaining waste, the stakeholders, public, and Tribes would typically prefer a full removal option.	0.31	3.4	$10.8M
	4	3	3	4	3	3			
Wetland Area Alternatives									
Alternative 2A: Full Impacted Soil Removal	This alternative is protective of human health but significantly impacts the ecological environment from a habitat loss standpoint, and habitat loss may be permanent.	This alternative is permanent (assuming landfill waste removal occurred) as it removes impacted soil from the Wetland Area.	Effectiveness is dependent on degree of waste removal and effectiveness of leachate collection system (for Alternative 1B). It is assumed that all leachate would be treated prior to discharge and long-term maintenance of the cap would occur. This maintenance may be longer and more involved than is planned due to climate-induced changes in rainfall or storm intensity.	Short-term contaminant risks to human health and the environment will be mitigated through BMPs. Increased off-site disposal presents higher potential for accidents and spills during hauling. Soil removal in the Wetland Area would cause significant short- and medium-term impacts to habitat through tree, vegetation, and soil removal. Re-establishment of habitat would take multiple years and may not fully occur.	This alternative is technically challenging to implement due to difficult access, extremely soft soil conditions, significant grade change between the Wetland Area and the top of the Landfill Area, and significant tree removal required. This will also require significant coordination with USACE due to 404 permitting requirements and USFWS and WDFW due to habitat impacts.	While the public typically prefers contaminant removal options, short-term impacts to habitat may overweigh contaminant removal concerns, especially if COC concentrations do not appear to be impacting habitat.	1.17	3.1	$2.65M
	2	5	4	2	2	3			
Alternative 2B: Natural Attenuation and Institutional Controls	While soil with elevated metals and TPH-GRO will remain isolated on Site in the Wetland Area, this alternative is protective of human health through the use of ICs and no ecological impacts are apparent. Maintaining the wetland habitat makes the Site more resilient to climate impacts.	This alternative is considered permanent if the Landfill Area remedial alternative eliminates sources and TPH-DRO/ORO and TPH-GRO are naturally attenuated. However, elevated metals will remain in Wetland Area soils. These metals do not pose a ecological or human health risk based on Site-specific evaluations.	Effectiveness is dependent on adherence to ICs by human receptors and ability of TPH-DRO/ORO and TPH-GRO to naturally attenuate. However, as the Wetland Area is extremely difficult to access, future exposure by human receptors is already limited and the residual direct contact risks would be minimal.	Short-term risks to human health and the environment will be limited as soil will not be disturbed through construction operations and metals concentrations in soil have not had measurable impacts on receptors to date (see the TEE). TPH-DRO/ORO (ecological) and TPH-GRO (human health) would pose a limited short term risk they naturally attenuate post source removal.	This alternative is technically and administratively implementable but will require future land use covenants, signage, and full delineation of the extent of elevated metals concentrations.	While there may be potential concerns regarding leaving impacted soils in place, the TEE suggests that elevated COC concentrations are not harming the biota and habitat and they are protected. Additionally, direct contact risks for humans visiting the area are minimal and the migration of impacts to the Mashel River is unlikely. This alternative also preserves the ecological function of the Wetland Area.	45.00	3.6	$0.08M
	4	2	4	5	4	3			

Notes

[1] Each of the DCA criteria listed were weighted, so the overall DCA score would be influenced by criteria directly relating to protectiveness and effectiveness. A score of 5 represents an alternative that satisfies the criteria to the highest degree.

[2] Probable cost reflects the total estimated cost including applicable contingencies (see cost detail in Appendix H).

[3] Probable costs were evaluated in increments of $0.1 million for comparison to benefit scoring.

BMP = best management practice
COC = contaminant of concern
DCA = disproportionate cost analysis
IC = institutional control
pCUL = proposed cleanup level
State Parks = Washington State Parks and Recreation Commission
TEE = terrestrial ecological evaluation
TPH-GRO = Total Petroleum Hydrocarbons Gasoline Range Organics
USACE = U.S. Army Corps of Engineers
USFWS = U.S. Fish and Wildlife Service
WDFW = Washington Department of Fish and Wildlife

Figures

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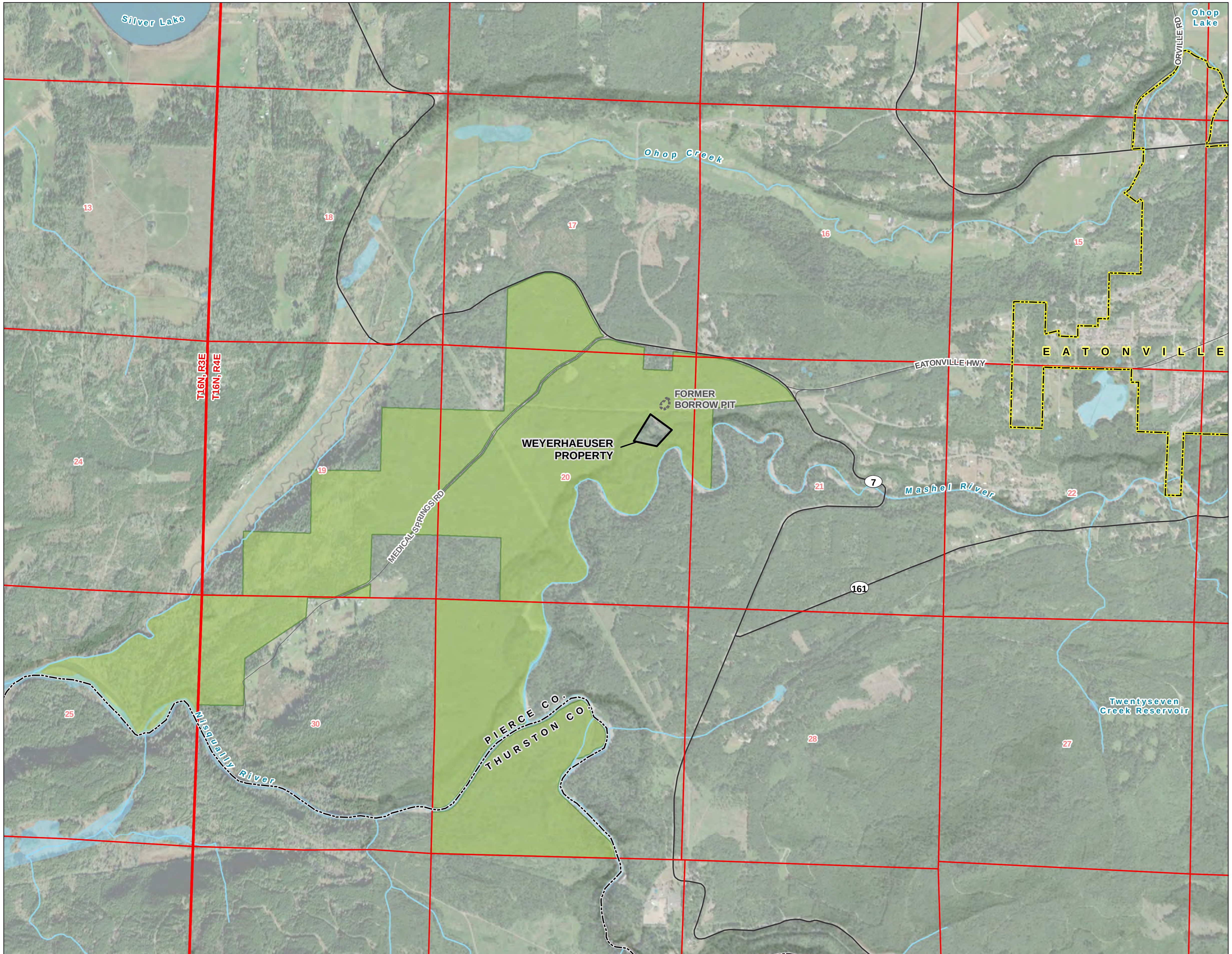

FIGURE 1-1

Vicinity Map

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Nisqually State Park
- Former Borrow Pit
- Weyerhaeuser Property
- City Boundary
- County Boundary
- Major Road
- Watercourse
- Waterbody

NOTE
Site features are approximate.

N

0 1,000 2,000 3,000
Feet

Date: November 29, 2023
Data Sources: USGS, ESRI, Maxar Imagery (2021), Pierce Co.

GSI Water Solutions, Inc.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure1-1_Vicinity_Map.mxd, iramos

FIGURE 1-2

Site Map

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Spring
- Wetland
- Inferred Wetland
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Former Borrow Pit
- Nisqually State Park
- Flow Path
- Mashel River
- Unnamed Creek

NOTE
Site features are approximate.

N

0 140 280 420
Feet

Date: November 29, 2023
Data Sources: USGS, ESRI, Maxar Imagery (2021), Pierce Co.

GSI Water Solutions, Inc.

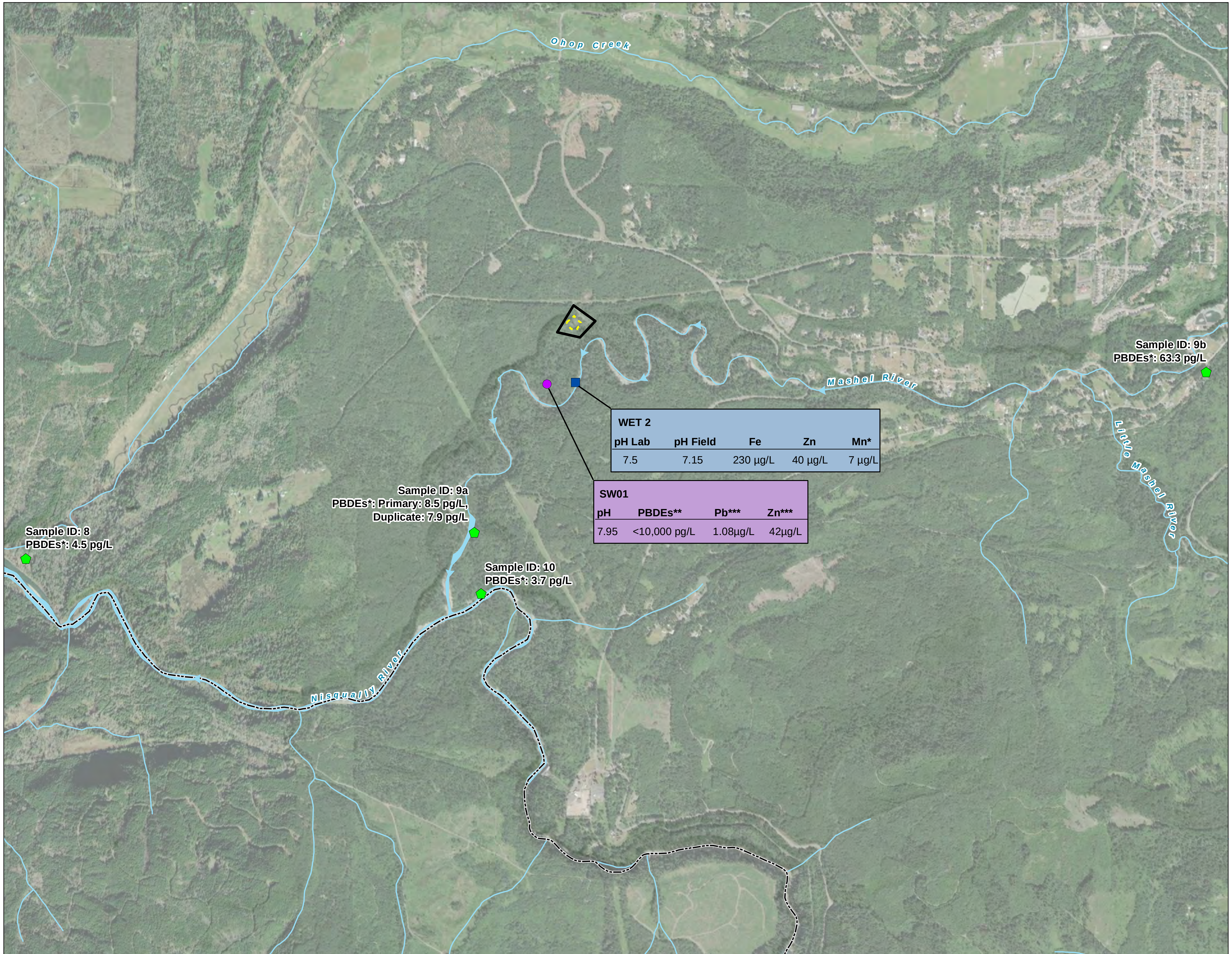

FIGURE 1-3

Previous Sampling Locations and Results: Mashel River

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Surface Water Sample Location (January 2021)
- Sample Location (September 2017)
- Sampling Location (July 1996)
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Watercourse
- Flow Direction

NOTES

µg/L: micrograms per liter
pg/L: picograms per liter
* No screening level for Mn provided.
** All PBDEs are non-detects, detection limits shown.
*** Sb, As, Ba, Cd, Cu, Ni, Vn all detected below screening levels.

PBDE: polybrominated diphenyl ether
As: Arsenic
Ba: Barium
Cd: Cadmium
Cu: Copper
Mn: Manganese
Ni: Nickle
Vn: Vanadium
Fe: Iron
Pb: Lead
Sb: Antimony
Zn: Zinc

N

0 1,000 2,000 3,000
Feet

Date: November 29, 2023
Data Sources: ESRI, Maxar Imagery (2021)

GSI Water Solutions, Inc.

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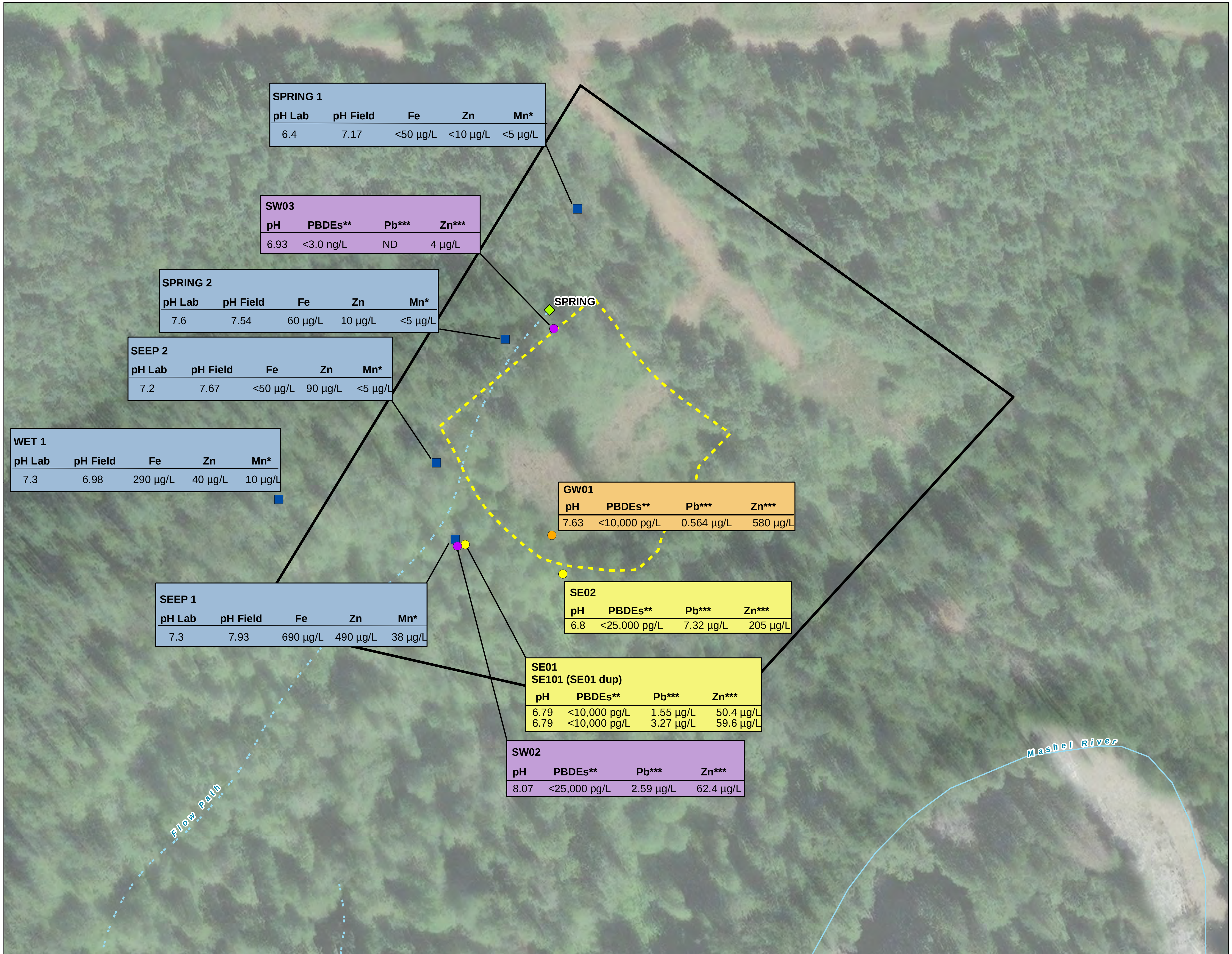


FIGURE 1-4

Site Analytical Results: July 1996 and January 2021

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

Spring

Sample Location

- Groundwater (January 2021)
- Seep (January 2021)
- Surface Water (January 2021)
- Sampling Location (July 1996)

All Other Features

- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path
- Mashel River

NOTES

µg/L: micrograms per liter
pg/L: picograms per liter
* No screening level for Mn provided.
** All PBDEs are non-detects, detection limits shown.
*** Sb, As, Ba, Cd, Cu, Ni, Vn all detected below screening levels.

1. The natural slopes of the surrounding Weyerhaeuser areas are approximately 1.5H:1V, with the total height of the landfill ranging from 105 to 140 feet.
2. Excavation of 27 test pits show that soil is a mixture of gravel, cobbles, and boulders. In the upper portions, there were about 12-18 inches of topsoil.

PBDE: polybrominated diphenyl ether
As: Arsenic
Ba: Barium
Cd: Cadmium
Cu: Copper
Mn: Manganese
Ni: Nickle
Vn: Vanadium
Fe: Iron
Pb: Lead
Sb: Antimony
Zn: Zinc

N
0 50 100 150
Feet

Date: November 29, 2023
Data Sources: ESRI, Maxar Imagery (2021)

GSI Water Solutions, Inc.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure1-4_Analytical_Results_Jan_2021_And_July_1996.mxd, iramos

FIGURE 2-1

Historical Aerial Imagery

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

Estimated Extent of the Landfill

Weyerhaeuser Property

NOTE

Site features are approximate.

N

0 200 400 600
Feet

GSI Water Solutions, Inc.

Date: November 29, 2023
Data Sources: ESRI, EDR, Maxar Imagery (2021), Pierce Co.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure2-1_Historical_Aerial_Imagery_Comparison.mxd, iramos

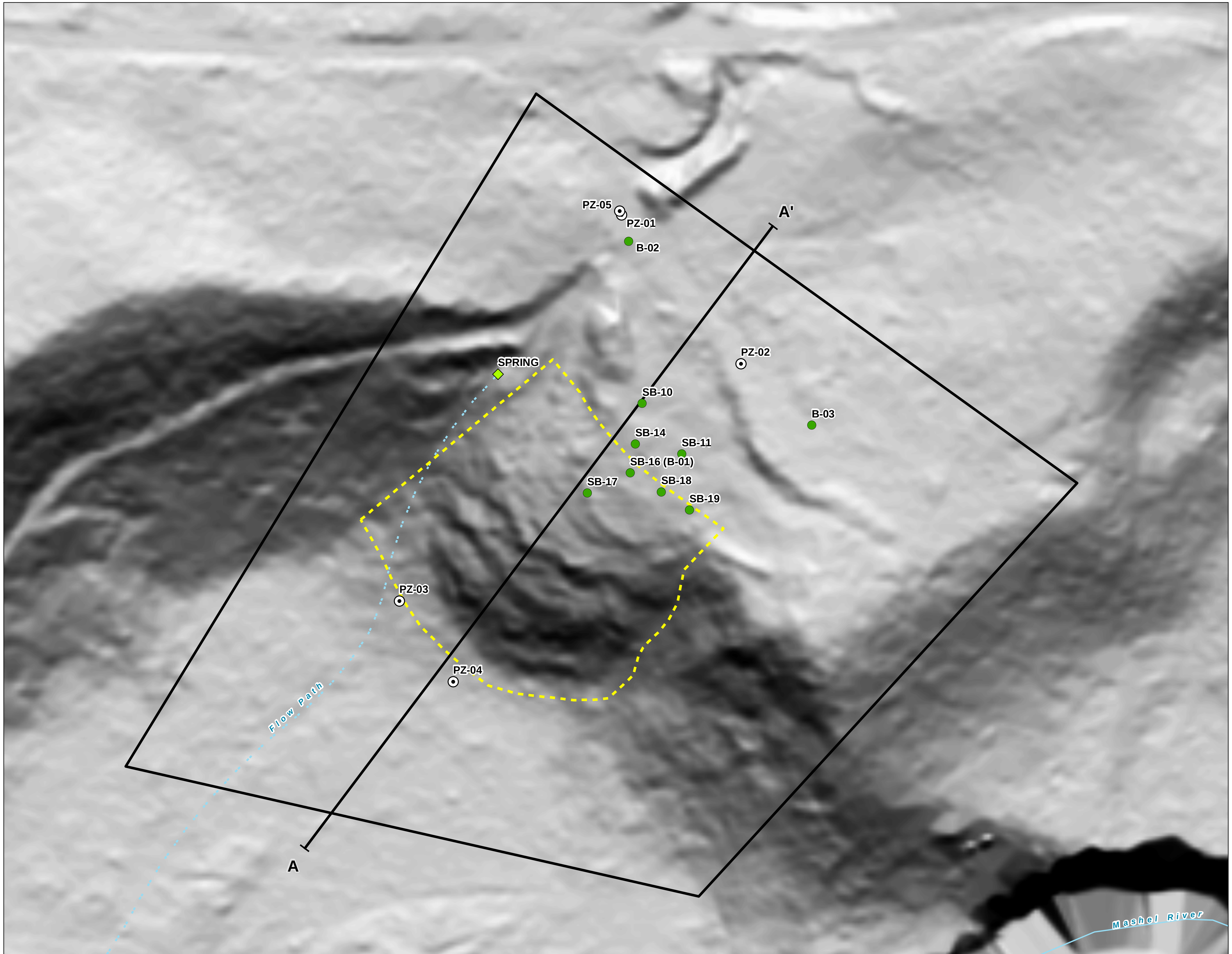


FIGURE 3-1

Geologic Cross Section - Plan View

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Piezometer
- Soil Boring Sample Location (September 2021 - Dry Season)
- Spring
- Cross Section Line
- Estimated Extent of the
- Weyerhaeuser Property
- Flow Path
- Mashel River

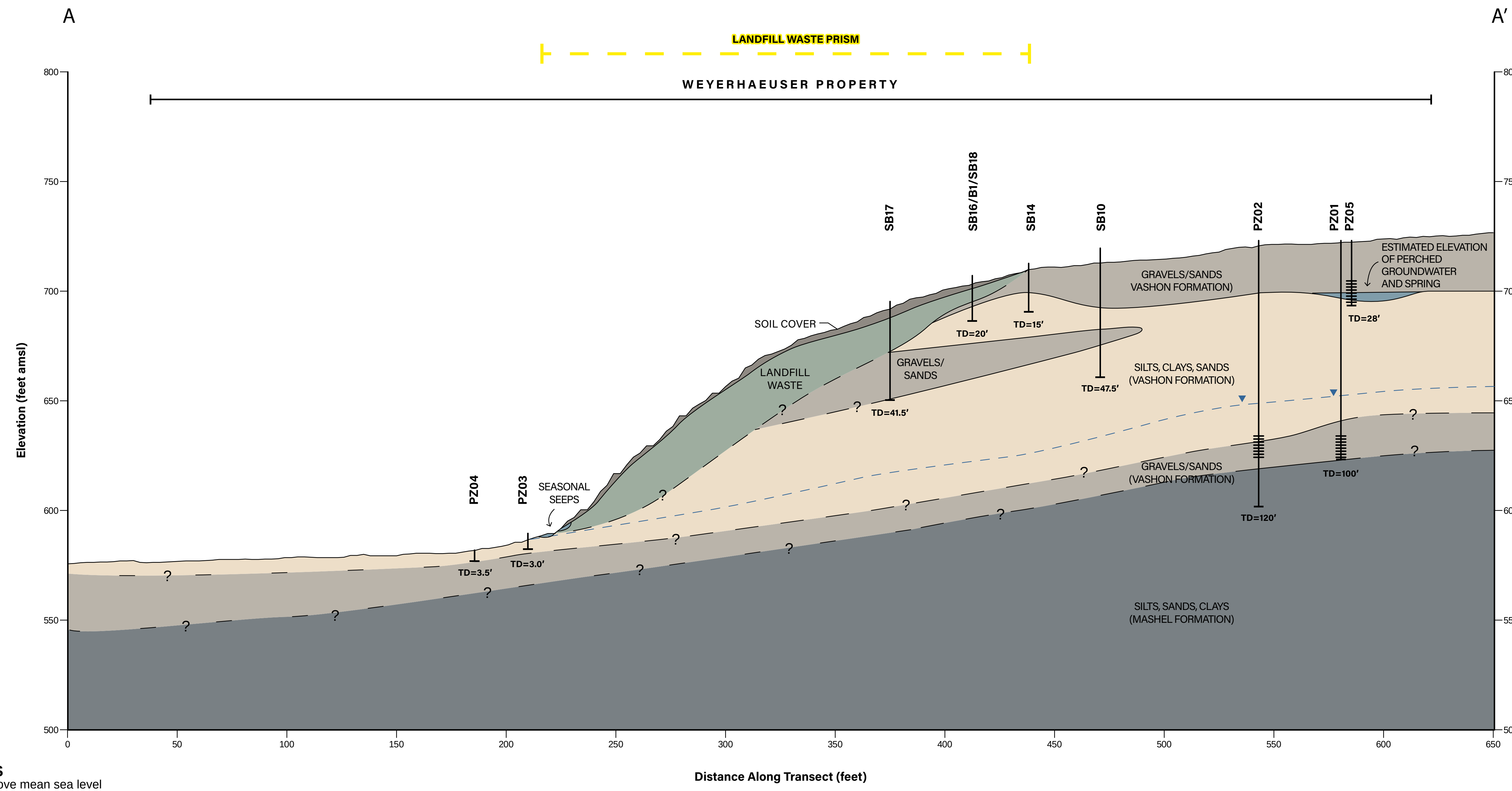
NOTE
Site features are approximate.

N

0 40 80 120
Feet

Date: November 29, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

GSI Water Solutions, Inc.



NOTES
amsl: above mean sea level
TD: total depth

LEGEND

Water Table

Boring and Piezometer Legend

Screen

Soil Cover

Landfill Waste

Vashon Formation

Coarse-Grained Unit

Fine-Grained Unit

Mashel Formation

Silts, Sands, Clays

FIGURE 3-2

Geologic Cross Section A-A'

Remedial Investigation/Feasibility Study
Former Eatonville Landfill
Eatonville, WA

GSI Water Solutions, Inc.

Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS

FIGURE 3-3

Regional Topography and Features

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Approximate Center of Wetland on Property (feet NAVD 88)
- OHW Sample Point (feet NAVD 88)
- Estimated OHW Line
- Spring
- Wetland
- Inferred Wetland
- Elevation Contour (20 foot interval NAVD 88)
- Estimated Extent of the Landfill
- Project
- Flow Path
- Mashel River
- Unnamed Creek

NOTES

Site features are approximate.

NAVD 88 : North American Vertical Datum of 1988
OHW: ordinary high water

N

0 140 280 420
Feet

GSI Water Solutions, Inc.

Date: November 29, 2023
Data Sources: USGS, ESRI, Maxar Imagery (2021), Pierce Co.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure3-3_Site_Topo.mxd, iramos

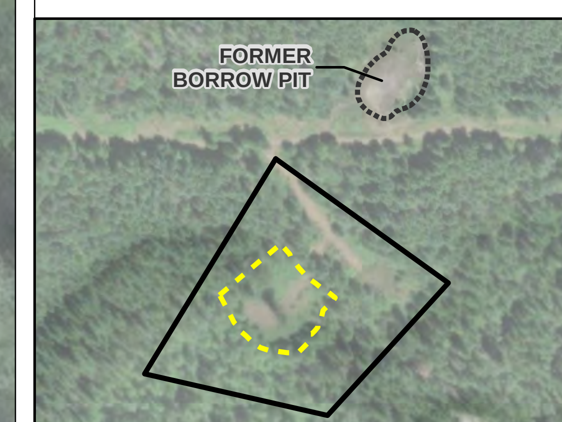
FIGURE 3-4

Site Features and Piezometers

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Piezometer
- Spring
- Wetland
- Inferred Wetland
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path
- Mashel River



NOTE

Site features are approximate.

N

0 40 80 120
Feet

Date: November 29, 2023
Data Sources: USGS, ESRI, Maxar Imagery (2021), Pierce Co., Foresight Surveying (2022)

GSI Water Solutions, Inc.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure3-4_Site_Features_and_Piezos.mxd, iramos

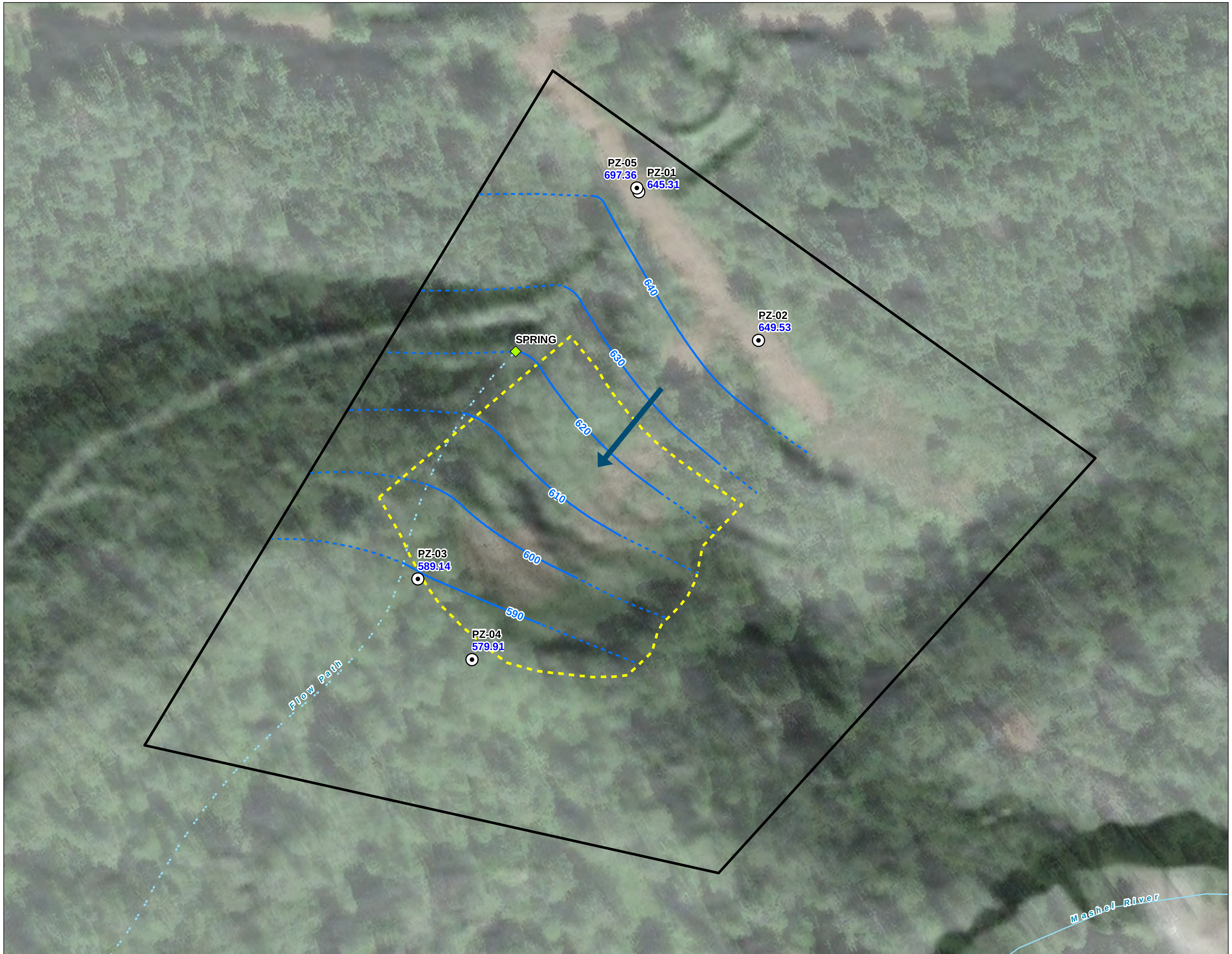


FIGURE 3-5

Groundwater Elevation Contours - November 17, 2021

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Piezometer
  Groundwater Elevation (feet amsl)
- Spring
- Groundwater Elevation Contour (feet amsl) (dashed where inferred)
- Groundwater Flow Direction
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path
- Mashel River

NOTES

1. Site features are approximate.
2. Well PZ-05 was not used for groundwater contouring.

amsl: above mean sea level

N

0 40 80 120
Feet

Date: November 29, 2023
Data Sources: USGS, ESRI, Maxar Imagery (2021), Pierce Co.

GSI Water Solutions, Inc.

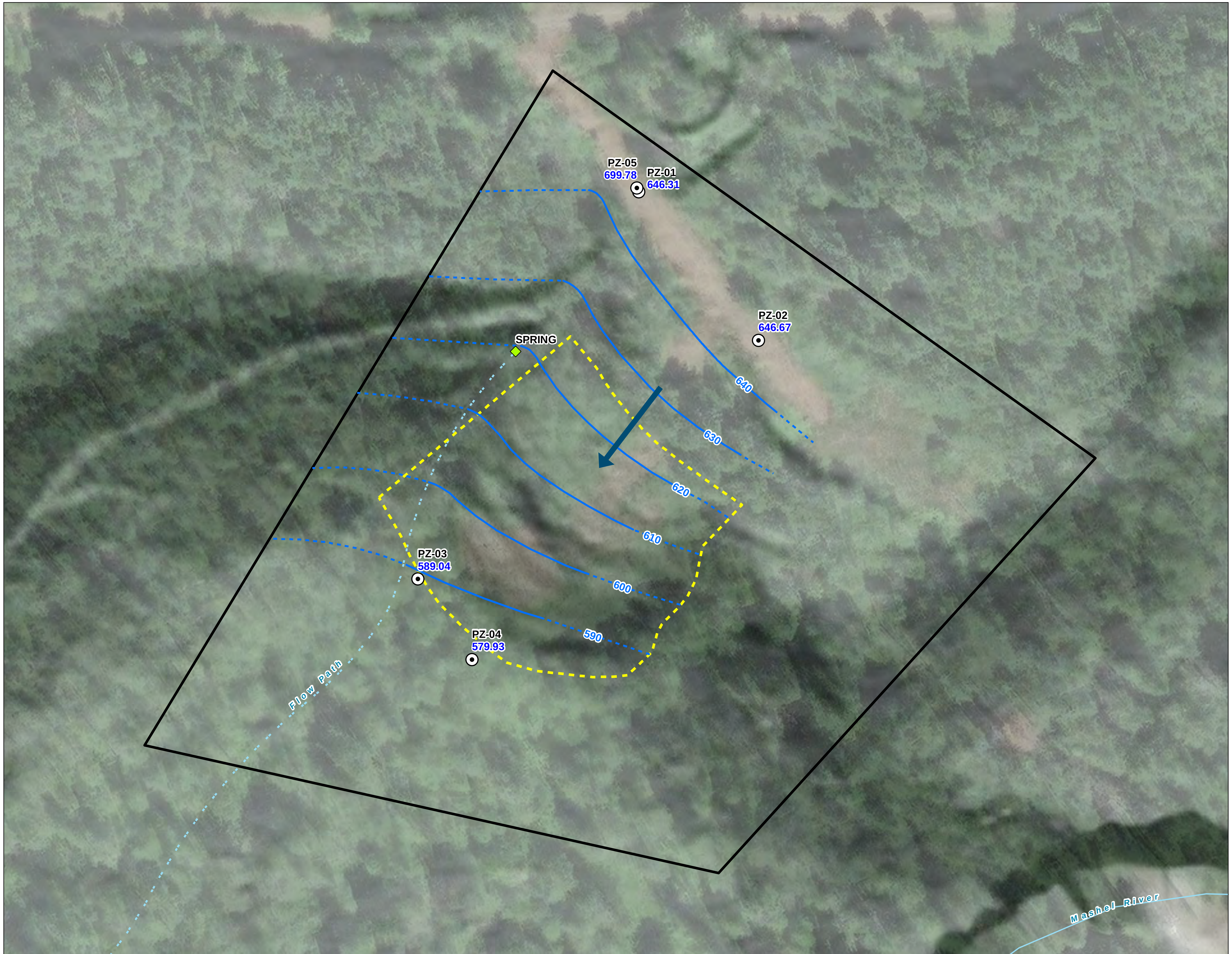


FIGURE 3-6

Groundwater Elevation Contours - February 3 and 4, 2022

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Piezometer
  Groundwater Elevation (feet amsl)
- Spring
- Groundwater Elevation Contour (feet amsl) (dashed where inferred)
- Groundwater Flow Direction
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path
- Mashel River

NOTES

1. Site features are approximate.
2. Well PZ-05 was not used for groundwater contouring.

amsl: above mean sea level

N

0 40 80 120
Feet

GSI Water Solutions, Inc.

Date: November 29, 2023
Data Sources: USGS, ESRI, Maxar Imagery (2021), Pierce Co.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure3-6_GW_Contours_Feb2022.mxd, iramos

FIGURE 3-7

Water Wells within a Half Mile from the Site

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Drinking Water Well
- Localized Groundwater Flow Direction at the Site
- Weyerhaeuser Property
- 1,000 foot Radius from Site
- Half-Mile Radius from Site
- Major Road
- Mashel River

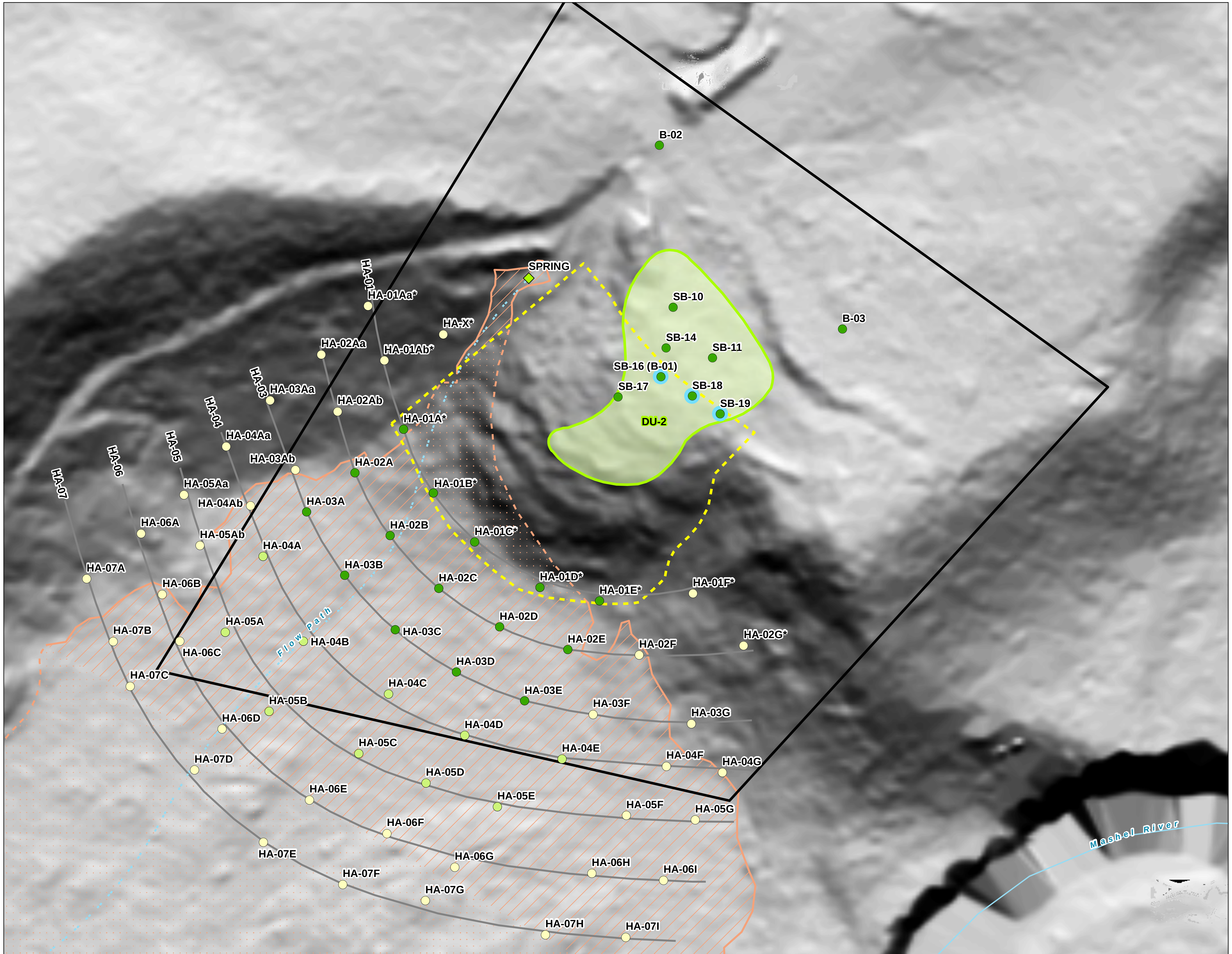
N

0 500 1,000 1,500
Feet

Date: November 29, 2023
Data Sources: ESRI, USGS, Department of Ecology, Maxar Imagery (2021)

GSI Water Solutions, Inc.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure3-7_Wells_Within_Half_Mile_of_Landfill.mxd, iramos



Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure4-1_Soil_Sample_Locs.mxd, iramos

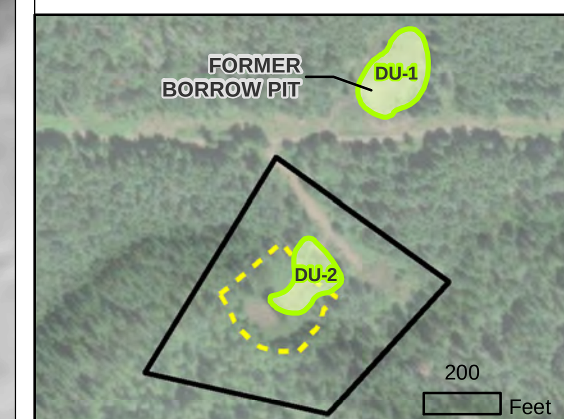
FIGURE 4-1

Soil Sample Locations

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Soil Boring Sample Location (September 2021 and February 2022)
- Soil Gas Boring Sample Location (September 2021)
- Soil Boring Sample Location (February 2022)
- Soil Boring Sample Location (August 2022)
- Spring
- Soil Sample Transect
- Wetland
- Inferred Wetland
- ISM Decision Unit Boundary
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path
- Mashel River



NOTES

1. Site features are approximate.
*Part of the Landfill Area

DU: Decision Unit
ISM: Incremental Sampling Method

N
0 40 80 120
Feet

GSI Water Solutions, Inc.

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

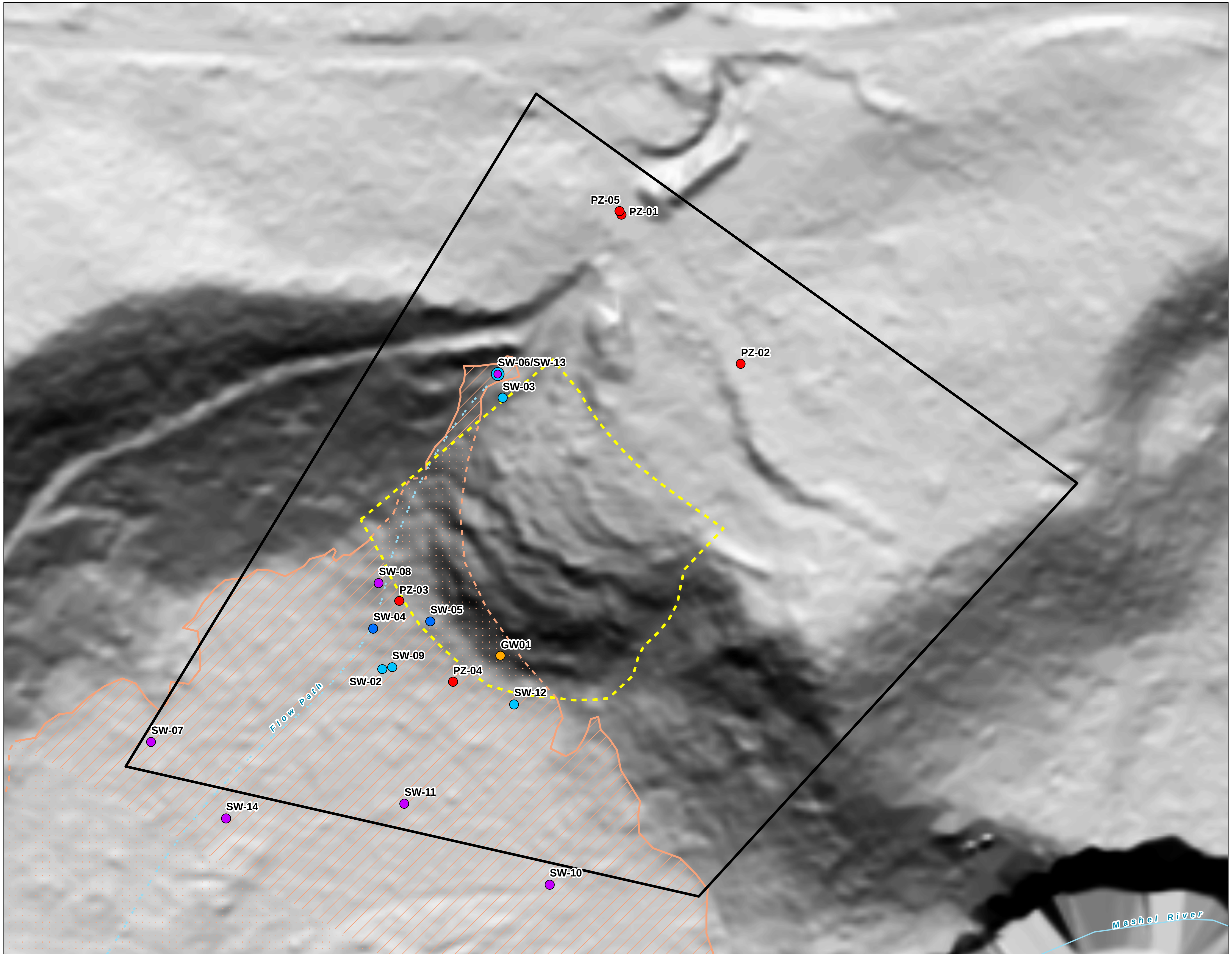


FIGURE 4-2

Groundwater and Surface Water Sample Locations (2021 - 2022)

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Wetland
- Inferred Wetland
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path
- Mashel River

Sample Locations

- Surface Water (Dry Season 2021)
- Surface Water (Wet Season 2021)
- Surface Water (Wet Season 2022)
- Groundwater (Wet and Dry Season 2021-2022)
- Shallow Groundwater (Wet Season 2021)

NOTES

1. Site features are approximate.
2. Surface water samples were opportunistically collected at low points/depressions or where limited volumes of concentrated flowing water was identified. In all cases, water was flowing through the sample location. Standing water was not identified within the lowlands.

N

0 40 80 120
Feet

Date: November 29, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

GSI Water Solutions, Inc.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure4-2_GW_SW_Sample_Locs.mxd, iramos

FIGURE 4-3

Geophysical Survey Seismic Lines

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Spring
- Geophysical Seismic Line
- Wetland
- Inferred Wetland
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path
- Mashel River

NOTES

1. Site features are approximate.
2. Surface water samples were opportunistically collected at low points/depressions or where limited volumes of concentrated flowing water was identified. In all cases, water was flowing through the sample location. Standing water was not identified within the lowlands.

N

0 40 80 120
Feet

Date: November 29, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co., Geophysical Survey (2022)

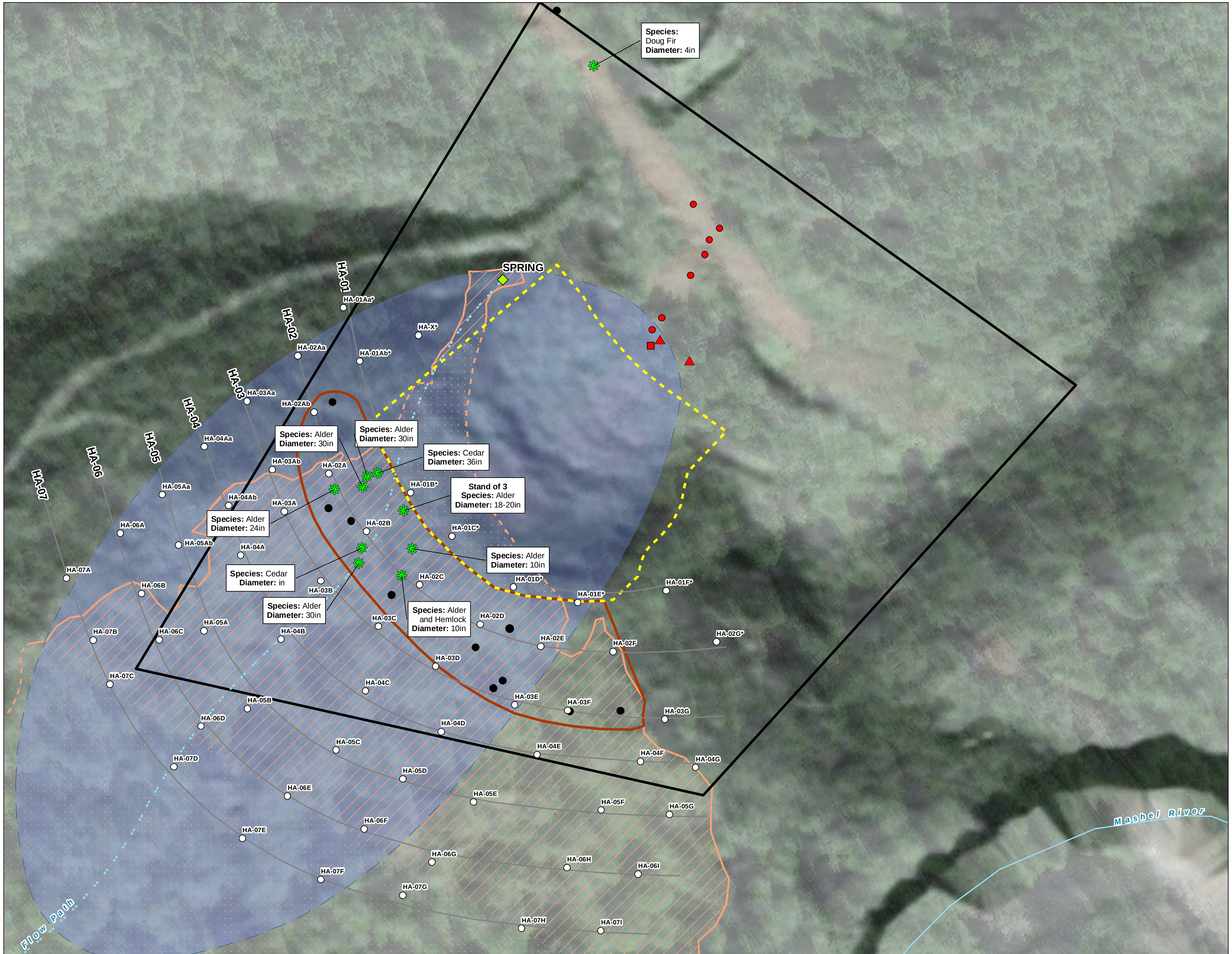


FIGURE 4-4

Extent of Landfill Debris in the Wetland Area

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Soil Boring Sample Location
- Tree
- Landfill Debris

Evidence of Firearm Usage

- Concentrated
- Dispersed
- Evidence of Small Arms

All Other Features

- Spring
- Soil Sample Transect
- Approximate Lead Shot Fallout Zone
- Wetland
- Inferred Wetland
- Approximate Extent of Landfill Debris in the Wetland Area
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path
- Mashel River

NOTES

1. Site features are approximate.
2. Debris in the wetland is composed primarily of tires and the occasional large piece of metal (near the landfill). The density of debris is greatest close to the toe of the landfill and diminishes with distance way from it.
3. The conceptual lead fallout zone is based on an approximate range of shotgun ammunition when fired from the top of the landfill (approximately 250 yards), with the assumption that lead fallout would land between the top of the landfill and this range.

* Part of the Landfill Area

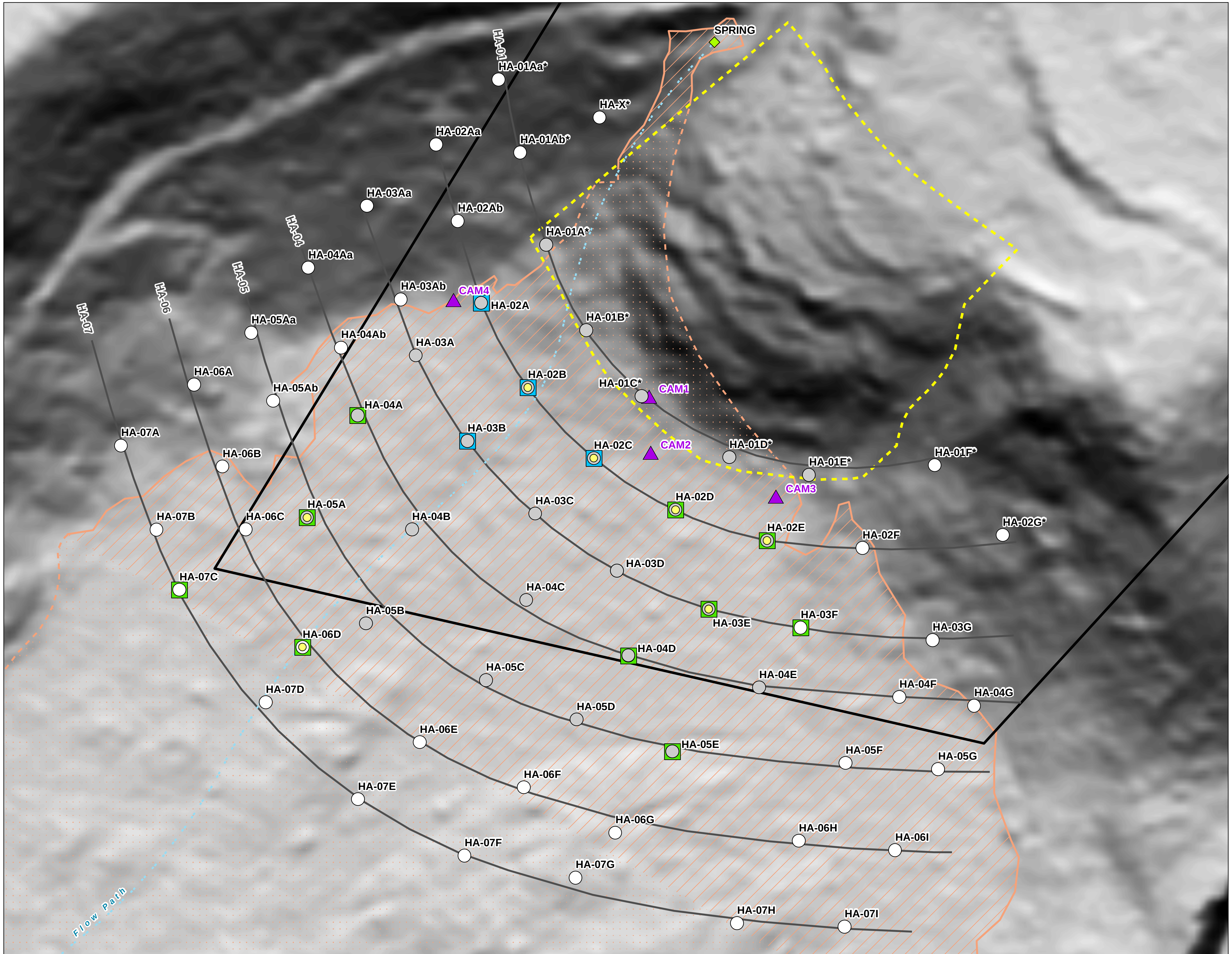
N

0 40 80 120
Feet

GSI Water Solutions, Inc.

Date: December 19, 2023
Data Sources: USGS, ESRI, Maxar Imagery (2021), Pierce Co., Foresight Surveying (2022)

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure4-4_Extent_Landfill_Debris_in_Wetlands.mxd, iramos



Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure4-5_Terrestrial_Locs.mxd, iramos

FIGURE 4-5

Terrestrial Ecological Evaluation Locations

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Wetland Area
- Inferred Wetland Area

Terrestrial Evaluation Locations

- Plant and Invertebrate
- Additional Plant and Root Density

All Other Features

- Camera Location
- Spring
- Impacted Location[1]
- Soil Boring Sample Location
- Summer 2022 Step-Outs
- Soil Sample Transect
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path

NOTES

1. All locations without this symbol are considered "Reference (non-impacted)" locations.

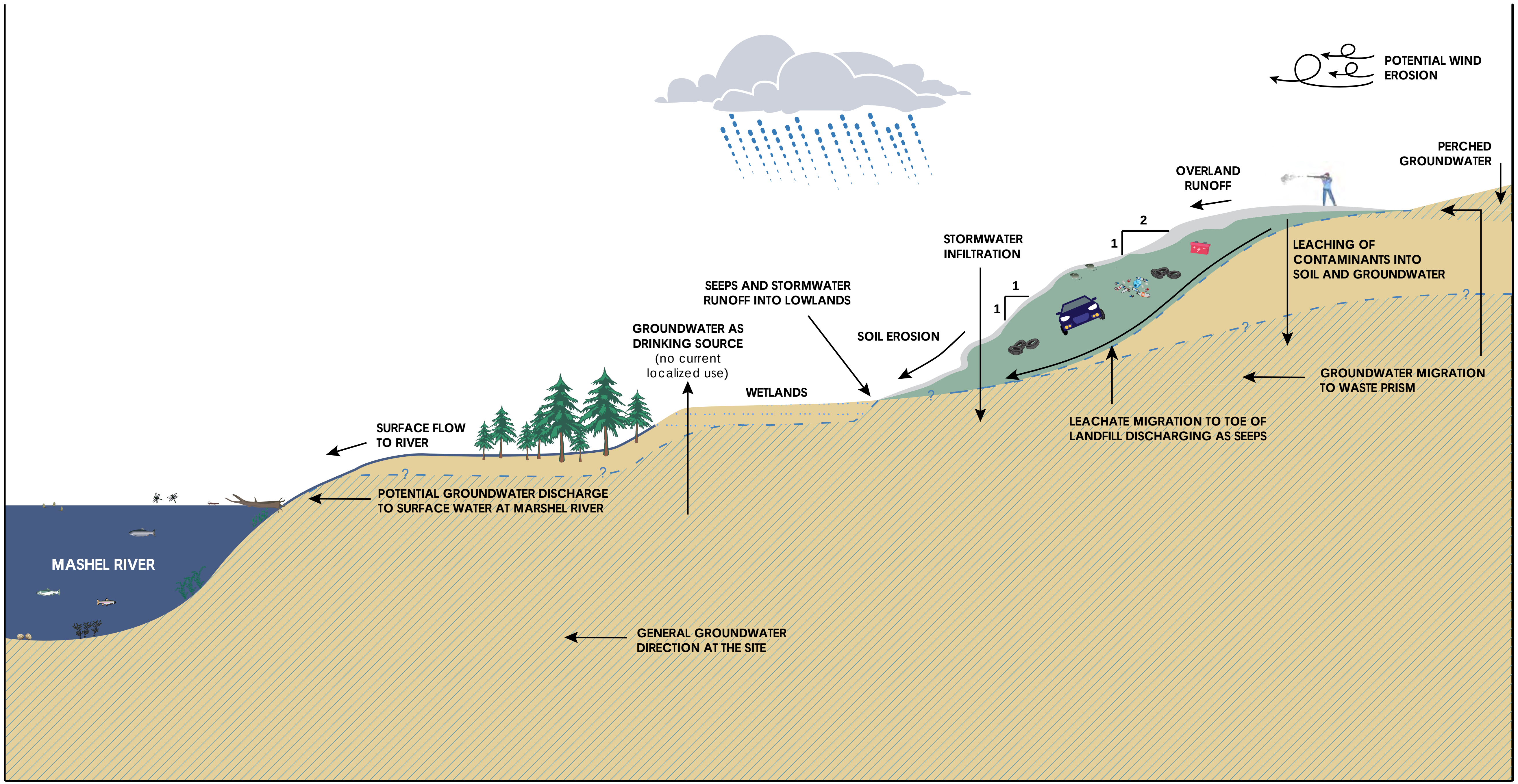
Site features are approximate.
*Part of the Landfill Area

N

0 30 60 90
Feet

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

GSI Water Solutions, Inc.



LEGEND

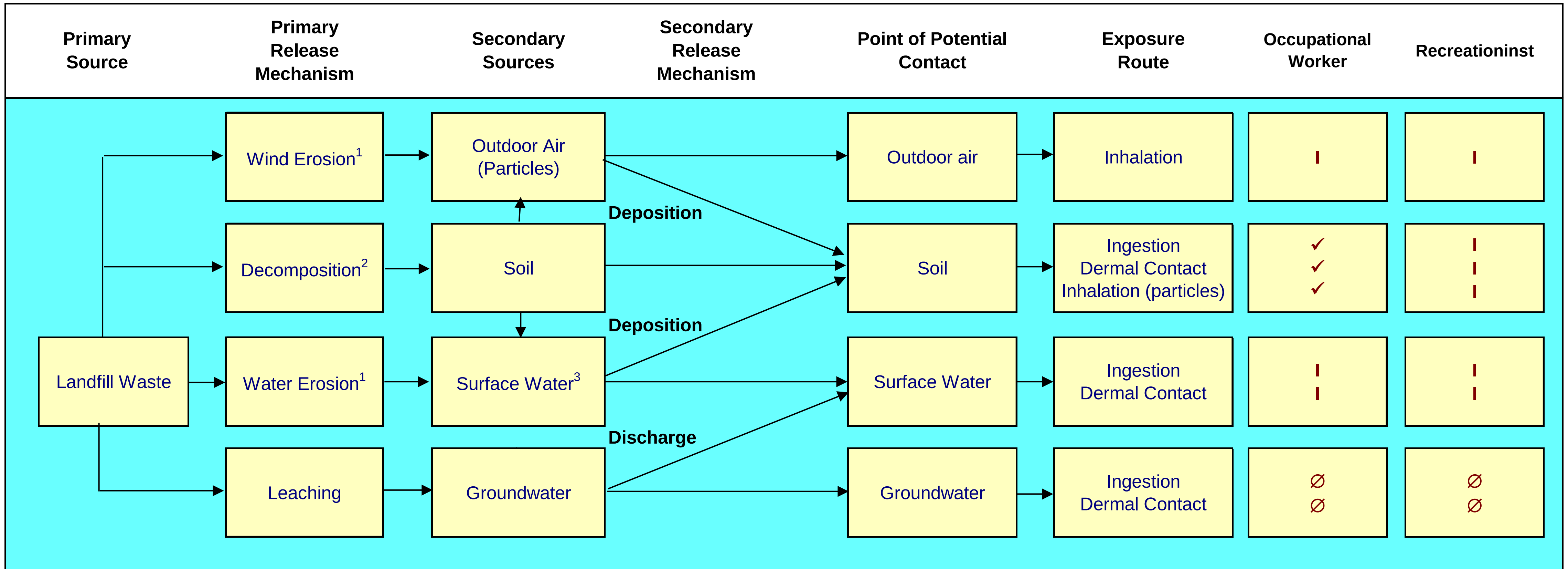
- Groundwater
- Landfill Cover
- Existing Landfill Waste
- Vashon Drift (coarse gravels and sands) overlying Mashel Formation (unconsolidated layers of clays, sands, and lignite)[1,2]: see Figure 3-2 for details.

[1]Schasse, 1987
[2] Walter and Kimmel, 1968

NOTE
Figure is not to scale.
Data sources: Vecteezy (2023)

FIGURE 5-1
Conceptual Site Model
Remedial Investigation/Feasibility Study
Former Eatonville Landfill
Eatonville, WA

GSI Water Solutions, Inc.



Notes:

[1] Wind and water erosion of exposed wastes and impacted soil on the surface

[2] Biotic and abiotic breakdown of waste

[3] Dissolved constituents and particles in ephemeral streams. Discharge of surface water to the Mashel River is considered insignificant.

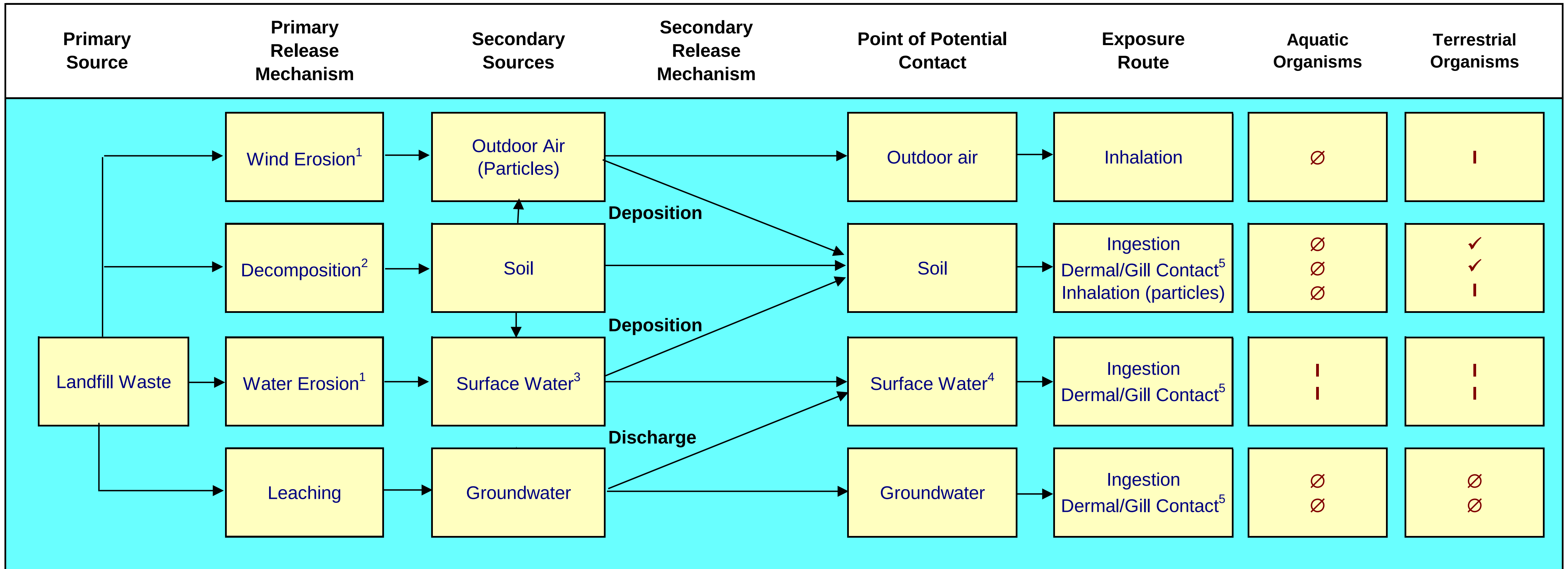
Primary pathway ⟶
Potentially Complete exposure route ✓
Incomplete exposure route ∅
Insignificant exposure route I

FIGURE 5-2

Conceptual Site Model - Human Receptors

Remedial Investigation/Feasibility Study
Former Eatonville Landfill
Eatonville, WA

GSI Water Solutions, Inc.



Notes:

[1] Wind and water erosion of exposed wastes and impacted soil on the surface

[2] Biotic and abiotic breakdown of waste

[3] Dissolved constituents and particles in ephemeral streams. Discharge of surface water to the Mashel River is considered insignificant.

[4] Ephemeral streams don't support wholly aquatic organisms

[5] Dermal contact for terrestrial organisms; dermal contact and gill uptake for aquatic organisms

Primary pathway ⟶
Potentially Complete exposure route ✓
Incomplete exposure route ∅
Insignificant exposure route I

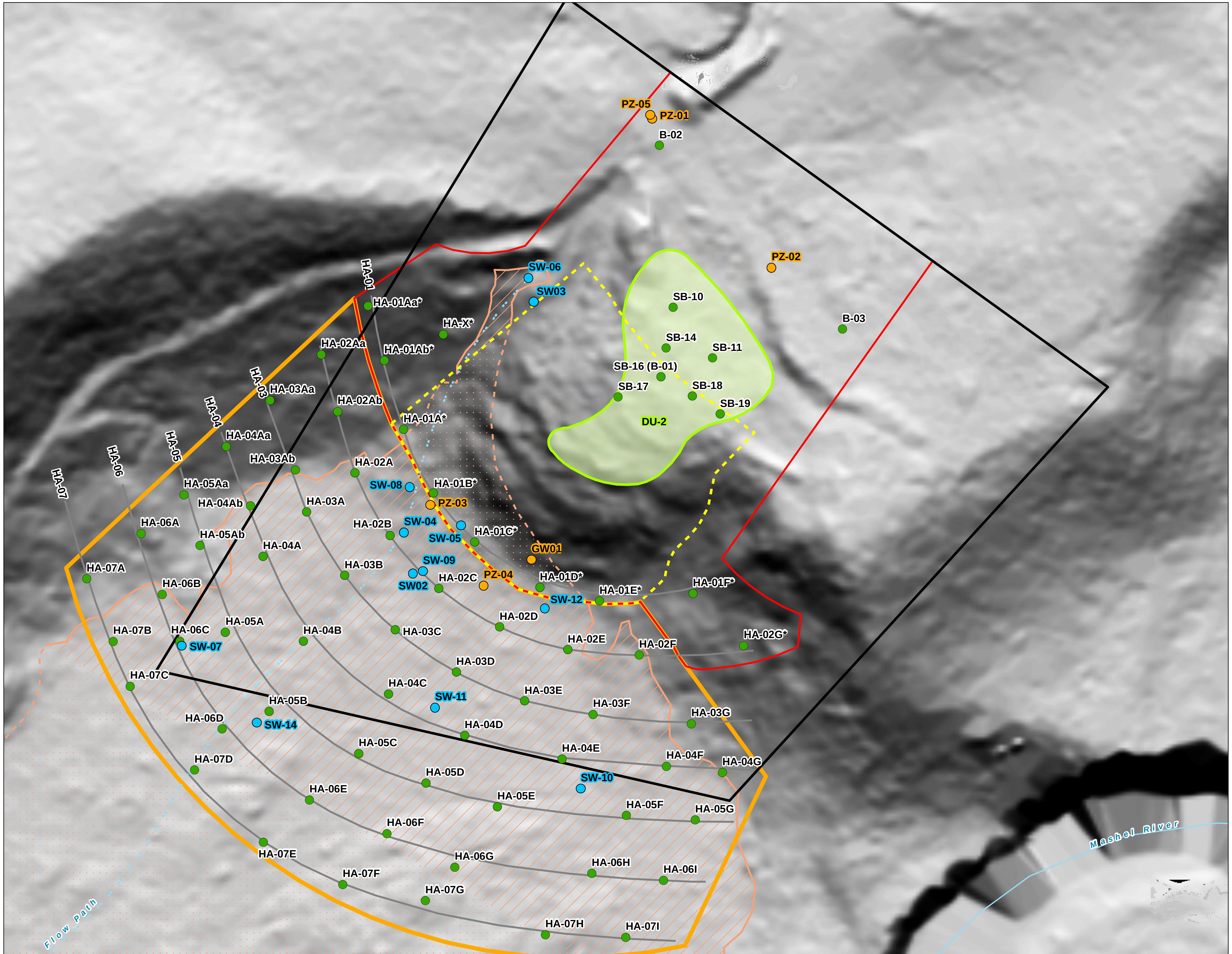
FIGURE 5-3

Conceptual Site Model - Ecological Receptors

Remedial Investigation/Feasibility Study
Former Eatonville Landfill
Eatonville, WA

GSI Water Solutions, Inc.

Y:Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS



Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure6-1_Site_Areas.mxd, iramos

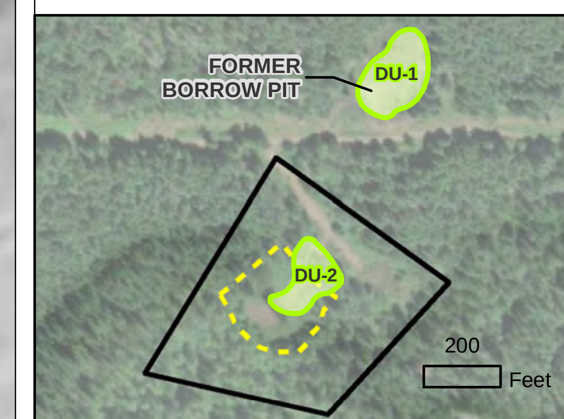
FIGURE 6-1

Site Areas

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Soil Sample Location
- Surface Water Sample Location
- Groundwater Sample Location
- Soil Sample Transect
- ISM Decision Unit Boundary
- Landfill Area
- Wetland Area
- Wetland
- Inferred Wetland
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path
- Mashel River



NOTES

1. Site features are approximate.
*Part of the Landfill Area

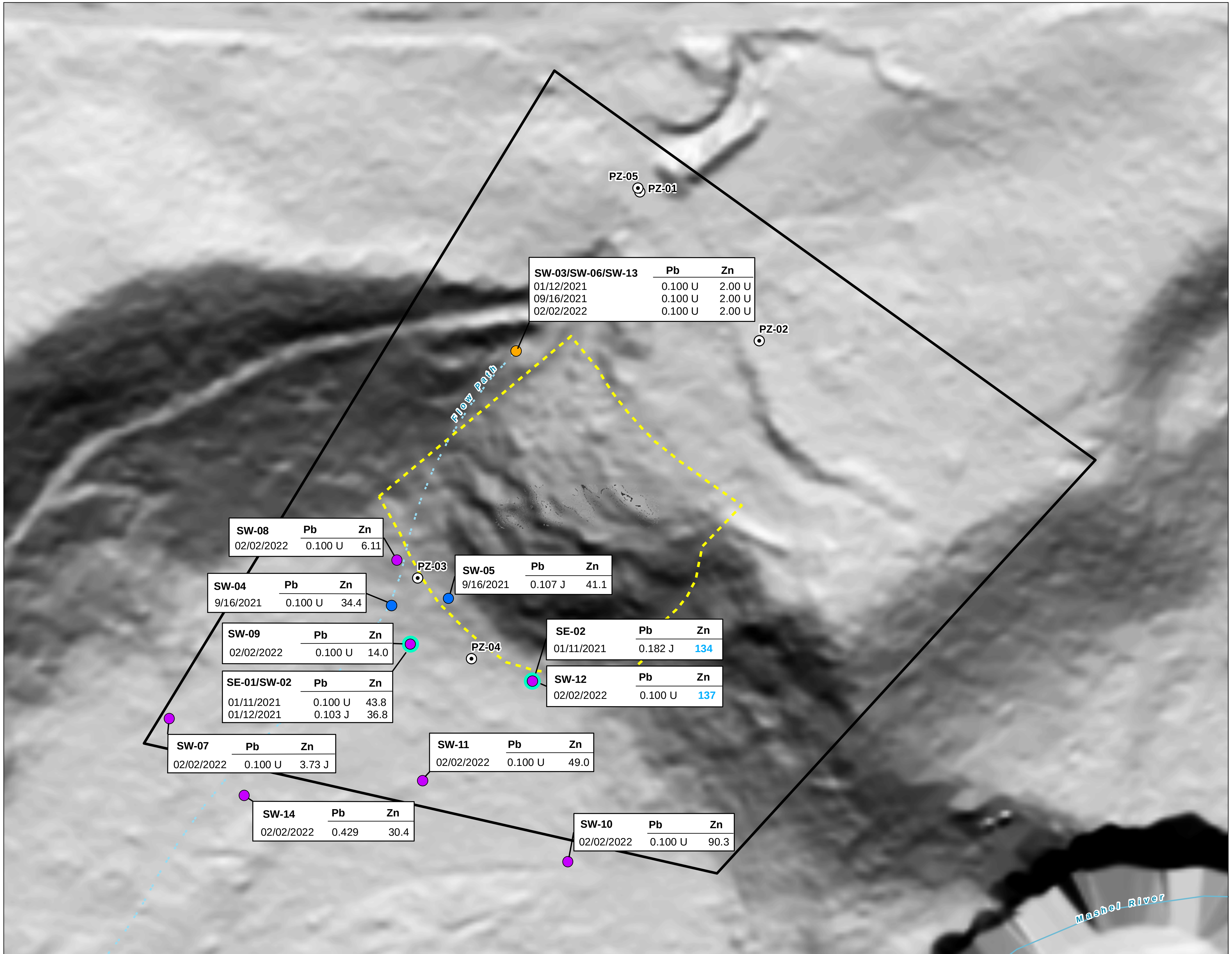
DU: Decision Unit
ISM: Incremental Sampling Method

N

0 40 80 120
Feet

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

GSI Water Solutions, Inc.



Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure8-1_SW_Analytical_Results_Landfill_2021.mxd, iramos

FIGURE 8-1

Surface Water Dissolved Metals Results (2021 - 2022)

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Groundwater Monitoring Well
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path

Sample Locations

- Spring (Dry and Wet Season)
- Surface Water (Dry Season)
- Surface Water (Wet Season)
- Seep (Wet Season)

NOTES

1. Site features are approximate.
2. Results shown in micrograms per liter.
3. SW-01 is located outside the extent on the Mashel River floodplain.

Surface Water Human Health Screening Levels
Lead = 2.5 µg/L
Zinc = 2,300 µg/L

Surface Water Ecological Screening Levels
Lead = 2.5 µg/L
Zinc = 100 µg/L

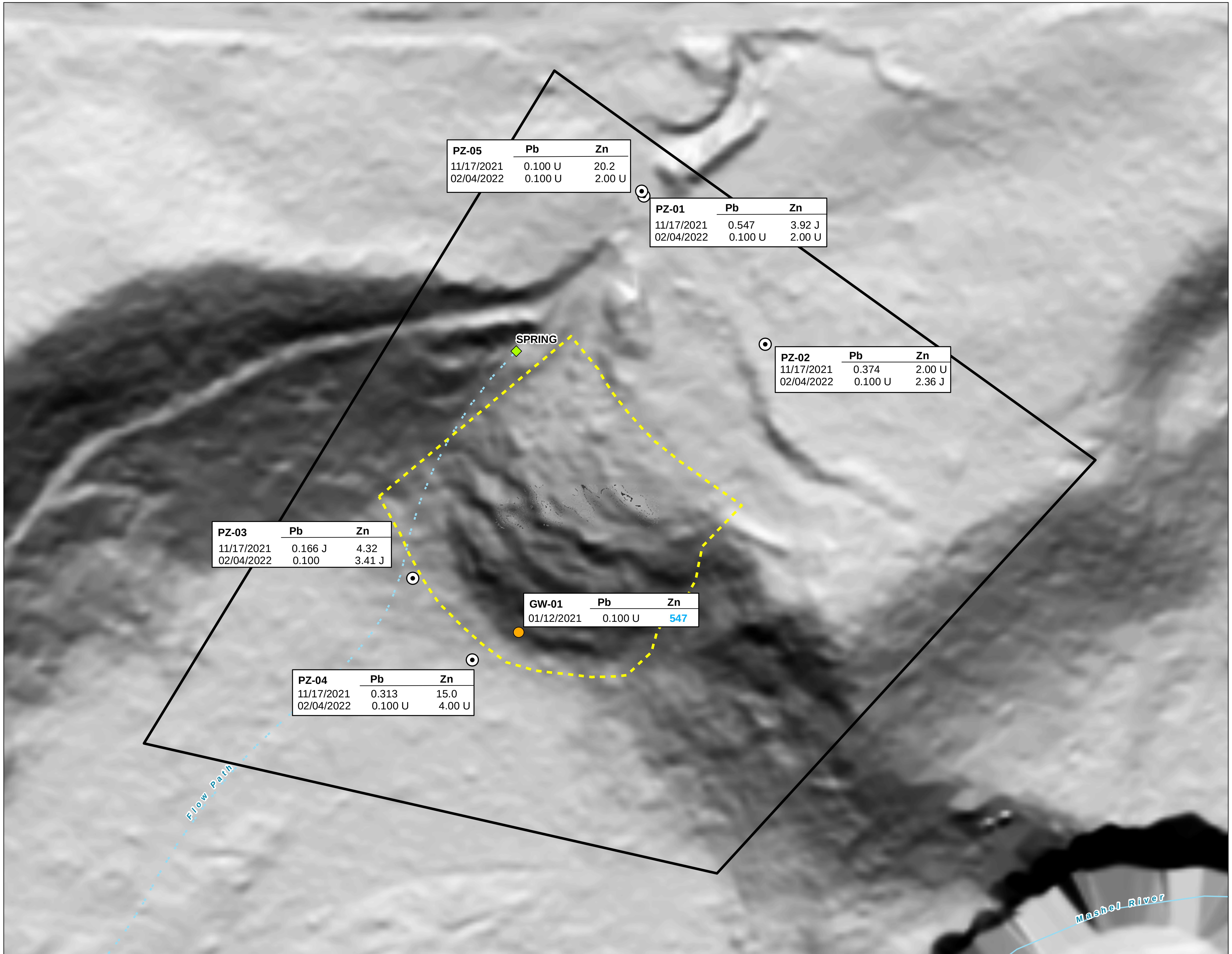
Pb: Lead
Zn: Zinc
J: estimated result
U: undetected at method detection limit
µg/L: micrograms per liter

N

0 40 80 120
Feet

Date: November 29, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

GSI Water Solutions, Inc.



Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure8-2_GW_Analytical_Results_Landfill_2021.mxd, iramos

FIGURE 8-2

Groundwater Dissolved Metals Results (2021 - 2022)

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Spring
- Piezometer
- Shallow Groundwater Sample Location
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path
- Mashel River

NOTES

1. Site features are approximate.
2. Results shown in micrograms per liter

Groundwater Human Health Screening Levels
Lead = 15 µg/L
Zinc = 4,800 µg/L

Groundwater Ecological Screening Levels
Lead = 2.5 µg/L
Zinc = 100 µg/L

Pb: Lead
Zn: Zinc
J: estimated result
U: undetected at method detection limit
µg/L: micrograms per liter

N

0 40 80 120
Feet

GSI Water Solutions, Inc.

Date: November 29, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

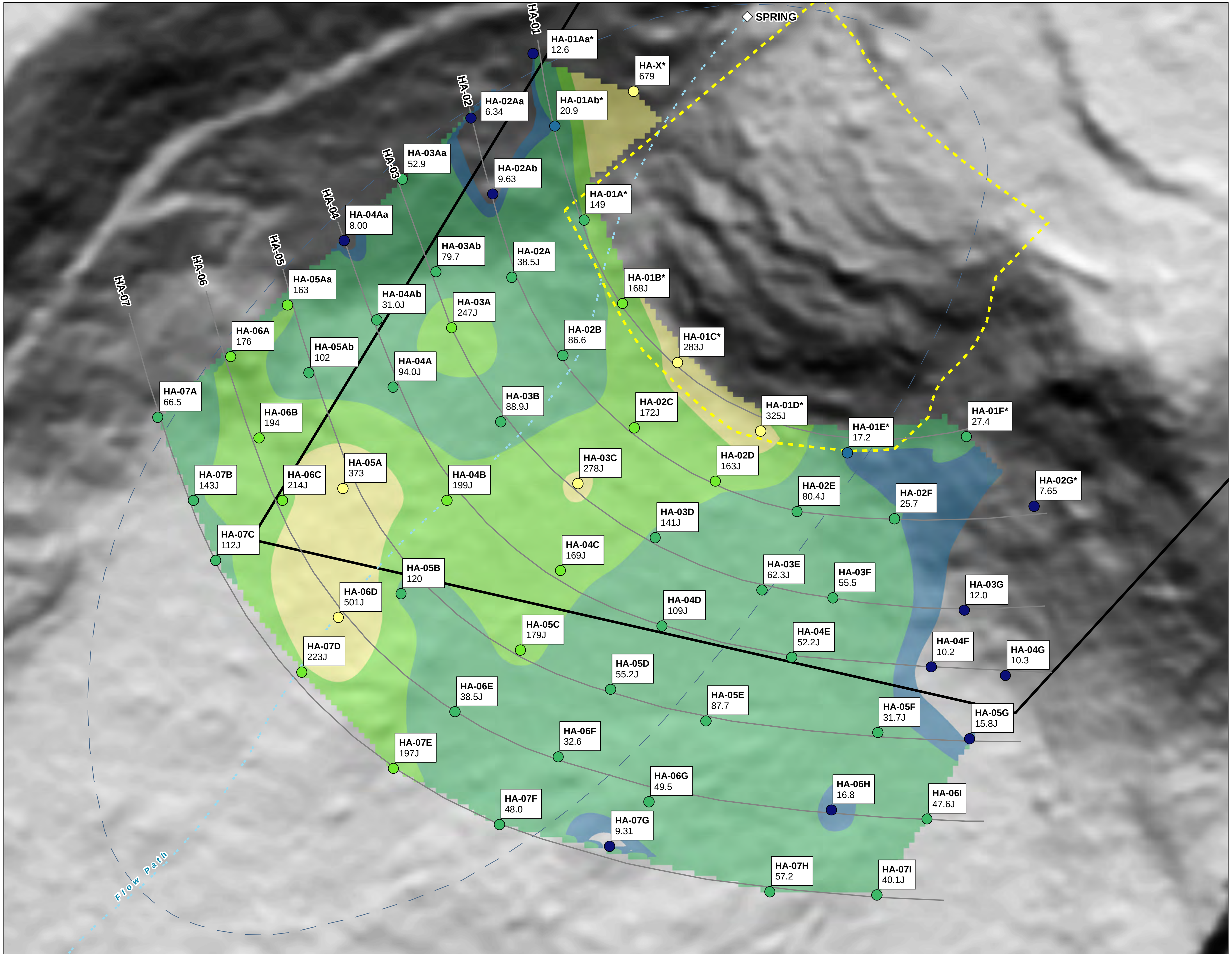


FIGURE 8-3a

Lead Human Health Surface Soil Screening Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

Lead Concentrations (mg/kg)

Sample points	Interpolated areas
0 - 17	0 - 17
18 - 25	18 - 25
26 - 150	26 - 150
151 - 250	151 - 250
> 250	> 250

All Other Features

- Spring
- Flow Path
- Soil Sample Transect
- Approximate Lead Shot Fallout Zone
- Estimated Extent of the Landfill
- Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.
4. The conceptual lead fallout zone is based on an approximate range of shotgun ammunition when fired from the top of the landfill (approximately 250 yards), with the assumption that lead fallout would land between the top of the landfill and this range.

*Part of the Landfill Area

Lead Screening Levels

17 mg/kg - Statewide Background
25 mg/kg - MTCA Method B Groundwater to Surface Water
150 mg/kg - MTCA Method B Protective of Groundwater
250 mg/kg - MTCA Method A Unrestricted Landuse

J, J+: esimated value
mg/kg: milligrams per kilogram
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level

N

0 30 60 90
Feet

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

GSI Water Solutions, Inc.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure8-3a_Soil_Analytical_Results_Pb__Human.mxd, iramos

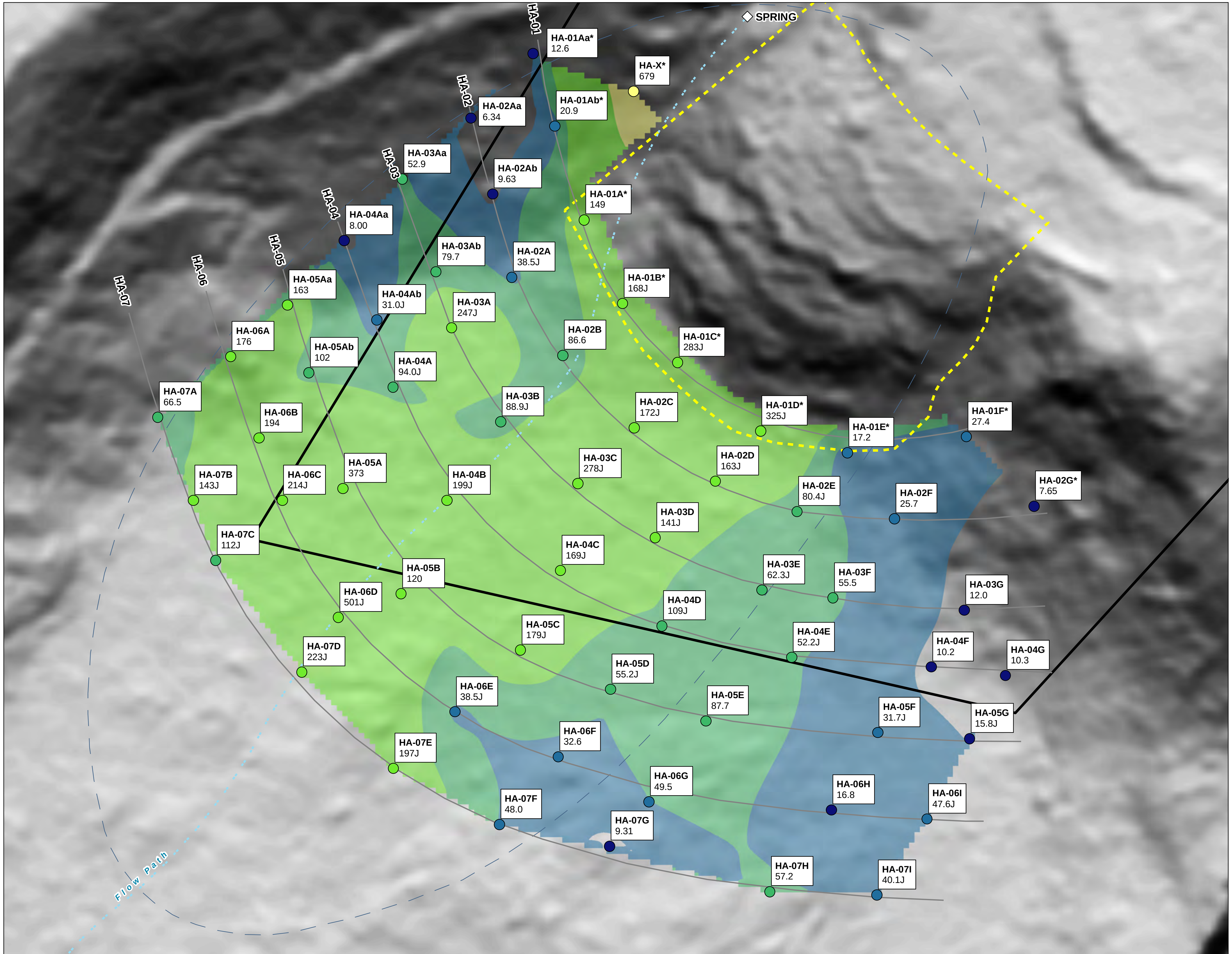


FIGURE 8-3b

Lead Ecological Surface Soil Screening Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

Lead Concentrations (mg/kg)

Sample points	Shaded areas
6 - 17	0 - 17
18 - 50	18 - 50
51 - 118	51 - 118
119 - 501	119 - 501
> 501	> 501

All Other Features

- Spring
- Flow Path
- Soil Sample Transect
- Approximate Lead Shot Fallout Zone
- Estimated Extent of the Landfill
- Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.
4. The conceptual lead fallout zone is based on an approximate range of shotgun ammunition when fired from the top of the landfill (approximately 250 yards), with the assumption that lead fallout would land between the top of the landfill and this range.

*Part of the Landfill Area

Lead Screening Levels

17 mg/kg - Statewide Background
50 mg/kg - MTCA Plants
118 mg/kg - MTCA Wildlife
500 mg/kg - MTCA Soil Biota
501 mg/kg - TEE pCUL

J, J+: esimated value
mg/kg: milligrams per kilogram
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level
TEE: Terrestrial Ecological Evaluation

N

0 30 60 90
Feet

GSI Water Solutions, Inc.

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure8-3b_Soil_Analytical_Results_Pb__Ecological.mxd, iramos

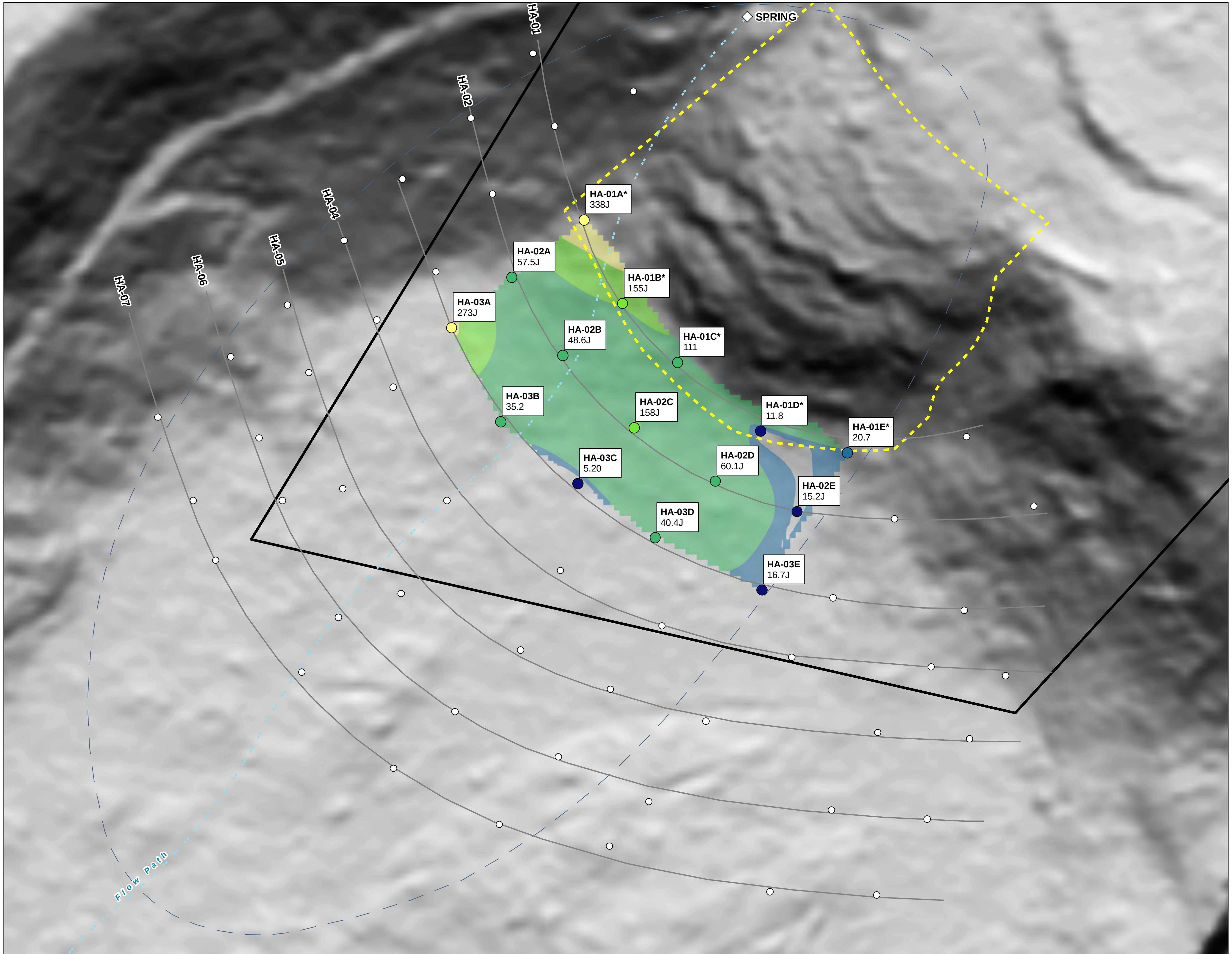


FIGURE 8-3c

Lead Human Health
0.5 to 1.0 foot Screening Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

Soil Boring Sample Location

Lead Concentrations (mg/kg)

Sample points	Shaded areas
0 - 17	0 - 17
18 - 25	18 - 25
26 - 150	26 - 150
151 - 250	151 - 250
> 250	> 250

All Other Features

Spring
Flow Path
Soil Sample Transect
Approximate Lead Shot Fallout Zone
Estimated Extent of the Landfill
Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.
4. The conceptual lead fallout zone is based on an approximate range of shotgun ammunition when fired from the top of the landfill (approximately 250 yards), with the assumption that lead fallout would land between the top of the landfill and this range.

*Part of the Landfill Area

Lead Screening Levels

17 mg/kg - Statewide Background
25 mg/kg - MTCA Method B Groundwater to Surface Water
150 mg/kg - MTCA Method B Protective of Groundwater
250 mg/kg - MTCA Method A Unrestricted Landuse

J, J+: esimated value
mg/kg: milligrams per kilogram
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level

N

0 30 60 90
Feet

GSI Water Solutions, Inc.

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure8-3c_Soil_Analytical_Results_Pb__Human.mxd, iramos

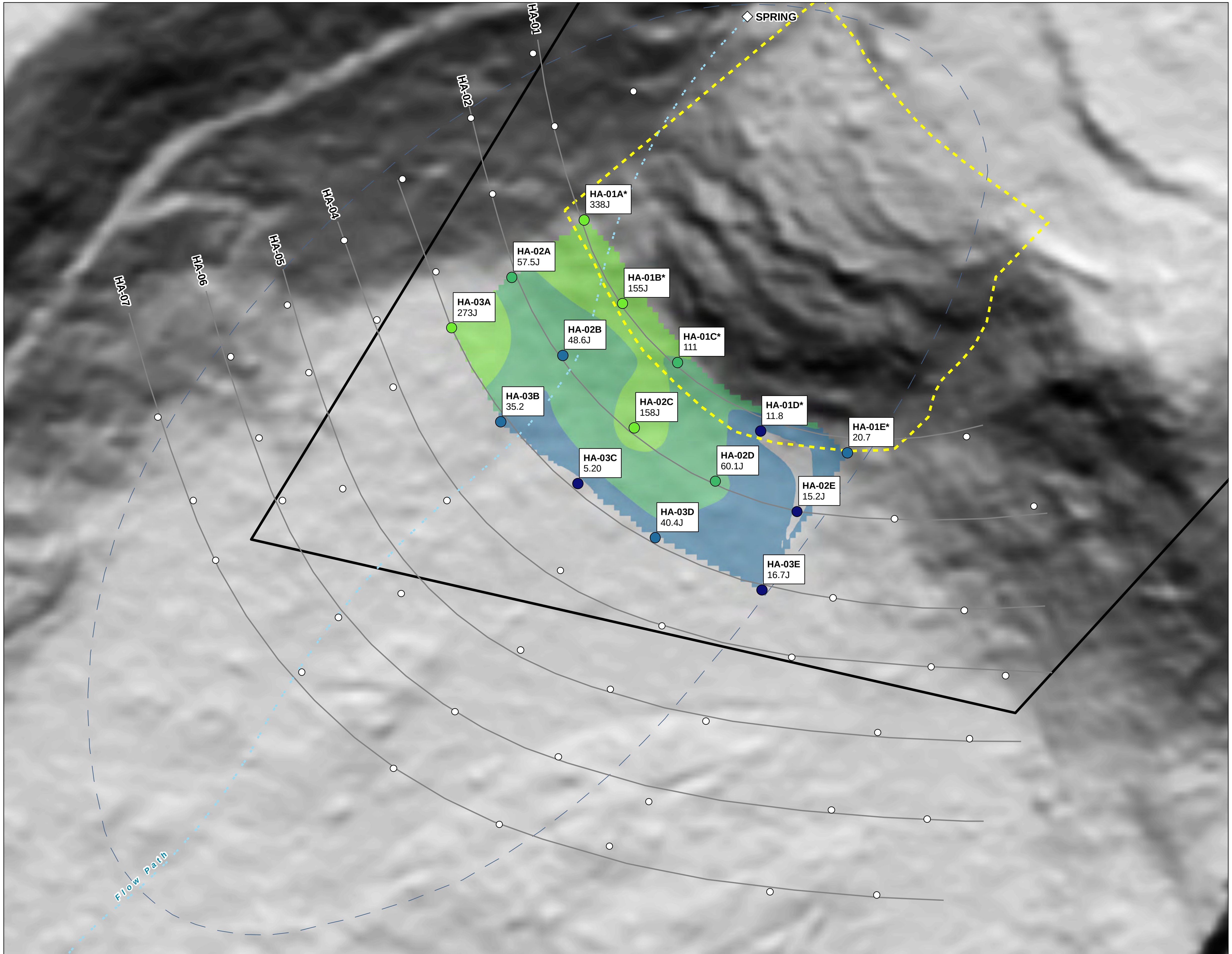


FIGURE 8-3d

Lead Ecological
0.5 to 1.0 foot Screening Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

○ Soil Boring Sample Location

Lead Concentrations (mg/kg)

Sample point	Shaded area
6 - 17	0 - 17
18 - 50	18 - 50
51 - 118	51 - 118
119 - 501	119 - 501
> 501	> 501

All Other Features

- Spring
- Flow Path
- Soil Sample Transect
- Approximate Lead Shot Fallout Zone
- Estimated Extent of the Landfill
- Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.
4. The conceptual lead fallout zone is based on an approximate range of shotgun ammunition when fired from the top of the landfill (approximately 250 yards), with the assumption that lead fallout would land between the top of the landfill and this range.

*Part of the Landfill Area

Lead Screening Levels

17 mg/kg - Statewide Background
50 mg/kg - MTCA Plants
118 mg/kg - MTCA Wildlife
500 mg/kg - MTCA Soil Biota
501 mg/kg - TEE pCUL

J, J+: esimated value
mg/kg: milligrams per kilogram
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level
TEE: Terrestrial Ecological Evaluation

N

0 30 60 90
Feet

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

GSI Water Solutions, Inc.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure8-3d_Soil_Analytical_Results_Pb__Ecological.mxd, iramos

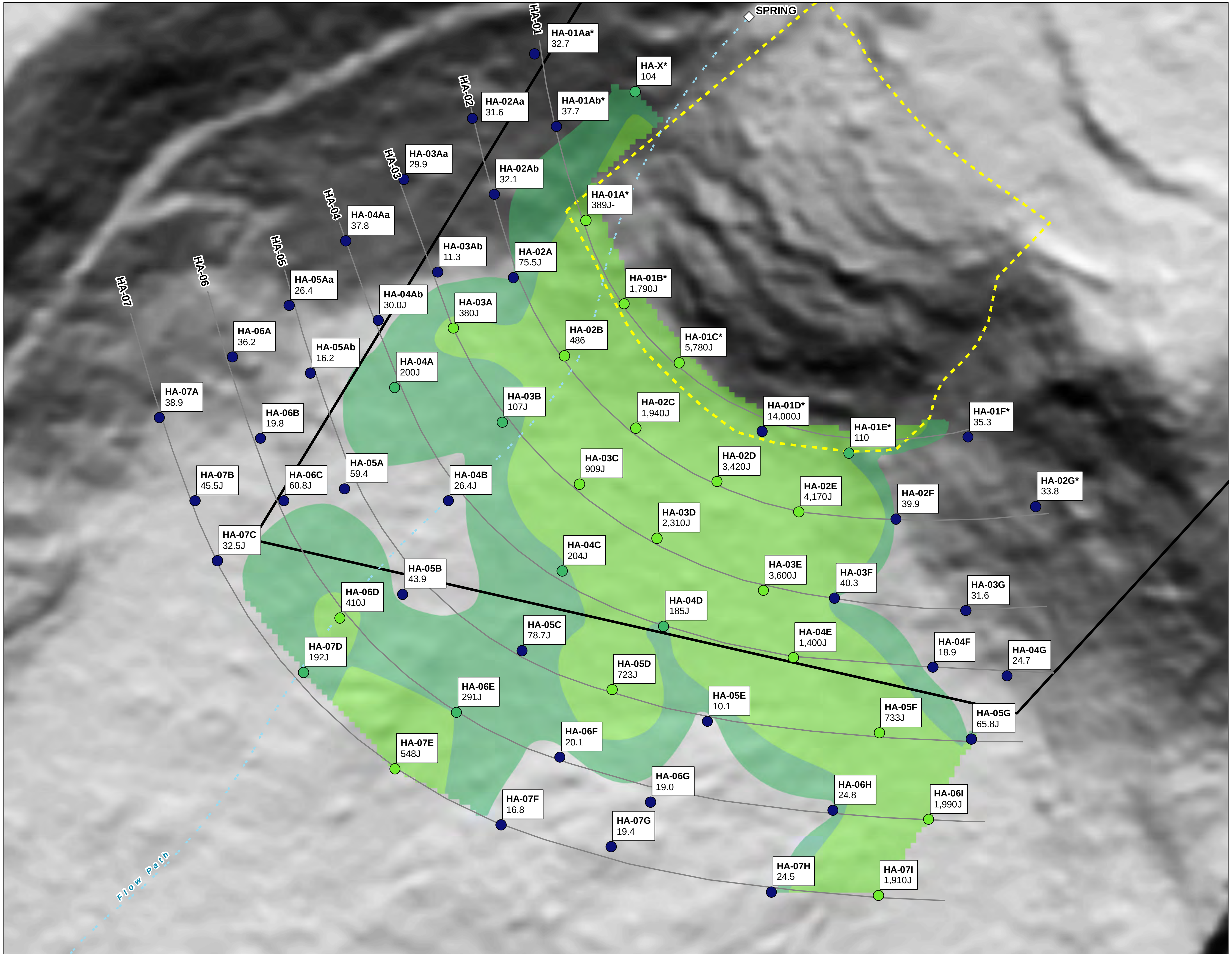


FIGURE 8-4a

Zinc Human Health Surface Soil Screening Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

Zinc Concentrations (mg/kg)

Points	Areas
0 - 86	0 - 86
87 - 300	87 - 300
> 300	> 300

All Other Features

- Spring
- Flow Path
- Soil Sample Transect
- Estimated Extent of the Landfill
- Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.

*Part of the Landfill Area

Zinc Screening Levels

86 mg/kg - Statewide Background
300 mg/kg - MTCA Method B Protective of Groundwater
24,000 mg/kg - MTCA Method B Direct Contact, Non-Cancer (no samples exceed)

J, J+: esimated value
mg/kg: milligrams per kilogram
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level

N

0 30 60 90
Feet

GSI Water Solutions, Inc.

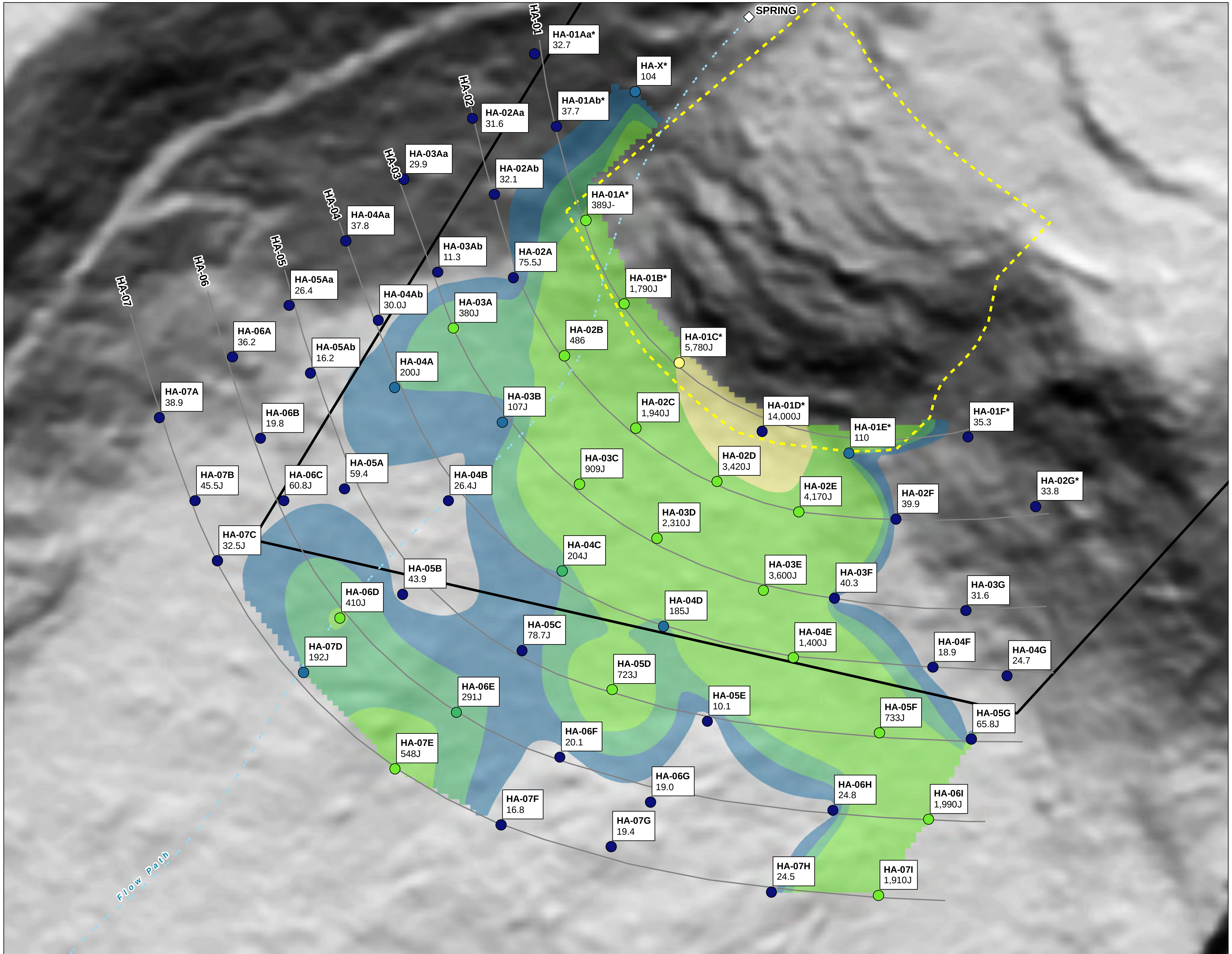
Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure8-4a_Soil_Analytical_Results_Zn_Landfill__Human.mxd, iramos

FIGURE 8-4b

Zinc Ecological Surface Soil Screening Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA



LEGEND

Zinc Concentrations

Sample points	Shaded areas
0 - 86	0 - 86
87 - 200	87 - 200
201 - 360	201 - 360
361 - 5,480	361 - 5,480
> 5,480	> 5,480

All Other Features

- Spring
- Flow Path
- Soil Sample Transect
- Estimated Extent of the Landfill
- Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.

*Part of the Landfill Area

Zinc Screening Levels

86 mg/kg - Statewide Background MTCA Plants
200 mg/kg - MTCA Soil Biota
360 mg/kg - MTCA Wildlife
5,480 mg/kg - TEE pCUL

J, J+: esimated value
mg/kg: milligrams per kilogram
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level
TEE: Terrestrial Ecological Evaluation

N

0 30 60 90
Feet

GSI Water Solutions, Inc.

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure8-4b_Soil_Analytical_Results_Zn_Landfill__Ecological.mxd, iramos

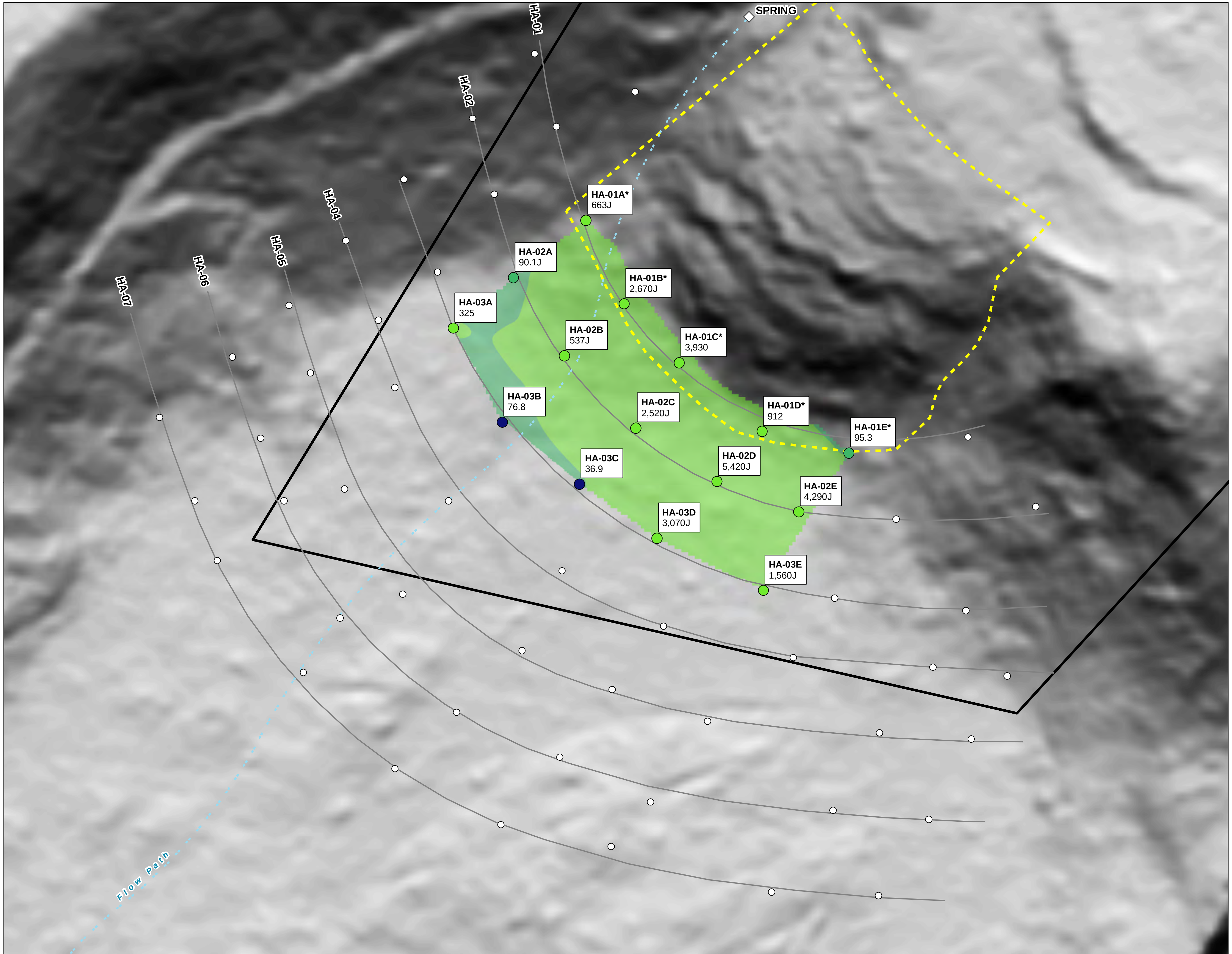


FIGURE 8-4c

Zinc Human Health
0.5 to 1.0 foot Screening Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

○ Soil Boring Sample Location

Zinc Concentrations (mg/kg)

Sample points	Shaded areas
0 - 86	0 - 86
87 - 300	87 - 300
> 300	> 300

All Other Features

- Spring
- Flow Path
- Soil Sample Transect
- Estimated Extent of the Landfill
- Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.

*Part of the Landfill Area

Zinc Screening Levels

86 mg/kg - Statewide Background
300 mg/kg - MTCA Method B Protective of Groundwater
24,000 mg/kg - MTCA Method B Direct Contact, Non-Cancer (no samples exceed)

J, J+: esimated value
mg/kg: milligrams per kilogram
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level

N

0 30 60 90
Feet

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

GSI Water Solutions, Inc.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure8-4c_Soil_Analytical_Results_Zn_Landfill__Human.mxd, iramos

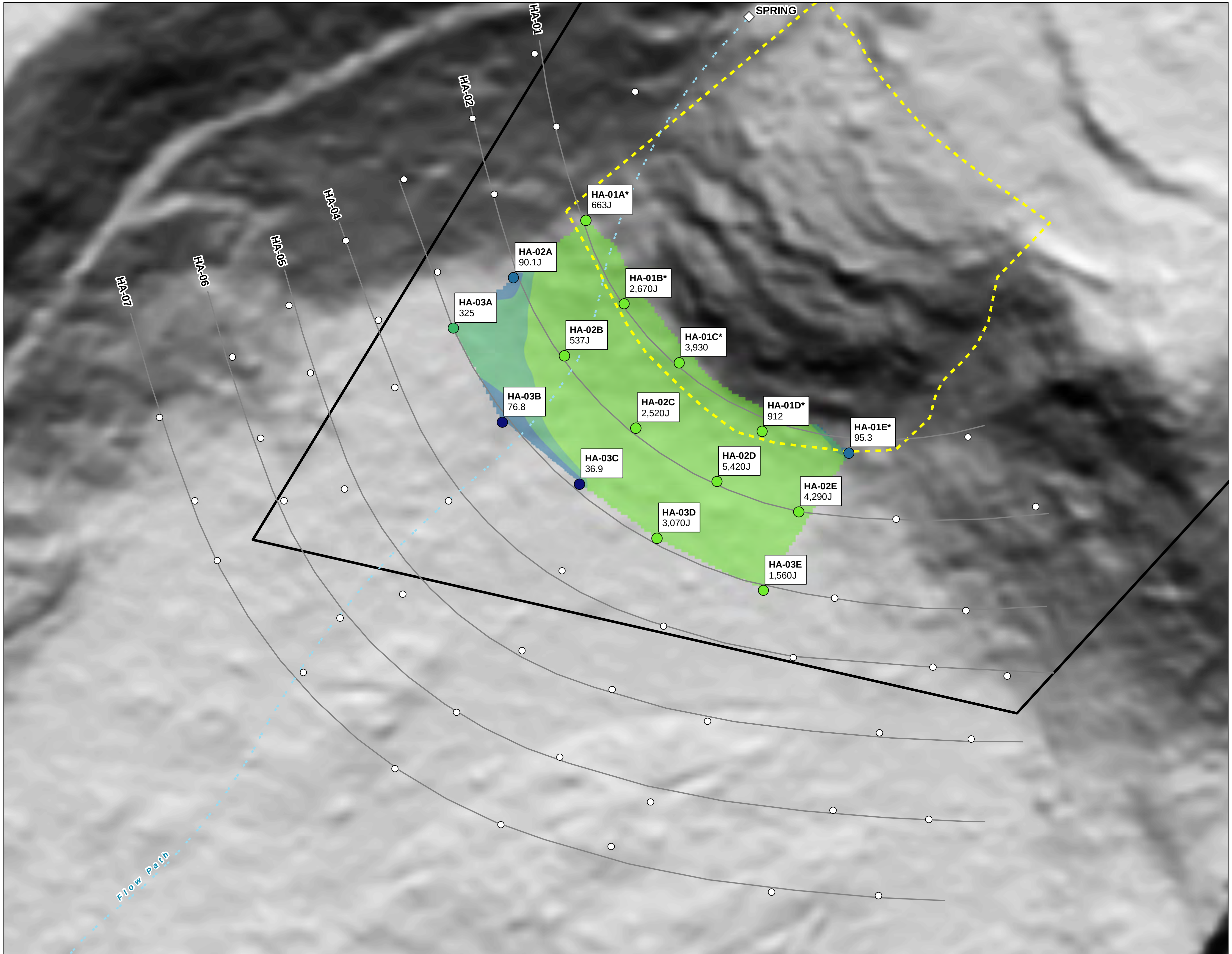


FIGURE 8-4d

Zinc Ecological
0.5 to 1.0 foot Screening Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

○ Soil Boring Sample Location

Zinc Concentrations

Points	Areas
0 - 86	0 - 86
87 - 200	87 - 200
201 - 360	201 - 360
361 - 5,480	361 - 5,480
> 5,480	> 5,480

All Other Features

- Spring
- Flow Path
- Soil Sample Transect
- Estimated Extent of the Landfill
- Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.

*Part of the Landfill Area

Zinc Screening Levels

86 mg/kg - Statewide Background MTCA Plants
200 mg/kg - MTCA Soil Biota
360 mg/kg - MTCA Wildlife
5,480 mg/kg - TEE pCUL

J, J+: esimated value
mg/kg: milligrams per kilogram
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level
TEE: Terrestrial Ecological Evaluation

N

0 30 60 90
Feet

GSI Water Solutions, Inc.

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure8-4d_Soil_Analytical_Results_Zn_Landfill__Ecological.mxd, iramos

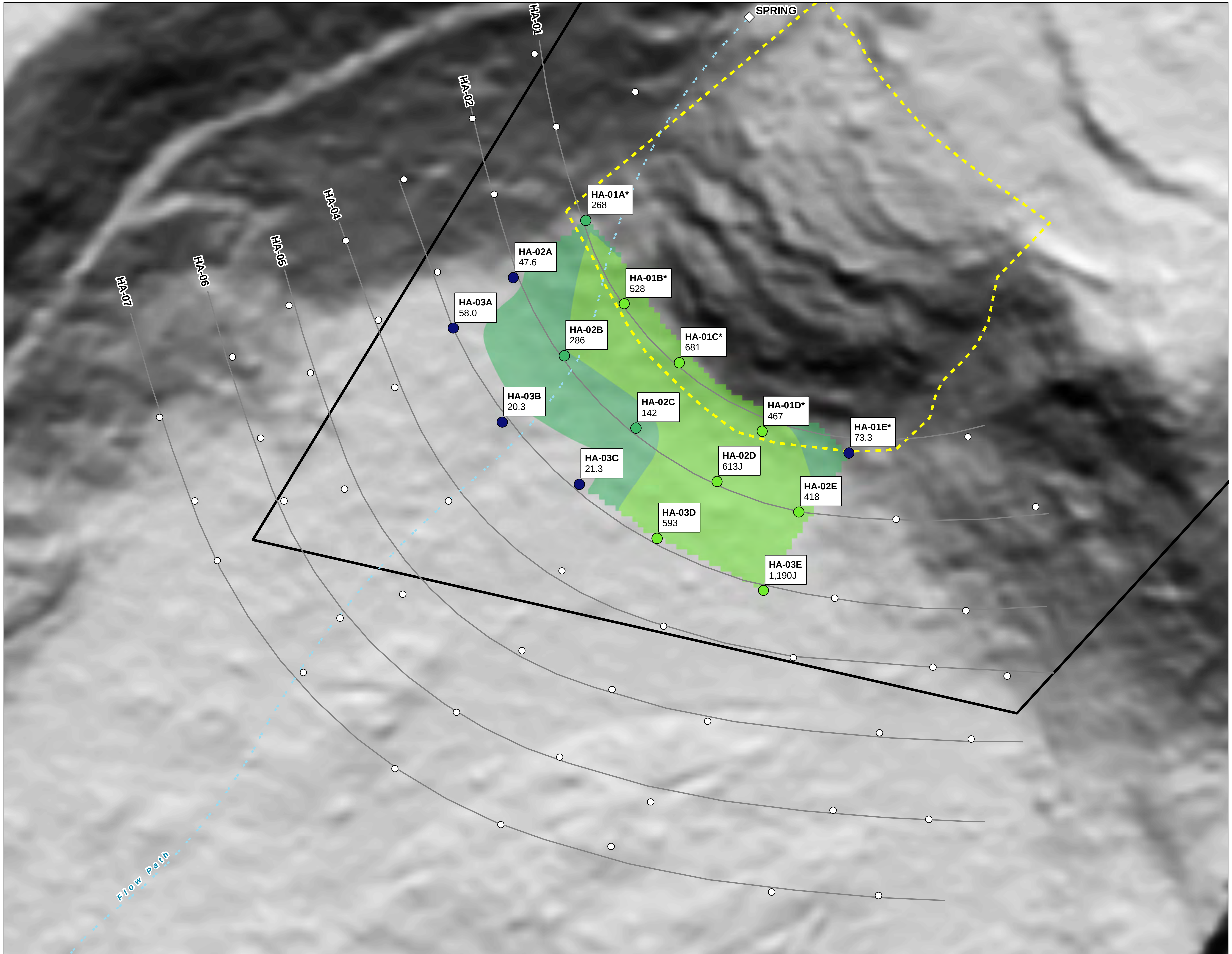


FIGURE 8-4e

Zinc Human Health
1.0 to 2.0 foot Screening Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

Soil Boring Sample Location

Zinc Concentrations (mg/kg)

Points	Areas
0 - 86	0 - 86
87 - 300	87 - 300
> 300	> 300

All Other Features

- Spring
- Flow Path
- Soil Sample Transect
- Estimated Extent of the Landfill
- Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.

*Part of the Landfill Area

Zinc Screening Levels
86 mg/kg - Statewide Background
300 mg/kg - MTCA Method B Protective of Groundwater
24,000 mg/kg - MTCA Method B Direct Contact, Non-Cancer (no samples exceed)

J, J+: esimated value
mg/kg: milligrams per kilogram
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level

N

0 30 60 90
Feet

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

GSI Water Solutions, Inc.

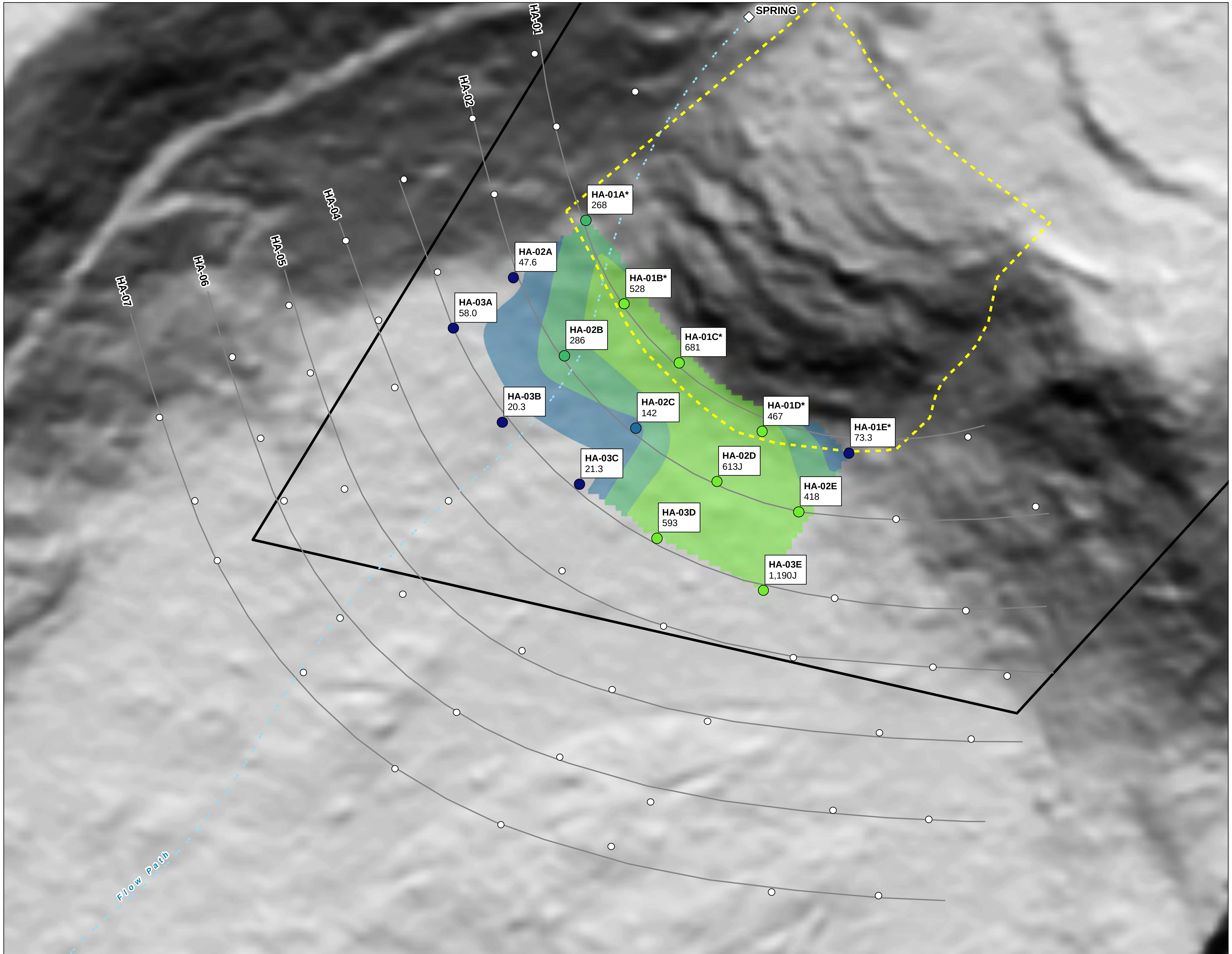


FIGURE 8-4f

Zinc Ecological
1.0 to 2.0 foot Screening Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

Soil Boring Sample Location

Zinc Concentrations

0 - 86	0 - 86
87 - 200	87 - 200
201 - 360	201 - 360
361 - 5,480	361 - 5,480
> 5,480	> 5,480

All Other Features

- Spring
- Flow Path
- Soil Sample Transect
- Estimated Extent of the Landfill
- Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.

*Part of the Landfill Area

Zinc Screening Levels

86 mg/kg - Statewide Background MTCA Plants
200 mg/kg - MTCA Soil Biota
360 mg/kg - MTCA Wildlife
5,480 mg/kg - TEE pCUL

J, J+: esimated value
mg/kg: milligrams per kilogram
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level
TEE: Terrestrial Ecological Evaluation

N

0 30 60 90
Feet

GSI Water Solutions, Inc.

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

Document Path: Y:\0171_Weyerhaeuser\Source_Figures\074_Former_Eatonville_Landfill\Final_RIFS\Figure8-4f_Soil_Analytical_Results_Zn_Landfill__Ecological.mxd, iramos

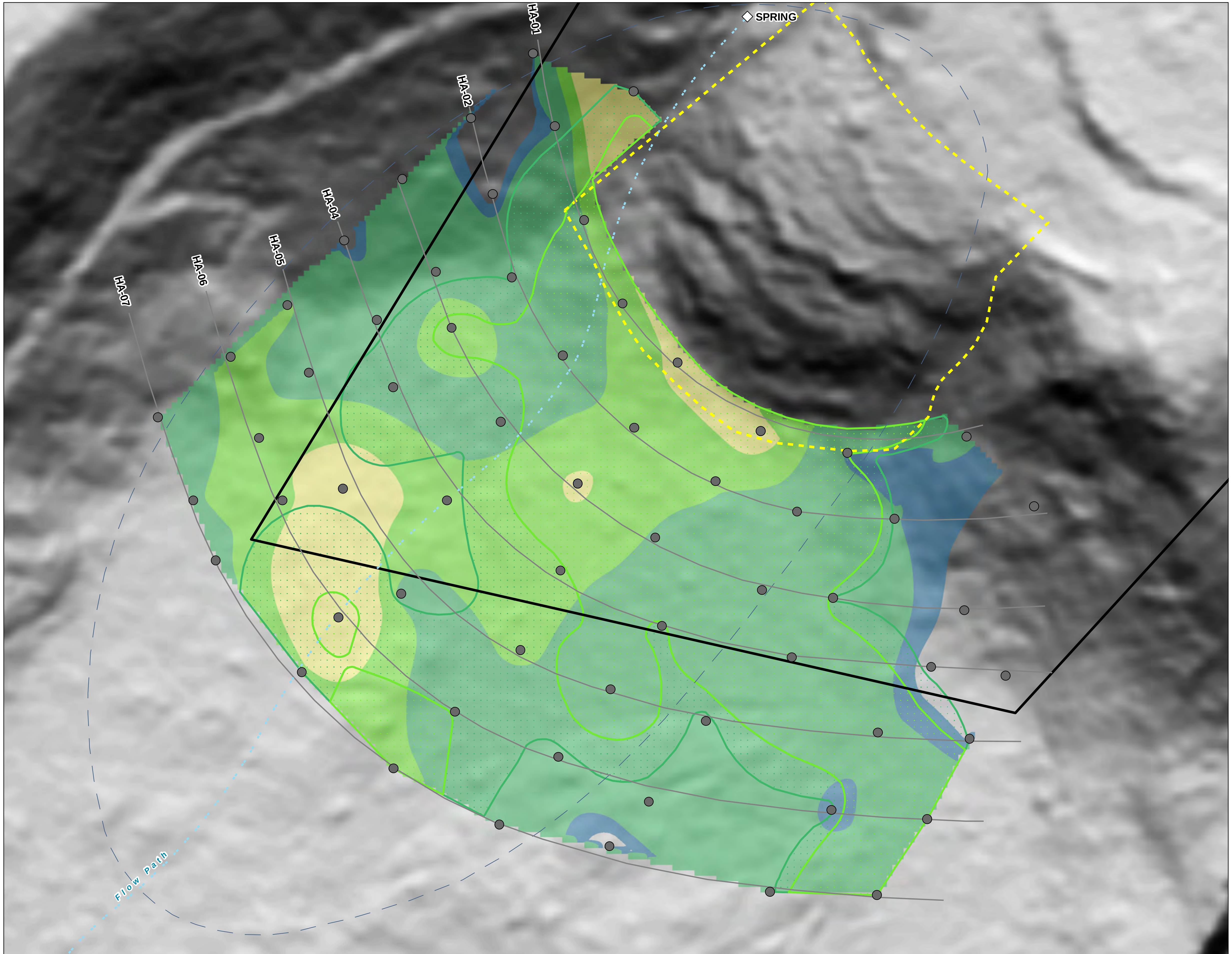


FIGURE 8-5a

Human Health Lead and Zinc Surface Soil Screening Overlay

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

Soil Boring Sample Location

Concentrations (mg/kg)

Lead	Zinc
0 - 17	0 - 86
18 - 25	87 - 300
26 - 150	> 300
151 - 250	
> 250	

All Other Features

- Spring
- Flow Path
- Soil Sample Transect
- Approximate Lead Shot Fallout Zone
- Estimated Extent of the Landfill
- Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.
4. The conceptual lead fallout zone is based on an approximate range of shotgun ammunition when fired from the top of the landfill (approximately 250 yards), with the assumption that lead fallout would land between the top of the landfill and this range.

*Part of the Landfill Area

Lead Screening Levels
17 mg/kg - Statewide Background
25 mg/kg - MTCA Method B Groundwater to Surface Water
50 mg/kg - MTCA Ecological Indicator
250 mg/kg - MTCA Method A Unrestricted Landuse
510 mg/kg - TEE pCUL

Zinc Screening Levels
86 mg/kg - Statewide Background
300 mg/kg - MTCA Method B Protective of Groundwater
5,500 mg/kg - TEE pCUL

J, J+: esimated value
mg/kg: milligrams per kilogram
Pb: Lead
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level
TEE: Terrestrial Ecological Evaluation

N

0 30 60 90
Feet

GSI Water Solutions, Inc.

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

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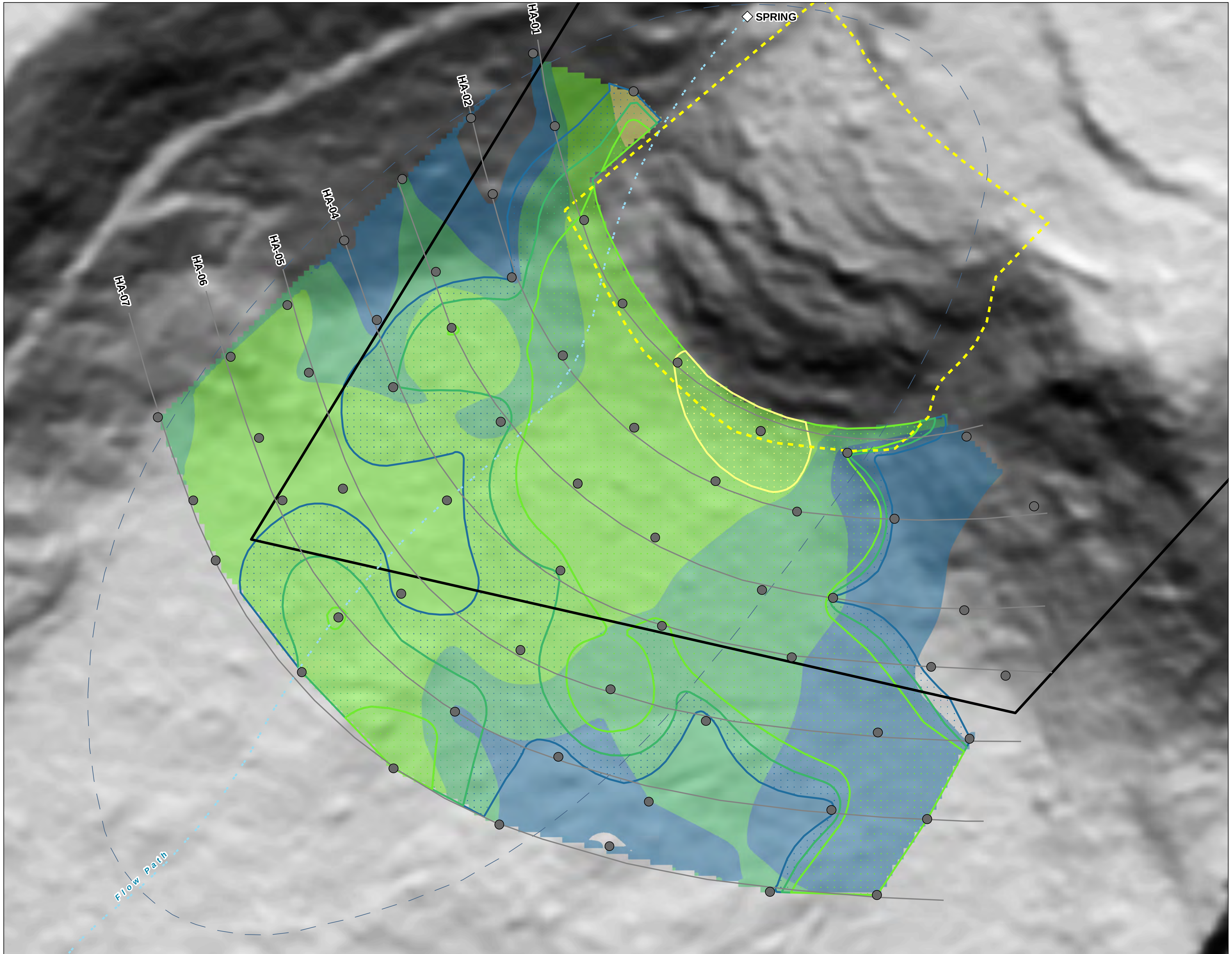


FIGURE 8-5b

Ecological Lead and Zinc Surface Soil Screening Overlay

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

Soil Boring Sample Location

Concentrations (mg/kg)

Lead	Zinc
0 - 17	0 - 86
18 - 50	87 - 200
51 - 118	201 - 360
119 - 501	361 - 5,480
> 501	> 5,480

All Other Features

- Spring
- Flow Path
- Soil Sample Transect
- Approximate Lead Shot Fallout Zone
- Estimated Extent of the Landfill
- Weyerhaeuser Property

NOTES

1. Site features are approximate.
2. Results shown in milligrams per kilogram.
3. Surface soil samples were collected to 0.5 feet below ground surface.
4. The conceptual lead fallout zone is based on an approximate range of shotgun ammunition when fired from the top of the landfill (approximately 250 yards), with the assumption that lead fallout would land between the top of the landfill and this range.

*Part of the Landfill Area

Lead Screening Levels
17 mg/kg - Statewide Background
25 mg/kg - MTCA Method B Groundwater to Surface Water
50 mg/kg - MTCA Ecological Indicator
250 mg/kg - MTCA Method A Unrestricted Landuse
501 mg/kg - TEE pCUL

Zinc Screening Levels
86 mg/kg - Statewide Background
300 mg/kg - MTCA Method B Protective of Groundwater
5,480 mg/kg - TEE pCUL

J, J+: esimated value
mg/kg: milligrams per kilogram
Pb: Lead
MTCA: Model Toxics Control Act
pCUL: Proposed Cleanup Level
TEE: Terrestrial Ecological Evaluation

N

0 30 60 90
Feet

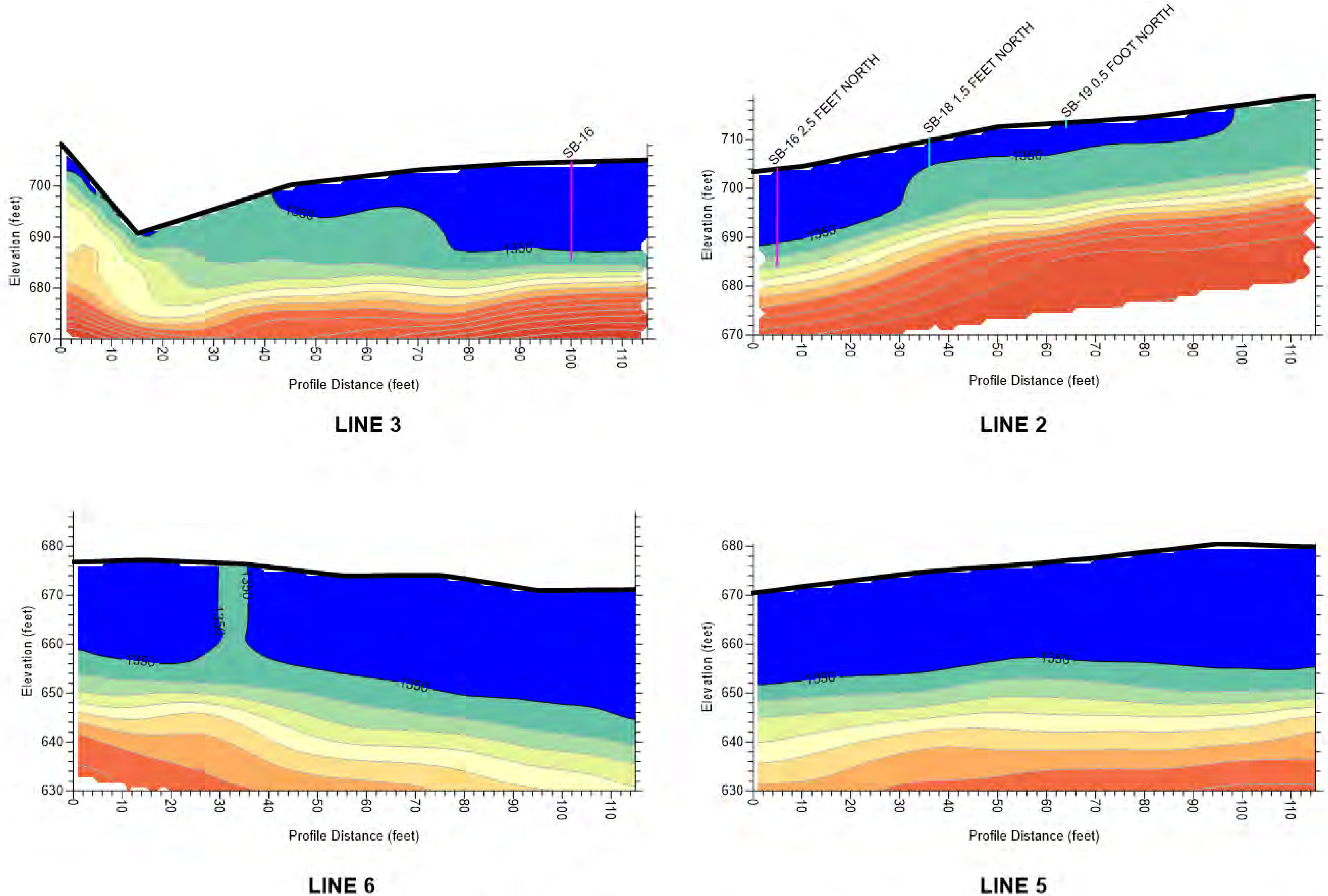
Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

GSI Water Solutions, Inc.

FIGURE 8-6a

Geophysical Survey Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

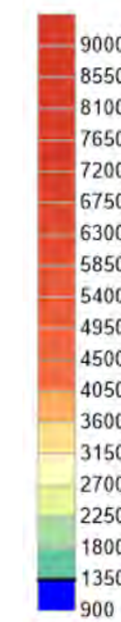


LEGEND

Soil Boring Bottom of Waste

Soil Boring

Compression Wave Velocity (feet/sec)



Data Sources: Geophysical Survey (2022)

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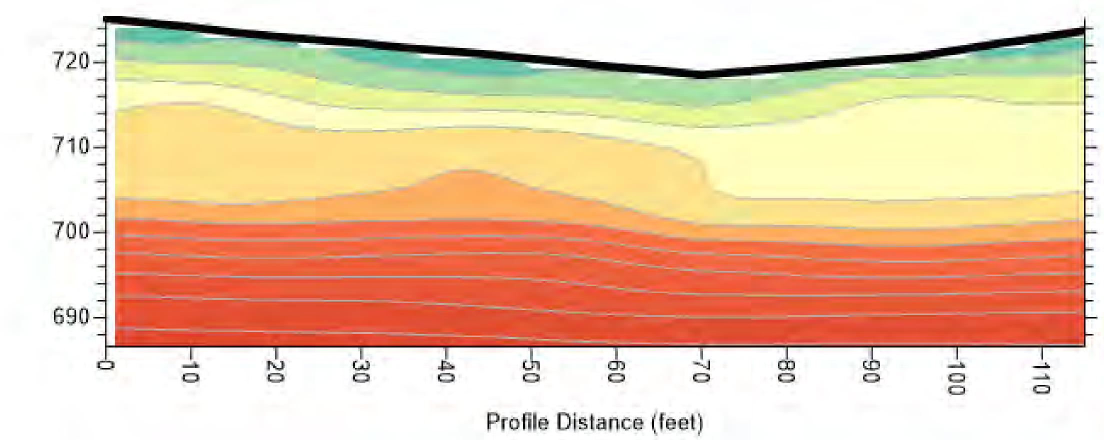
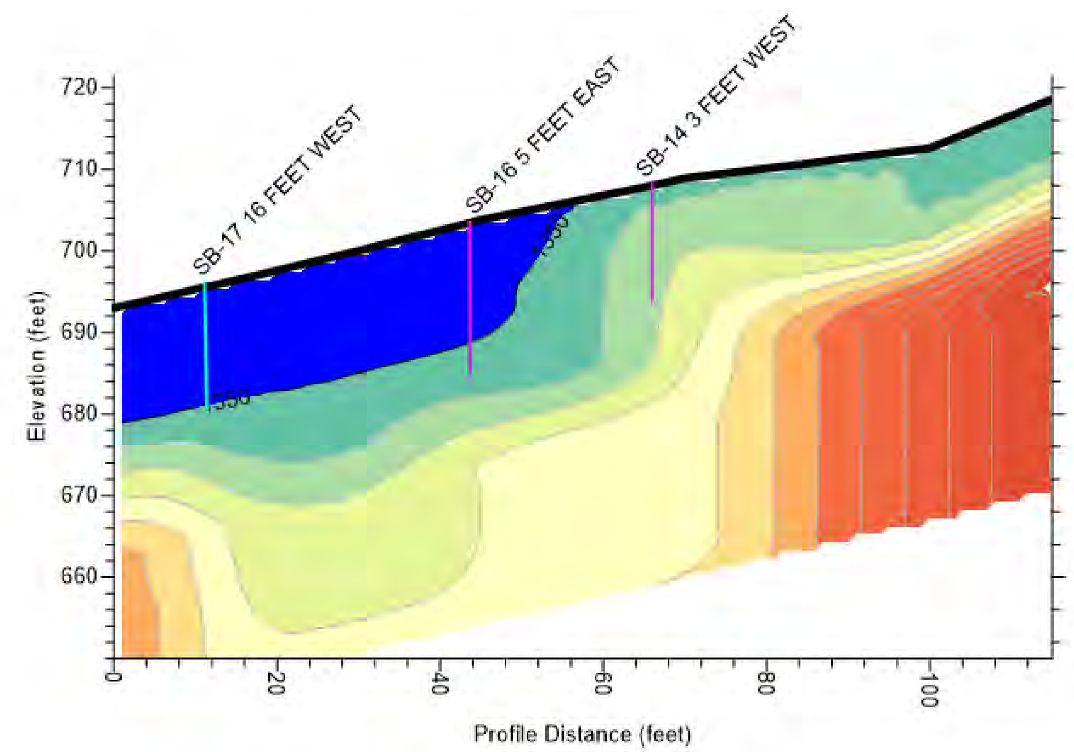
FIGURE 8-6b

Geophysical Survey Results

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA



LINE 1



LINE 4

LEGEND

Soil Boring Bottom of Waste

Soil Boring

Compression Wave Velocity (feet/sec)

9000
8550
8100
7650
7200
6750
6300
5850
5400
4950
4500
4050
3600
3150
2700
2250
1800
1350
900

Data Sources: Geophysical Survey (2022)

GSI Water Solutions, Inc.

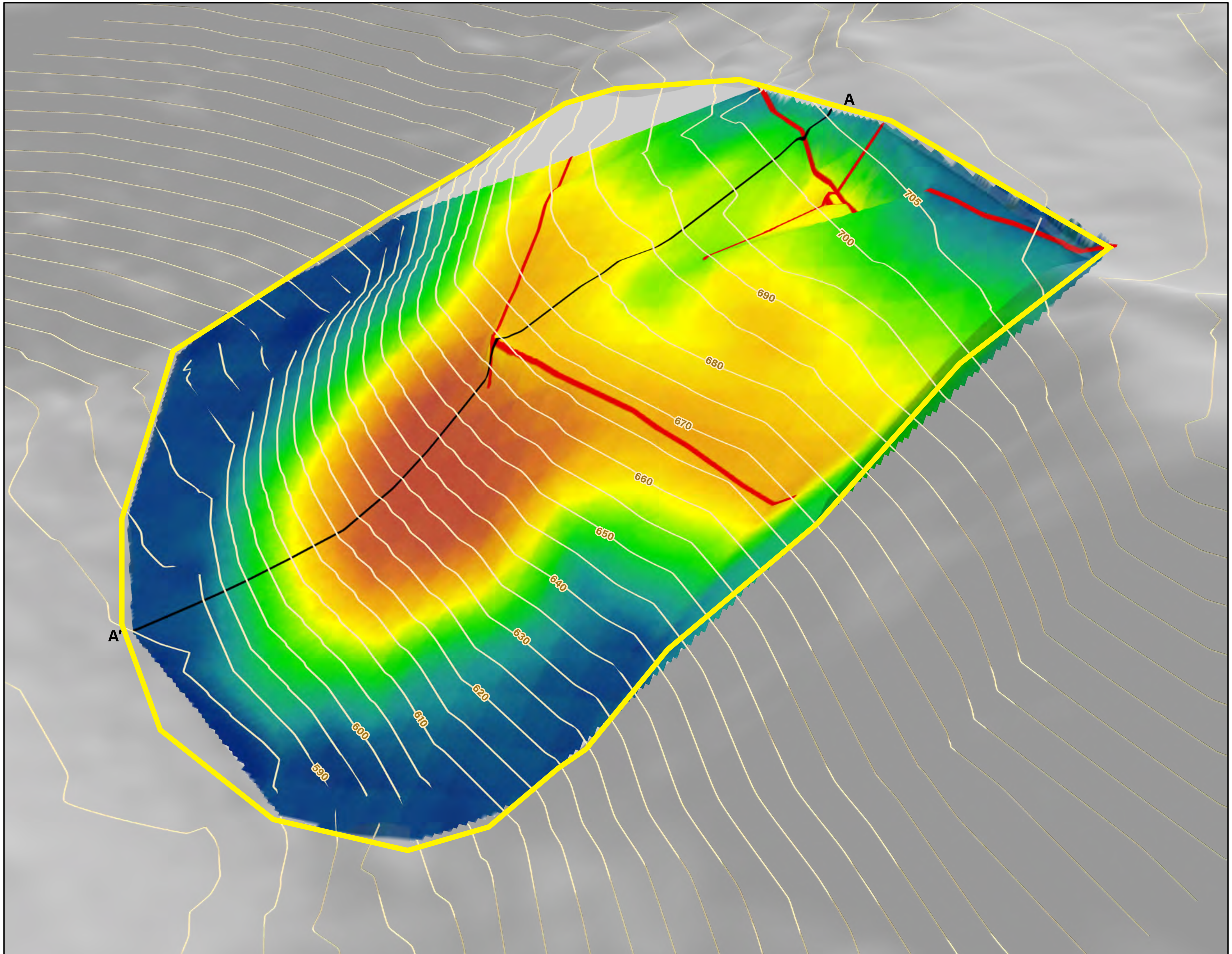


FIGURE 8-7

Estimated Waste Prism Extents

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Cross Section A-A'
- Geophysical Seismic Line
- Elevation Contour (feet NAVD 88)
- Estimated Extent of the Landfill

Waste Prism Thickness (feet)

0

31.2

NOTE

NAVD 88: North American Vertical Datum of 1988

N

0 30 60 90
Feet

Date: April 26, 2023
Data Sources: BLM, ESRI, ODOT, USGS, Pierce Co., Foresight Surveying (2022)
Geophysical Survey (2022)

GSI Water Solutions, Inc.

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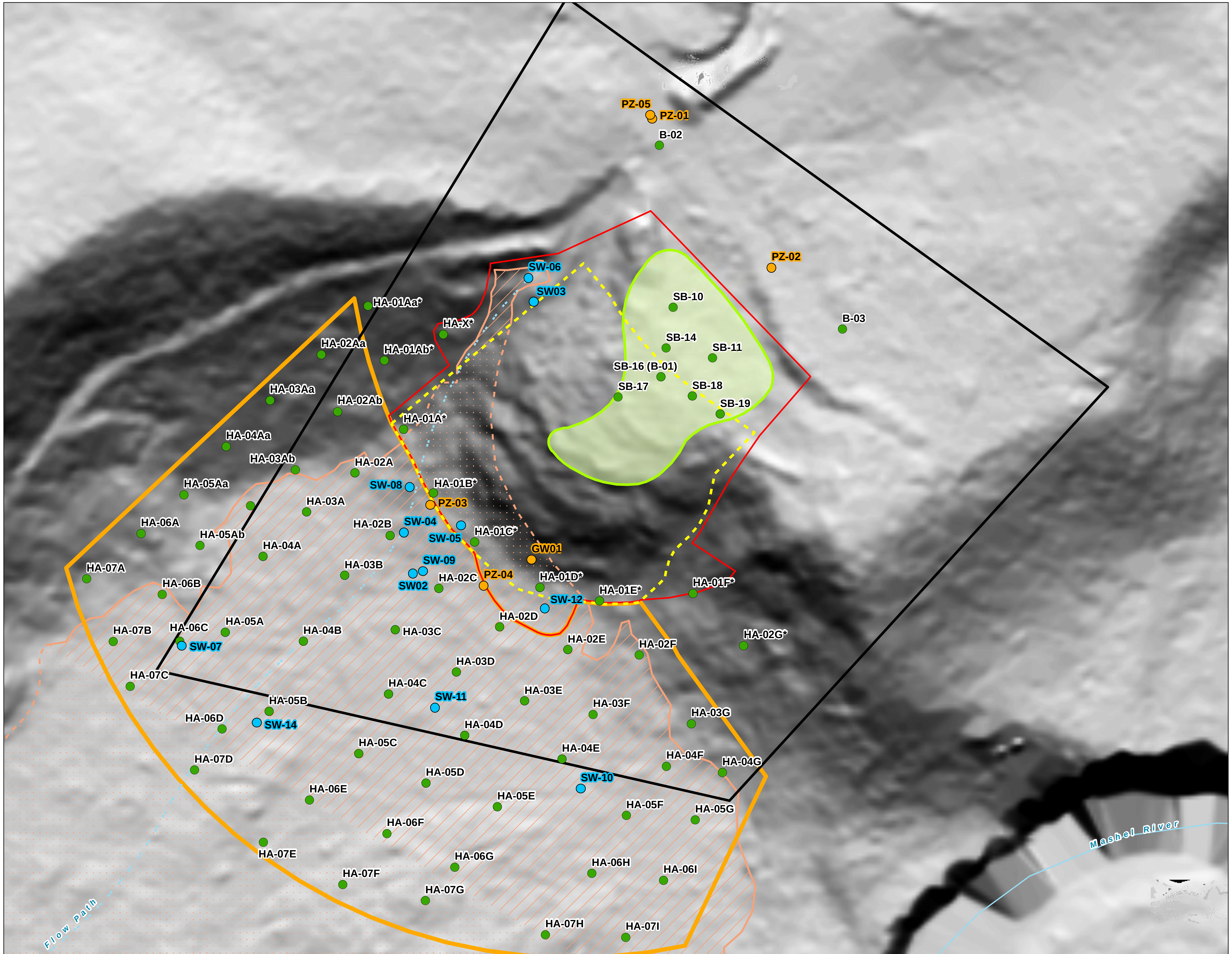

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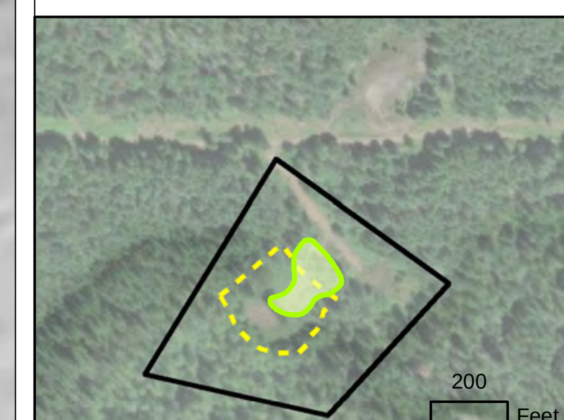
FIGURE 12-1

Remedial Alternative Areas

Remedial Investigation/
Feasibility Study
Former Eatonville Landfill
Eatonville, WA

LEGEND

- Soil Sample Location
- Surface Water Sample Location
- Groundwater Sample Location
- Landfill Area
- Wetland Area
- Wetland
- Inferred Wetland
- Estimated Extent of the Landfill
- Weyerhaeuser Property
- Flow Path
- Mashel River



NOTES

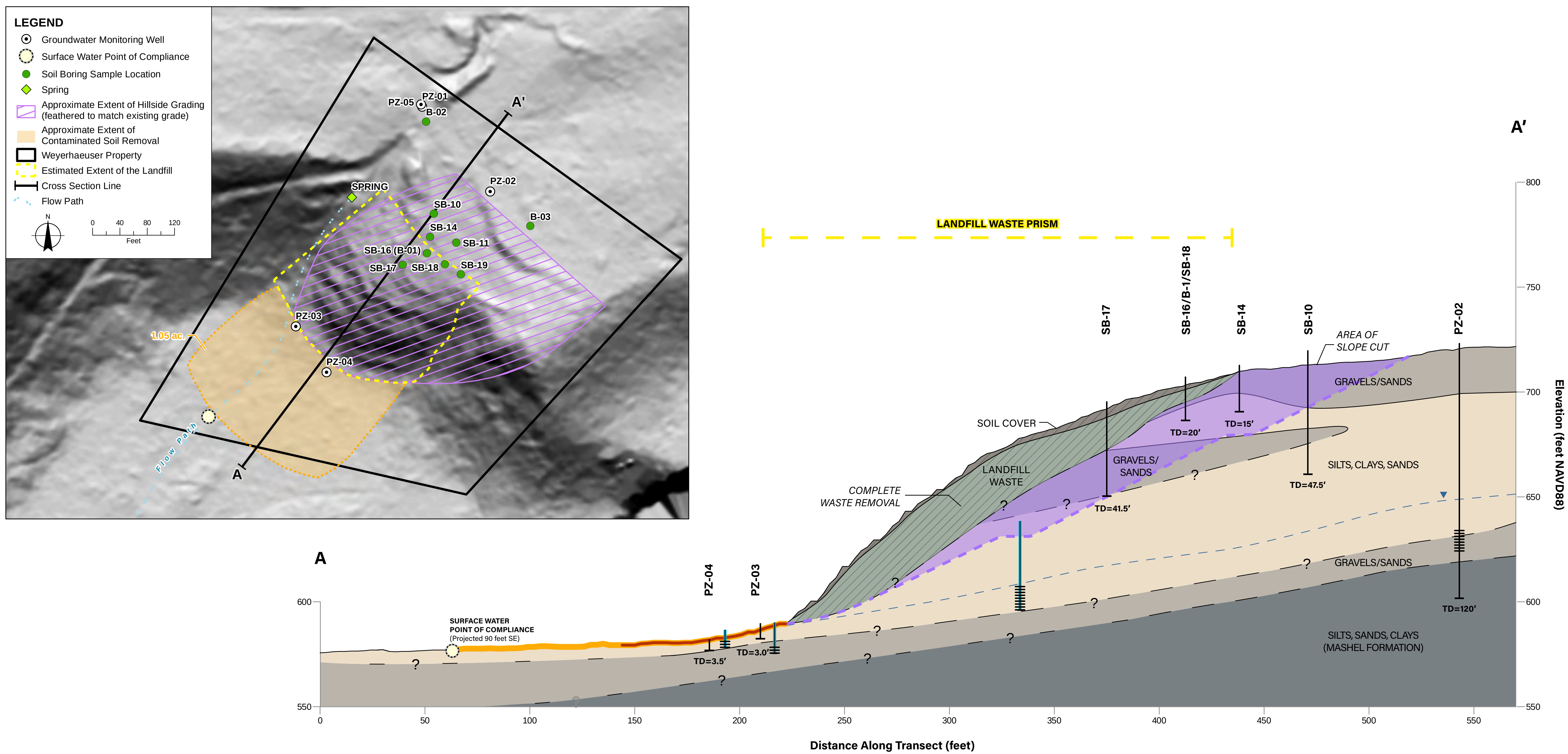
1. Site features are approximate.
*Part of the Landfill Area

N

0 40 80 120
Feet

Date: December 19, 2023
Data Sources: USGS, ESRI, DNR (2011), Pierce Co.

GSI Water Solutions, Inc.



LEGEND

Water Table

Boring and Well Legend

Groundwater Point of Compliance

Screen

Soil Cover

Landfill Waste Prism

Vashon Drift

Coarse Gravels and Sands; Silty

Silts, Clays, Silty Sands

Mashel Formation

Silts, Sands, Clays

New Surface Grade: full removal 2:1 slope with 15 ft wide benches every 100 feet and no extension into Wetland Area (See note)

Approximate Extent of Contaminated Soil Removal

Approximate Extent of Landfill Debris in the Wetlands

Complete Waste Removal

Area of Slope Cut

NOTES

NAVD88: North American Vertical Datum of 1988

TD: total depth

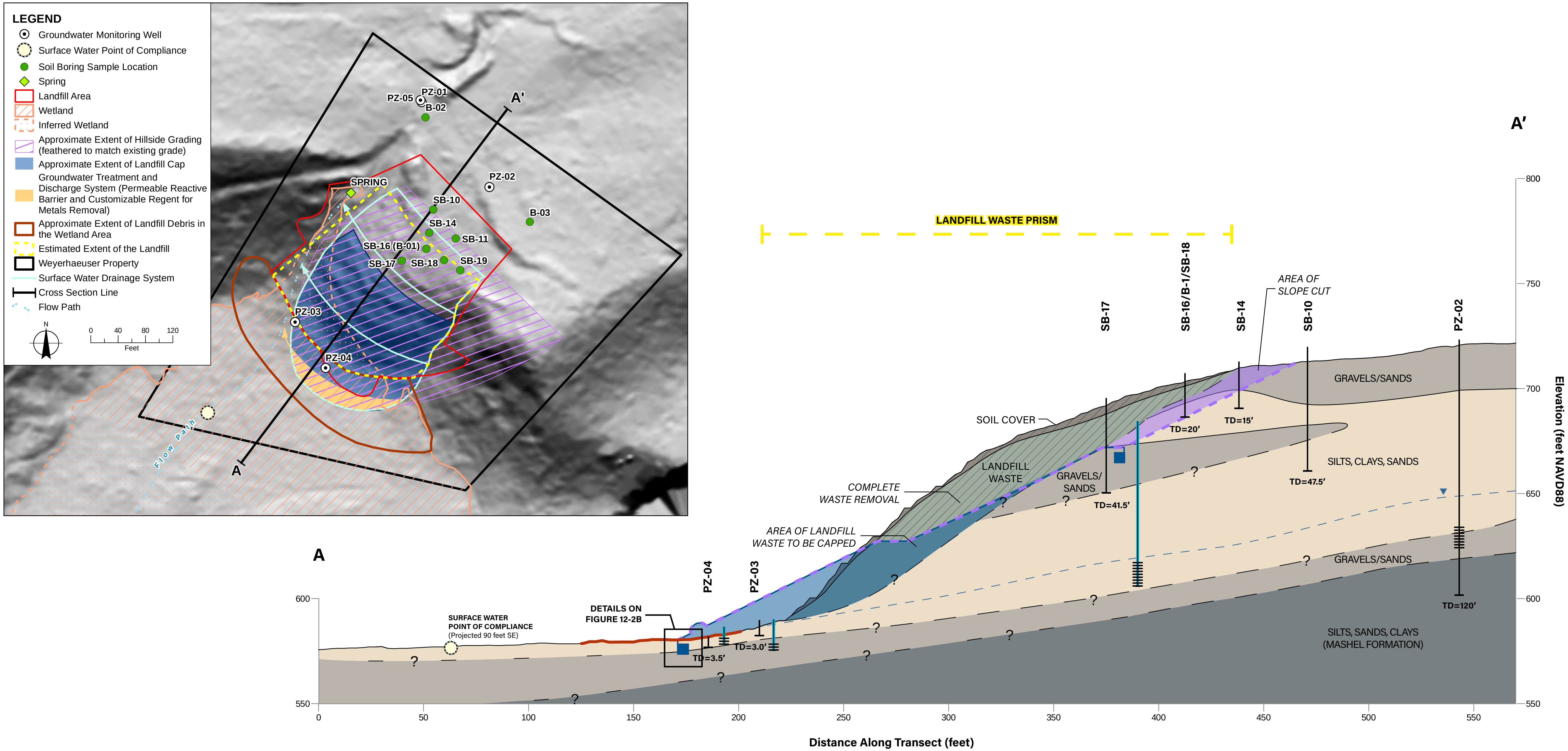
If loose gravel or sand is observed at the new leave surface, this material will be either removed and filled with suitable base-course (potentially material excavated from Site) or slopes will be no greater than 2.5H:1V.

FIGURE 12-2

Alternatives 1A and 2A Plan View and Cross Section A-A'

Remedial Investigation/Feasibility Study
Former Eatonville Landfill
Eatonville, WA

GSI Water Solutions, Inc.



LEGEND

Water Table

Boring and Well Legend

Groundwater Point of Compliance

Screen

- Soil Cover
- Landfill Waste

Vashon Drift

- Coarse Gravels and Sands; Silty
- Silts, Clays, Silty Sands

Mashel Formation

- Silts, Sands, Clays

- Approximate Extent of Contaminated Soil Removal
- New Surface Grade for partial removal 2:1 slope with 15 ft wide benches every 100 ft. The net cut/fill volumes for final grade will be near zero (See note)
- Approximate Extent of Landfill Debris in the Wetlands
- Cap Anchor Trench and Drainage Feature

- Complete Waste Removal
- Area of Slope Cut
- Area of Landfill Waste to be Capped

NOTES

NAVD88: North American Vertical Datum of 1988

TD: total depth

If loose gravel or sand is observed at the new leave surface, this material will be either removed and filled with suitable base-course (potentially material excavated from Site) or slopes will be no greater than 2.5H:1V.

FIGURE 12-3a

Alternatives 1B and 2B Plan View and Cross Section A-A'

Remedial Investigation/Feasibility Study
Former Eatonville Landfill
Eatonville, WA

GSI Water Solutions, Inc.

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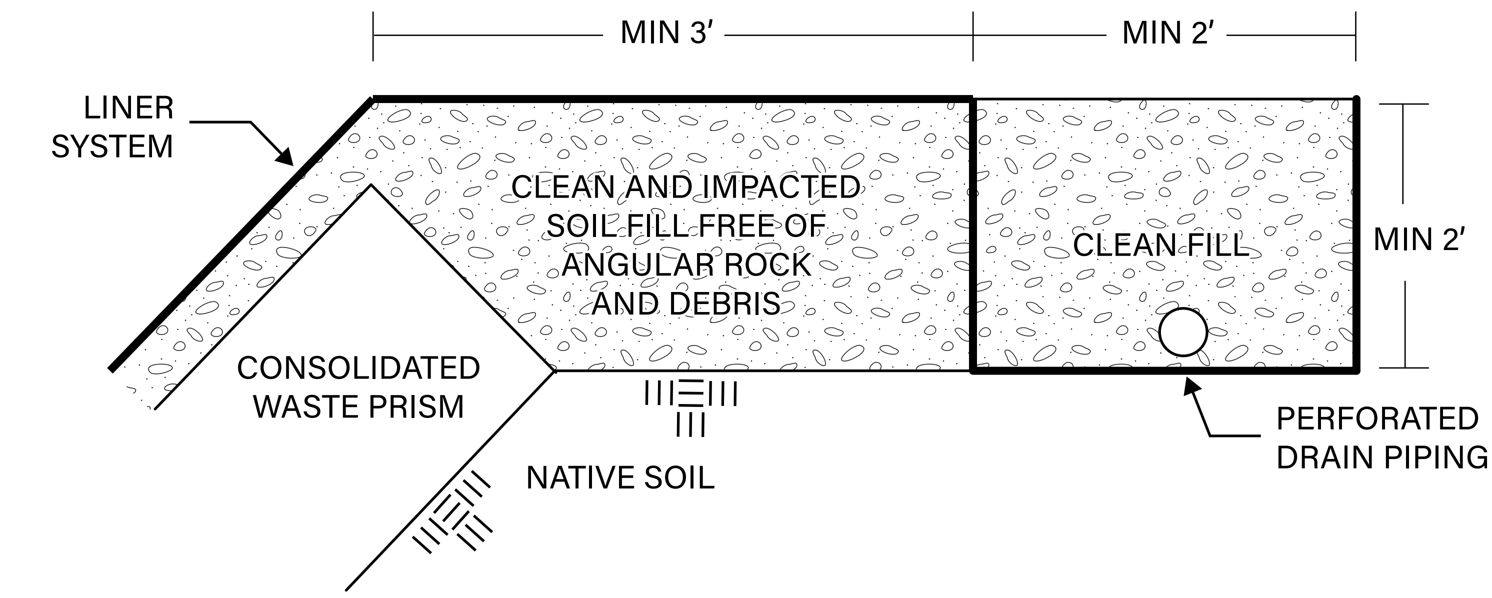
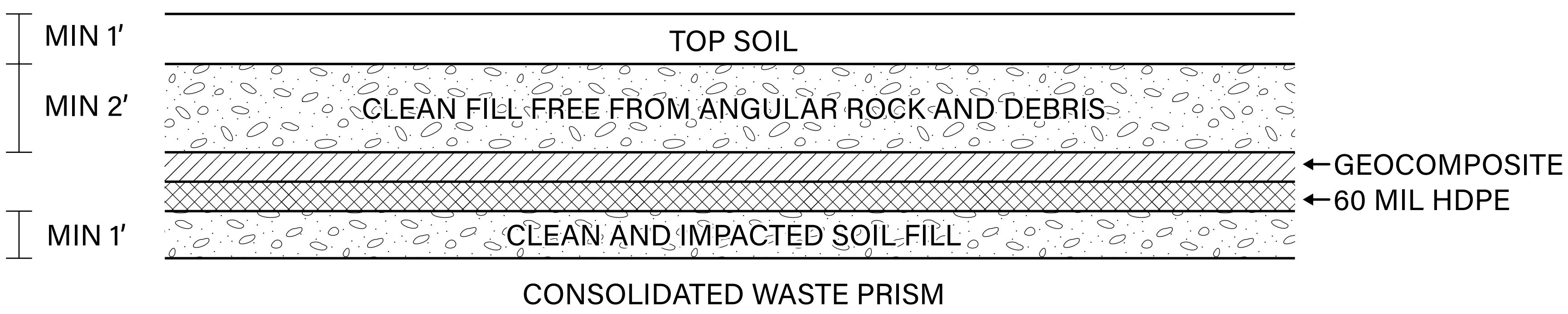
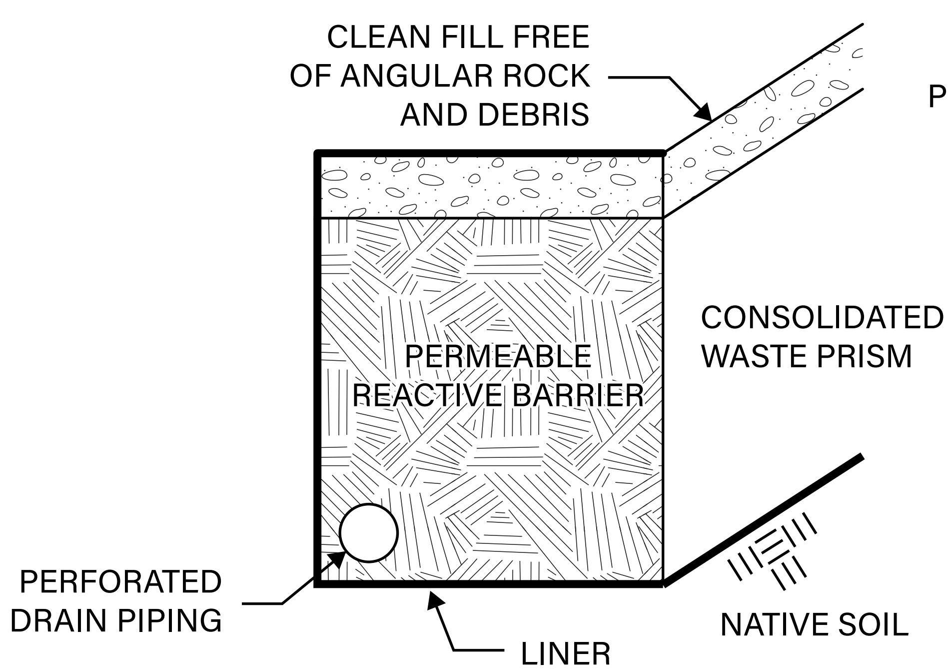
ANCHOR TRENCH DETAIL



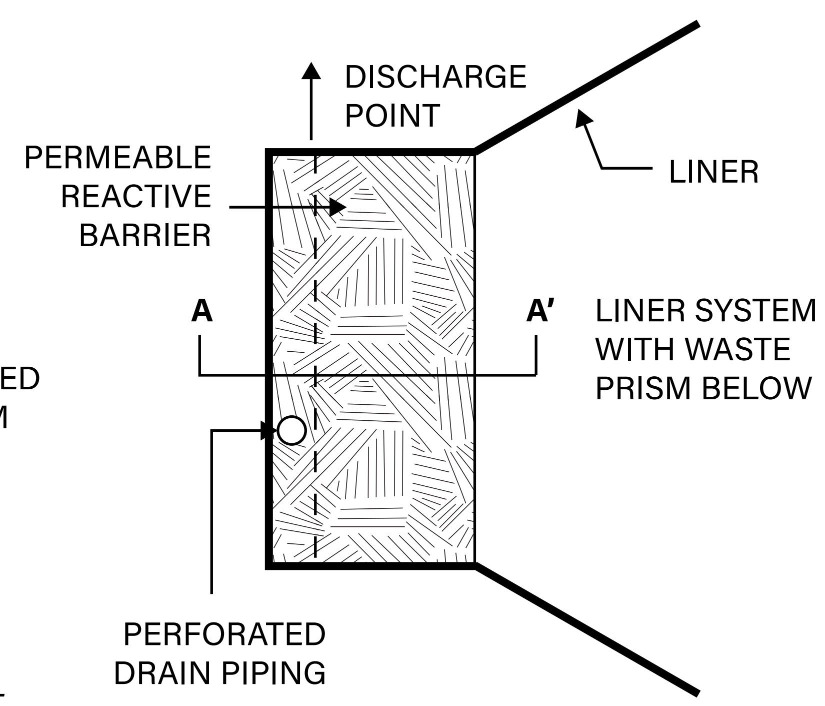
LINER DETAIL



LEACHATE COLLECTION TRENCH DETAIL



A-A′ CROSS SECTION



PLAN VIEW

FIGURE 12-3b

Alternative 1B Cap Anchor Trench and Drainage Feature Detail

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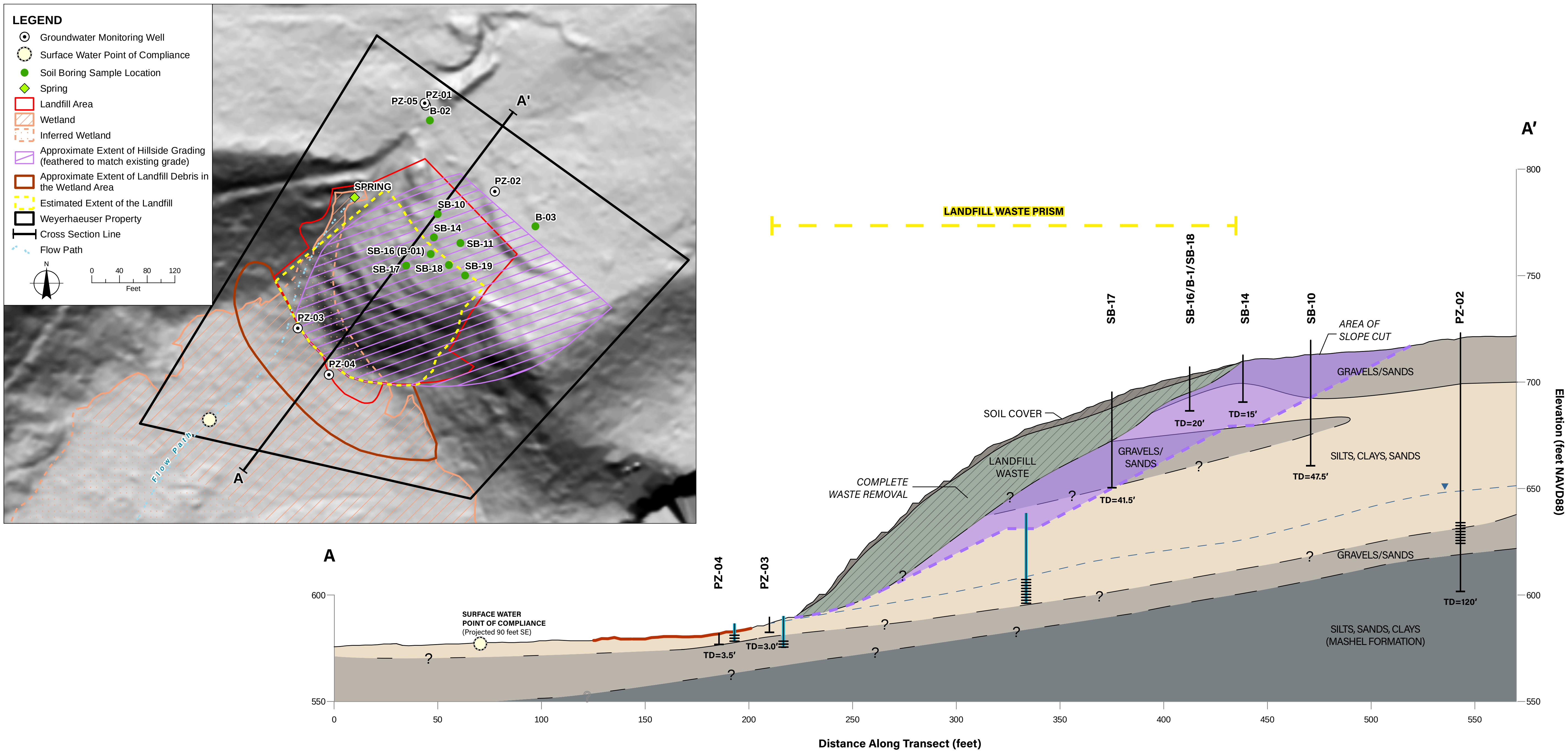

LEGEND

Water Table

Boring and Well Legend

Groundwater Point of Compliance

Screen

- Soil Cover
- Landfill Waste Prism

Vashon Drift

- Coarse Gravels and Sands; Silty
- Silts, Clays, Silty Sands

Mashel Formation

- Silts, Sands, Clays

- New Surface Grade: full removal 2:1 slope with 15 ft wide benches every 100 feet and no extension into Wetland Area (See note)
- Approximate Extent of Landfill Debris in the Wetlands
- Complete Waste Removal
- Area of Slope Cut

NOTES

NAVD88: North American Vertical Datum of 1988

TD: total depth

If loose gravel or sand is observed at the new leave surface, this material will be either removed and filled with suitable base-course (potentially material excavated from Site) or slopes will be no greater than 2.5H:1V.

FIGURE 14-1

Remedial Action Plan View and Cross Section A-A'

Remedial Investigation/Feasibility Study
Former Eatonville Landfill
Eatonville, WA

GSI Water Solutions, Inc.

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