Remedial Investigation Work Plan

Go East Corp Landfill Site
Everett, Washington
Ecology Agreed Order No. DE 18121

for
Washington State Department of Ecology
on Behalf of P&GE, LLC

June 30, 2021

GeoEngineers
Earth Science + Technology

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GEOENGINEERS

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File No. 6694-002-05

June 30, 2021

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1.0 INTRODUCTION

GeoEngineers, Inc. (GeoEngineers) has prepared this Remedial Investigation (RI) Work Plan (Work Plan) on behalf of P&GE, LLC (P&GE) to describe the RI that will be conducted at the Go East Corp Landfill Site in Everett, Washington (Site) (Figure 1).

The Go East Corp Landfill (Landfill) is a 9.6-acre, inactive, limited-purpose landfill as defined in Washington Administrative Code (WAC) Chapter 173-350, Section 400. The Landfill and the 40.9-acre property on which it is located (Property) are owned by P&GE.

The RI will be completed following Landfill closure activities, which are described in the *Go East Landfill Closure Plan* (LFCP) (PACE Engineers, Inc. [PACE] 2018). As part of Landfill closure, the Landfill area will be reduced from the current 9.6 acres to a final area of approximately 6.8 acres by excavating and relocating landfill material from the outer margin of the Landfill to the interior portion of the Landfill. An engineered capping system will then be installed over the Landfill. The landfill cap will prevent direct contact with landfill materials, reduce stormwater infiltration, and control landfill gas emissions.

Undeveloped land on the west, south, and east sides of the Landfill will be developed with 97 residential lots as part of the Bakerview Plat Subdivision following Landfill closure. The LFCP describes the planned development of the Bakerview Plat Subdivision. The Snohomish Health District (SHD) and the Washington State Department of Ecology (Ecology) approved the LFCP as part of SHD Solid Waste Facility Permit # SW-027 (Permit), subject to the development and written approval of Landfill closure construction plans comprising final design drawings, construction specifications, and a Construction Quality Assurance Plan (CQAP) pursuant to WAC 173-350-400(5). The Landfill closure construction plans were reviewed by SHD and Ecology and approved by SHD in August 2020.

Native soil at the base of the excavation will be sampled after landfill material is excavated and relocated from the outer margin of the Landfill to confirm the native soil does not contain Landfill-related chemical contaminants at concentrations exceeding risk-based regulatory criteria. This confirmation soil sampling is part of an interim action being conducted by P&GE under Agreed Order No. DE 18121 with Ecology (Agreed Order). The interim action is described in the Interim Action Work Plan (IAWP) (GeoEngineers 2020a), included as Exhibit D of the Agreed Order. The outer margin area of the Landfill to be excavated and relocated is identified in the IAWP and this Work Plan as the “interim action excavation area”.

The Agreed Order identifies remedial actions that P&GE must undertake to comply with the Washington State Model Toxics Control Act (MTCA) (Revised Code of Washington [RCW] Chapter 70A.305). In addition to the requirement to implement the IAWP, the Agreed Order also requires P&GE to prepare an interim action completion report, prepare and implement this Work Plan, prepare an RI and feasibility study (FS) report, and prepare a preliminary draft cleanup action plan (DCAP) in accordance with applicable requirements of the MTCA Cleanup Regulation (WAC 173-340), the Washington State Solid Waste Handling Standards (WAC 173-350), and the Washington State Sediment Management Standards (WAC 173-204).

1.1 Site Cleanup Process Under the Model Toxics Control Act

P&GE will perform the following actions as part of the Site cleanup process under MTCA:

- Complete an interim action during Landfill closure as described in the IAWP (GeoEngineers 2020a). The interim action will ensure that after landfill materials are excavated and relocated from the interim action excavation area, native soil remaining at the base of the excavation does not contain Landfill-related chemical contamination at concentrations exceeding risk-based regulatory criteria. After native soil is confirmed to meet regulatory criteria, the excavated area will be backfilled with clean fill material. Any native soil that contains contamination at concentrations exceeding criteria will be removed and disposed offsite at an approved facility.
- Prepare an interim action completion report describing the scope and results of the interim action.
- Complete an RI as described in this Work Plan, to collect data necessary to characterize the nature and extent of contamination at the Site, if any.
- Complete an FS to evaluate cleanup action alternatives for the Site. This will include an evaluation of whether the Landfill post-closure care activities described in the LFCP satisfy MTCA requirements for protection of human health and the environment. If the FS concludes that additional cleanup beyond the LFCP post-closure care activities is necessary, cleanup action alternatives will be developed and evaluated accordingly and a preferred cleanup action alternative will be identified.
- Prepare a draft RI/FS report. There will be a public comment period following completion of the draft RI/FS report. A final RI/FS report will be prepared after the public comment period.
- If additional cleanup beyond the LFCP post-closure care activities is necessary, P&GE will prepare a preliminary DCAP for Ecology review. The preliminary DCAP will present the selected cleanup action alternative for the Site, identify cleanup standards and other requirements for the cleanup action, and describe how the cleanup action will be implemented. Ecology will prepare the DCAP for public review after it approves the preliminary DCAP. After the DCAP public review and comment period, Ecology will prepare the final cleanup action plan (CAP).
- If additional cleanup beyond the LFCP post-closure care activities is necessary, P&GE will perform the cleanup action described in the final CAP and prepare a cleanup action completion report.
- Perform confirmational groundwater and/or surface water monitoring as needed to ensure the cleanup action remains protective of human health and the environment.

1.2 Remedial Investigation Purpose and Scope

The purpose of the RI is to collect the data needed to adequately characterize the Site for the purpose of developing and evaluating cleanup action alternatives (WAC 173-340-350[7][a]). The RI will include sampling of soil, groundwater, surface water, and sediment outside the future Landfill limit to evaluate whether these media contain hazardous substances at concentrations exceeding regulatory criteria. The RI data will be used to characterize the nature and extent of Site-related contamination (if any) and to further develop the preliminary conceptual site model (CSM) described in this Work Plan. Exposure pathways and risks will be evaluated and the contaminants and media requiring cleanup will be identified if Site-related contaminants of potential concern (COPCs) are identified in soil, groundwater, surface water, or sediment.

1.3 Work Plan Organization

This Work Plan includes the following sections:

- Section 1.0 – Introduction
- Section 2.0 – Background
- Section 3.0 – Environmental Setting
- Section 4.0 – Previous Investigations
- Section 5.0 – Preliminary Conceptual Site Model
- Section 6.0 – Data Gaps
- Section 7.0 – Remedial Investigation Field Activities
- Section 8.0 – Remedial Investigation Data Evaluation
- Section 9.0 – Project Management Strategy
- Section 10.0 – Reporting
- Section 11.0 – Schedule
- Section 12.0 – References

2.0 BACKGROUND

This section describes the Property and the Landfill operational history and regulatory background.

2.1 Property Description

This section describes the Property location and physiographic setting, the spatial extent of the Landfill, vegetation and structures on the Property, surrounding land use, and the planned future land use of the Property.

2.1.1 Location and Physiographic Setting

The Property (Snohomish County Parcel Number 280521-004-002-00) is located at 4330 108th Street Southeast in Everett, Washington (Figure 1), in the northwest quarter of the southeast quarter of Section 21, Township 28 North, Range 5 East, Willamette Meridian. The Property is situated on a bluff overlooking the Snohomish River Valley, which is approximately at sea level. The Snohomish River is approximately 1.8 miles north-northeast of the Property. Silver Lake is approximately 1.4 miles west of the Property. The location of the Property relative to regional physiographic features is shown in Figure 2.

The Landfill is situated within a former eastward-sloping ravine that previously existed in the northern half of the Property. A map showing the topography and surficial geology of the former ravine beneath the Landfill is shown in Figure 3. Sand and gravel were mined from the walls of the ravine from 1969 until the early 1970s before landfilling operations began. The sand and gravel mine was a source of aggregate fill material for local construction projects. The mining operations widened the ravine before landfilling activities began in the early 1970s. Portions of the steep bank below the plateau areas in the western and northwestern areas of the Property likely represent relic cut faces from the mining operations. The approximate shape of the widened ravine created by the mining activities has been estimated by others (Associated Earth Sciences, Inc. [AESI] 2009a) and is depicted in Figure 3. Landfilling operations began in the early 1970s after sand and gravel mining ceased and continued until 1983 (see Section 2.2).

The present-day topography of the Property is depicted in Figure 4. Two eastward-sloping drainage ravines are present in the southern half of the Property. These ravines merge near the eastern Property boundary and become a single, northward-sloping ravine that extends to the Snohomish River Valley. The ground surface generally slopes gently to the east in the western and southwestern portions of the Landfill (Figure 4). The ground surface slopes steeply to the northeast in the northeastern portion of the Landfill and is heavily vegetated. Elevations of the Landfill surface range from approximately 260 feet above the North American Vertical Datum of 1988 (NAVD88) in the westernmost portion of the Landfill, to 225 feet NAVD88 at the top of the steep northeastern slope, to 110 feet NAVD88 at the base of the northeastern slope.

2.1.2 Landfill Spatial Extent

The spatial extent of the Landfill is defined by the lateral limits and depth of the waste materials historically placed in the Landfill. The lateral limits of the Landfill correspond to the approximate lateral limits of the historical sand and gravel mining activities. The depth of the Landfill corresponds to the depth of the former ravine beneath the Landfill surface.

The lateral limits of the Landfill have been delineated and surveyed based on previous test pit explorations completed between 2002 and 2020 (see Section 4.0), Go East Corporation's (Go East) knowledge of the Landfill limits at the time landfilling activities ceased in 1983, and the estimated limits of the historical mining activities. The approximate lateral limits of the Landfill encompass an area of approximately 9.6 acres (Figure 4).

The depth of the Landfill has been estimated based on information obtained from previous test pit explorations and a comparison of Landfill surface elevations to estimated historical ground surface elevations in the former ravine. The estimated depth of the Landfill ranges from approximately 1 foot below ground surface (bgs) near the outer margins of the Landfill to a maximum of approximately 50 feet bgs in the central portion of the Landfill near the top of the steep northeastern slope. Figure 5 shows two generalized cross sections through the Landfill along section lines A-A' and B-B' shown in Figure 4. The cross sections shown in Figure 5 were developed based on observations and data from field reconnaissance and subsurface explorations (Geolabs–Washington, Inc. 1970, AESI 2009a), and on topographic and geologic information obtained from land surveying and geologic mapping studies in western Snohomish County (Newcomb 1952, Smith 1976, United States Geological Survey [USGS] 1985). The groundwater levels and subdrain depicted on the cross sections are discussed in Sections 3.4 and 3.6.

2.1.3 Vegetation and Structures

Vegetation across most of the area disturbed by historical landfilling activities, including the Landfill and the south-adjacent flat area that was historically graded to obtain cover soil for the Landfill, consists of a sparse canopy of red alder and Black cottonwood, with Himalayan blackberry in the understory. Undisturbed portions of the Property west of the Landfill and in ravine areas south of the Landfill contain red alder, big leaf maple, Western hemlock, salmonberry, sword fern, filaree, and piggy-back plant (Wetland Resources, Inc. 2010).

There are several trails on the Property including trails around and across portions of the Landfill. Four groundwater monitoring wells installed in 2009 (MW-1 through MW-4) are present around the Landfill perimeter (Figure 4). The monitoring wells are discussed in Section 4.2. The only existing structure on the

Property is a small wooden storage shed located approximately 200 feet south of the northwestern corner of the Property (Figure 4). This shed belongs to the owner of the west-adjacent residential property.

An abandoned storage tank was discovered by P&GE approximately 40 feet east of the wooden storage shed in approximately 2010 (Figure 4). The cylindrical tank was found resting on its side directly on the ground surface and was not connected to any piping, equipment, or other structures. The tank was empty and was assumed to have been disposed of on the Property by a trespasser sometime after Landfill operations ceased in 1983. The tank appeared to be a former steel underground storage tank with a capacity of approximately 500 gallons and was presumed to be a former residential heating oil tank (P&GE 2020).

The tank was never used by the then owner of the Landfill, Go East, nor by the present owner, P&GE. A previous owner of the west-adjacent residential property asked P&GE in approximately 2017 if P&GE would be willing to remove the tank, as the property owner considered it an eyesore. P&GE agreed to remove the tank during Landfill closure construction that was anticipated to begin in 2019. The residential property owner expressed displeasure at having to wait until 2019 for the tank to be removed. P&GE noticed that the storage tank was gone during a Property visit in September 2018. The tank was not seen during subsequent Property visits in 2019 and 2020 and was assumed to have been removed by a trespasser (P&GE 2020).

2.1.4 Surrounding Land Use

Land use in the vicinity of the Property primarily consists of residential parcels and open space with limited commercial development. The Property is bounded on the north by The Pointe residential subdivision and an open space tract; on the west by King's Ridge Division 1 residential subdivision and an open space tract; on the south by the Waldenwood West Division 1 and the Pinehurst at Waldenwood Division 2 open space tracts; and on the east by an Olympic Pipeline easement and the Pinehurst at Waldenwood Division 2 open space tract.

The Snohomish River Valley (beginning at Lowell Larimer Road) is approximately 1,000 feet northeast of the Property at an approximate elevation of 25 feet NAVD88, which is approximately 235 feet below the surface of the landfill and approximately 85 feet below the toe of the landfill (Figure 2). The predominant land use in the Snohomish River Valley is agricultural.

2.1.5 Future Land Use

The area within the future Landfill limit will be developed with a grass cover, stormwater control facilities, and playfields following installation of the engineered capping system over the Landfill. An environmental covenant will be filed for the Property to ensure the engineered capping system remains protective in the future. The undeveloped areas adjacent to the future Landfill limit will be developed with the Bakerview Plat Subdivision. The planned lot layout of the subdivision is shown in Figure 4.

2.2 Landfill Operational History and Regulatory Background

Detailed descriptions of the Landfill operational history are provided in the Agreed Order, the LFCP, and the *Amended Decision of the Snohomish County Hearing Examiner: Amended Decision Affirming SEPA Threshold Determination, Approving Rezone, and Approving Preliminary Subdivision with Conditions* (Amended Decision) (Snohomish County 2018). The Agreed Order and the Amended Decision also provide detailed summaries of the Landfill regulatory background. The summary presented below is based on information contained in the Agreed Order.

The former ravine beneath the Landfill was used as a source of sand and gravel aggregate materials beginning in 1969 when a permit was issued for excavation and sand reclamation for a two-year period. Sand and gravel were mined from the walls of the ravine for several years before landfilling activities began.

Rekoway, Inc. (Rekoway) purchased the Property in February 1972 and received a conditional use (CU) permit in March 1972 to perform sand and gravel excavation and operate a solid waste landfill accepting wood, mineral, and concrete solid materials, but not garbage or putrescibles (i.e., solid waste containing organic material that is liable to decompose). In 1974 or 1975, Rekoway sought authorization to accept tires and bulk packaging such as cardboard, pallets, large parcel wrappings, shredded paper, and warehousing waste materials. In September 1975, Snohomish County issued a CU permit allowing additional types of waste.

In August 1974, Rekoway accepted approximately 200 cubic yards of baghouse dust containing magnesium, phosphate, and aluminum dusts from Northwest Wire and Rope in Seattle (Ecology & Environment, Inc. 1987). The initial intermixing of these waste materials caused fires when the materials were first deposited in the Landfill. The fire hazard was eliminated when the different types of wastes were separated using a front-end loader. The fires caused by the metal dusts soon burned out and the remaining waste materials were covered with soil (Ecology & Environment, Inc. 1987). Rekoway also accepted partially burned trees and stumps that may have contributed to ongoing smoldering through 1977, when SHD and Snohomish County suspended Rekoway's CU permit.

Go East conditionally purchased the Property from Rekoway in 1979 and applied to Snohomish County to reinstate the CU permit and approve its transfer to Go East. Go East applied for a new woodwaste landfill permit following Snohomish County's conditional approval of these requests. Both the CU permit and the woodwaste landfill permit were conditioned on extinguishing existing fire(s) left by Rekoway. From November 1979 through early 1980, Go East excavated smoldering woodwaste debris (primarily large tree stumps) associated with Rekoway's previous operations and extinguished the smoldering fires. Full Landfill operations commenced in early 1980 after the Snohomish County Fire Marshal formally verified that Go East had successfully extinguished the fires. Thereafter, the CU permit and the woodwaste landfill permit were renewed until 1982 when the CU permit expired. SHD renewed the woodwaste landfill permit into 1983. SHD frequently oversaw and inspected the operations and the imported waste materials without finding problems under its regulations throughout Go East's operation of the Landfill. SHD issued a stop work order in 1983 and Go East stopped accepting waste in the summer of 1983.

An additional fire began on the surface of the Landfill's northeastern slope in October 1983. The soil cover in the area where this fire started was washed away when the local fire district sprayed water on the slope in an effort to extinguish the fire. This caused the fire to spread across the top surface of the Landfill without penetrating to the lower disposal cells. The fire burned out by January 1986. There have been no other fires at the Landfill since January 1986.

SHD prepared a Site Hazard Assessment (SHA) under MTCA in May 2004 (SHD 2004). Based on the SHA findings, SHD recommended that future residential development of the Property include and implement a landfill closure plan. SHD further recommended No Further Action (NFA) at the Site under MTCA. SHD subsequently issued an NFA letter in June 2004 that stated Ecology had made an NFA determination for the Site based on the SHA.

P&GE acquired the Property from Go East in May 2009 and subsequently developed plans to close the Landfill as part of Property redevelopment. SHD issued the Permit to P&GE on May 11, 2018. The Permit authorized a limited-purpose landfill subject to WAC 173-350-400 and required P&GE to close the Landfill in accordance with the approved LFCP. Ecology's Solid Waste Management Program has provided technical support to SHD for the authorization and oversight of the Permit.

The Kings Ridge Homeowners Association and the 108th Street Point Homeowners Association (collectively, the HOAs) appealed SHD's issuance of the Permit to the Washington State Pollution Control Hearings Board (PCHB). Following an adjudicative hearing on the appeal, the PCHB found that the HOAs had not met their burden to prove either that the LFCP or the Permit violated applicable landfill closure regulations. The PCHB determined that the LFCP met the closure requirements specified in WAC 173-350-400(8) and that additional design evaluation and components could be added to the Permit-required design drawings, construction specifications, and CQAP if necessary and appropriate.

Ecology prepared an Initial Investigation Field Report for the Site in June 2019 based on information contained in the report *Go East Landfill – Information for MTCA Assessment* (Practical Environmental Solutions [PES] 2019) that was submitted to Ecology in March 2019 on behalf of the HOAs. The Initial Investigation Field Report stated that concentrations of total and dissolved arsenic and total chromium, iron, lead, and/or manganese reported in groundwater samples collected from three groundwater monitoring wells in 2009 exceeded MTCA default cleanup levels and recommended that the Site be listed on Ecology's Confirmed and Suspected Contaminated Sites List.

Ecology rescinded its 2004 NFA determination on June 18, 2019, and added the Site to Ecology's Confirmed and Suspected Contaminated Sites List. The Cleanup Site Identification Number is 4294 and the Facility/Site Identification Number is 2708.

3.0 ENVIRONMENTAL SETTING

This section describes the climate of the Everett area, the Site geology, the regional and Site surface water hydrology, the regional and Site hydrogeology, groundwater use in the vicinity of the Site, and ecological habitat on the Property.

3.1 Climate

Western Snohomish County has a temperate marine climate characterized by cool, wet winters and warm, dry summers. Air temperatures are moderated by the Pacific Ocean and Puget Sound, which provide a large supply of moisture for storms that typically move from west to east across the County (USGS 1997). The temperature in the Everett area is rarely below 26 degrees Fahrenheit (°F) or above 87°F (weatherspark.com 2020). The record high temperature for Everett is 98 °F; the record low temperature is 0°F. The average monthly maximum temperature is about 73 °F in July and August, and the average monthly minimum temperature is about 33 to 34 °F in December, January, and February (en.wikipedia.org 2020).

The Everett area receives precipitation 163 days per year on average. The average annual precipitation is approximately 36 inches. The average annual snowfall is approximately 7 inches. Most of the precipitation occurs October through April, with an average of 27 inches of precipitation falling during these months and 120 days receiving measurable precipitation. The wettest months are November through January, which historically have averaged approximately 4.5 to 5.0 inches of precipitation per month. The driest months are July and August, which historically have averaged approximately 1.0 to 1.5 inches of precipitation per month (en.wikipedia.org 2020). The highest monthly rainfall total was approximately 9.8 inches, recorded in January 1971 (komonews.com 2020). The 100-year rainfall amounts in the Everett area for a 6-hour, 24-hour, 4-day, and 7-day storm, respectively, are approximately 1.8 inches, 3.4 inches, 6.5 inches, and 8.0 inches (Otak, Inc. 2015).

The predominant average hourly wind direction in Everett varies throughout the year. The predominant wind direction from October through March usually ranges from south to east. The predominant wind direction from May through August usually ranges from west to north. Mean hourly wind speeds in Everett generally range from approximately 1 to 8 miles per hour, with only minor seasonal variation over the course of the year (weatherspark.com 2020). Peak historical wind gusts recorded in the Everett area are on the order of 45 miles per hour (komonews.com 2020).

In 2019, barometric pressure in the Everett area ranged from approximately 29.1 to 30.6 inches of mercury. The largest pressure fluctuations occurred in the fall and winter with a periodicity of approximately 7 to 15 days. Barometric pressure fluctuations in the spring and summer were typically one tenth to one half the amplitude of the fall and winter pressure fluctuations (wxug.org 2020).

3.2 Site Geology

Three geologic units have been mapped on the Property (Figure 3). These units consist of approximately 10 to 60 feet of Vashon glacial till (Qvt) (a mixture of sand, silt, pebbles, cobbles, and boulders), underlain by approximately 80 to 140 feet of Vashon glacial advance outwash (Qva) (primarily sand with some gravel), underlain by pre-Vashon glacial lacustrine silt deposits. Within the Property boundary, the glacial lacustrine silt deposits constitute the upper portion of the transitional beds stratigraphic sequence (Qtb) that has been identified throughout the Snohomish River Valley and adjacent bluff areas. The glacial till (Qvt) mantles the plateau areas in the western and northwestern portions of the Property at elevations greater than approximately 260 to 320 feet NAVD88. Directly beneath the Qvt, the advance outwash (Qva) deposits constitute the ridges, walls, and floors of the ravines at elevations between approximately 180 feet NAVD88 and 260 to 320 feet NAVD88. The lacustrine silt deposits of the upper Qtb constitute the walls and floors of the ravines at elevations below approximately 180 feet NAVD88. Some sand present near the toe of the landfill could represent historical erosion and subsequent deposition of advance outwash sand before or during the mining operations, or sand eroded and subsequently deposed from the soil cap that was placed over the landfill’s northeast slope after landfill operations ceased.

The *Geologic Map of the Everett 7.5-Minute Quadrangle, Snohomish County, Washington* (USGS 1985) indicates that the Qtb unit comprising the lacustrine silt and other pre-Vashon deposits are laterally continuous across a broad area of the bluffs along the western margin of the Snohomish River Valley including the areas north, northeast, and east of the Property. This suggests the lacustrine silt is present below the Qva unit throughout the Property. The lacustrine silt was encountered below the Qva deposits in the four groundwater monitoring well borings drilled in 2009 (see Section 4.2), providing additional evidence that the lacustrine silt is present below the Qva unit throughout the Property. The lacustrine silt was encountered at the following elevations (NAVD88): MW-1, 209 feet; MW-2, 174 feet; MW-3, 198 feet; MW-4 177 feet.

3.3 Regional Surface Water Hydrology

The Property is situated in the Marshland Tributaries drainage basin within the City of Everett Snohomish River watershed (Otak, Inc. 2017). The Marshland Tributaries basin constitutes 3.5 square miles (30 percent) of the City's 11.6 square-mile Snohomish River watershed. Most of this basin lies southeast of the Everett city limits but within the Everett Urban Growth Area. The headwaters of the basin's tributaries are in the upland bluffs along the western margin of the Snohomish River Valley. The upland bluffs are heavily urbanized with a significant amount of residential land use and some commercial use. The tributaries receive surface water drainage from the bluff areas and flow through steep ravines in an easterly to northeasterly direction before discharging to a series of agricultural drainage channels in the Snohomish River floodplain. The floodplain drainage channels discharge to the Snohomish River (Otak, Inc. 2017). As of 2004 there were 565 acres of land irrigated with surface water collected within a 2-mile radius downgradient of the Property (SHD 2004). The land acreage currently irrigated with downgradient surface water, including water obtained from floodplain drainage channels and the Snohomish River, is unknown.

The historical development in the residential and commercial areas of the Marshland Tributaries basin has resulted in degraded water quality conditions. The significant urban footprint of the upland bluff areas produces surface water runoff with a variety of pollutants including metals, fertilizers, pesticides, nutrients, and fecal coliform bacteria. Commercial agriculture and pasture lands dominate land uses in the Snohomish River Valley. These land uses likely contribute sediment, nutrient, and bacterial contamination to receiving waters through disturbed soils, application of fertilizers, and livestock grazing (Otak, Inc. 2017).

Surface water quality in the Marshland Tributaries basin is generally poor based on 2002 data. Elevated concentrations of fecal coliform, copper, and lead have been reported (Otak, Inc. 2017). Pet wastes and failing septic systems are likely sources of fecal coliform. The elevated copper and lead concentrations are likely a result of untreated stormwater from roads and parking lots. High sediment loads have been reported and are likely due to erosion from the steep streams on the bluffs. Elevated nutrient concentrations also have been reported and are likely a result of fertilizer use in upland residential areas (Otak, Inc. 2017).

A 2002 study conducted by the Snohomish County Public Works Department predicted increased residential infill development in the Marshland Tributaries basin (Otak, Inc. 2017). These land use changes typically increase pollutant levels in surface water runoff due to increased impervious surfaces, roadway traffic, and accompanying commercial activity. The 2002 study predicts water quality problems will persist and potentially worsen due to increased development, including potential increases in nutrient loading and fecal coliform concentrations (Otak, Inc. 2017).

3.4 Site Surface Water Hydrology

There are three streams (Streams 1 through 3) in the vicinity of the Landfill (Figure 4). Stream 1 enters the Property from the west and flows southeast across the flat, historically graded area south-adjacent to the Landfill before descending into the drainage ravine south of the Landfill where it joins Stream 2. Stream 1 previously flowed along the bottom of the former ravine beneath the Landfill. Go East diverted Stream 1 to the south at the direction of SHD and Snohomish County Planning and Development Services (PDS) following acquisition of the Property in 1979 (P&GE 2020). Stream 1 provides water to Wetland A and loses water to the advanced outwash formation.

Stream 2 flows east in the drainage ravine south of the Landfill and then off the Property where it turns toward the north. Stream 2 converges with Stream 3 (described below) near the northeastern corner of the Property and ultimately drains to the Snohomish River Valley.

Stream 3 originates from at least two “leachate springs” at the base of the Landfill’s northeastern slope and flows east off the Property where it joins Stream 2. There are no other known surface water sources to Stream 3 from north of the property. Rekoway (the operator of the Landfill prior to Go East’s acquisition of the Property) installed a subdrain on the bottom of the former ravine beneath the Landfill at the direction of SHD and PDS before landfilling activities began (P&GE 2020). The subdrain reportedly consists of a perforated pipe embedded in gravel. The pipe has not been observed at the toe of the landfill and its operational status is unknown. The pipe may be clogged and potentially crushed. This subdrain likely drains groundwater beneath the Landfill and discharges it toward the base of the northeastern slope where it emerges at the leachate springs to form Stream 3. The groundwater that discharges from the leachate springs is inferred to occur in the Qva deposits and to flow northeast beneath the Landfill based on the historical topography of the former ravine beneath the Landfill, local geology, and measured groundwater levels in the existing groundwater monitoring wells on the Property. This conceptual model of groundwater occurrence and flow is depicted in Figures 4 and 5.

3.5 Regional Hydrogeology

The USGS published a report in 1997 that describes the groundwater system and groundwater quality in western Snohomish County (USGS 1997). Most of the information presented in this section is summarized from this USGS report.

Western Snohomish County is underlain by up to 1,200 feet of unconsolidated Quaternary deposits that are mostly of glacial origin. Six hydrogeologic units have been defined in the Quaternary deposits. The two upper units, the alluvium (Qal) and the Vashon glacial recessional outwash (Qvr), have been defined as aquifers. The Qal ranges from approximately 40 to 120 feet thick and the Qvr ranges from approximately 40 to 250 feet thick. Neither of these units is present on the Property.

The Qvr is underlain by the Qvt (Vashon glacial till), which acts as is an extensive confining unit and ranges from approximately 70 to 250 feet thick. Beneath the Qvt is the Qva (Vashon glacial advance outwash). The Qva ranges from approximately 120 to 350 feet thick and is considered western Snohomish County’s principal aquifer in terms of use and lateral extent. The Qva is underlain by the Qtb deposits (transitional beds), which constitute a confining unit that ranges from approximately 100 to 400 feet thick, and the undifferentiated sediments (Qu), which constitute a poorly-defined heterogenous unit (due to sparse data) that ranges from approximately 500 to 1,000 feet thick (USGS 1997).

The groundwater system in western Snohomish County is estimated to receive an average of about 24 inches of recharge per year from infiltration of precipitation. Groundwater flow generally follows the land surface gradient, with groundwater migrating toward the major streams and lowlands. In most areas there is also a downward component of groundwater flow. Groundwater discharges to streams, springs, lakes, and seepage faces on bluffs (USGS 1997).

The regional groundwater system has no known widespread groundwater contamination. The most common and widespread water quality impacts result from natural causes. High iron and manganese concentrations are common. The median and maximum concentrations of iron reported in groundwater samples collected from 297 wells in 1993 and 1994 were 0.038 milligrams per liter (mg/L) and 26 mg/L, respectively (USGS 1997). Twenty percent of the samples exceeded the current Washington State and United States Environmental Protection Agency (EPA) Secondary Maximum Contaminant Level drinking water standard for iron of 0.3 mg/L.

The median and maximum concentrations of manganese reported in the 297 groundwater samples collected in 1993 and 1994 were 0.031 mg/L and 0.91 mg/L, respectively (USGS 1997), with 41 percent of the samples exceeding the current Washington State and EPA Secondary Maximum Contaminant Level of 0.05 mg/L.

In addition to iron and manganese, arsenic was detected in 63 percent of the 295 groundwater samples analyzed for arsenic in 1993 and 1994. The median and maximum arsenic concentrations reported in the samples were 0.002 mg/L and 0.28 mg/L, respectively (USGS 1997). The arsenic concentrations reported in 52 wells throughout the study area exceeded the current EPA Maximum Contaminant Level of 0.01 mg/L. Most of the higher arsenic concentrations were detected in wells located between Granite Falls and Arlington, approximately 15 to 20 miles north of the Property. The USGS considers the elevated iron, manganese, and arsenic concentrations in western Snohomish County groundwater to be a result of natural anoxic, reducing conditions in the regional system (UGS 1997).

The regional hydrogeologic units of interest on the Property include the Qvt, Qva, and Qtb. Section 3.2 describes where these units occur on the Property. Western Snohomish County's primary aquifer, the Qva, generally does not pinch out but terminates abruptly in bluffs due to erosion by rivers and streams. It occurs at a higher elevation than the Snohomish River Valley and therefore is absent beneath the Valley. The Qva outcrops in bluffs and ravines along the western margin of the Snohomish River Valley (USGS 1997). Its lower boundary is the top surface of the Qtb confining unit, which is represented by the glacial lacustrine silt unit on the Property. Because the Qtb restricts vertical groundwater flow, groundwater flow in the Qva generally follows the land surface gradient. Groundwater in the Qva generally migrates horizontally from higher-elevation recharge areas toward lower-elevation discharge areas along bluffs or in stream valleys. On the bluffs at the western margin of the Snohomish River Valley, groundwater in the Qva generally flows east or northeast toward the Valley and discharges from seeps at or above the contact between the Qva and Qtb. The median estimated horizontal hydraulic conductivity of the Qva aquifer in western Snohomish County is 40 feet per day. Horizontal hydraulic gradients in the Qva are typically on the order of 0.02 foot per foot (USGS 1997).

3.6 Site Hydrogeology

Four groundwater monitoring wells (wells MW-1 through MW-4) were installed around the Landfill perimeter in 2009 as part of a hydrogeologic investigation of the Property (Figure 4). The monitoring well installation and groundwater sampling are described in Section 4.2. Groundwater was measured at depths of approximately 30 to 50 feet bgs in wells MW-1 through MW-3 during three well gauging events in 2009 and 2011. Groundwater was not present in well MW-4 during the three gauging events (see below).

Groundwater on the Property occurs as perched groundwater in the Qva above the low-permeability lacustrine silt unit (AESI 2009a) and likely is not connected to deeper aquifers in the regional groundwater system due to the presence of the lacustrine silt deposits (Golder Associates Inc. 2016). Groundwater is inferred to generally flow to the northeast toward the Snohomish River Valley, with a component of southeasterly flow in the northern portion of the Property (AESI 2009a) (Figure 4). Groundwater discharges from seeps at or near the Qva/Qtb contact on the ravine walls and contributes to stream flow in the ravines.

Groundwater was not present in well MW-4 during the three well gauging events conducted in 2009 and 2011. Well MW-4 was installed at the northern end of a former narrow ridge that existed between the former ravine beneath the Landfill and the existing ravine east-adjacent to the Property (Figure 4). The boring log for well MW-4 indicates that MW-4 is screened across the Qva/Qtb contact, with approximately 8.5 feet of screen in the Qva aquifer and 1.5 feet of screen in the lacustrine silt unit (AESI 2009a). The reason well MW-4 was dry when measured in 2009 and 2011 is likely that the Qva aquifer in the vicinity of MW-4 contains very little groundwater due to the narrow width of the former ridge between the two (existing and former) ravines and the fact that the former ridge terminates immediately north of MW-4. In other words, the Qva aquifer in the vicinity of MW-4 likely contains very little groundwater due to the aquifer's small volume, and hence limited storage capacity, in this area. Any groundwater recharge that occurs in this area likely discharges from the aquifer relatively quickly at or near the Qva/Qtb contact on the walls of the adjacent (existing and former) ravines.

Slug testing was conducted at monitoring wells MW-1 and MW-2 in 2009 to estimate the hydraulic conductivity of the Qva aquifer in the vicinity of these two wells (AESI 2009a). The Qva within the screened intervals of these wells consists of fine sand to silty very fine sand. The slug tests yielded hydraulic conductivity estimates of approximately 1 to 3 feet per day. These estimates are consistent with published hydraulic conductivity values for silty fine sand (AESI 2009a). The estimated horizontal groundwater seepage velocity beneath the Property is approximately 0.4 foot per day. This estimate was calculated using a hydraulic conductivity of 3 feet per day, a horizontal hydraulic gradient of 0.02 foot per foot, and an effective porosity of 0.15 (AESI 2009a).

Available information suggests that in general, groundwater in the Landfill area occurs near or below the bottom of the Landfill. This is based on several lines of evidence including the Site geology and surface water hydrology, the elevation of the bottom of the Landfill as estimated from the historical topography of the former ravine beneath the Landfill, the reported presence of a subdrain beneath the Landfill (described in Section 3.4), measured groundwater levels in monitoring wells MW-1 through MW-3, and regional groundwater studies. The subdrain likely drains groundwater beneath the Landfill and discharges it toward the base of the Landfill's northeastern slope as noted in Section 3.4. The subdrain pipe may be clogged and potentially crushed. However, it is unlikely that groundwater rises to significant levels within the landfill due to the coarse material content in the landfill (primarily woody debris) and the inferred high bulk permeability of the landfill material. Groundwater occurrence relative to the bottom of the Landfill is depicted conceptually in Figure 5.

A groundwater divide is inferred to exist in the Qva deposits along the former topographic divide that separated the former ravine beneath the Landfill and the ravine south- and east-adjacent to the Landfill (i.e., the ravine containing Stream 2). The approximate alignment of the inferred groundwater divide is shown in Figure 4. The topographic divide no longer exists due to the landfilling of the former ravine and the historical grading of the former ridge to obtain cover soil for the Landfill. Groundwater to the north and west of the groundwater divide is inferred to flow toward the north and west (i.e., toward the Landfill), while groundwater to the south and east of the groundwater divide is inferred to flow toward the south and east (i.e., toward Stream 2) (Figure 4).

Groundwater occurrence and migration in the Qtb deposits below the Qva is likely limited due to the low permeability of the Qtb silt and clay deposits.

3.7 Groundwater Use

The primary uses of groundwater in western Snohomish County include public and private potable water supply, irrigation, and livestock uses (USGS 1997). The population in the vicinity of the Property, including the residential areas to the north, south, and west and the Snohomish River Valley east and hydraulically downgradient of the Property, is served by the Everett public water system (SHD 2004). SHD conducted a private well survey within a 1-mile radius east and southeast (i.e., downgradient) of the Property in 2003 and concluded that none of the residences in the search area used or maintained private wells (SHD 2004). As of 2004 there were 180 acres of land irrigated with groundwater within a 2-mile radius downgradient of the Property (SHD 2004). The land acreage currently irrigated with downgradient groundwater is unknown.

GeoEngineers reviewed Ecology's online water well report database (Ecology 2020) to identify potential water supply wells within 1 mile north, northeast, and east (i.e., downgradient) of the Property. Two wells were identified. One of the wells was installed in 1978 approximately 0.75-mile northeast of the Property in the Snohomish River Valley and was screened from 154 to 159 feet bgs. The other well was installed in 1985 approximately 1-mile northeast of the Property in the Snohomish River Valley and was screened from 103 to 108 feet bgs. The well reports for both wells indicate that the proposed use of the wells was for domestic water supply. It is unknown whether these wells are currently in use.

In addition to Ecology's online water well report database, GeoEngineers reviewed community/public water supply well and critical aquifer recharge area data available through the online PDS Map Portal (PDS 2020). The nearest community water supply well is a Mountain View Community well located approximately 1 mile southeast of the Property based on this review. No public water supply wells were identified within 3 miles of the Property.

Groundwater use will be further evaluated in the RI report.

3.8 Ecological Habitat

Vegetation at the Property is described in Section 2.1.3.

Snohomish County critical area maps and Washington Department of Fish and Wildlife and Washington Department of Natural Resources (DNR) information sources indicate that fish do not use Streams 1, 2, or 3 or the agricultural drainage channels in the Snohomish River floodplain (PDS 2020; Wetland Resources, Inc. 2010). Fish are deterred from using the floodplain drainage channels by a pump station located adjacent to the Snohomish River and by poor water quality in the drainage channels (Wetland Resources, Inc. 2010).

Streams 1 and 2 have been classified as Type Np streams according to the DNR forest practices water typing classification system; Stream 3 has been classified as a Type Ns stream (Wetland Resources, Inc. 2010). Type Np streams are defined as non-fish supporting, perennial streams that may have spatially intermittent dry reaches. Type Ns streams are defined as non-fish supporting, seasonal streams. Type Np and Ns streams do not meet the physical criteria to be potentially used by fish (DNR 2020).

Two depressional wetlands (Wetlands A and B) have been identified on the flat, historically graded area west and southwest of the Landfill (Figure 4). Wetland A contains the Stream 1 channel and covers approximately 20,400 square feet; Wetland B is south of the Stream 1 channel and covers approximately 420 square feet (Wetland Resources, Inc. 2017). Both wetlands are rated as inland (i.e., non-coastal) Category III wetlands according to Ecology's wetland rating system for Western Washington (Wetland Resources, Inc. 2010). Ecology's wetland rating system (Ecology 2006) uses four categories to rate wetlands based on wetland functions and values. The categories differentiate wetlands based on sensitivity to disturbance, rarity, the functions they provide, and whether they can be replaced. Category I wetlands generally provide the highest level of functions and values and Category IV wetlands provide the lowest level of functions and values. Category III wetlands such as Wetlands A and B are defined as wetlands with a moderate level of functions that have generally been disturbed in some ways and are often less diverse or more isolated from other natural resources in the landscape than Category II wetlands (Ecology 2006).

Vegetation in Wetland A includes a canopy of red alder and Black cottonwood trees and an understory comprising salmonberry, Himalayan blackberry, lady fern, reed canary grass, climbing nightshade, and duckweed. Surface soil throughout much of Wetland A was covered with ponded water to a depth of 6 inches during a wetland field survey conducted in May 2009 (Wetland Resources, Inc. 2010). Vegetation in Wetland B includes red alder, salmonberry, lady fern, and field horsetail. Surface soil in Wetland B was observed to be saturated during the May 2009 wetland survey (Wetland Resources, Inc. 2010).

It is likely that these wetlands are used by a variety of wildlife (Wetland Resources, Inc. 2010) given the proximity of Wetlands A and B to the forested buffer, the on-site forested ravines, and the Snohomish River Valley. The edge habitat between the wetlands, streams, and upland buffers provides protected wildlife movement corridors, as well as forage and cover opportunities. However, the level of functions provided by Wetlands A and B is limited by the wetlands' small size, the prevalence of invasive plant species in the wetlands and adjacent buffers, and the extent of disturbance. Examples of disturbance include historical uses such as filling and grading and ongoing uses such as camping and dog walking (Wetland Resources, Inc. 2010).

3.9 Post-Development Setting

The Landfill is to undergo permitted closure, and the area will be graded and completed using a grass cover, stormwater control facilities, and playfields following installation of the engineered capping system over the Landfill. Stormwater control facilities include detention ponds and a stormwater outlet with energy dissipator at the base of the northeast slope along the north property line. The existing two leachate springs that feed Stream 3 will be collected in a concrete structure with a weir outlet. Landfill gas will be managed using an impermeable cover and gas ventilation system. The system will passively vent methane. However, the system will be convertible to active venting if needed[1]. The undeveloped areas adjacent to the future Landfill limit will be developed with the Bakerview Plat Subdivision. A conceptualized planned development layout is provided in Figure 6. The RI report will include a section evaluating the potential for terrestrial ecological exposure (TEE).

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[1] Active venting is unlikely to be necessary because the landfill is likely in the late stages of gas development, with the last deposition of waste occurring almost 40 years ago in 1983.

4.0 PREVIOUS INVESTIGATIONS

Previous subsurface explorations and environmental sampling on the Property have included test pit explorations and soil sampling, groundwater monitoring well installation and groundwater sampling, surface water sampling, and landfill gas studies. This section summarizes these previous investigation activities.

4.1 Test Pit Explorations and Soil Sampling

This section briefly summarizes test pit exploration and soil sampling activities at the Property. Full descriptions of previous investigations are contained in the IAWP and in the report titled *Results of Pre-Construction Soil Sampling – Go East Corp Landfill Site, Everett, Washington* (Pre-Construction Soil Sampling Memorandum) (GeoEngineers 2020b).

A total of 152 test pits have been excavated to depths of 1 to 38 feet bgs on the Property (Figures 4 and 7) to investigate the types of materials contained in the Landfill, the depth and lateral limits of the Landfill, concentrations of hazardous substances potentially present in the landfill material and in native soil outside the Landfill, and/or geotechnical properties of the landfill material and native soil.

Landfill materials encountered in test pits completed in the Landfill consisted of construction debris including gravel, concrete, wire, woody debris, tires, brick, asphalt, plastic pipe, dimensional lumber, burned wood, metal, broken glass, cement board, roofing materials, and carpet. Landfill materials also included intermixed native soil (loose silty sand and gravel) from the former ridge that existed in the flat area south-adjacent to the Landfill. This native soil was used as cover soil during Landfill operations. Native soil encountered beneath the landfill materials in the test pits generally consisted of gray or tan to brown, fine to medium-grained sand interpreted as Qva deposits.

Soil analytical results of the Landfill material were compared to RI screening levels (Section 8) to identify COPCs that may be present in soil outside of the landfill at concentrations exceeding screening levels. Based on the comparison, COPCs include oil range organics (ORO), bis(2-ethylhexyl) phthalate, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), fluoranthene, fluorene, pyrene, polychlorinated biphenyls (PCBs), 4,4'-Dichlorodiphenyldichloroethane (4,4’-DDD), 4,4’- Dichlorodiphenyldichloroethylene (4,4’-DDE), 4,4'-Dichlorodiphenyltrichloroethane (4,4’-DDT), trans-chlordane, cadmium, chromium, copper, lead, mercury, nickel, and zinc. The detected concentrations of these constituents in the landfill material soil samples do not preclude the relocation of landfill material from the interim action excavation area to the interior portion of the Landfill during Landfill closure.

4.2 Groundwater Monitoring Well Installation and Groundwater Sampling

AESI installed four groundwater monitoring wells (MW-1 through MW-4) around the perimeter of the Landfill in August 2009 (Figure 4) to measure groundwater levels and evaluate groundwater quality. The monitoring well installation and results of the previous groundwater sampling are described in *Revised Hydrogeology, Ground Water, and Surface Water Quality Report, Former Go East Landfill, Snohomish County, Washington* dated December 15, 2009, revised October 26, 2011, prepared by AESI (Water Quality Report) (AESI 2009a).

Monitoring well boring and well construction logs are included in Appendix A. Native soil encountered from the ground surface to depths ranging from 28 to 73 feet bgs in the borings (depending on location) consisted of gray or tan to brown, fine to medium-grained sand with occasional gravel and silt lenses. AESI interpreted this soil as Qva deposits. Soil encountered below the Qva to depths ranging from 46 to 101 feet bgs consisted of very stiff to hard, bluish gray silt interpreted as pre-Vashon glacial lacustrine silt (AESI 2009a, 2009b). The base of the lacustrine silt deposits has not been identified in subsurface explorations completed on the Property. However, the fine-grained Admiralty clay geologic unit, a member of the Qtb that includes the lacustrine silt deposits, is reportedly hundreds of feet thick beneath Snohomish County's main river troughs such as the Snohomish River Valley (Newcomb 1952).

The monitoring well depths range from 31 feet bgs (well MW-4) to 75 feet bgs (well MW-1). The wells are constructed of 2-inch diameter polyvinyl chloride (PVC) casing with 10-foot well screens that span the Qva/Qtb contact, with the lower portion of the screen extending approximately 2 feet into the Qtb (lacustrine silt) and the upper portion extending approximately 8 feet into the Qva. Each well is completed with an aboveground outer steel casing set in concrete and three protective bollards at the surface.

Groundwater levels were measured in August 2009, February 2011, and April 2011. Groundwater depths were consistently approximately 50 feet bgs in MW-1 (Elevation 210); 50 feet bgs in MW-2 (Elevation 184); and 30 to 40 feet bgs in MW-3 (Elevation 204 to 214) (AESI 2009a). Well MW-4 was dry (i.e., did not contain groundwater) during each of the well gauging events. The water elevations were above the lacustrine deposits in wells MW-1 through MW-3 which is to be expected. Wells MW-1 and MW-3 are hydraulically upgradient of the Landfill and well MW-2 is upgradient or crossgradient of the Landfill based on the measured groundwater levels.

Groundwater samples were collected from monitoring wells MW-1, MW-2, and MW-3 in August 2009. Well MW-4 was not sampled because it was dry. The groundwater samples were analyzed for the following constituents (AESI 2009a):

- Semivolatile organic compounds (SVOCs) by EPA Method 8270C.
- Total arsenic, barium, cadmium, chromium, iron, lead, manganese, mercury, selenium, and silver by EPA Methods 6010B/6020/7470A.
- Dissolved arsenic, chromium, iron, lead, and manganese by EPA Methods 6010B/6020.
- Chloride, sulfate, pH, and specific conductance by EPA Methods 300.0/150.1/120.1.

Analytical results for the groundwater samples collected in August 2009 are presented in the Water Quality Report (AESI 2009a) and are summarized in Table 1 of this Work Plan.

Ecology used groundwater concentrations protective of drinking water use, surface water beneficial uses, and sediment to derive Site-specific soil IALs for the interim action (i.e., screening levels) as documented in Appendix D of the IAWP. The August 2009 groundwater analytical results presented in the Water Quality Report (AESI 2009a) were compared to the screening levels for the purpose of identifying COPCs in this Work Plan.

Constituents detected in one or more of the August 2009 groundwater samples at concentrations exceeding screening levels include total and dissolved arsenic, total and dissolved manganese, and total chromium, iron, lead, and mercury. The total metal concentrations reported in unfiltered groundwater samples were greater than the dissolved metal concentrations reported in filtered samples, indicating that the total metal concentrations in unfiltered samples likely were biased high by suspended soil particles in the samples. SVOCs were not detected above laboratory reporting limits in any of the groundwater samples (AESI 2009a).

4.3 Surface Water Sampling

Surface water on the Property was sampled on multiple occasions between 1981 and 2009. The surface water samples were collected from Streams 2 and 3, and possibly also at several groundwater seep locations along or near the Qva/Qtb contact on the northern and western walls of the ravine south- and east-adjacent to the Landfill (i.e., the ravine containing Stream 2) (not all surface water sampling locations are known). The scope and results of the historical surface water sampling are described in detail in the Water Quality Report (AESI 2009a). The scope of the surface water sampling is summarized below.

Surface water sampling was conducted by Ecology and/or SHD between 1981 and 2004[2]; by Robert G. Bober Jr., P.E. in September 1997; by HWA in May 2002; and by AESI in August 2009 (AESI 2009a). The surface water samples were analyzed for various general chemistry parameters (e.g., ammonia, chemical oxygen demand, chloride, iron, manganese, nitrate, pH, phosphate, sulfate, tannins and lignins, total organic carbon). Some samples also were analyzed for GRO, DRO, BTEX, VOCs, cPAHs, SVOCs, PCBs, pesticides, and/or Resource Conservation and Recovery Act (RCRA) metals or Priority Pollutant metals (antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and/or zinc) (AESI 2009a).

Ecology used surface water concentrations protective of surface water beneficial uses and sediment to derive protective soil IALs for the interim action (i.e., screening levels) as documented in Appendix D of the IAWP. The historical surface water analytical results presented in the Water Quality Report (AESI 2009a) were compared to the screening levels for the purpose of identifying COPCs in this Work Plan.

Constituents detected in one or more surface water samples at concentrations exceeding screening levels are listed in Table 2 and include fluoranthene, arsenic, iron, lead, manganese, and zinc. The exceedances were detected in surface water samples known or inferred to be collected from Stream 3 or from the "leachate spring" at the base of the Landfill's northeastern slope. The following constituents were not detected above laboratory reporting limits in surface water: GRO, DRO, VOCs, PCBs, pesticides, antimony, beryllium, cadmium, copper, mercury, selenium, silver, and thallium (AESI 2009a, SHD 2004).

4.4 Landfill Gas Studies

Landfill gas sampling was conducted at ten temporary landfill gas probe locations in August and October 2009 (AESI 2009b). Nine gas probes (GS-1 through GS-3 and GS-5 through GS-10) were completed within the current Landfill limit and one gas probe (GS-4) was completed outside the Landfill limit (Figure 4). Concentrations of oxygen, carbon dioxide, and methane in landfill gas were measured at multiple depths between 5 and 50 feet bgs at each gas probe location using a direct-push drill rig and a GEM 2000 portable landfill gas monitor. Some of the deeper landfill gas measurements near the outer margin of the Landfill likely were obtained from native soil below landfill material. Details of the landfill gas sampling methodology are described in AESI (2009b).

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[2] Per the 1987 Site Inspection Report (Ecology & Environment), Snohomish Health District collected surface water samples in 1981, 1983, 1984, and 1986 and the samples were analyzed by Ecology. The surface water sampling attributed to Ecology in the 2009 AESI report appears to have actually been performed by Snohomish Health District based on information contained in the Site Inspection Report.

Measured oxygen concentrations in the gas probes ranged from 0.0 to 21.5 percent and measured carbon dioxide concentrations ranged from 0.1 to 22.8 percent. Methane was detected at three of the ten gas probe locations (GS-3, GS-5, and GS-8, all within the current Landfill limit) at depths ranging from 15 to 50 feet bgs. The maximum methane concentrations detected at locations GS-3, GS-5, and GS-8 were 8.4 percent, 2.7 percent, and 0.2 percent, respectively.

Methane migration is regulated under WAC 173-350 and is not regulated under MTCA. Landfill gas will be managed as part of landfill closure activities. Non-methane VOCs in soil gas beyond the landfill boundary may be regulated under MTCA. Non-methane VOCs have not been analyzed for in landfill gas. However, VOCs were generally not detected in landfill material soil samples or surface water samples.

5.0 PRELIMINARY CONCEPTUAL SITE MODEL

This section presents the preliminary CSM, including the Site setting, potential sources of environmental contamination, COPCs, contaminant transport pathways, and potential receptors.

5.1 Site Setting

The inactive Landfill is situated in a former ravine on a bluff overlooking the Snohomish River Valley. It is covered by up to 2 feet of native sandy soil that was obtained from the flat, historically graded area south-adjacent to the Landfill. The soil cover was spread over the top of the Landfill when operations ceased in 1983. Erosion has eliminated or reduced the thickness of the soil cover in some areas. The Landfill surface is uneven and largely covered by scrub vegetation including blackberry brambles. The northeastern portion of the Landfill slopes steeply to the northeast and is covered by a sparse canopy of trees and an understory of scrub vegetation.

Lithologic information obtained from monitoring well borings on the Property and Regional geological studies indicate that the Landfill is underlain by a variable thickness of permeable sand and gravel (Qva) deposits ranging from 0 to 60 feet thick, underlain by between 100 and 400 feet of low-permeability lacustrine silt and other pre-Vashon glacial deposits that constitute the transitional beds stratigraphic sequence (Qtb). On-site monitoring wells MW-1 through MW-4 encountered the Qtb deposits to depths of up to approximately 30 feet thick without encountering the bottom of the deposits. The boring logs generally describe the Qtb as moist bluish gray silt. Regional geological studies include Newcomb (1952) which indicates the low-permeability lacustrine silt and other pre-Vashon glacial deposits are reportedly hundreds of feet thick beneath Snohomish County’s main river troughs such as the Snohomish River Valley, and USGS (1997) which similarly indicates the deposits are generally fine grained and 100 to 400 feet thick in the region.

Groundwater occurs in the Qva at depths ranging from approximately 30 to 50 feet bgs and appears to be perched above the lacustrine silt deposits. A subdrain consisting of perforated pipe embedded in gravel was reportedly installed along the bottom of the former ravine beneath the Landfill before landfilling activities began in the early 1970s. This subdrain is assumed to drain groundwater beneath the Landfill and discharge it toward the base of the Landfill’s northeastern slope, where it emerges from the “leachate spring” at the base of the slope to form Stream 3. As noted previously, the pipe has not been observed at the toe of the landfill and the subdrain pipe may be clogged and potentially crushed.

The Property is located within a discharge area for the regionally important Qva aquifer which terminates in the bluffs along the western margin of the Snohomish River Valley (USGS 1997). Groundwater in the Landfill area is inferred to occur near or below the bottom of the Landfill and to generally flow to the northeast toward the Snohomish River Valley based on Site geology and surface water hydrology, the topography of the former ravine beneath the Landfill, the reported presence of a subdrain beneath the Landfill, measured groundwater levels in Site monitoring wells, and regional groundwater studies.

A groundwater divide is inferred to exist within the Qva along the former topographic divide that historically separated the former ravine beneath the Landfill and the ravine south- and east-adjacent to the Landfill (i.e., the ravine containing Stream 2) (Figure 4). Groundwater to the north and west of the groundwater divide is inferred to flow toward the north and west (i.e., toward the Landfill), while groundwater to the south and east of the groundwater divide is inferred to flow toward the south and east (i.e., toward Stream 2).

Groundwater occurrence and migration in the Qtb deposits below the Qva is likely limited due to the low permeability of the Qtb silt and clay deposits.

5.2 Potential Sources of Environmental Contamination

The primary potential source of environmental contamination at the Site is leaching of hazardous substances from landfill material to groundwater. Another potential source of contamination is the mobilization of naturally occurring metals in soil by reduction-oxidation (redox) reactions that may occur in saturated soil within or adjacent to the Landfill. For example, naturally occurring arsenic, iron, or manganese can be mobilized under anoxic, reducing conditions. Groundwater beneath the landfill discharges to surface water and many mobilized metals precipitate when exposed to the aerobic conditions of surface water.

5.3 Contaminants of Potential Concern

In this Work Plan, COPCs are defined as hazardous substances present in environmental media outside the landfill (e.g., soil, groundwater, surface water, and sediment) at concentrations exceeding RI screening levels.

COPCs identified to date that may be present in soil outside the Landfill based on previous chemical analysis of landfill material soil include ORO, SVOCs (bis[2-ethylhexyl] phthalate, cPAHs, fluoranthene, fluorene, and pyrene), PCBs (Aroclor 1254), pesticides (4,4’-DDD, 4,4’-DDE, 4,4’-DDT, and trans-chlordane), and metals (cadmium, chromium, copper, lead, mercury, nickel, and zinc) (Table 4).

COPCs identified to date in groundwater include arsenic, chromium, iron, lead, manganese, and mercury. (Table 1).

COPCs identified to date in surface water include fluoranthene, arsenic, iron, lead, manganese, and zinc (Table 2). The surface water exceedances were detected in surface water samples known or inferred to be collected from Stream 3 or the “leachate spring” at the base of the Landfill’s northeastern slope.

In addition to the COPCs identified above, methane was detected at three landfill gas probe locations in 2009 as discussed in Section 4.4. Non-methane VOCs have not been analyzed for in landfill gas. However, VOCs were generally not detected in landfill material soil samples or surface water samples. Landfill gases that are present within a permitted landfill and managed in accordance with the permit generally are not considered by Ecology to constitute a release as defined in the MTCA Cleanup Regulation. Landfill gas control requirements for limited-purpose landfills are defined in WAC 173-350. The Permit requires that the Landfill closure and post-closure care activities comply with applicable regulations in WAC 173-350. The engineered capping system that will be installed during Landfill closure includes a landfill gas control system to capture and remove landfill gas. Post-closure landfill gas monitoring will be performed pursuant to the Permit to ensure subsurface landfill gases are contained within the future Landfill limit and are vented to the atmosphere at concentrations below applicable regulatory limits. Remedial actions are not required under MTCA to address landfill gas because the landfill gas control and monitoring plans were approved by Ecology and SHD pursuant to WAC 173-350 and these post-closure care activities will be regulated under WAC 173-350.

5.4 Contaminant Transport Pathways

Potential contaminant transport pathways include the following based on the current understanding of Site conditions:

- Leaching of contaminants from landfill material to groundwater.
- Migration of contaminants in groundwater via advection and diffusion.
- Discharge of contaminated groundwater to Stream 3.
- Partitioning of dissolved contaminants to sediment in Stream 3.
- Migration of contaminants in Stream 3 surface water and sediment to downgradient surface water in the Snohomish River Valley via advection and sediment erosion.

Landfill gas migration to groundwater including upgradient of the landfill could potentially be contaminant transport pathway. However, it is not considered further because of the landfill's historical permeable cover. Furthermore, landfill gas will be managed in the future using an impermeable cover and gas ventilation system.

5.5 Potential Receptors

Receptors that may be exposed to Site-related contaminants via the contaminant transport pathways identified above include humans, terrestrial wildlife, and aquatic life in downgradient surface water. These potential receptors may be exposed to Site-related contaminants through direct contact (i.e., ingestion and/or dermal contact) with contaminated groundwater, surface water, or sediment. In addition, humans and other higher trophic level organisms may be exposed to contaminants through consumption of contaminated animal or plant tissue (e.g. consumption of plants irrigated with contaminated surface water).

As noted previously, Streams 1, 2, and 3 and the downgradient drainage channels in the Snohomish River Valley do not support fish. However, the Snohomish River receives discharge from the drainage channels and provides fish habitat for feeding and spawning.

6.0 DATA GAPS

This section identifies data gaps in the existing Site characterization.

6.1 Soil Data Gaps

The material within the landfill is not subject to MTCA regulations. Soil outside the landfill is subject to MTCA. Characterization of the nature and extent of soil contamination outside the future Landfill limit was partially characterized during historical test pit sampling activities described in Section 4.1 with the completion of the characterization based on the data collected during the interim action.

Previous soil sampling conducted at the Site is summarized in Section 4.1. The previous soil sampling consists of the landfill material sampling conducted within and adjacent to the interim action excavation area in June 2019 and June 2020, and the on-site fill source sampling and former storage tank area sampling conducted in areas outside the Landfill in June 2020.

Additional soil sampling is necessary to characterize the nature and extent of soil contamination outside the future Landfill limit. As described in the IAWP (GeoEngineers 2020a), confirmation soil sampling will be conducted immediately following the relocation of landfill materials from the interim action excavation area to the interior portion of the Landfill to confirm that soil at the interim action excavation limits does not contain hazardous substances at concentrations exceeding Ecology-derived IALs. The approximate proposed confirmation soil sampling locations for the interim action are shown in Figure 8. The confirmation soil samples will be analyzed for GRO, DRO, ORO, VOCs, SVOCs, PCBs, pesticides, herbicides, and metals. The interim action confirmation soil sampling will address the identified soil data gaps.

Several groundwater monitoring wells will be installed and sampled during the RI as discussed in Section 7.2.2. Soil samples will be collected from the monitoring well borings to characterize the drill cuttings for disposal and to compare concentrations of hazardous substances in soil and groundwater at the new monitoring well locations.

6.2 Landfill Soil Gas Data Gaps

Non-methane VOCs in soil is a potential data gap pending analysis of groundwater VOCs during the RI. VOCs were not detected in previous sampling of landfill material soils and surface water samples. Soil gas will be sampled for non-methane VOCs only if VOCs are detected in groundwater at concentrations exceeding MTCA screening levels for the vapor intrusion pathway. A SAP addendum will be submitted for Ecology review if groundwater VOC detections trigger soil gas sampling prior to conducting the sampling.

6.3 Groundwater Data Gaps

Groundwater quality and flow directions at the Site have not been fully evaluated, including background metals concentrations in groundwater that is hydraulically upgradient of the Landfill.

As discussed in Section 4.2, groundwater at the Site was sampled in August 2009. This sampling was conducted to evaluate groundwater quality and flow directions. Groundwater samples were collected from monitoring wells MW-1 through MW-3; well MW-4 was not sampled because it did not contain groundwater. Groundwater levels were measured, and groundwater samples were collected and analyzed for SVOCs, metals, and the general chemistry parameters chloride, sulfate, pH, and specific conductance. The results of the August 2009 groundwater sampling are summarized in Section 4.2.

Additional groundwater sampling is necessary to characterize the groundwater quality and flow directions at the Site, including upgradient/background locations and other locations not evaluated by the August 2009 groundwater sampling event. A goal of the RI will be to calculate groundwater background metals concentrations. The proposed RI groundwater sampling and analytical testing is discussed in Sections 7.2.2 and 7.3.

6.4 Surface Water Data Gaps

Surface water quality at the Site has not been fully evaluated.

The scope and results of previous surface water sampling conducted at the Site are summarized in Section 4.3. Multiple surface water sampling events were conducted between 1981 and 2009 to evaluate surface water quality in Streams 2 and 3. Several groundwater seeps along or near the Qva/Qtb contact on the walls of the ravine south- and east-adjacent to the Landfill also may have been sampled (not all surface water sampling locations are known). The surface water samples were analyzed for various general chemistry parameters. One or more samples also were analyzed for GRO, DRO, ORO, VOCs, SVOCs, cPAHs, PCBs, pesticides, and/or metals.

Concentrations of hazardous substances exceeding Ecology-derived concentrations protective of surface water beneficial uses and sediment have been detected in surface water samples obtained from Stream 3. As discussed in Section 3.4, the source of Stream 3 is groundwater that flows to the northeast under the Landfill and discharges at the “leachate spring” located at the base of the Landfill’s northeastern slope.

Additional surface water sampling is necessary to characterize surface water quality in Stream 3 and at groundwater seep locations on the western wall of the ravine east-adjacent to the Landfill. The proposed RI surface water sampling and analytical testing is discussed in Sections 7.2.3 and 7.3.

6.5 Sediment Data Gaps

Sediment quality at the Site has not been evaluated. Sediment sampling is necessary to characterize the sediment quality in Stream 3. Stream 3 is the most likely stream on the Property to be affected by the Landfill because it is fed by groundwater that flows under the Landfill and discharges at the “leachate spring” at the base of the Landfill’s northeastern slope. The proposed RI sediment sampling and analytical testing is discussed in Sections 7.2.3 and 7.3.

7.0 REMEDIAL INVESTIGATION FIELD ACTIVITIES

This section provides a general description of the planned RI field activities. Details regarding sampling procedures, analytical testing, and quality assurance/quality control (QA/QC) guidelines and procedures are provided in the Sampling and Analysis Plan (SAP) and the Quality Assurance Project Plan (QAPP) contained in Appendices B and C, respectively.

7.1 Objective

The objective of the RI field activities is to gather sufficient data to characterize the Site, evaluate potential risks to human health and the environment, and develop cleanup action alternatives (if necessary) in the FS. This will be accomplished by collecting and analyzing samples of groundwater, surface water, and sediment to address the data gaps identified in Section 6.0. The confirmation soil sampling to be performed as part of the interim action during Landfill closure as described in the IAWP will address the soil data gaps identified in Section 6.1.

The RI sampling data will be used to characterize the nature and extent of Site-related contamination, if any, and to refine the preliminary CSM described in Section 5.0 as needed. If Site-related contaminants are identified in the sampled media, potential exposure pathways and risks associated with the COPCs will be evaluated and the contaminants and media requiring cleanup will be identified.

7.2 Media and Locations to be Sampled

This section identifies the environmental media to be sampled and the proposed sampling locations.

7.2.1 Soil

The confirmation soil sampling to be performed during the interim action (Figure 8) will address the soil data gaps identified in Section 6.1, and no additional soil sampling is proposed to characterize the nature and extent of soil contamination at the Site. As described in Section 7.2.2 below, several groundwater monitoring wells will be installed and sampled during the RI. Soil samples will be collected from the monitoring well borings to characterize the drill cuttings for disposal and to compare concentrations of hazardous substances in soil and groundwater at the new monitoring well locations. Details regarding soil sampling are provided in the SAP.

7.2.2 Groundwater

Four new groundwater monitoring wells (MW-5 through MW-8) will be installed around the Landfill in presumed upgradient locations as part of the RI. The wells will be screened within the advanced outwash. The rationale and general plans for installing and sampling these wells are described below. Details regarding drilling and groundwater sampling procedures provided in the SAP. Separately, two new groundwater monitoring wells (MW-9 and MW-10) will be installed in the area near the base of the Landfill's northeastern slope as part of the RI and also part of Landfill closure construction activities. These two monitoring wells will be sampled as part of the RI and also as part of Permit-required post-closure monitoring program as described in the LFCP and Landfill closure construction plans. The Permit requires post-closure groundwater monitoring at the base of the Landfill's northeastern slope because this is where Site-related groundwater contamination, if any, is most likely to be observed.

The proposed locations of RI monitoring wells MW-5 through MW-8 and the planned locations of monitoring wells MW-9 and MW-10 to be installed during Landfill closure construction are shown in Figure 9. The proposed locations of wells MW-5 through MW-8 are assumed to be hydraulically upgradient of the future Landfill limit based on the inferred general northeasterly groundwater flow direction beneath the Landfill. It is assumed that groundwater quality data obtained from monitoring well MW-5 will represent background conditions based on the proposed location of this well relative to the Landfill. The planned locations of MW-9 and MW-10 are subject to modification based on the location of infrastructure to be installed in the area including a stormwater outfall, energy dissipator, and weir box.

Monitoring wells MW-5 through MW-10 will be installed and constructed by a Washington-licensed well driller in accordance with Washington State well construction standards using hollow-stem auger or sonic drilling methods. Monitoring well borings MW-5 through MW-8 will be advanced to the top of the lacustrine silt deposits that are anticipated to occur at a depth ranging from approximately 45 feet bgs at MW-8 to 100 feet bgs at MW-5. Monitoring well borings MW-9 and MW-10 will likely be screened directly within the lacustrine silt deposits and are anticipated to have low yield.

Soil types encountered during drilling will be logged and described using the Unified Soil Classification System and field-screened for evidence of potential chemical contamination. Drill cuttings will be contained and stored on site in drums pending characterization and disposal. Management of investigation-derived waste (IDW) is discussed in Section 7.6. Additional details regarding soil sampling and field screening are provided in the SAP (Appendix B).

The new monitoring wells will be constructed of 2-inch diameter PVC casing and will be completed with steel well monument set in a concrete surface seal. The screened interval of wells MW-5 through MW-8 will consist of approximately 10 to 15 feet of machine-slotted screen (0.010-inch slot width) installed in the lowermost portion of the Qva sand and gravel deposits[3]. The bottom 1 to 2 feet of the well screen may extend into the uppermost portion of the Qtb deposits (i.e., the lacustrine silt unit). Wells MW-9 and MW-10 will likely only have 5-foot well screens based on a total drill depth of only 10 feet bgs.

A filter pack consisting of 12/20 silica sand (or similar) will be constructed in the annular space between the well screen and the borehole wall, and a minimum 2-foot-thick hydrated bentonite seal will be installed above the filter pack. The hydrated bentonite seal may need to be reduced to a minimum of 1-foot for wells MW-9 and MW-10. The remaining annular space between the bentonite seal and the concrete surface seal will be filled with hydrated bentonite chips, neat cement, or cement-bentonite grout. Following well installation, the new monitoring wells will be developed by surging the screened interval and purging at least five well casing volumes of water from each well. Well development water will be contained and stored on site in drums pending characterization and disposal.

Quarterly groundwater monitoring will be conducted for one year to evaluate groundwater quality and flow directions. Groundwater levels in the ten monitoring wells (MW-1 through MW-10) will be gauged prior to sampling groundwater each quarter, and monitoring wells containing a sufficient volume of groundwater for sampling will be sampled. Well MW-5 will be sampled more frequently than other wells to assist in evaluating background metals concentrations. Well MW-5 will be sampled twice per quarter (i.e., eight samples per year) with the goal of sampling MW-5 approximately every six weeks. Well MW-4 will be decommissioned because groundwater has not been observed in the advanced outwash at this location.

Groundwater samples will be collected using a bladder pump and low-flow purging and sampling methods. Field water quality parameters including temperature, pH, specific conductance, turbidity, dissolved oxygen (DO), and oxidation-reduction potential (ORP) will be measured during well purging. Groundwater samples will be collected after field parameters stabilize. Both unfiltered and field-filtered samples will be collected for total and dissolved metals analysis, respectively. The groundwater samples will be stored in a cooler containing ice and delivered to the analytical laboratory under chain of custody. The laboratory will analyze the samples for the constituents identified in Section 7.3. Monitoring well purge water will be contained and stored on site in marked drums pending characterization and disposal. Additional details regarding groundwater sampling are provided in the SAP (Appendix B).

7.2.3 Surface Water and Sediment

Surface water and sediment sampling will be conducted in Stream 3 near the base of the Landfill's northeastern slope. Surface water sampling will also be conducted at groundwater seep locations on the

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[3] Saturated thicknesses observed in existing MW-1 through MW-3 in 2011 ranged from approximately 10 feet to 24 feet.

western wall of the ravine east-adjacent to the Landfill. The approximate proposed surface water sampling locations are shown in Figure 9.

Surface water sampling will occur at the outlet of the weir structure to be built at the toe of the northeast slope at SWS-1 (Figure 9). One surface water sample will be collected at the surface water sampling station during each of the four quarterly groundwater monitoring events described in Section 7.2.2. The surface water samples will be unfiltered and will be obtained using one or more of the following pieces of field equipment: disposable Teflon bailer; peristaltic pump and disposable polyethylene tubing; or a stainless steel or polyethylene cup or ladle. Field water quality parameters including temperature, pH, specific conductance, turbidity, DO, and ORP will be measured prior to collecting samples for chemical analysis.

Groundwater seep sampling will also be conducted during the quarterly groundwater monitoring events. The goal will be to collect seep samples from 2 locations per quarter over 4 quarters, for a total of eight representative groundwater seep samples[4]. At least one of the sampling events will be targeted during dry weather to minimize potential stormwater interferences. The seep sampling locations shown in Figure 9 (Seep-1 through Seep-4) are representative and approximate; the actual seep sampling locations will be selected in the field based on field conditions at the time of sampling (e.g., observed seep locations and flow rates).

The groundwater seep samples will be unfiltered and will be obtained using a stainless steel or polyethylene cup or ladle. Field water quality parameters including temperature, pH, specific conductance, turbidity, DO, and ORP will be measured prior to collecting samples for chemical analysis.

The surface water samples collected from the weir and from groundwater seeps will be stored in a cooler containing ice and delivered to the analytical laboratory under chain of custody. The laboratory will analyze the samples for the constituents identified in Section 7.3. Additional details regarding surface water sampling are provided in the SAP (Appendix B).

Three sediment sampling stations will be established in Stream 3 and sampled prior to disturbance from construction activities. The sampling locations include SED-1 just downgradient of the weir outlet, SED-3 just south of the property line where Stream 3 exits the Property, and SED-2 approximately in between SED-1 and SED-3 (prior to confluence of Stream 3 with future "clean" stormwater discharges). The sediment samples will be obtained from the upper 4 inches of sediment on the bottom of Stream 3 using a manual coring device, spade, or stainless steel spoon. The sediment samples will be stored in a cooler containing ice and delivered to the analytical laboratory under chain of custody. The laboratory will analyze the samples for the constituents identified in Section 7.3. Additional details regarding sediment sampling are provided in the SAP (Appendix B).

7.3 Analytical Testing

The soil, groundwater, surface water, and sediment samples collected during the RI will be submitted to a Washington State accredited laboratory for analytical testing. It is anticipated that OnSite Environmental,

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[4] If field conditions are such that this goal cannot be met, the alternative goal will be to collect a total of eight samples, but not necessarily during each of four quarters.

Inc. in Redmond, Washington (OnSite) will be the primary subcontracted laboratory. Other laboratories may be used depending on analytical requirements.

The soil, groundwater, and Stream 3 surface water and sediment samples will be analyzed for the following constituents:

- GRO by Method NWTPH-Gx (note: Stream 3 sediment samples will not be analyzed for GRO, as screening levels have not been established for sediment).
- DRO and ORO by Method NWTPH-Dx without acid/silica gel cleanup. If DRO or ORO are detected above respective screening levels (see Section 8.0), follow-up analysis with an acid/silica gel cleanup preparation process may be performed to assess potential analytical interference by biogenic material (e.g., tannins and lignins from woody debris).
- VOCs by EPA Method 8260D (note: Stream 3 sediment samples will not be analyzed for VOCs, as screening levels have not been established for sediment).
- SVOCs with low-level PAHs by EPA Method 8270E/Selective Ion Monitoring.
- PCBs as Aroclors by EPA Method 8082A.
- Organochlorine pesticides by EPA Method 8081B.
- Chlorinated acid herbicides by EPA Method 8151A.
- Metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, and zinc) by EPA Methods 6010D/6020B/7470A/7471B/200.7/200.8/245.1. Groundwater samples will be analyzed for both total metals (unfiltered samples) and dissolved metals (field-filtered samples).
- Total organic carbon by EPA Method 9060A (Stream 3 sediment samples only).

Groundwater samples will also be analyzed for the following geochemical and leachate indicator parameters required by WAC 173-350-500(4)(h) for landfill post-closure care:

- Alkalinity and bicarbonate by SM 2320B.
- Dissolved calcium, dissolved potassium, total and dissolved magnesium, and dissolved sodium by EPA 200.7/200.8.
- Chloride by SM 4500-Cl.
- Nitrate by EPA 353.2.
- Sulfate by ASTM D516-11.
- Ammonia by SM4500-NH3.
- Total Dissolved Solids by SM 2540 C.

The surface water samples collected from the weir box (SWS-1) and the groundwater seeps (Seep-1 through Seep-4) on the western wall of the ravine east-adjacent to the Landfill will be analyzed for arsenic, iron, and manganese, and for leachate indicator parameters ammonia, TOC and TDS.

In addition to the analytical constituents identified above, the field water quality parameters including temperature, pH, specific conductance, turbidity, DO, and ORP will be measured for groundwater and surface water samples as discussed in Sections 7.2.2 and 7.2.3.

7.4 Data Quality Assurance/Quality Control

An important goal of the RI sampling and measurement activities is to collect environmental data that are scientifically valid, of known and acceptable quality, and meet established objectives. The QAPP contained in Appendix C presents the quality objectives for environmental measurement data that will be generated during the RI and the QA/QC procedures for achieving the quality objectives. The QA/QC procedures described in the QAPP will be implemented so that the precision, accuracy, representativeness, completeness, and comparability of the RI data meet the measurement quality objectives to the maximum extent possible.

7.5 Land Surveying

A professional land surveyor will survey the locations and elevations of the following:

- Groundwater monitoring wells MW-1 through MW-10;
- Actual groundwater seep sampling locations;
- Actual sediment sampling locations; and
- Proposed features at the toe of the northeast slope once they are constructed including the inlet and outlet inverts of the weir box.

Note that existing monitoring wells MW-1 through MW-4 were previously surveyed. However, these wells and the other relevant site features referenced above will be resurveyed in one mobilization.

7.6 Investigation-Derived Waste Management

Investigation-derived waste (IDW) will consist of drill cuttings from the monitoring well borings, drilling and sampling equipment decontamination wash water and rinse water, and monitoring well development and purge water. The IDW will be stored on site in drums pending waste characterization and will be disposed of in accordance with applicable regulations. Drill cuttings and monitoring well development and purge water will be characterized for disposal based on the RI soil and groundwater sampling analytical data. Drilling and sampling equipment decontamination wash water and rinse water will be characterized for disposal by analyzing a sample of the drummed water for the constituents identified in Section 7.3. Gloves and other incidental waste will be disposed of in off-site waste receptacles.

8.0 REMEDIAL INVESTIGATION DATA EVALUATION

The laboratory analytical data for groundwater samples collected during the RI will be evaluated by comparing the data to screening levels developed from the protective concentrations used by Ecology to derive Site-specific soil IALs and from Washington State groundwater quality criteria defined in WAC 173-200. The laboratory analytical data for soil, surface water, and sediment samples will be evaluated by comparing the data to screening levels developed from the protective concentrations used by Ecology to derive Site-specific soil IALs. Ecology's derivation of the Site-specific soil IALs is presented in Appendix D of the IAWP. The proposed screening levels for soil, groundwater, surface water, and sediment are presented in Tables 3 through 6.

The RI data will be used to characterize groundwater flow directions, the nature and extent of contamination in the sampled media (if any), and potential Site-related risks to human health and the environment. Additionally, the groundwater monitoring data from monitoring well MW-5 (and possibly data from other monitoring wells and/or the groundwater seeps) will be used to evaluate background metals concentrations in groundwater. The RI will propose unrestricted groundwater cleanup levels based on applicable screening levels, Applicable or Relevant and Appropriate Requirements (ARARs), and background concentrations. The preliminary CSM presented in this Work Plan will be updated as necessary, Site-specific cleanup standards will be developed, and contamination requiring cleanup will be identified. The results of these evaluations will be presented in the RI/FS report (see Section 10.0).

9.0 PROJECT MANAGEMENT STRATEGY

This section describes the project management strategy for implementing and reporting RI activities. The responsibility and authority of the organizations and key personnel involved in conducting the RI are outlined below.

P&GE, as the Potentially Liable Party named in the Agreed Order, will have overall responsibility for completing the RI in accordance with the Agreed Order. P&GE will be represented by Gary East and Marty Penhallegon, who will have the authority to direct RI activities and adjust work scopes and schedules as necessary to meet project objectives.

GeoEngineers will serve as P&GE's environmental consultant and will manage and staff the RI project to ensure the technical work is conducted in accordance with this Work Plan and applicable regulatory requirements. GeoEngineers will:

- Prepare task scopes and schedules consistent with the RI scope and objectives described in this Work Plan.
- Allocate resources (labor, equipment, and supplies) needed to conduct the RI.
- Contract with subcontractors, coordinate subcontractor efforts, and review subcontractor work products for conformance with objectives.
- Submit sampling and laboratory analytical data to Ecology for entry into Ecology's Environmental Information Management System.
- Prepare progress reports and other Agreed Order deliverables.
- Liaise with Ecology on behalf of P&GE.
- Perform other work as needed to comply with the requirements of the Agreed Order.

Terry McPhetridge will be GeoEngineers' Principal-in-Charge and will have overall responsibility for ensuring the RI is conducted in accordance with this Work Plan.

Garrett Leque will be GeoEngineers' project manager and will assign project team members, coordinate field activities and laboratory analytical testing, coordinate subcontractors, and track the project schedule.

Mr. Leque will also verify that SAP and QAPP objectives are achieved and that deviations from the Work Plan, SAP, or QAPP are documented. Mr. Leque will also provide overall technical oversight of the RI and coordinate production of project deliverables.

Mark Lybeer will be GeoEngineers' Quality Assurance (QA) Leader responsible for overseeing quality assurance/quality control for laboratory testing of environmental samples. Specific responsibilities of the QA Leader are outlined in the SAP (Appendix B).

Drilling and laboratory analytical services will be contracted directly by P&GE or subcontracted by GeoEngineers. The drilling company has not yet been selected. It is anticipated that OnSite will perform most or all of the analytical chemistry testing. David Baumeister or designee will be OnSite's Laboratory QA Coordinator. Specific responsibilities of the Laboratory QA Coordinator are outlined in the SAP (Appendix B). Sediment samples may be submitted to a different Washington-accredited laboratory for analysis.

10.0 REPORTING

The results and conclusions of the RI will be presented in an RI/FS report prepared pursuant to the Agreed Order and MTCA requirements.

11.0 SCHEDULE

In accordance with Exhibit C of the Agreed Order, the RI field work will be completed within approximately 12 months following Ecology approval of this Work Plan, and the agency review draft RI/FS report will be completed within 90 days following receipt of laboratory data from the RI field work. The public review draft RI/FS report will be completed within 30 days following receipt of Ecology's comments on the agency review draft RI/FS report. The RI/FS report will not be considered final until after a public review and comment period.

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Table 1

Constituents Detected in Groundwater at Concentrations Exceeding Screening Levels

Go East Corp Landfill Site

Everett, Washington

Constituent	Units	Screening Level (a)	Basis for Protective Concentration is Protection of:	No. Samples Analyzed	No. Detections Exceeding Protective Concentration	Exceedance Frequency	Highest Concentration Detected	Location ID for Highest Concentration Detected	Comments
Total arsenic	mg/L	0.0050	Surface water, adjusted to background	3	3	100%	0.076	MW-2	
Dissolved arsenic	mg/L	0.0050	Surface water, adjusted to background	3	3	100%	0.021	MW-1	Dissolved concentrations in all wells were less than total concentrations.
Total chromium	mg/L	0.050	Drinking water	3	3	100%	0.60	MW-2	Dissolved chromium not detected in any well (PQL was less than the protective concentration).
Total iron	mg/L	0.30 (b)	Drinking water	3	3	100%	240	MW-2	
Dissolved iron	mg/L	0.30 (b)	Drinking water	3	1	33%	0.47	MW-1	Not detected in wells MW-2 or MW-3 (PQL was less than the protective concentration).
Total lead	mg/L	0.0011	Drinking water, adjusted to PQL	3	3	100%	0.084	MW-2	Dissolved lead not detected in any well (PQL exceeded the protective concentration).
Total manganese	mg/L	0.050 (b)	Drinking water	3	3	100%	5.9	MW-2	
Dissolved manganese	mg/L	0.050 (b)	Drinking water	3	3	100%	0.12	MW-2	Dissolved concentrations in all wells were less than total concentrations.
Total mercury	mg/L	0.000025	Surface water, adjusted to PQL	3	2	67%	0.00062	MW-2	Not detected in well MW-1 (PQL exceeded the protective concentration). Dissolved mercury not analyzed.

Notes:

Data source: Table 5 of AESI (2009a)

(a) Unless noted otherwise, the listed values are based on the most stringent of: (1) the Site-specific protective concentrations used by Ecology to develop soil interim action levels (as documented in Appendix D of the Interim Action Work Plan; GeoEngineers 2020a), and (2) WAC 173-200 groundwater quality criteria. The protective concentrations were adjusted to natural background or the PQL as applicable per WAC 173-340-720(7)(c).

(b) Site-specific protective concentration not defined by Ecology. Listed value is the Washington State and Federal Drinking Water Secondary Maximum Contaminant Level (WAC 246-290-310, 40 CFR 143.3).

CFR = Code of Federal Regulations

mg/L = Milligram per liter

PQL = Laboratory practical quantitation limit

WAC = Washington Administrative Code

Table 2

Constituents Detected in Surface Water at Concentrations Exceeding Screening Levels

(Samples Collected 1981-2009)

Go East Corp Landfill Site

Everett, Washington

Constituent	Units	Screening Level (a)	Basis for Protective Concentration is Protection of:	No. Samples Analyzed	No. Detections Exceeding Protective Concentration	Exceedance Frequency	Highest Concentration Detected	Year Highest Concentration Detected	Location ID for Highest Concentration Detected
Fluoranthene	µg/L	0.10	Sediment, adjusted to PQL	3	1	33%	0.15	2002	Unknown (d)
Total arsenic	mg/L	0.0050	Surface water, adjusted to groundwater background	5	1	20%	0.055	2004	Go East #2 Surface Water (e)
Total iron	mg/L	1.0 (b)	Surface water	NA	NA	NA	110	2009	SP-1 (f)
Dissolved iron	mg/L	1.0 (b)	Surface water	NA	NA	NA	6.5	Unknown (1989-1996)	"Leachate Spring"
Total lead	mg/L	0.0011	Sediment, adjusted to PQL	5	1	20%	0.0020	2002	Unknown (d)
Total manganese	mg/L	0.050 (c)	Surface water	NA	NA	NA	2.8	Unknown (1981-1986)	"Leachate Spring"
Dissolved manganese	mg/L	0.050 (c)	Surface water	NA	NA	NA	1.63	Unknown (1989-1996)	"Leachate Spring"
Dissolved zinc	mg/L	0.10	Surface water	NA	NA	NA	0.90	Unknown (1989-1996)	Stream 3

Notes:

Data source: Tables 3 and 4 of AESI (2009a)

(a) The listed values are based on the most stringent of the Site-specific protective concentrations used by Ecology to develop soil interim action levels as documented in Appendix D of the Interim Action Work Plan (GeoEngineers 2020a) unless noted otherwise. The protective concentrations were adjusted to groundwater natural background or the PQL as applicable per WAC 173-340-730(5)(c).

(b) Site-specific protective concentration not defined by Ecology. Listed value is the National Recommended Water Quality Criterion for protection of aquatic life (Federal Clean Water Act Section 304).

(c) Site-specific protective concentration not defined by Ecology. Listed value is the National Recommended Water Quality Criterion for protection of human health (Federal Clean Water Act Section 304).

(d) Although the specific surface water sampling location is unknown, it is inferred to be the "leachate spring" or Stream 3 at the base of the Landfill's northeastern slope based on the fact that full-suite analysis was performed on this sample to assess potential Landfill impacts. Landfill impacts are most likely to be observed in the "leachate spring" or Stream 3.

(e) This location is inferred to be in Stream 3 based on the description of the sampling location provided in the May 14, 2004 Site Hazard Assessment prepared by Snohomish Health District.

(f) This is the "leachate spring" location at the base of the Landfill's northeastern slope.

µg/L = Microgram per liter

mg/L = Milligram per liter

NA = Not available. Multiple surface water samples were analyzed between 1981 and 2009; the number of samples analyzed and the number of detections exceeding the protective concentration are not known.

PQL = Laboratory practical quantitation limit

WAC = Washington Administrative Code

Table 3

Soil Screening Levels

Go East Corp Landfill Site

Everett, Washington

Analyte	Soil Screening Level (a)
Total Petroleum Hydrocarbons (mg/kg)	
Gasoline Range Organics (GRO)	30/100 (b)
Total Diesel and Heavy Oil-Range Organics (DRO+ORO)	260
Volatile Organic Compounds (mg/kg)	
1,1,1,2-Tetrachloroethane	38
1,1,1-Trichloroethane	1.5
1,1,2,2-Tetrachloroethane	0.0010
1,1,2-Trichloroethane	0.0019
1,1-Dichloroethane	0.041
1,1-Dichloroethylene	0.044
1,1-Dichloropropene	--
1,2,3-Trichlorobenzene	20
1,2,3-Trichloropropane	0.033
1,2,4-Trimethylbenzene	800
1,2-Dibromo-3-chloropropane	1.3
1,2-Dichloroethane	0.023
1,2-Dichloroethylene (mixed isomers)	720
1,2-Dichloropropane	0.0036
1,3,5-Trimethylbenzene	800
1,3-Dichloropropane	--
2,2-Dichloropropane	--
2-Chloroethyl vinyl ether	--
2-Chlorotoluene	1,600
2-Hexanone	400
4-Chlorotoluene	--
4-Isopropyltoluene (p-Isopropyltoluene)	--
Acetone	29
Benzene	0.0024
Bromobenzene	0.56
Bromochloromethane	--
Bromoform	0.030
Bromomethane	0.050
Carbon disulfide	5.0
Carbon tetrachloride	0.0017
Chlorobenzene	0.17
Chloroethane	--
Chloroform	0.074
Chloromethane	--
cis-1,2-Dichloroethylene	0.078
cis-1,3-Dichloropropene	0.0011
Dibromochloromethane	0.0032
Dibromomethane	800
Dichlorobromomethane (Bromodichloromethane)	0.0038
Dichlorodifluoromethane (CFC-12)	16,000
Ethylbenzene	0.24
Ethylene dibromide (EDB) (1,2-Dibromoethane)	0.0010

Analyte	Soil Screening Level (a)
Isopropylbenzene	8,000
Methyl ethyl ketone (MEK) (2-Butanone)	48,000
Methyl iodide (Iodomethane)	--
Methyl isobutyl ketone (4-Methyl-2-Pentanone)	6,400
Methyl tert-butyl ether	0.10
Methylene chloride	0.021
n-Butylbenzene	4,000
n-Propylbenzene	8,000
sec-Butylbenzene	8,000
Styrene	2.2
tert-Butylbenzene	8,000
Tetrachloroethylene	0.024
Toluene	0.40
Total xylenes	14
trans-1,2-Dichloroethylene	0.52
trans-1,3-Dichloropropene	0.0011
Trichloroethylene	0.0019
Trichlorofluoromethane	24,000
Vinyl acetate	33
Vinyl chloride	0.0010
Semivolatile Organic Compounds (mg/kg)	
1,2,4-Trichlorobenzene	0.033
1,2-Dichlorobenzene	7.0
1,2-Dinitrobenzene	8.0
1,2-Diphenylhydrazine	1.3
1,3-Dichlorobenzene (m-Dichlorobenzene)	--
1,3-Dinitrobenzene	8.0
1,4-Dichlorobenzene (p-Dichlorobenzene)	0.98
1,4-Dinitrobenzene	8.0
1,4-Dioxane	10
2,3,4,6-Tetrachlorophenol	2,400
2,3,5,6-Tetrachlorophenol	--
2,4,5-Trichlorophenol	4.0
2,4,6-Trichlorophenol	0.033
2,4-Dichlorophenol	0.069
2,4-Dimethylphenol	0.70
2,4-Dinitrophenol	0.17
2,4-Dinitrotoluene	0.033
2,6-Dinitrotoluene	0.033
2-Chloronaphthalene	6,400
2-Chlorophenol	0.18
2-Methylphenol (o-Cresol)	2.3
2-Nitroaniline	800
2-Nitrophenol	--
3,3'-Dichlorobenzidine	0.17
(3+4)-Methylphenol (m,p-Cresol)	4,000
3-Nitroaniline	--
4,6-Dinitro-2-methylphenol	--
4-Bromophenyl phenyl ether	--
4-Chloro-3-methylphenol	--
4-Chloroaniline	0.17

Analyte	Soil Screening Level (a)
4-Chlorophenyl phenyl ether	--
4-Nitroaniline	320
4-Nitrophenol	7.0
Aniline	180
Benzyl alcohol	8,000
Bis(2-chloroethoxy)methane	--
Bis(2-chloroethyl)ether	0.033
Bis(2-ethylhexyl) phthalate	0.17
Butyl benzyl phthalate	0.17
Carbazole	3.7
Dibutyl phthalate	0.28
Diethyl phthalate	1.1
Dimethyl phthalate	200
Di-n-octyl phthalate	0.17
Hexachlorobenzene	0.033
Hexachlorobutadiene	0.033
Hexachlorocyclopentadiene	4.0
Hexachloroethane	0.033
Isophorone	0.13
Nitrobenzene	0.064
n-Nitrosodimethylamine	0.033
n-Nitrosodi-n-propylamine	0.033
n-Nitrosodiphenylamine	0.033
Pentachlorophenol	0.17
Phenol	0.74
Pyridine	80
Polycyclic Aromatic Hydrocarbons (mg/kg)	
1-Methylnaphthalene	34
2-Methylnaphthalene	320
Acenaphthene	3.1
Acenaphthylene	--
Anthracene	47
Benzo(g,h,i)perylene	--
Fluoranthene	0.020
Fluorene	1.6
Naphthalene	4.5
Phenanthrene	--
Pyrene	0.020
cPAHs (TTEC)	0.084
Polychlorinated Biphenyls as Aroclors (mg/kg)	
Total PCB Aroclors	0.050
Organochlorine Pesticides (mg/kg)	
4,4'-DDD	0.010
4,4'-DDE	0.010
4,4'-DDT	0.010
Aldrin	0.0050
alpha-BHC	0.0050
beta-BHC	0.0050
cis-Chlordane (alpha-Chlordane)	0.010
delta-BHC	6.0
Dieldrin	0.010

Analyte	Soil Screening Level (a)
Endosulfan I	0.0050
Endosulfan II	0.010
Endosulfan sulfate	480
Endrin	0.0050
Endrin aldehyde	--
Endrin ketone	--
gamma-BHC (Lindane)	0.0050
Heptachlor	0.0050
Heptachlor epoxide	0.0050
Methoxychlor	0.032
Toxaphene	0.050
trans-Chlordane (beta- or gamma-Chlordane)	0.0050
Chlorinated Acid Herbicides (mg/kg)	
2,4,5-T	800
2,4,5-TP (Silvex)	640
2,4-D	800
2,4-DB	2,400
Dalapon	2,400
Dicamba	2,400
Dichlorprop	--
Dinoseb	80
MCPA	40
MCPP	80
Metals (mg/kg)	
Arsenic	20
Cadmium	0.80
Chromium	48
Copper	36
Iron	56,000 (c)
Lead	50
Manganese	3,700 (c)
Mercury	0.070
Nickel	48
Selenium	0.80
Zinc	86

Notes:

(a) The soil screening levels are based on the soil interim action levels (IALs) developed by Ecology for the Go East Corp Landfill Site in 2020 as documented in Appendix D of the Interim Action Work Plan (GeoEngineers 2020a) unless noted otherwise. The Ecology-derived IALs were adjusted to natural background or the laboratory practical quantitation limit as applicable per WAC 173-340-740(5)(c).

(b) The 100 mg/kg value applies to gasoline mixtures without benzene and the total of toluene, ethylbenzene, and xylene is less than 1% of the gasoline mixture; the 30 mg/kg value applies to all other gasoline mixtures.

(c) Ecology didn't develop Site-specific soil IALs for iron or manganese. Listed value is the MTCA Method B standard formula value calculated using MTCA Eq. 740-1 (WAC 173-340-740[3][b][iii][B][I]) and associated default assumptions.

-- = Not established

cPAHs = Carcinogenic polycyclic aromatic hydrocarbons - includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

IAL = Interim action level

MTCA = Washington State Model Toxics Control Act

PCB = Polychlorinated biphenyl

WAC = Washington Administrative Code

mg/kg = Milligram per kilogram

TTEC = Total toxic equivalent concentration of benzo(a)pyrene calculated per WAC 173-340-708(8)(e)(iii)(A) and using one-half the laboratory reporting limit for non-detected cPAHs.

Table 4

Groundwater Screening Levels

Go East Corp Landfill Site
Everett, Washington

Analyte	Concentration Protective of Drinking Water Use (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Surface Water Beneficial Uses (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Sediment (Defined by Ecology Unless Noted Otherwise)*	WAC 173-200 Groundwater Quality Criterion	Preliminary Groundwater Screening Level	Natural Background	PQL (a)	Groundwater Screening Level Adjusted for Background and PQL (b)	Basis for Screening Level
Total Petroleum Hydrocarbons (µg/L)									
Gasoline Range Organics (GRO)	800 (c)	1,000	NA	NA	800	--	100	800 (c)	Protection of DWU (noncarcinogen)
Total Diesel and Heavy Oil-Range Organics (DRO+ORO)	500	3,000	NA	NA	500	--	200	500	Protection of DWU (noncarcinogen)
Volatile Organic Compounds (µg/L)									
1,1,1,2-Tetrachloroethane	1.7	NA	NA	NA	1.7	--	0.20	1.7	Protection of DWU (carcinogen)
1,1,1-Trichloroethane	200	10,000	NA	200	200	--	0.20	200	Washington State/Federal MCL
1,1,2,2-Tetrachloroethane	0.22	0.10	NA	NA	0.10	--	0.20	0.20	Project PQL
1,1,2-Trichloroethane	3.0	0.35	NA	NA	0.35	--	0.20	0.35	Protection of surface water (NTR-HH)
1,1-Dichloroethane	7.7	NA	NA	1.0	1.0	--	0.20	1.0	WAC 173-200 criterion
1,1-Dichloroethylene	7.0	300	NA	NA	7.0	--	0.20	7.0	Washington State/Federal MCL
1,1-Dichloropropene	NA	NA	NA	NA	--	--	0.20	--	--
1,2,3-Trichlorobenzene	NA	NA	NA	NA	--	--	0.20	--	--
1,2,3-Trichloropropane	0.0015	NA	NA	NA	0.0015	--	0.20	0.20	Project PQL
1,2,4-Trimethylbenzene	80	NA	NA	NA	80	--	0.20	80	Protection of DWU (noncarcinogen)
1,2-Dibromo-3-chloropropane	0.20	NA	NA	NA	0.20	--	1.0	1.0	Project PQL
1,2-Dichloroethane	4.2	8.9	NA	0.50	0.50	--	0.20	0.50	WAC 173-200 criterion
1,2-Dichloroethylene (mixed isomers)	72	NA	NA	NA	72	--	0.20	72	Protection of DWU (noncarcinogen)
1,2-Dichloropropane	5.0	0.71	NA	0.60	0.60	--	0.20	0.60	WAC 173-200 criterion
1,3,5-Trimethylbenzene	80	NA	NA	NA	80	--	0.20	80	Protection of DWU (noncarcinogen)
1,3-Dichloropropane	NA	NA	NA	NA	--	--	0.20	--	--
2,2-Dichloropropane	NA	NA	NA	NA	--	--	0.20	--	--
2-Chloroethyl vinyl ether	NA	NA	NA	NA	--	--	1.0	--	--
2-Chlorotoluene	160	NA	NA	NA	160	--	0.20	160	Protection of DWU (noncarcinogen)
2-Hexanone	40	NA	NA	NA	40	--	2.0	40	Protection of DWU (noncarcinogen)
4-Chlorotoluene	NA	NA	NA	NA	--	--	0.20	--	--
4-Isopropyltoluene (p-Isopropyltoluene)	NA	NA	NA	NA	--	--	0.20	--	--
Acetone	7,200	NA	NA	NA	7,200	--	5.0	7,200	Protection of DWU (noncarcinogen)
Benzene	2.4	0.44	NA	1.0	0.44	--	0.20	0.44	Protection of surface water (WWQC-HH)
Bromobenzene	64	NA	NA	NA	64	--	0.20	64	Protection of DWU (noncarcinogen)
Bromochloromethane	NA	NA	NA	NA	--	--	0.20	--	--
Bromoform	55	4.6	NA	5.0	4.6	--	1.0	4.6	Protection of surface water (NTR-HH)
Bromomethane	11	100	NA	NA	11	--	0.20	11	Protection of DWU (noncarcinogen)
Carbon disulfide	400	NA	NA	NA	400	--	0.20	400	Protection of indoor air
Carbon tetrachloride	0.56	0.20	NA	0.30	0.20	--	0.20	0.20	Protection of surface water (WWQC-HH)
Chlorobenzene	100	20	NA	NA	20	--	0.20	20	Protection of surface water (NRWQC-HH)
Chloroethane	19,000	NA	NA	NA	19,000	--	0.20	19,000	Protection of indoor air
Chloroform	1.2	60	NA	7.0	1.2	--	0.20	1.2	Protection of indoor air
Chloromethane	150	NA	NA	NA	150	--	1.0	150	Protection of indoor air
cis-1,2-Dichloroethylene	16	NA	NA	NA	16	--	0.20	16	Protection of DWU (noncarcinogen)
cis-1,3-Dichloropropene	0.44	0.22	NA	NA	0.22	--	0.20	0.22	Protection of surface water (NTR-HH)
Dibromochloromethane	5.2	0.60	NA	NA	0.60	--	0.20	0.60	Protection of surface water (NTR-HH)
Dibromomethane	80	NA	NA	NA	80	--	0.20	80	Protection of DWU (noncarcinogen)
Dichlorobromomethane (Bromodichloromethane)	1.8	0.73	NA	0.30	0.30	--	0.20	0.30	WAC 173-200 criterion
Dichlorodifluoromethane (CFC-12)	5.6	NA	NA	NA	5.6	--	0.20	5.6	Protection of indoor air
Ethylbenzene	700	29	NA	NA	29	--	0.20	29	Protection of surface water (NTR-HH)

Analyte	Concentration Protective of Drinking Water Use (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Surface Water Beneficial Uses (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Sediment (Defined by Ecology Unless Noted Otherwise)*	WAC 173-200 Groundwater Quality Criterion	Preliminary Groundwater Screening Level	Natural Background	PQL (a)	Groundwater Screening Level Adjusted for Background and PQL (b)	Basis for Screening Level
Ethylene dibromide (EDB) (1,2-Dibromoethane)	0.050	NA	NA	0.0010	0.0010	--	0.20	0.20	Project PQL
Isopropylbenzene	800	NA	NA	NA	800	--	0.20	800	Protection of DWU (noncarcinogen)
Methyl ethyl ketone (MEK) (2-Butanone)	4,800	NA	NA	NA	4,800	--	5.0	4,800	Protection of DWU (noncarcinogen)
Methyl iodide (Iodomethane)	NA	NA	NA	NA	--	--	1.0	--	--
Methyl isobutyl ketone (4-Methyl-2-Pentanone)	640	NA	NA	NA	640	--	2.0	640	Protection of DWU (noncarcinogen)
Methyl tert-butyl ether	24	NA	NA	NA	24	--	0.50	24	Protection of DWU (carcinogen)
Methylene chloride	5.0	NA	NA	5.0	5.0	--	1.0	5.0	Washington State/Federal MCL
n-Butylbenzene	400	NA	NA	NA	400	--	0.20	400	Protection of DWU (noncarcinogen)
n-Propylbenzene	800	NA	NA	NA	800	--	0.20	800	Protection of DWU (noncarcinogen)
sec-Butylbenzene	800	NA	NA	NA	800	--	0.20	800	Protection of DWU (noncarcinogen)
Styrene	100	NA	NA	NA	100	--	0.20	100	Washington State/Federal MCL
tert-Butylbenzene	800	NA	NA	NA	800	--	0.20	800	Protection of DWU (noncarcinogen)
Tetrachloroethylene	5.0	2.4	NA	0.80	0.80	--	0.20	0.80	WAC 173-200 criterion
Toluene	640	57	NA	NA	57	--	1.0	57	Protection of surface water (NRWQC-HH)
Total xylenes	330	NA	NA	NA	330	--	0.60	330	Protection of indoor air
trans-1,2-Dichloroethylene	100	100	NA	NA	100	--	0.20	100	Washington State/Federal MCL
trans-1,3-Dichloropropene	0.44	0.22	NA	NA	0.22	--	0.20	0.22	Protection of surface water (NTR-HH)
Trichloroethylene	1.5	0.30	NA	3.0	0.30	--	0.20	0.30	Protection of surface water (NTR-HH)
Trichlorofluoromethane	120	NA	NA	NA	120	--	0.20	120	Protection of indoor air
Vinyl acetate	7,800	NA	NA	NA	7,800	--	1.0	7,800	Protection of indoor air
Vinyl chloride	0.29	0.020	NA	0.020	0.020	--	0.20	0.20	Project PQL
Semivolatile Organic Compounds (µg/L)									
1,2,4-Trichlorobenzene	15	0.036	3,300	NA	0.036	--	1.0	1.0	Project PQL
1,2-Dichlorobenzene	600	700	1,900,000	NA	600	--	1.0	600	Washington State/Federal MCL
1,2-Dinitrobenzene	1.6	NA	NA	NA	1.6	--	1.0	1.6	Protection of DWU (noncarcinogen)
1,2-Diphenylhydrazine	0.11	0.010	NA	0.090	0.010	--	1.0	1.0	Project PQL
1,3-Dichlorobenzene (m-Dichlorobenzene)	NA	2.0	NA	NA	2.0	--	1.0	2.0	Protection of surface water (NTR-HH)
1,3-Dinitrobenzene	1.6	NA	NA	NA	1.6	--	1.0	1.6	Protection of DWU (noncarcinogen)
1,4-Dichlorobenzene (p-Dichlorobenzene)	4.9	60	13,000	NA	4.9	--	1.0	4.9	Protection of indoor air
1,4-Dinitrobenzene	1.6	NA	NA	NA	1.6	--	1.0	1.6	Protection of DWU (noncarcinogen)
1,4-Dioxane	0.44	NA	NA	7.0	0.44	--	0.10	0.44	Protection of DWU (carcinogen)
2,3,4,6-Tetrachlorophenol	480	NA	NA	NA	480	--	1.0	480	Protection of DWU (noncarcinogen)
2,3,5,6-Tetrachlorophenol	NA	NA	NA	NA	--	--	1.0	--	--
2,4,5-Trichlorophenol	800	300	57,000	NA	300	--	1.0	300	Protection of surface water (NRWQC-HH)
2,4,6-Trichlorophenol	4.0	0.25	590	4.0	0.25	--	1.0	1.0	Project PQL
2,4-Dichlorophenol	24	10	7,000	NA	10	--	1.0	10	Protection of surface water (NRWQC-HH)
2,4-Dimethylphenol	160	85	2,100,000	NA	85	--	1.0	85	Protection of surface water (WWQC-HH)
2,4-Dinitrophenol	32	10	550,000	NA	10	--	5.0	10	Protection of surface water (NRWQC-HH)
2,4-Dinitrotoluene	0.28	0.039	2,500	0.10	0.039	--	1.0	1.0	Project PQL
2,6-Dinitrotoluene	0.058	NA	600	0.10	0.058	--	1.0	1.0	Project PQL
2-Chloronaphthalene	640	100	NA	NA	100	--	1.0	100	Protection of surface water (NTR-HH)
2-Chlorophenol	40	15	2,900	NA	15	--	1.0	15	Protection of surface water (WWQC-HH)
2-Methylphenol (o-Cresol)	400	NA	8,000,000	NA	400	--	1.0	400	Protection of DWU (noncarcinogen)
2-Nitroaniline	160	NA	NA	NA	160	--	1.0	160	Protection of DWU (noncarcinogen)
2-Nitrophenol	NA	NA	NA	NA	--	--	1.0	--	--
3,3'-Dichlorobenzidine	0.19	0.0031	130	0.20	0.0031	--	1.0	1.0	Project PQL
(3+4)-Methylphenol (m,p-Cresol)	400	NA	NA	NA	400	--	2.0	400	Protection of DWU (noncarcinogen)
3-Nitroaniline	NA	NA	NA	NA	--	--	1.0	--	--
4,6-Dinitro-2-methylphenol	NA	2.0	NA	NA	2.0	--	5.0	5.0	Project PQL
4-Bromophenyl phenyl ether	NA	NA	NA	NA	--	--	1.0	--	--

Analyte	Concentration Protective of Drinking Water Use (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Surface Water Beneficial Uses (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Sediment (Defined by Ecology Unless Noted Otherwise)*	WAC 173-200 Groundwater Quality Criterion	Preliminary Groundwater Screening Level	Natural Background	PQL (a)	Groundwater Screening Level Adjusted for Background and PQL (b)	Basis for Screening Level
4-Chloro-3-methylphenol	NA	36	NA	NA	36	--	1.0	36	Protection of surface water (WWQC-HH)
4-Chloroaniline	0.22	NA	4,600	NA	0.22	--	1.0	1.0	Project PQL
4-Chlorophenyl phenyl ether	NA	NA	NA	NA	--	--	1.0	--	--
4-Nitroaniline	64	NA	NA	NA	64	--	1.0	64	Protection of DWU (noncarcinogen)
4-Nitrophenol	NA	NA	NA	NA	--	--	5.0	--	--
Aniline	7.7	NA	NA	14	7.7	--	5.0	7.7	Protection of DWU (carcinogen)
Benzyl alcohol	800	NA	NA	NA	800	--	1.0	800	Protection of DWU (noncarcinogen)
Bis(2-chloroethoxy)methane	NA	NA	NA	NA	--	--	1.0	--	--
Bis(2-chloroethyl)ether	0.040	0.020	790	NA	0.020	--	1.0	1.0	Project PQL
Bis(2-ethylhexyl) phthalate	6.0	0.045	0.90	6.0	0.045	--	1.0	1.0	Project PQL
Butyl benzyl phthalate	46	0.013	6,500	NA	0.013	--	1.0	1.0	Project PQL
Carbazole	NA	NA	51	5.0	5.0	--	1.0	5.0	WAC 173-200 criterion
Dibutyl phthalate	1,600	8.0	12	NA	8.0	--	5.0	8.0	Protection of surface water (NTR-HH)
Diethyl phthalate	13,000	200	130,000,000	NA	200	--	1.0	200	Protection of surface water (NTR-HH)
Dimethyl phthalate	NA	600	NA	NA	600	--	5.0	600	Protection of surface water (NTR-HH)
Di-n-octyl phthalate	160	NA	0.000094	NA	0.000094	--	1.0	1.0	Project PQL
Hexachlorobenzene	0.55	0.0000050	0.0025	0.050	0.0000050	--	1.0	1.0	Project PQL
Hexachlorobutadiene	0.56	0.010	0.0011	NA	0.0011	--	1.0	1.0	Project PQL
Hexachlorocyclopentadiene	48	1.0	1,000	NA	1.0	--	1.0	1.0	Protection of surface water (NTR-HH)
Hexachloroethane	1.1	0.020	2,200	NA	0.020	--	1.0	1.0	Project PQL
Isophorone	46	27	1,100,000	NA	27	--	1.0	27	Protection of surface water (WWQC-HH)
Nitrobenzene	16	10	280,000	NA	10	--	1.0	10	Protection of surface water (NRWQC-HH)
n-Nitrosodimethylamine	0.00086	0.00065	NA	0.0020	0.00065	--	1.0	1.0	Project PQL
n-Nitrosodi-n-propylamine	0.013	0.0044	170	0.010	0.0044	--	1.0	1.0	Project PQL
n-Nitrosodiphenylamine	18	0.62	25,000	17	0.62	--	1.0	1.0	Project PQL
Pentachlorophenol	1.0	0.0020	0.86	NA	0.0020	--	5.0	5.0	Project PQL
Phenol	2,400	4,000	160	NA	160	--	1.0	160	Protection of sediment (SMS-BC)
Pyridine	8.0	NA	NA	NA	8.0	--	1.0	8.0	Protection of DWU (noncarcinogen)
Polycyclic Aromatic Hydrocarbons (µg/L)									
1-Methylnaphthalene	1.5	NA	NA	NA	1.5	--	0.10	1.5	Protection of DWU (carcinogen)
2-Methylnaphthalene	32	NA	NA	NA	32	--	0.10	32	Protection of DWU (noncarcinogen)
Acenaphthene	960	30	400,000	NA	30	--	0.10	30	Protection of surface water (NTR-HH)
Acenaphthylene	NA	NA	NA	NA	--	--	0.10	--	--
Anthracene	4,800	100	430,000	NA	100	--	0.10	100	Protection of surface water (NTR-HH)
Benzo(g,h,i)perylene	NA	NA	NA	NA	--	--	0.010	--	--
Fluoranthene	640	6.0	0.020	NA	0.020	--	0.10	0.10	Project PQL
Fluorene	640	10	170,000	NA	10	--	0.10	10	Protection of surface water (NTR-HH)
Naphthalene	8.9	1,400	520,000	NA	8.9	--	0.10	8.9	Protection of indoor air
Phenanthrene	NA	NA	NA	NA	--	--	0.10	--	--
Pyrene	480	8.0	0.015	NA	0.015	--	0.10	0.10	Project PQL
cPAHs (TTEC)	0.20 (d)	0.012	0.0043	0.0080	0.0043	--	0.0076 (e)	0.0076	Project PQL
Polychlorinated Biphenyls as Aroclors (µg/L)									
Total PCB Aroclors	0.44	0.0000070	0.0078	0.010	0.0000070	--	0.050	0.050	Project PQL
Organochlorine Pesticides (µg/L)									
4,4'-DDD	0.36	0.0000079	15	NA	0.0000079	--	0.0050	0.0050	Project PQL
4,4'-DDE	0.26	0.00000088	5.8	NA	0.00000088	--	0.0050	0.0050	Project PQL
4,4'-DDT	0.26	0.0000012	0.000029	NA	0.0000012	--	0.0050	0.0050	Project PQL
Aldrin	0.0026	0.000000041	0.00041	0.0050	0.000000041	--	0.0050	0.0050	Project PQL
alpha-BHC	0.014	0.000048	14	NA	0.000048	--	0.0050	0.0050	Project PQL
beta-BHC	0.049	0.0013	0.64	NA	0.0013	--	0.0050	0.0050	Project PQL

Analyte	Concentration Protective of Drinking Water Use (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Surface Water Beneficial Uses (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Sediment (Defined by Ecology Unless Noted Otherwise)*	WAC 173-200 Groundwater Quality Criterion	Preliminary Groundwater Screening Level	Natural Background	PQL (a)	Groundwater Screening Level Adjusted for Background and PQL (b)	Basis for Screening Level
cis-Chlordane (alpha-Chlordane)	0.25	0.00036	0.00010	0.060	0.00010	--	0.0050	0.0050	Project PQL
delta-BHC	NA	NA	NA	NA	--	--	0.0050	--	--
Dieldrin	0.0055	0.000000070	0.00078	0.0050	0.000000070	--	0.0050	0.0050	Project PQL
Endosulfan I	96	0.056	--	NA	0.056	--	0.0050	0.056	Protection of surface water (WWQC-AL)
Endosulfan II	96	0.056	--	NA	0.056	--	0.0050	0.056	Protection of surface water (WWQC-AL)
Endosulfan sulfate	96	9.0	NA	NA	9.0	--	0.0050	9.0	Protection of surface water (NTR-HH)
Endrin	2.0	0.0020	--	0.20	0.0020	--	0.0050	0.0050	Project PQL
Endrin aldehyde	NA	0.034	NA	NA	0.034	--	0.0050	0.034	Protection of surface water (WWQC-HH)
Endrin ketone	NA	NA	NA	NA	--	--	0.020	--	--
gamma-BHC (Lindane)	0.20	0.080	110	0.060	0.060	--	0.0050	0.060	WAC 173-200 criterion
Heptachlor	0.19	0.00000034	0.0021	0.020	0.00000034	--	0.0050	0.0050	Project PQL
Heptachlor epoxide	0.048	0.0000024	--	0.0090	0.0000024	--	0.0050	0.0050	Project PQL
Methoxychlor	40	0.020	2,100	40	0.020	--	0.010	0.020	Protection of surface water (NRWQC-HH)
Toxaphene	0.80	0.000032	--	0.080	0.000032	--	0.050	0.050	Project PQL
trans-Chlordane (beta- or gamma-Chlordane)	0.25	0.00036	0.00010	0.060	0.00010	--	0.0050	0.0050	Project PQL
Chlorinated Acid Herbicides (µg/L)									
2,4,5-T	160	NA	NA	NA	160	--	0.071	160	Protection of DWU (noncarcinogen)
2,4,5-TP (Silvex)	50	100	NA	10	10	--	0.048	10	WAC 173-200 criterion
2,4-D	70	1,300	NA	70	70	--	0.094	70	Washington State/Federal MCL
2,4-DB	480	NA	NA	NA	480	--	0.071	480	Protection of DWU (noncarcinogen)
Dalapon	200	NA	NA	NA	200	--	0.46	200	Washington State/Federal MCL
Dicamba	480	NA	NA	NA	480	--	0.047	480	Protection of DWU (noncarcinogen)
Dichlorprop	NA	NA	NA	NA	--	--	0.047	--	--
Dinoseb	7.0	NA	NA	NA	7.0	--	0.047	7.0	Washington State/Federal MCL
MCPA	8.0	NA	NA	NA	8.0	--	23	23	Project PQL
MCPP	16	NA	NA	NA	16	--	9.4	16	Protection of DWU (noncarcinogen)
Metals (mg/L)									
Arsenic	0.00058	0.000018	0.35	0.000050	0.000018	0.0050	0.0033	0.0050	Washington state natural background
Cadmium	0.0050	0.00072	0.00019	0.0050	0.00019	--	0.0044	0.0044	Project PQL
Chromium	0.10 (total chromium)	NA	NA	0.050	0.050	--	0.011	0.050	WAC 173-200 criterion
Copper	0.64	0.011	0.0016	1.0	0.0016	--	0.011	0.011	Project PQL
Iron	0.30 (f)	1.0 (g)	NA	0.30	0.30	--	0.020	0.30	Washington State/Federal MCL
Lead	0.015	0.0025	0.00090	zero	zero	--	0.0011	0.0011	Project PQL
Manganese	0.050 (f)	0.050 (h)	NA	0.050	0.050	--	0.011	0.050	Washington State/Federal MCL
Mercury	0.00029	0.000012	0.0010	0.0020	0.000012	--	0.000025	0.000025	Project PQL
Nickel	0.10	0.052	0.026	NA	0.026	--	0.022	0.026	Protection of sediment (SMS-ALHH-NB)
Selenium	0.050	0.0050	0.036	0.010	0.0050	--	0.0056	0.0056	Project PQL
Zinc	4.8	0.10	0.18	5.0	0.10	--	0.028	0.10	Protection of surface water (WWQC-AL)

See notes on Page 5

Notes:

*Site-specific protective concentrations labeled "Defined by Ecology" were used by Ecology to develop soil interim action levels for the Go East Corp Landfill Site in 2020.

(a) Listed values provided by OnSite Environmental, Inc., Redmond, Washington.

(b) Screening levels are based on the most stringent of the listed protective concentrations and the WAC 173-200 criteria, adjusted for natural background and PQLs as applicable (WAC 173-340-720[7][c]).

(c) MTCA Method A value for groundwater containing detectable benzene. The MTCA Method A value for groundwater containing no detectable benzene is 1,000 ug/L.

(d) Site-specific protective concentration not defined by Ecology. Listed value is the Washington State and Federal Drinking Water Primary Maximum Contaminant Level (MCL) for benzo(a)pyrene (WAC 246-290-310, 40 CFR 141 Subpart G).

(e) The PQL for individual cPAHs is 0.010 ug/L; the PQL for cPAHs (TTEC) was calculated per WAC 173-340-708(8)(e)(iii)(A) using one-half the PQL for individual cPAHs.

(f) Site-specific protective concentration not defined by Ecology. Listed value is the Washington State and Federal Drinking Water Secondary Maximum Contaminant Level (MCL) (WAC 246-290-310, 40 CFR 143.3).

(g) Site-specific protective concentration not defined by Ecology. Listed value is the National Recommended Water Quality Criterion for protection of aquatic life (Federal Clean Water Act Section 304).

(h) Site-specific protective concentration not defined by Ecology. Listed value is the National Recommended Water Quality Criterion for protection of human health (Federal Clean Water Act Section 304).

cPAHs = Carcinogenic polycyclic aromatic hydrocarbons - includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

DWU = Drinking water use. For specific basis (e.g., MCL, MTCA Method B standard formula value for cancer/noncancer risk, etc.), see Appendix D of the Interim Action Work Plan (GeoEngineers 2020a).

MCL = Primary or Secondary Maximum Contaminant Level for drinking water
ug/L = Microgram per liter
mg/L = Milligram per liter
MTCA = Washington State Model Toxics Control Act
NA = Not available

WAC = Washington Administrative Code
PCB = Polychlorinated biphenyl
PQL = Laboratory practical quantitation limit
-- = Not established
CFR = Code of Federal Regulations

NRWQC-HH = National Recommended Water Quality Criteria (Federal Clean Water Act Section 304) - human health protection. Protective concentration is based on consumption of surface water and fish.

NTR-HH = National Toxics Rule (30 CFR 131.45) - human health protection. Protective concentration is based on consumption of surface water and fish.

SCUM = Sediment Cleanup User's Manual (Ecology Pub. No. 12-09-057, December 2019)

SMS-ALHH-NB = Washington Sediment Management Standards (WAC 173-204) - aquatic life and human health protection. Protective concentration is based on marine sediment natural background (SCUM Table 10-1).

SMS-BC = Washington Sediment Management Standards (WAC 173-204) - benthic community protection. Protective concentration is based on the freshwater Sediment Cleanup Objective from SCUM Table 8-1.

TTEC = Total toxic equivalent concentration of benzo(a)pyrene calculated per WAC 173-340-708(8)(e)(iii)(A) and using one-half the laboratory reporting limit for non-detected cPAHs.

WWQC-AL = Washington Water Quality Criteria (WAC 173-201A) - aquatic life protection. Protective concentration is based on freshwater chronic effects.

WWQC-HH = Washington Water Quality Criteria (WAC 173-201A) - human health protection. Protective concentration is based on consumption of surface water and fish.

Grey-shaded values were selected as screening levels.

Table 5

Surface Water Screening Levels

Go East Corp Landfill Site
Everett, Washington

Analyte	Concentration Protective of Surface Water Beneficial Uses (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Sediment (Defined by Ecology Unless Noted Otherwise)*	Preliminary Surface Water Screening Level	Groundwater Natural Background	PQL (a)	Surface Water Screening Level Adjusted for Groundwater Background and PQL (b)	Basis for Screening Level
Total Petroleum Hydrocarbons (µg/L)							
Gasoline-Range Organics (GRO)	1,000	NA	1,000	--	100	1,000	Protection of AL (IM 23)
Total Diesel-and Heavy Oil-Range Organics (DRO+ORO)	3,000	NA	3,000	--	200	3,000	Protection of AL (IM 23)
Volatile Organic Compounds (µg/L)							
1,1,1,2-Tetrachloroethane	NA	NA	--	--	0.20	--	--
1,1,1-Trichloroethane	10,000	NA	10,000	--	0.20	10,000	Protection of HH (NRWQC-HH)
1,1,2,2-Tetrachloroethane	0.10	NA	0.10	--	0.20	0.20	Project PQL
1,1,2-Trichloroethane	0.35	NA	0.35	--	0.20	0.35	Protection of HH (NTR-HH)
1,1-Dichloroethane	NA	NA	--	--	0.20	--	--
1,1-Dichloroethylene	300	NA	300	--	0.20	300	Protection of HH (NRWQC-HH)
1,1-Dichloropropene	NA	NA	--	--	0.20	--	--
1,2,3-Trichlorobenzene	NA	NA	--	--	0.20	--	--
1,2,3-Trichloropropane	NA	NA	--	--	0.20	--	--
1,2,4-Trimethylbenzene	NA	NA	--	--	0.20	--	--
1,2-Dibromo-3-chloropropane	NA	NA	--	--	1.0	--	--
1,2-Dichloroethane	8.9	NA	8.9	--	0.20	8.9	Protection of HH (NTR-HH)
1,2-Dichloroethylene (mixed isomers)	NA	NA	--	--	0.20	--	--
1,2-Dichloropropane	0.71	NA	0.71	--	0.20	0.71	Protection of HH (WWQC-HH)
1,3,5-Trimethylbenzene	NA	NA	--	--	0.20	--	--
1,3-Dichloropropane	NA	NA	--	--	0.20	--	--
2,2-Dichloropropane	NA	NA	--	--	0.20	--	--
2-Chloroethyl vinyl ether	NA	NA	--	--	1.0	--	--
2-Chlorotoluene	NA	NA	--	--	0.20	--	--
2-Hexanone	NA	NA	--	--	2.0	--	--
4-Chlorotoluene	NA	NA	--	--	0.20	--	--
4-Isopropyltoluene (p-Isopropyltoluene)	NA	NA	--	--	0.20	--	--
Acetone	NA	NA	--	--	5.0	--	--
Benzene	0.44	NA	0.44	--	0.20	0.44	Protection of HH (WWQC-HH)
Bromobenzene	NA	NA	--	--	0.20	--	--
Bromochloromethane	NA	NA	--	--	0.20	--	--
Bromoform	4.6	NA	4.6	--	1.0	4.6	Protection of HH (NTR-HH)
Bromomethane	100	NA	100	--	0.20	100	Protection of HH (NRWQC-HH)
Carbon disulfide	NA	NA	--	--	0.20	--	--
Carbon tetrachloride	0.20	NA	0.20	--	0.20	0.20	Protection of HH (WWQC-HH)
Chlorobenzene	20	NA	20	--	0.20	20	Protection of HH (NRWQC-HH)
Chloroethane	NA	NA	--	--	0.20	--	--
Chloroform	60	NA	60	--	0.20	60	Protection of HH (NRWQC-HH)
Chloromethane	NA	NA	--	--	1.0	--	--
cis-1,2-Dichloroethylene	NA	NA	--	--	0.20	--	--
cis-1,3-Dichloropropene	0.22	NA	0.22	--	0.20	0.22	Protection of HH (NTR-HH)
Dibromochloromethane	0.60	NA	0.60	--	0.20	0.60	Protection of HH (NTR-HH)
Dibromomethane	NA	NA	--	--	0.20	--	--
Dichlorobromomethane (Bromodichloromethane)	0.73	NA	0.73	--	0.20	0.73	Protection of HH (NTR-HH)
Dichlorodifluoromethane (CFC-12)	NA	NA	--	--	0.20	--	--
Ethylbenzene	29	NA	29	--	0.20	29	Protection of HH (NTR-HH)

Analyte	Concentration Protective of Surface Water Beneficial Uses (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Sediment (Defined by Ecology Unless Noted Otherwise)*	Preliminary Surface Water Screening Level	Groundwater Natural Background	PQL (a)	Surface Water Screening Level Adjusted for Groundwater Background and PQL (b)	Basis for Screening Level
Ethylene dibromide (EDB) (1,2-Dibromoethane)	NA	NA	--	--	0.20	--	--
Isopropylbenzene	NA	NA	--	--	0.20	--	--
Methyl ethyl ketone (MEK) (2-Butanone)	NA	NA	--	--	5.0	--	--
Methyl iodide (Iodomethane)	NA	NA	--	--	1.0	--	--
Methyl isobutyl ketone (4-Methyl-2-Pentanone)	NA	NA	--	--	2.0	--	--
Methyl tert-butyl ether	NA	NA	--	--	0.50	--	--
Methylene chloride	10	NA	10	--	1.0	10	Protection of HH (NTR-HH)
n-Butylbenzene	NA	NA	--	--	0.20	--	--
n-Propylbenzene	NA	NA	--	--	0.20	--	--
sec-Butylbenzene	NA	NA	--	--	0.20	--	--
Styrene	NA	NA	--	--	0.20	--	--
tert-Butylbenzene	NA	NA	--	--	0.20	--	--
Tetrachloroethylene	2.4	NA	2.4	--	0.20	2.4	Protection of HH (NTR-HH)
Toluene	57	NA	57	--	1.0	57	Protection of HH (NRWQC-HH)
Total xylenes	NA	NA	--	--	0.60	--	--
trans-1,2-Dichloroethylene	100	NA	100	--	0.20	100	Protection of HH (NRWQC-HH)
trans-1,3-Dichloropropene	0.22	NA	0.22	--	0.20	0.22	Protection of HH (NTR-HH)
Trichloroethylene	0.30	NA	0.30	--	0.20	0.30	Protection of HH (NTR-HH)
Trichlorofluoromethane	NA	NA	--	--	0.20	--	--
Vinyl acetate	NA	NA	--	--	1.0	--	--
Vinyl chloride	0.020	NA	0.020	--	0.20	0.20	Project PQL
Semivolatile Organic Compounds (µg/L)							
1,2,4-Trichlorobenzene	0.036	3,300	0.036	--	1.0	1.0	Project PQL
1,2-Dichlorobenzene	700	1,900,000	700	--	1.0	700	Protection of HH (NTR-HH)
1,2-Dinitrobenzene	NA	NA	--	--	1.0	--	--
1,2-Diphenylhydrazine	0.01	NA	0.010	--	1.0	1.0	Project PQL
1,3-Dichlorobenzene (m-Dichlorobenzene)	2.0	NA	2.0	--	1.0	2.0	Protection of HH (NTR-HH)
1,3-Dinitrobenzene	NA	NA	--	--	1.0	--	--
1,4-Dichlorobenzene (p-Dichlorobenzene)	60	13,000	60	--	1.0	60	Protection of HH (WWQC-HH-adj)
1,4-Dinitrobenzene	NA	NA	--	--	1.0	--	--
1,4-Dioxane	NA	NA	--	--	0.10	--	--
2,3,4,6-Tetrachlorophenol	NA	NA	--	--	1.0	--	--
2,3,5,6-Tetrachlorophenol	NA	NA	--	--	1.0	--	--
2,4,5-Trichlorophenol	300	57,000	300	--	1.0	300	Protection of HH (NRWQC-HH)
2,4,6-Trichlorophenol	0.25	590	0.25	--	1.0	1.0	Project PQL
2,4-Dichlorophenol	10	7,000	10	--	1.0	10	Protection of HH (NRWQC-HH)
2,4-Dimethylphenol	85	2,100,000	85	--	1.0	85	Protection of HH (WWQC-HH)
2,4-Dinitrophenol	10	550,000	10	--	5.0	10	Protection of HH (NRWQC-HH)
2,4-Dinitrotoluene	0.039	2,500	0.039	--	1.0	1.0	Project PQL
2,6-Dinitrotoluene	NA	600	600	--	1.0	600	Protection of sediment (HHDC-carc)
2-Chloronaphthalene	100	NA	100	--	1.0	100	Protection of HH (NTR-HH)
2-Chlorophenol	15	2,900	15	--	1.0	15	Protection of HH (WWQC-HH)
2-Methylphenol (o-Cresol)	NA	8,000,000	8,000,000	--	1.0	8,000,000	Protection of sediment (HHDC-noncarc)
2-Nitroaniline	NA	NA	--	--	1.0	--	--
2-Nitrophenol	NA	NA	--	--	1.0	--	--
3,3'-Dichlorobenzidine	0.0031	130	0.0031	--	1.0	1.0	Project PQL
(3+4)-Methylphenol (m,p-Cresol)	NA	NA	--	--	2.0	--	--
3-Nitroaniline	NA	NA	--	--	1.0	--	--
4,6-Dinitro-2-methylphenol	2.0	NA	2.0	--	5.0	5.0	Project PQL
4-Bromophenyl phenyl ether	NA	NA	--	--	1.0	--	--

Analyte	Concentration Protective of Surface Water Beneficial Uses (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Sediment (Defined by Ecology Unless Noted Otherwise)*	Preliminary Surface Water Screening Level	Groundwater Natural Background	PQL (a)	Surface Water Screening Level Adjusted for Groundwater Background and PQL (b)	Basis for Screening Level
4-Chloro-3-methylphenol	36	NA	36	--	1.0	36	Protection of HH (WWQC-HH)
4-Chloroaniline	NA	4,600	4,600	--	1.0	4,600	Protection of sediment (HHDC-carc)
4-Chlorophenyl phenyl ether	NA	NA	--	--	1.0	--	--
4-Nitroaniline	NA	NA	--	--	1.0	--	--
4-Nitrophenol	NA	NA	--	--	5.0	--	--
Aniline	NA	NA	--	--	5.0	--	--
Benzyl alcohol	NA	NA	--	--	1.0	--	--
Bis(2-chloroethoxy)methane	NA	NA	--	--	1.0	--	--
Bis(2-chloroethyl)ether	0.020	790	0.020	--	1.0	1.0	Project PQL
Bis(2-ethylhexyl) phthalate	0.045	0.90	0.045	--	1.0	1.0	Project PQL
Butyl benzyl phthalate	0.013	6,500	0.013	--	1.0	1.0	Project PQL
Carbazole	NA	51	51	--	1.0	51	Protection of sediment (SMS-BC)
Dibutyl phthalate	8.0	12	8.0	--	5.0	8.0	Protection of HH (NTR-HH)
Diethyl phthalate	200	130,000,000	200	--	1.0	200	Protection of HH (NTR-HH)
Dimethyl phthalate	600	NA	600	--	5.0	600	Protection of HH (NTR-HH)
Di-n-octyl phthalate	NA	0.000094	0.000094	--	1.0	1.0	Project PQL
Hexachlorobenzene	0.0000050	0.0025	0.0000050	--	1.0	1.0	Project PQL
Hexachlorobutadiene	0.010	0.0011	0.0011	--	1.0	1.0	Project PQL
Hexachlorocyclopentadiene	1.0	1,000	1.0	--	1.0	1.0	Protection of HH (NTR-HH)
Hexachloroethane	0.020	2,200	0.020	--	1.0	1.0	Project PQL
Isophorone	27	1,100,000	27	--	1.0	27	Protection of HH (WWQC-HH)
Nitrobenzene	10	280,000	10	--	1.0	10	Protection of HH (NRWQC-HH)
n-Nitrosodimethylamine	0.00065	NA	0.00065	--	1.0	1.0	Project PQL
n-Nitrosodi-n-propylamine	0.0044	170	0.0044	--	1.0	1.0	Project PQL
n-Nitrosodiphenylamine	0.62	25,000	0.62	--	1.0	1.0	Project PQL
Pentachlorophenol	0.0020	0.86	0.0020	--	5.0	5.0	Project PQL
Phenol	4,000	160	160	--	1.0	160	Protection of sediment (SMS-BC)
Pyridine	NA	NA	--	--	1.0	--	--
Polycyclic Aromatic Hydrocarbons (µg/L)							
1-Methylnaphthalene	NA	NA	--	--	0.10	--	--
2-Methylnaphthalene	NA	NA	--	--	0.10	--	--
Acenaphthene	30	400,000	30	--	0.10	30	Protection of HH (NTR-HH)
Acenaphthylene	NA	NA	--	--	0.10	--	--
Anthracene	100	430,000	100	--	0.10	100	Protection of HH (NTR-HH)
Benzo(g,h,i)perylene	NA	NA	--	--	0.010	--	--
Fluoranthene	6.0	0.020	0.020	--	0.10	0.10	Project PQL
Fluorene	10	170,000	10	--	0.10	10	Protection of HH (NTR-HH)
Naphthalene	1,400	520,000	1,400	--	0.10	1,400	Protection of HH (MTCA Eq. 730-1)
Phenanthrene	NA	NA	--	--	0.10	--	--
Pyrene	8.0	0.015	0.015	--	0.10	0.10	Project PQL
cPAHs (TTEC)	0.012	0.0043	0.0043	--	0.0076 (c)	0.0076	Project PQL
Polychlorinated Biphenyls as Aroclors (µg/L)							
Total PCB Aroclors	0.0000070	0.0078	0.0000070	--	0.050	0.050	Project PQL
Organochlorine Pesticides (µg/L)							
4,4'-DDD	0.0000079	15	0.0000079	--	0.0050	0.0050	Project PQL
4,4'-DDE	0.00000088	5.8	0.00000088	--	0.0050	0.0050	Project PQL
4,4'-DDT	0.0000012	0.000029	0.0000012	--	0.0050	0.0050	Project PQL
Aldrin	0.000000041	0.00041	0.000000041	--	0.0050	0.0050	Project PQL
alpha-BHC	0.000048	14	0.000048	--	0.0050	0.0050	Project PQL
beta-BHC	0.0013	0.64	0.0013	--	0.0050	0.0050	Project PQL

Analyte	Concentration Protective of Surface Water Beneficial Uses (Defined by Ecology Unless Noted Otherwise)*	Concentration Protective of Sediment (Defined by Ecology Unless Noted Otherwise)*	Preliminary Surface Water Screening Level	Groundwater Natural Background	PQL (a)	Surface Water Screening Level Adjusted for Groundwater Background and PQL (b)	Basis for Screening Level
cis-Chlordane (alpha-Chlordane)	0.00036	0.00010	0.00010	--	0.0050	0.0050	Project PQL
delta-BHC	NA	NA	--	--	0.0050	--	--
Dieldrin	0.000000070	0.00078	0.000000070	--	0.0050	0.0050	Project PQL
Endosulfan I	0.056	--	0.056	--	0.0050	0.056	Protection of AL (WWQC-AL)
Endosulfan II	0.056	--	0.056	--	0.0050	0.056	Protection of AL (WWQC-AL)
Endosulfan sulfate	9.0	NA	9.0	--	0.0050	9.0	Protection of HH (NTR-HH)
Endrin	0.0020	--	0.0020	--	0.0050	0.0050	Project PQL
Endrin aldehyde	0.034	NA	0.034	--	0.0050	0.034	Protection of HH (WWQC-HH)
Endrin ketone	NA	NA	--	--	0.020	--	--
gamma-BHC (Lindane)	0.080	110	0.080	--	0.0050	0.080	Protection of AL (WWQC-AL)
Heptachlor	0.00000034	0.0021	0.00000034	--	0.0050	0.0050	Project PQL
Heptachlor epoxide	0.0000024	--	0.0000024	--	0.0050	0.0050	Project PQL
Methoxychlor	0.020	2,100	0.020	--	0.010	0.020	Protection of HH (NRWQC-HH)
Toxaphene	0.000032	--	0.000032	--	0.050	0.050	Project PQL
trans-Chlordane (beta- or gamma-Chlordane)	0.00036	0.00010	0.00010	--	0.0050	0.0050	Project PQL
Chlorinated Acid Herbicides (µg/L)							
2,4,5-T	NA	NA	--	--	0.071	--	--
2,4,5-TP (Silvex)	100	NA	100	--	0.048	100	Protection of HH (NRWQC-HH)
2,4-D	1,300	NA	1,300	--	0.094	1,300	Protection of HH (NRWQC-HH)
2,4-DB	NA	NA	--	--	0.071	--	--
Dalapon	NA	NA	--	--	0.46	--	--
Dicamba	NA	NA	--	--	0.047	--	--
Dichlorprop	NA	NA	--	--	0.047	--	--
Dinoseb	NA	NA	--	--	0.047	--	--
MCPA	NA	NA	--	--	23	--	--
MCPP	NA	NA	--	--	9.4	--	--
Metals (mg/L)							
Arsenic	0.000018	0.35	0.000018	0.0050	0.0033	0.0050	Washington state natural background (groundwater)
Cadmium	0.00072	0.00019	0.00019	--	0.0044	0.0044	Project PQL
Chromium	NA	NA	--	--	0.011	--	--
Copper	0.011	0.0016	0.0016	--	0.011	0.011	Project PQL
Iron	1.0 (d)	--	1.0	--	0.020	1.0	Protection of AL (NRWQC-AL)
Lead	0.0025	0.00090	0.00090	--	0.0011	0.0011	Project PQL
Manganese	0.050 (e)	--	0.050	--	0.011	0.050	Protection of HH (NRWQC-HH)
Mercury	0.000012	0.0010	0.000012	--	0.000025	0.000025	Project PQL
Nickel	0.052	0.026	0.026	--	0.022	0.026	Protection of sediment (SMS-ALHH-NB)
Selenium	0.0050	0.036	0.0050	--	0.0056	0.0056	Project PQL
Zinc	0.10	0.18	0.10	--	0.028	0.10	Protection of AL (WWQC-AL)

See notes on Page 5

Notes:

*Site-specific protective concentrations labeled "Defined by Ecology" were used by Ecology to develop soil interim action levels for the Go East Corp Landfill Site in 2020.

(a) Listed values provided by OnSite Environmental, Inc., Redmond, Washington.

(b) Screening levels are based on the most stringent of the listed protective concentrations, adjusted for groundwater natural background and PQLs as applicable (WAC 173-340-730[5][c]).

(c) The PQL for individual cPAHs is 0.010 ug/L; the PQL for cPAHs (TTEC) was calculated per WAC 173-340-708(8)(e)(iii)(A) using one-half the PQL for individual cPAHs.

(d) Site-specific protective concentration not defined by Ecology. Listed value is the National Recommended Water Quality Criterion for protection of aquatic life (Federal Clean Water Act Section 304).

(e) Site-specific protective concentration not defined by Ecology. Listed value is the National Recommended Water Quality Criterion for protection of human health (Federal Clean Water Act Section 304).

-- = Not established

AL = Aquatic life

cPAHs = Carcinogenic polycyclic aromatic hydrocarbons - includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

HH = Human health

HHDC-carc = Human health direct contact - carcinogenic effects (SCUM Eq. 9-1a). Protective concentration is based on child beach play and adult subsistence clam digging and net fishing exposure scenarios and incidental ingestion and dermal exposure routes.

HHDC-noncarc = Human health direct contact - noncarcinogenic effects (SCUM Eq. 9-2). Protective concentration is based on child beach play and adult subsistence clam digging and net fishing exposure scenarios and incidental ingestion and dermal exposure routes.

IM 23 = Ecology Implementation Memo 23

µg/L = Microgram per liter

mg/L = Milligram per liter

MTCA Eq. 730-1 = Model Toxics Control Act Equation 730-1 (WAC 173-340-730[3][b][iii][A]). Protective concentration is based on consumption of ~98 grams of fish per day.

NA = Not available

NRWQC-AL = National Recommended Water Quality Criteria (Federal Clean Water Act Section 304) - aquatic life protection. Protective concentration is based on freshwater chronic effects.

NRWQC-HH = National Recommended Water Quality Criteria (Federal Clean Water Act Section 304) - human health protection. Protective concentration is based on consumption of surface water and fish.

NTR-HH = National Toxics Rule (30 CFR 131.45) - human health protection. Protective concentration is based on consumption of surface water and fish.

PCB = Polychlorinated biphenyl

PQL = Laboratory practical quantitation limit

SCUM = Sediment Cleanup User's Manual (Ecology Pub. No. 12-09-057, December 2019)

SMS-ALHH-NB = Washington Sediment Management Standards (WAC 173-204) - aquatic life and human health protection. Protective concentration is based on marine sediment natural background (SCUM Table 10-1).

SMS-BC = Washington Sediment Management Standards (WAC 173-204) - benthic community protection. Protective concentration is based on the freshwater Sediment Cleanup Objective from SCUM Table 8-1.

TTEC = Total toxic equivalent concentration of benzo(a)pyrene calculated per WAC 173-340-708(8)(e)(iii)(A) and using one-half the laboratory reporting limit for non-detected cPAHs.

WAC = Washington Administrative Code

WWQC-AL = Washington Water Quality Criteria (WAC 173-201A) - aquatic life protection. Protective concentration is based on freshwater chronic effects.

WWQC-HH = Washington Water Quality Criteria (WAC 173-201A) - human health protection. Protective concentration is based on consumption of surface water and fish.

WWQC-HH-adj = Washington Water Quality Criteria (WAC 173-201A) - human health protection. Protective concentration is based on consumption of surface water and fish, adjusted to a cancer risk level of 1E-05.

Grey-shaded values were selected as screening levels.

Table 6

Sediment Screening Levels

Go East Corp Landfill Site
Everett, Washington

Analyte	Concentration Protective of Sediment (Defined by Ecology Unless Noted Otherwise)*	PQL (a)	Sediment Screening Level Adjusted for PQL (b)	Basis for Screening Level
Total Petroleum Hydrocarbons (mg/kg dw)				
Gasoline Range Organics (GRO)	NA	5.0	--	--
Diesel Range Organics (DRO)	340 (c)	25	340	Protection of BC
Heavy Oil-Range Organics (ORO)	3,600 (c)	50	3,600	Protection of BC
Volatile Organic Compounds (mg/kg dw)				
1,1,1,2-Tetrachloroethane	NA	0.0010	--	--
1,1,1-Trichloroethane	NA	0.0010	--	--
1,1,2,2-Tetrachloroethane	NA	0.0010	--	--
1,1,2-Trichloroethane	NA	0.0010	--	--
1,1-Dichloroethane	NA	0.0010	--	--
1,1-Dichloroethylene	NA	0.0010	--	--
1,1-Dichloropropene	NA	0.0010	--	--
1,2,3-Trichlorobenzene	NA	0.0010	--	--
1,2,3-Trichloropropane	NA	0.0010	--	--
1,2,4-Trimethylbenzene	NA	0.0010	--	--
1,2-Dibromo-3-chloropropane	NA	0.0050	--	--
1,2-Dichloroethane	NA	0.0010	--	--
1,2-Dichloroethylene (mixed isomers)	NA	0.0010	--	--
1,2-Dichloropropane	NA	0.0010	--	--
1,3,5-Trimethylbenzene	NA	0.0010	--	--
1,3-Dichloropropane	NA	0.0010	--	--
2,2-Dichloropropane	NA	0.0010	--	--
2-Chloroethyl vinyl ether	NA	0.0050	--	--
2-Chlorotoluene	NA	0.0010	--	--
2-Hexanone	NA	0.0050	--	--
4-Chlorotoluene	NA	0.0010	--	--
4-Isopropyltoluene (p-Isopropyltoluene)	NA	0.0010	--	--
Acetone	NA	0.0050	--	--
Benzene	NA	0.0010	--	--
Bromobenzene	NA	0.0010	--	--
Bromochloromethane	NA	0.0010	--	--
Bromoform	NA	0.0050	--	--
Bromomethane	NA	0.0010	--	--
Carbon disulfide	NA	0.0010	--	--
Carbon tetrachloride	NA	0.0010	--	--
Chlorobenzene	NA	0.0010	--	--
Chloroethane	NA	0.0050	--	--
Chloroform	NA	0.0010	--	--
Chloromethane	NA	0.0050	--	--
cis-1,2-Dichloroethylene	NA	0.0010	--	--
cis-1,3-Dichloropropene	NA	0.0010	--	--
Dibromochloromethane	NA	0.0010	--	--
Dibromomethane	NA	0.0010	--	--
Dichlorobromomethane (Bromodichloromethane)	NA	0.0010	--	--
Dichlorodifluoromethane (CFC-12)	NA	0.0010	--	--
Ethylbenzene	NA	0.0010	--	--
Ethylene dibromide (EDB) (1,2-Dibromoethane)	NA	0.0010	--	--
Isopropylbenzene	NA	0.0010	--	--
Methyl ethyl ketone (MEK) (2-Butanone)	NA	0.0050	--	--
Methyl iodide (Iodomethane)	NA	0.0050	--	--
Methyl isobutyl ketone (4-Methyl-2-Pentanone)	NA	0.0050	--	--
Methyl tert-butyl ether	NA	0.0010	--	--
Methylene chloride	NA	0.0050	--	--
n-Butylbenzene	NA	0.0010	--	--
n-Propylbenzene	NA	0.0010	--	--
sec-Butylbenzene	NA	0.0010	--	--
Styrene	NA	0.0010	--	--
tert-Butylbenzene	NA	0.0010	--	--
Tetrachloroethylene	NA	0.0010	--	--
Toluene	NA	0.0050	--	--
Total xylenes	NA	0.0020	--	--
trans-1,2-Dichloroethylene	NA	0.0010	--	--
trans-1,3-Dichloropropene	NA	0.0010	--	--
Trichloroethylene	NA	0.0010	--	--
Trichlorofluoromethane	NA	0.0010	--	--
Vinyl acetate	NA	0.0050	--	--
Vinyl chloride	NA	0.0010	--	--
Semivolatile Organic Compounds (mg/kg dw)				
1,2,4-Trichlorobenzene	29	0.033	29	Protection of HHDC (carcinogen)
1,2-Dichlorobenzene	15,000	0.033	15,000	Protection of HHDC (noncarcinogen)
1,2-Dinitrobenzene	17	0.033	17	Protection of HHDC (noncarcinogen)
1,2-Diphenylhydrazine	1.1	0.033	1.1	Protection of HHDC (carcinogen)
1,3-Dichlorobenzene (m-Dichlorobenzene)	NA	0.033	--	--
1,3-Dinitrobenzene	17	0.033	17	Protection of HHDC (noncarcinogen)
1,4-Dichlorobenzene (p-Dichlorobenzene)	160	0.033	160	Protection of HHDC (carcinogen)
1,4-Dinitrobenzene	17	0.033	17	Protection of HHDC (noncarcinogen)
1,4-Dioxane	8.5	0.0067	8.5	Protection of HHDC (carcinogen)
2,3,4,6-Tetrachlorophenol	5,100	0.033	5,100	Protection of HHDC (noncarcinogen)

Analyte	Concentration Protective of Sediment (Defined by Ecology Unless Noted Otherwise)*	PQL (a)	Sediment Screening Level Adjusted for PQL (b)	Basis for Screening Level
2,3,5,6-Tetrachlorophenol	NA	0.033	--	--
2,4,5-Trichlorophenol	17,000	0.033	17,000	Protection of HHDC (noncarcinogen)
2,4,6-Trichlorophenol	78	0.033	78	Protection of HHDC (carcinogen)
2,4-Dichlorophenol	510	0.033	510	Protection of HHDC (noncarcinogen)
2,4-Dimethylphenol	3,400	0.033	3,400	Protection of HHDC (noncarcinogen)
2,4-Dinitrophenol	340	0.17	340	Protection of HHDC (noncarcinogen)
2,4-Dinitrotoluene	2.8	0.033	2.8	Protection of HHDC (carcinogen)
2,6-Dinitrotoluene	0.57	0.033	0.57	Protection of HHDC (carcinogen)
2-Chloronaphthalene	14,000	0.033	14,000	Protection of HHDC (noncarcinogen)
2-Chlorophenol	840	0.033	840	Protection of HHDC (noncarcinogen)
2-Methylphenol (o-Cresol)	8,400	0.033	8,400	Protection of HHDC (noncarcinogen)
2-Nitroaniline	1,700	0.033	1,700	Protection of HHDC (noncarcinogen)
2-Nitrophenol	NA	0.033	--	--
3,3'-Dichlorobenzidine	1.9	0.17	1.9	Protection of HHDC (carcinogen)
(3+4)-Methylphenol (m,p-Cresol)	0.26	0.033	0.26	Protection of BC
3-Nitroaniline	NA	0.033	--	--
4,6-Dinitro-2-methylphenol	NA	0.17	--	--
4-Bromophenyl phenyl ether	NA	0.033	--	--
4-Chloro-3-methylphenol	NA	0.033	--	--
4-Chloroaniline	4.3	0.17	4.3	Protection of HHDC (carcinogen)
4-Chlorophenyl phenyl ether	NA	0.033	--	--
4-Nitroaniline	680	0.033	680	Protection of HHDC (noncarcinogen)
4-Nitrophenol	NA	0.033	--	--
Aniline	150	0.17	150	Protection of HHDC (carcinogen)
Benzyl alcohol	17,000	0.17	17,000	Protection of HHDC (noncarcinogen)
Bis(2-chloroethoxy)methane	NA	0.033	--	--
Bis(2-chloroethyl)ether	0.78	0.033	0.78	Protection of HHDC (carcinogen)
Bis(2-ethylhexyl) phthalate	0.50	0.17	0.50	Protection of BC
Butyl benzyl phthalate	450	0.17	450	Protection of HHDC (carcinogen)
Carbazole	0.90	0.033	0.90	Protection of BC
Dibutyl phthalate	0.38	0.17	0.38	Protection of BC
Diethyl phthalate	140,000	0.17	140,000	Protection of HHDC (noncarcinogen)
Dimethyl phthalate	NA	0.033	--	--
Di-n-octyl phthalate	0.039	0.17	0.17	Project PQL
Hexachlorobenzene	0.0010 (d)	0.033	0.033	Project PQL
Hexachlorobutadiene	0.00030 (d)	0.033	0.033	Project PQL
Hexachlorocyclopentadiene	1,000	0.033	1,000	Protection of HHDC (noncarcinogen)
Hexachloroethane	21	0.033	21	Protection of HHDC (carcinogen)
Isophorone	900	0.033	900	Protection of HHDC (carcinogen)
Nitrobenzene	340	0.033	340	Protection of HHDC (noncarcinogen)
n-Nitrosodimethylamine	0.017	0.033	0.033	Project PQL
n-Nitrosodi-n-propylamine	0.12	0.033	0.12	Protection of HHDC (carcinogen)
n-Nitrosodiphenylamine	170	0.033	170	Protection of HHDC (carcinogen)
Pentachlorophenol	0.36 (d)	0.17	0.36	Ecology programmatic PQL
Phenol	0.12	0.033	0.12	Protection of BC
Pyridine	170	0.33	170	Protection of HHDC (noncarcinogen)
Polycyclic Aromatic Hydrocarbons (mg/kg dw)				
1-Methylnaphthalene	29	0.0067	29	Protection of HHDC (carcinogen)
2-Methylnaphthalene	680	0.0067	680	Protection of HHDC (noncarcinogen)
Acenaphthene	10,000	0.0067	10,000	Protection of HHDC (noncarcinogen)
Acenaphthylene	NA	0.0067	--	--
Anthracene	51,000	0.0067	51,000	Protection of HHDC (noncarcinogen)
Benzo(g,h,i)perylene	0.0050 (d)	0.0067	0.0067	Project PQL
Fluoranthene	0.0050 (d)	0.0067	0.0067	Project PQL
Fluorene	6,800	0.0067	6,800	Protection of HHDC (noncarcinogen)
Naphthalene	3,400	0.0067	3,400	Protection of HHDC (noncarcinogen)
Phenanthrene	NA	0.0067	--	--
Pyrene	0.0050 (d)	0.0067	0.0067	Project PQL
cPAHs (TTEC)	0.021	0.0051	0.021	Protection of ALHH
Polychlorinated Biphenyls as Aroclors (mg/kg dw)				
Total PCB Aroclors	0.012 (d)	0.050	0.050	Project PQL
Organochlorine Pesticides (mg/kg dw)				
4,4'-DDD	3.6	0.010	3.6	Protection of HHDC (carcinogen)
4,4'-DDE	2.5	0.010	2.5	Protection of HHDC (carcinogen)
4,4'-DDT	0.00010 (d)	0.010	0.010	Project PQL
Aldrin	0.00010 (d)	0.0050	0.0050	Project PQL
alpha-BHC	0.14	0.0050	0.14	Protection of HHDC (carcinogen)
beta-BHC	0.0072	0.0050	0.0072	Protection of BC
cis-Chlordane (alpha-Chlordane)	0.00010 (d)	0.010	0.010	Project PQL
delta-BHC	NA	0.0050	--	--
Dieldrin	0.00010 (d)	0.010	0.010	Project PQL
Endosulfan I	NA	0.0050	0.0050	Project PQL
Endosulfan II	NA	0.010	0.010	Project PQL
Endosulfan sulfate	1,000	0.010	1,000	Protection of HHDC (noncarcinogen)
Endrin	NA	0.0050	0.0050	Project PQL
Endrin aldehyde	NA	0.010	--	--
Endrin ketone	0.0085	0.010	0.010	Project PQL
gamma-BHC (Lindane)	0.78	0.0050	0.78	Protection of HHDC (carcinogen)
Heptachlor	0.00010 (d)	0.0050	0.0050	Project PQL
Heptachlor epoxide	NA	0.0050	0.0050	Project PQL
Methoxychlor	840	0.010	840	Protection of HHDC (noncarcinogen)
Toxaphene	NA	0.050	0.050	Project PQL
trans-Chlordane (beta- or gamma-Chlordane)	0.00010 (d)	0.0050	0.0050	Project PQL

Analyte	Concentration Protective of Sediment (Defined by Ecology Unless Noted Otherwise)*	PQL (a)	Sediment Screening Level Adjusted for PQL (b)	Basis for Screening Level
Chlorinated Acid Herbicides (mg/kg dw)				
2,4,5-T	1,700	0.0095	1,700	Protection of HHDC (noncarcinogen)
2,4,5-TP (Silvex)	1,400	0.0095	1,400	Protection of HHDC (noncarcinogen)
2,4-D	1,700	0.0094	1,700	Protection of HHDC (noncarcinogen)
2,4-DB	5,100	0.0095	5,100	Protection of HHDC (noncarcinogen)
Dalapon	5,100	0.18	5,100	Protection of HHDC (noncarcinogen)
Dicamba	5,100	0.0094	5,100	Protection of HHDC (noncarcinogen)
Dichlorprop	NA	0.071	--	--
Dinoseb	170	0.0095	170	Protection of HHDC (noncarcinogen)
MCPA	84	2.3	84	Protection of HHDC (noncarcinogen)
MCPP	170	0.94	170	Protection of HHDC (noncarcinogen)
Metals (mg/kg dw)				
Arsenic	11	10	11	Protection of ALHH
Cadmium	0.80	0.50	0.80	Protection of ALHH
Chromium	62	0.50	62	Protection of ALHH
Copper	45	1.0	45	Protection of ALHH
Iron	56,000 (e)	25	56,000	Protection of HHDC (noncarcinogen)
Lead	21	5.0	21	Protection of ALHH
Manganese	3,700 (e)	0.50	3,700	Protection of HHDC (noncarcinogen)
Mercury	0.20	0.025	0.20	Protection of ALHH
Nickel	50	2.5	50	Protection of ALHH
Selenium	0.10	0.80	0.80	Project PQL
Zinc	93	2.5	93	Protection of ALHH

Notes:

*Site-specific protective concentrations labeled "Defined by Ecology" were used by Ecology to develop soil interim action levels for the Go East Corp Landfill Site in 2020.

(a) Listed values are soil/solids PQLs provided by OnSite Environmental, Inc., Redmond, Washington for results reported on a wet-weight basis.

(b) Screening levels are based on the listed protective concentrations, adjusted for PQLs as applicable (WAC 173-204-500[5][a][i][A]).

(c) Site-specific protective concentration not defined by Ecology. Listed value is the Washington Sediment Management Standards freshwater Sediment Cleanup Objective from SCUM Table 8-1.

(d) Protective concentration for bioaccumulative compounds is based on the Ecology programmatic PQL (SCUM Table 11-1).

(e) Site-specific protective concentration not defined by Ecology. Listed value is the MTCA Method B standard formula value for soil calculated using MTCA Eq. 740-1 (WAC 173-340-740[3][b][iii][B][I]) and associated default assumptions. MTCA Eq. 740-1 is based on incidental ingestion exposure.

-- = Not established

ALHH = Aquatic life and human health. Protective concentration is based on marine sediment natural background (SCUM Table 10-1) per Washington Sediment Management Standards (WAC 173-204).

BC = Benthic community. Protective concentration is based on the Washington Sediment Management Standards (WAC 173-204) freshwater Sediment Cleanup Objective from SCUM Table 8-1.

cPAHs = Carcinogenic polycyclic aromatic hydrocarbons - includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

HHDC = Human health direct contact. For all analytes except iron and manganese, the protective concentration was calculated using SCUM Eq. 9-1a (carcinogens) and Eq. 9-2 (noncarcinogens) based on child beach play and adult subsistence clam digging and net fishing exposure scenarios and incidental ingestion and dermal exposure routes. The protective concentrations for iron and manganese are MTCA Method B standard formula values for soil calculated using MTCA Eq. 740-1, which is based on incidental ingestion exposure.

mg/kg dw = Milligram per kilogram (dry weight)

MTCA = Washington State Model Toxics Control Act

NA = Not available

PCB = Polychlorinated biphenyl

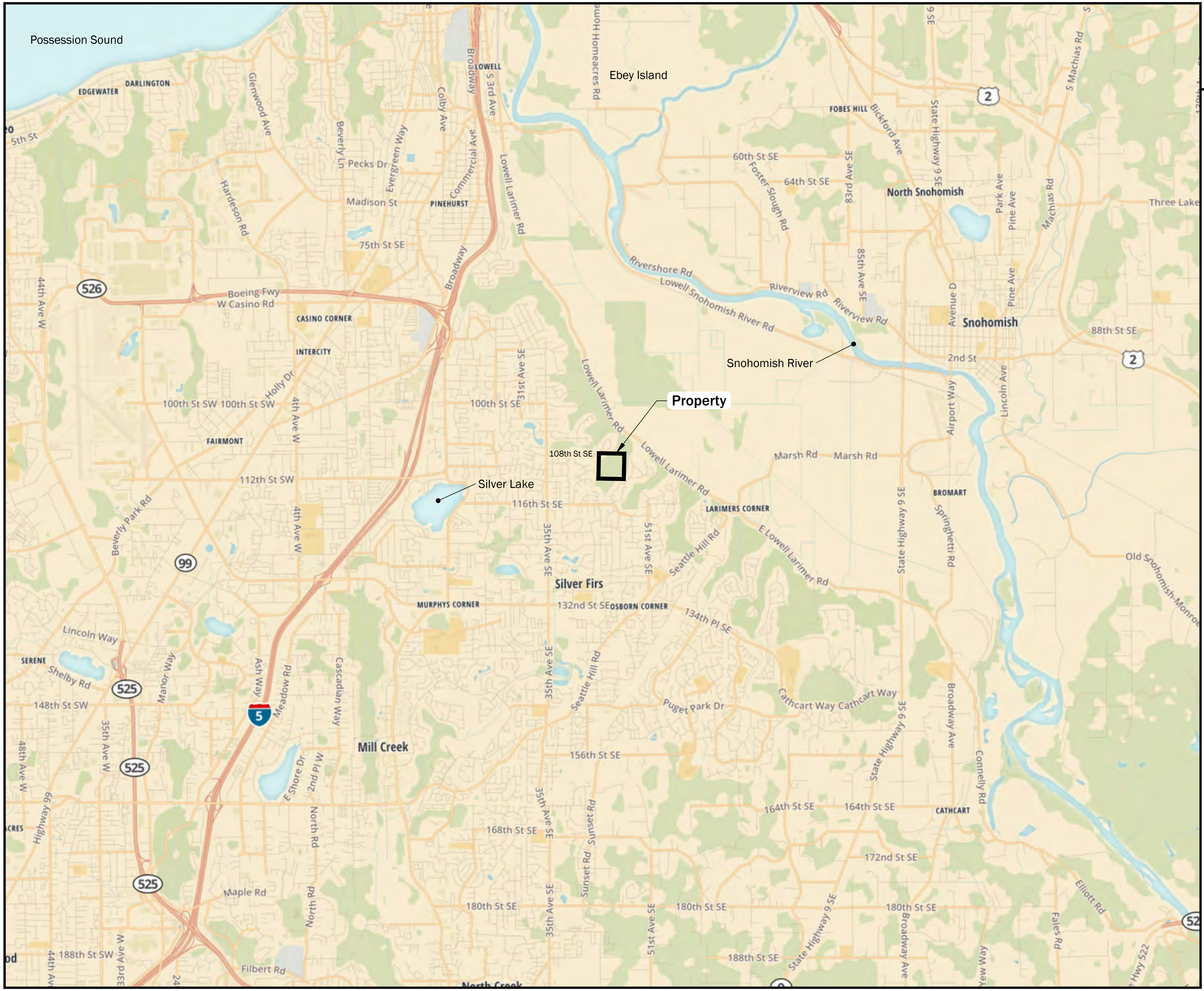
PQL = Laboratory practical quantitation limit

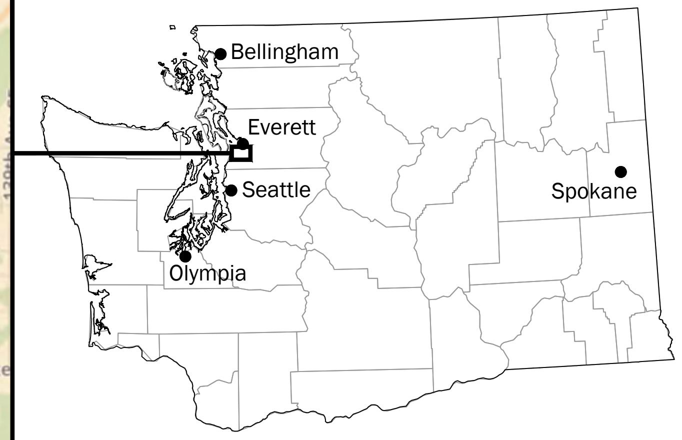
SCUM = Sediment Cleanup User's Manual (Ecology Pub. No. 12-09-057, December 2019)

TTEC = Total toxic equivalent concentration of benzo(a)pyrene calculated per WAC 173-340-708(8)(e)(iii)(A) and using one-half the laboratory reporting limit for non-detected cPAHs.

WAC = Washington Administrative Code

Grey-shaded values were selected as screening levels.





Not To Scale

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2016.

Projection: NAD 1983 UTM Zone 10N

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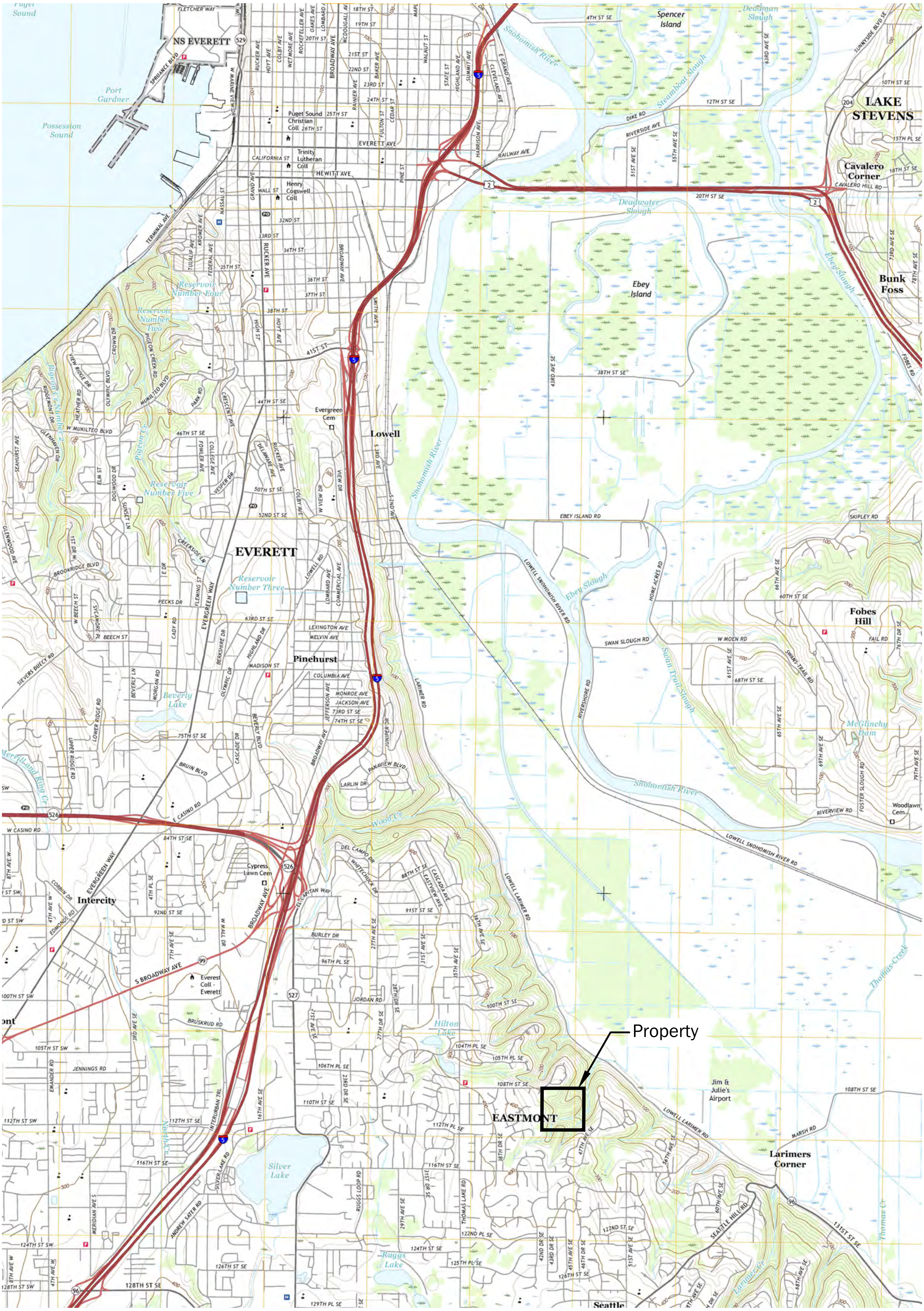
Vicinity Map

Go East Corp Landfill Site
Everett, Washington

GeoEngineers

Figure 1

\\geoengineers.com\WAN\Projects\6\6694002\CAD\03\Geotech\669400203_F01_Vicinity Map.dwg TAB:F01 Date Exported: 01/31/20 - 11:52 by mwoods



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Notes:

1. The locations of all features shown are approximate.
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Data Source: Map from USGS dated 2017.

Property Location in Relation to Physiographic Features

Go East Corp Landfill Site
Everett, Washington

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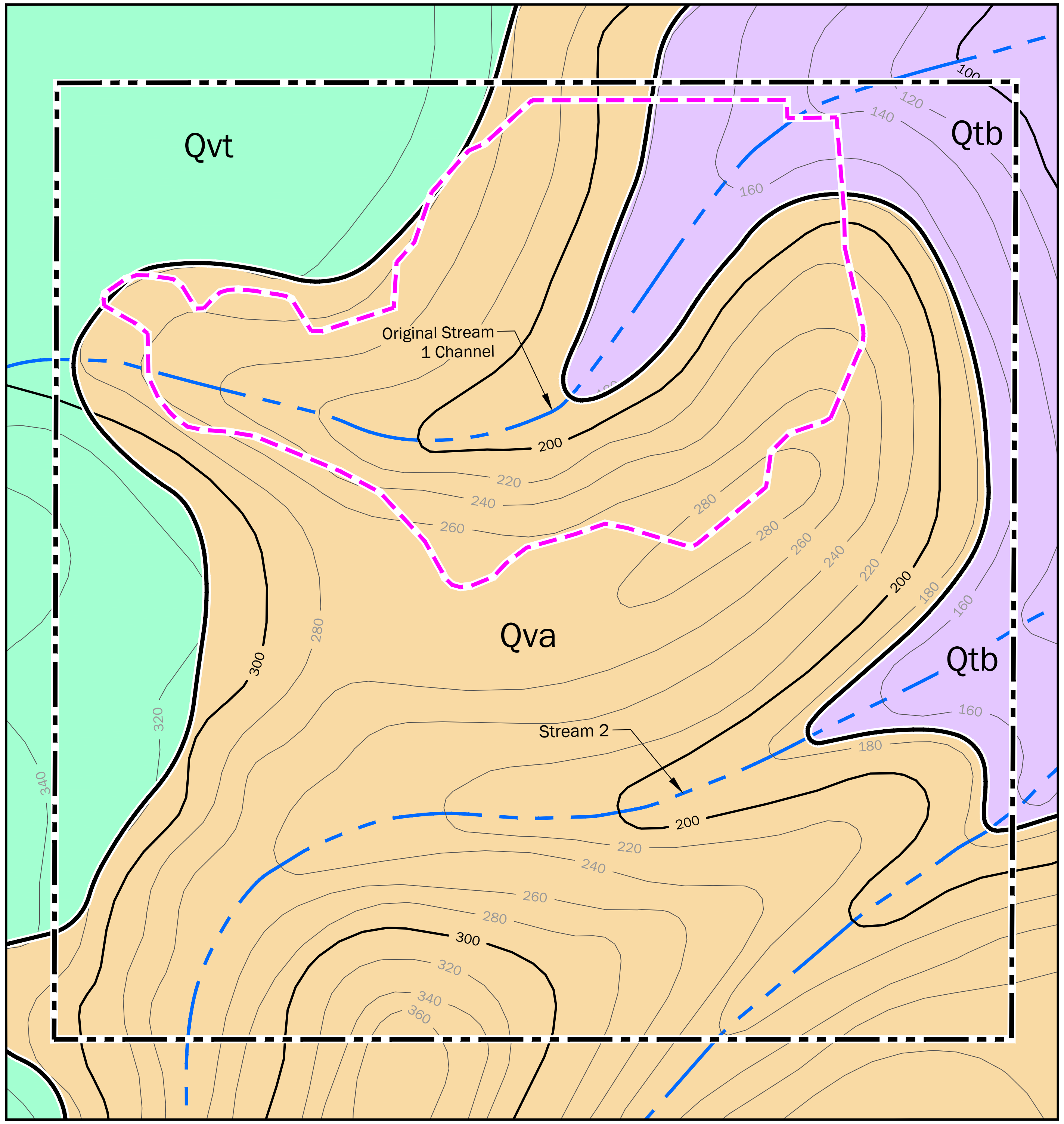
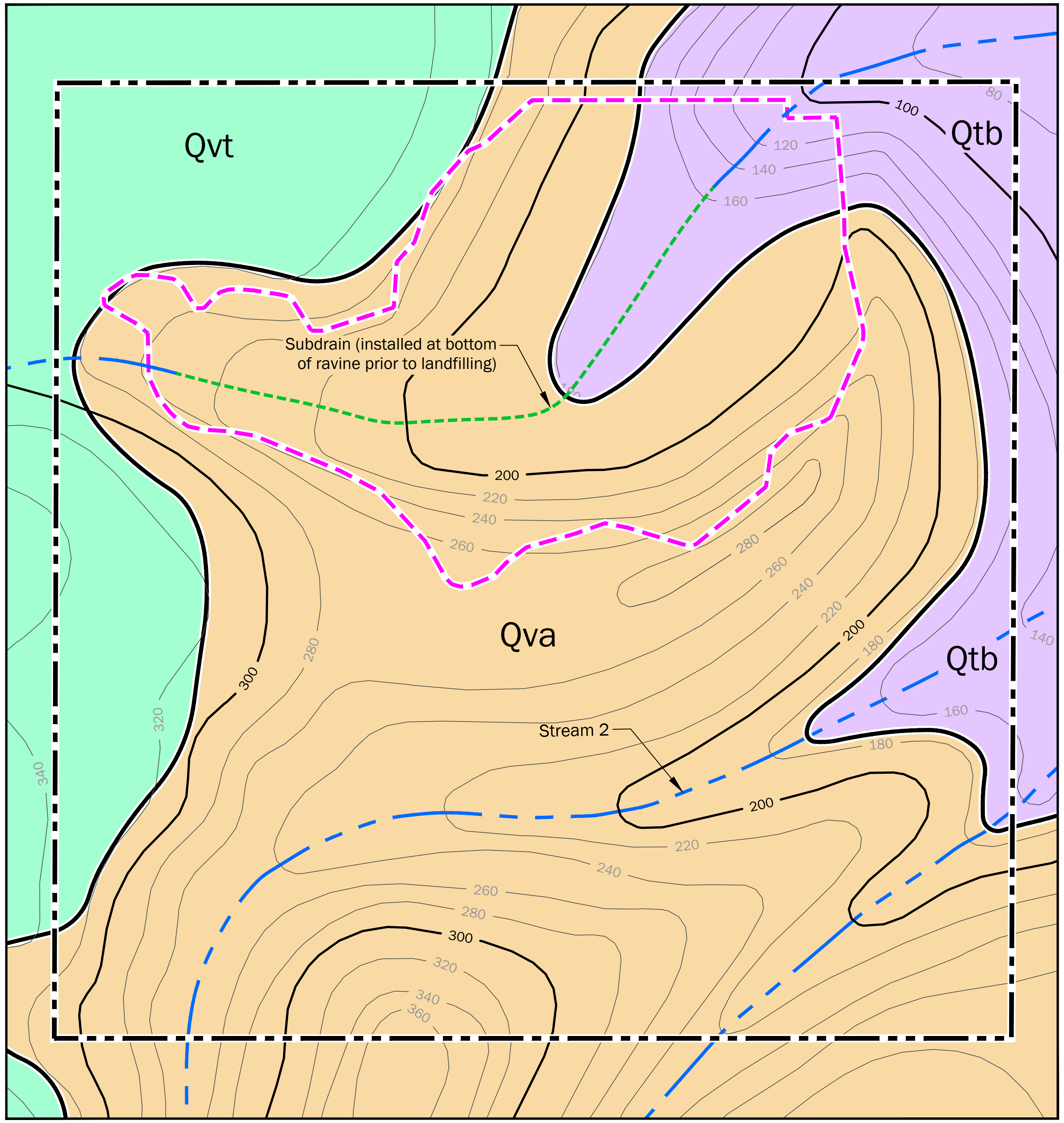
Figure 2

\\geoengineers.com\WAN\Projects\6\6694002\CAD\03\Geotech\669400203_F02_Geology Map.dwg TAB:F02 Date Exported: 01/31/20 - 13:16 by mwoods



Approximate Pre-Sand Mining Condition



Approximate Post-Sand Mining Condition (prior to landfilling)

Notes:

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Data source for pre-sand mining contours and map unit descriptions:
USGS 1985.
Data sources for geologic contacts: AESI 2009b; USGS 1985; Smith 1976;
Geolabs - Washington, Inc. 1970; Newcomb 1952.

Projection: HPGN (HARN) Washington State Planes, North Zone, US Foot

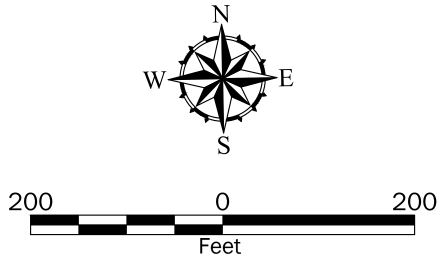
Datum: NAVD88

Legend

▬ ▪ ▪ ▬	Property Boundary
- - - -	Approximate Current Landfill Limit
▬▬	Geologic Contact (Location Approximate)

Map Unit Descriptions

Qvt	Vashion Glacial Till - These deposits mantle hills, ridges, and slopes and consist of a nonsorted mixture of mud, sand, pebbles, cobbles and boulders resembling concrete mix.
Qva	Vashion Glacial Advance Outwash - These deposits underlie the till and consist of clean, mostly gray, well stratified, unconsonsolidated sand with pebbles and some cobbles. The sand is locally silty and oxidized to shades of brown.
Qtb	Transitional Beds (includes pre-Vashon glacial lacustrine silt) - These deposits underlie the advance outwash and consist of clay, silt, and very fine to fine sand. The sediments were mostly deposited in still to slowly moving water (e.g., lakes and slowly flowing rivers/streams).



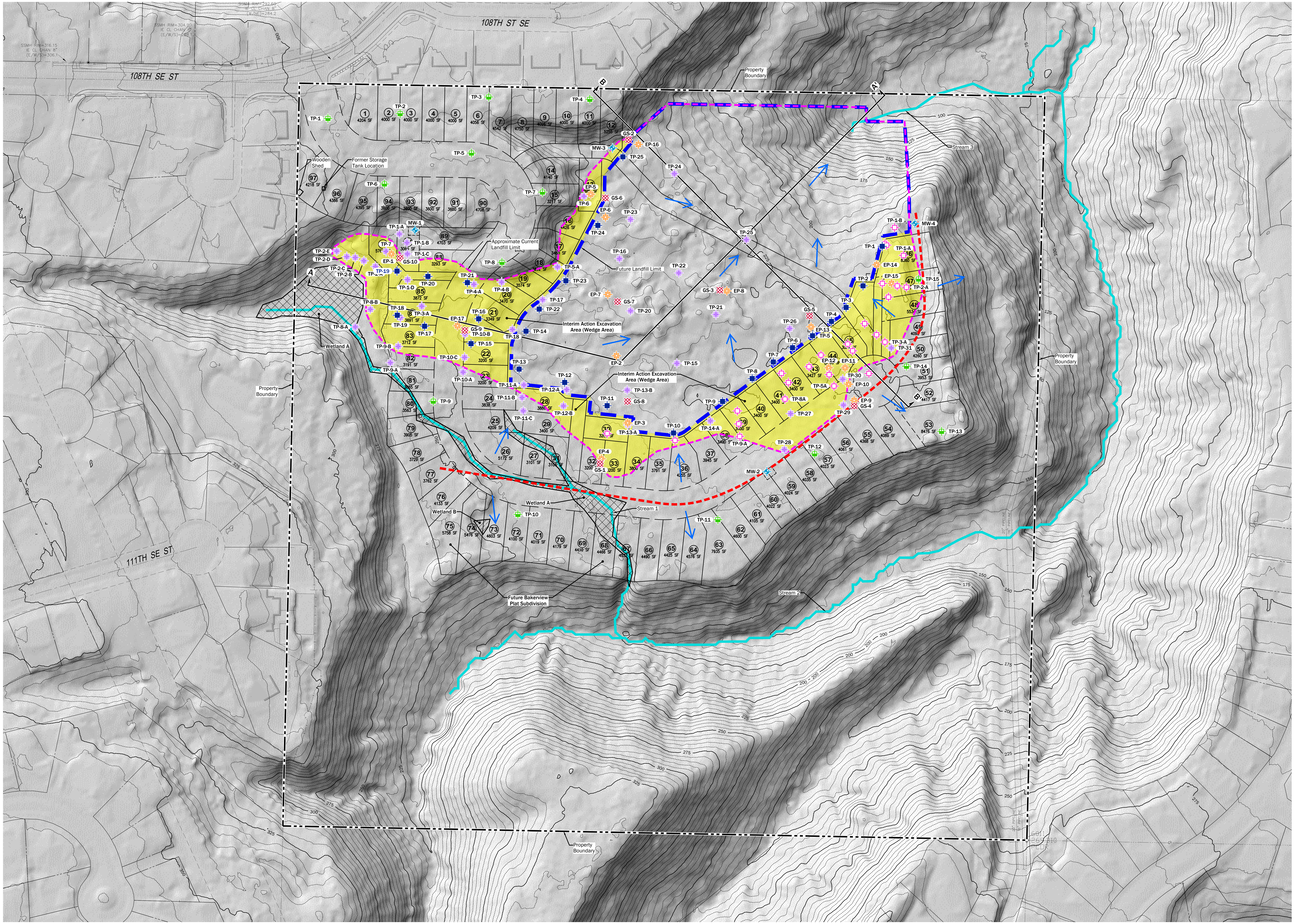
Historical Topography and Surface Geology

Go East Corp Landfill Site
Everett, Washington

GeoEngineers

Figure 3

\\geoengineers.com\WAN\Projects\6\6694002\CAD\03\Interim Action Work Plan\669400203_F03_Historical Topography and Surface Geology.dwg TAB:F03 Date Exported: 03/25/20 - 8:42 by mwoods



Legend

- ▬ ▪ ▬ Property Boundary
- 🟨 Interim Action Excavation Area (Wedge Area)
- Approximate Current Landfill Limit
- Future Landfill Limit
- Inferred Groundwater Divide
- → Inferred Groundwater Flow Direction
- ☒ Wetland A
- ▨ Wetland B
- A A' Cross Section Location
- Test Pit - Landfill Material Sampling Location (Terra Associates, June 2019)
- Reconnaissance Test Pit (Hos Brothers, July 2019)
- Test Pit (Terra Associates, January 2019)
- Test Pit (AESI, 2009)
- Test Pit (Hong West Associates, 2002)
- Groundwater Monitoring Well (AESI, 2009)
- Landfill Gas Probe (AESI, 2009)

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Property boundary survey from PACE Engineers, dated 1/27/2020.
Lidar image and elevation contours from Puget Sound Lidar Consortium dated 2013.

Projection: HPGN (HARN) Washington State Planes, North Zone, US Foot

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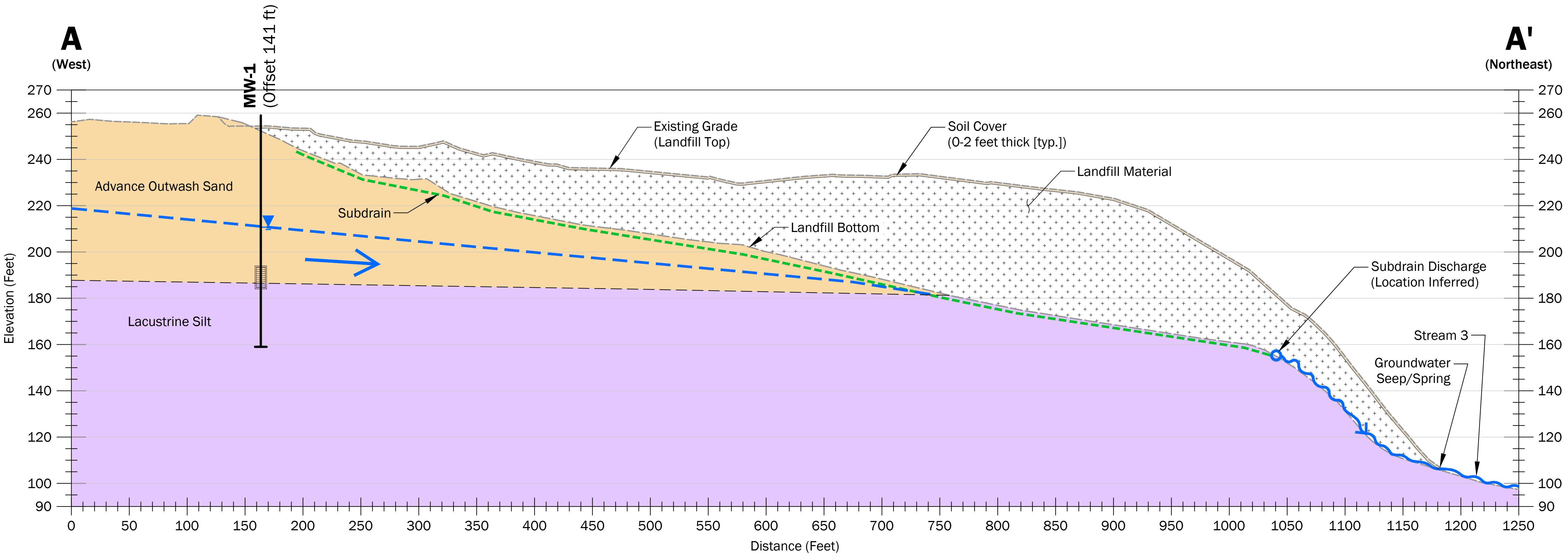
Present-Day Topography and Previous Subsurface Exploration Locations through 2019

Go East Corp Landfill Site
Everett, Washington

GeoEngineers

Figure 4

\\geoengineers.com\WAN\Projects\6\6694002\CAD\03\Draft RI Work Plan\669400203_F04-F08_Site Plan.dwg TAB:F04 Date Exported: 04/15/21 - 16:43 by mwoods



Legend

MW-1 (Offset) — Monitoring Well

Inferred Geologic Contact

Well Screen

Inferred Groundwater Table (Triangle Indicates Measured Groundwater Level in Well)

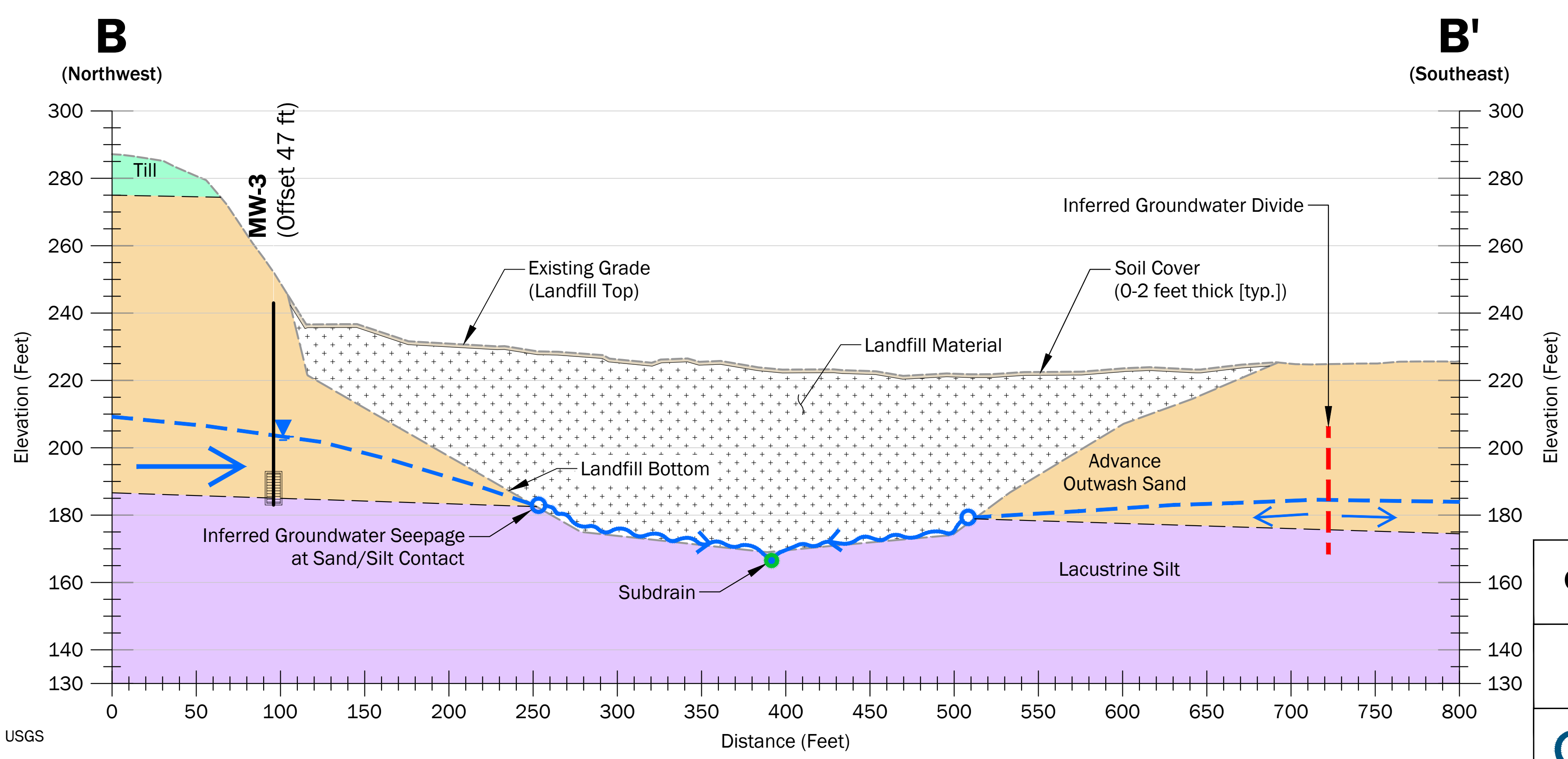
Inferred Groundwater Flow Direction

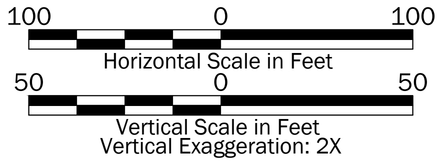
Soil Cover

Advance Outwash Sand

Lacustrine Silt

Glacial Till





Notes:

1. The subsurface conditions shown are inferred from the data sources cited below, and should be considered approximate; actual subsurface conditions may vary from those shown.
2. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.

Data source for existing grade and landfill bottom: PACE Engineers

Data sources for geologic contacts and groundwater table: AESI 2009b; USGS 1985; Smith 1976; Geolabs - Washington, Inc. 1970; Newcomb 1952.

Datum: NAVD88

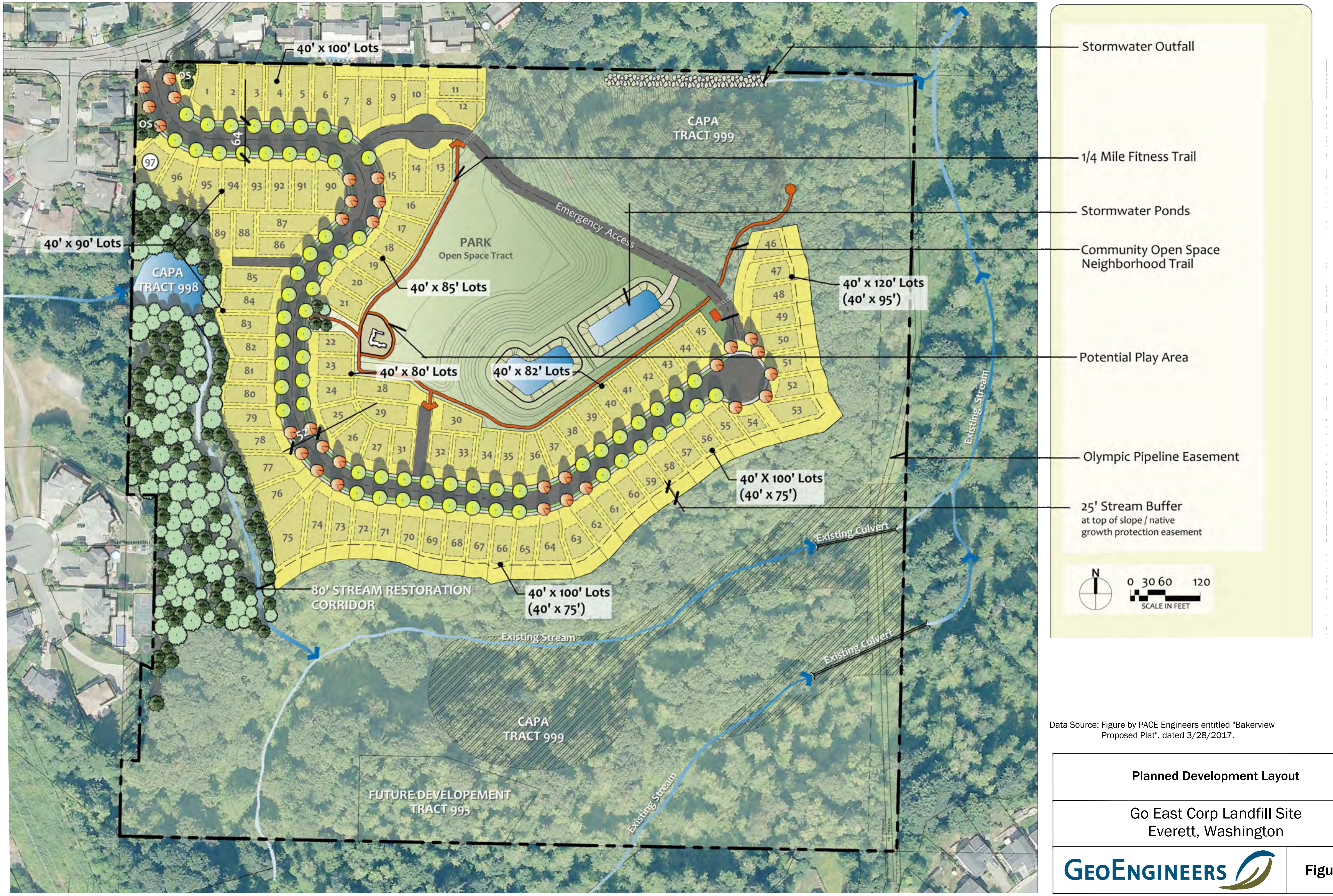
\\geoengineers.com\WAN\Projects\6\6694002\CAD\03\Draft RI Work Plan\669400203_F05_Schematic Cross Sections Through Landfill.dwg TAB:F05 Date Exported: 04/09/21 - 13:39 by mwoods

Generalized Cross Sections Through Landfill

Go East Corp Landfill Site
Everett, Washington

GeoEngineers

Figure 5



Data Source: Figure by PACE Engineers entitled "Bakerview Proposed Plat", dated 3/28/2017.

Planned Development Layout

Go East Corp Landfill Site
Everett, Washington

GeoEngineers

Figure 6

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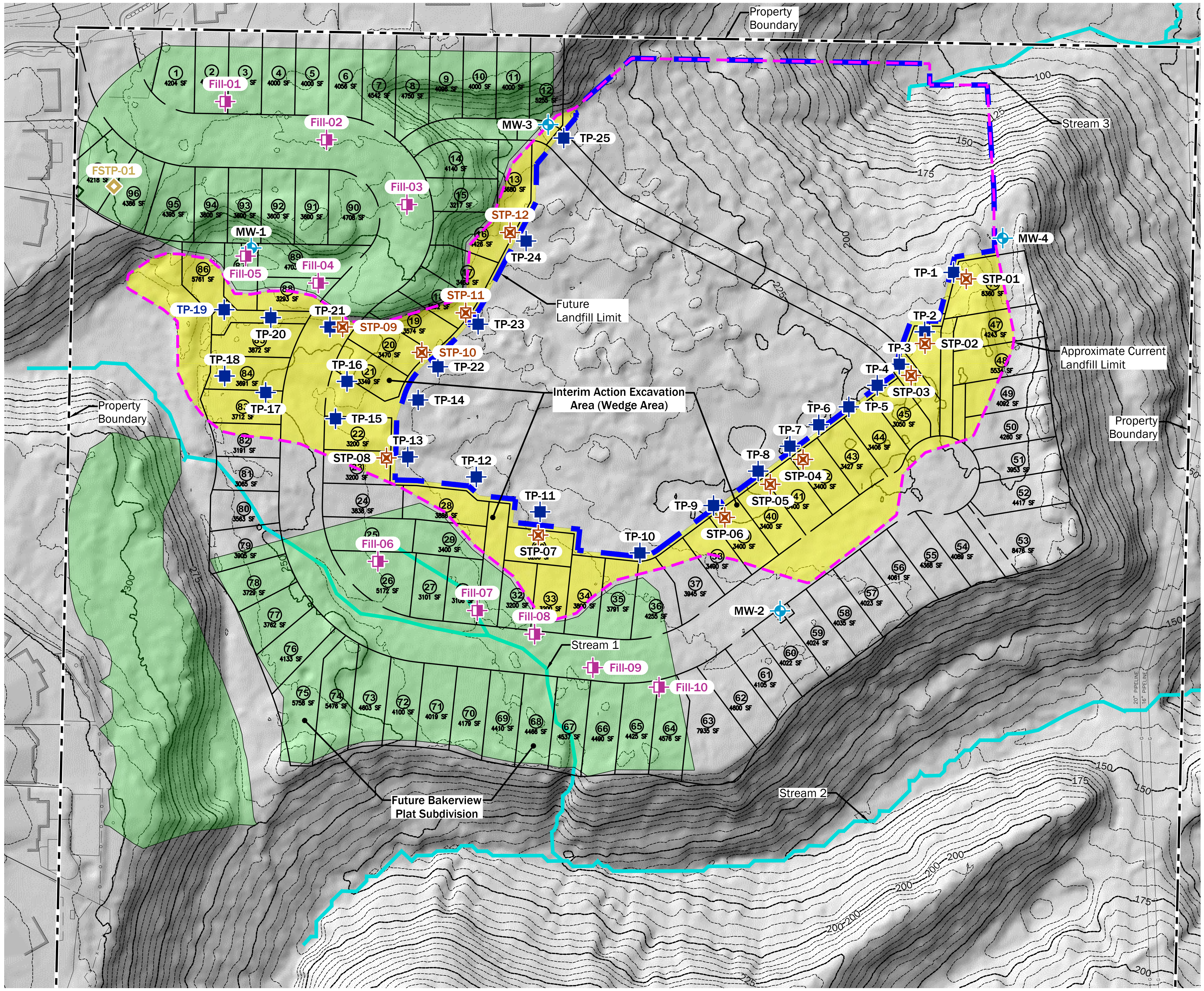

Legend

- Property Boundary
- 🟨 Interim Action Excavation Area (Wedge Area)
- Approximate Current Landfill Limit
- Future Landfill Limit
- Test Pit - Landfill Material Sampling Location (Terra Associates, June 2019)
- ☒ Test Pit - Supplemental Landfill Material Sampling Location (GeoEngineers, June 2020)
- Test Pit - On-Site Fill Source Sampling Location (GeoEngineers, June 2020)
- ◇ Former Storage Tank Area Sampling Location (GeoEngineers, June 2020)
- Groundwater Monitoring Well (AESI, 2009)
- 🟩 On-Site Source Area for Structural Fill

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Property boundary survey from PACE Engineers, dated 1/27/2020.
Lidar image and elevation contours from Puget Sound Lidar Consortium dated 2013.

Projection: HPGN (HARN) Washington State Planes, North Zone, US Foot

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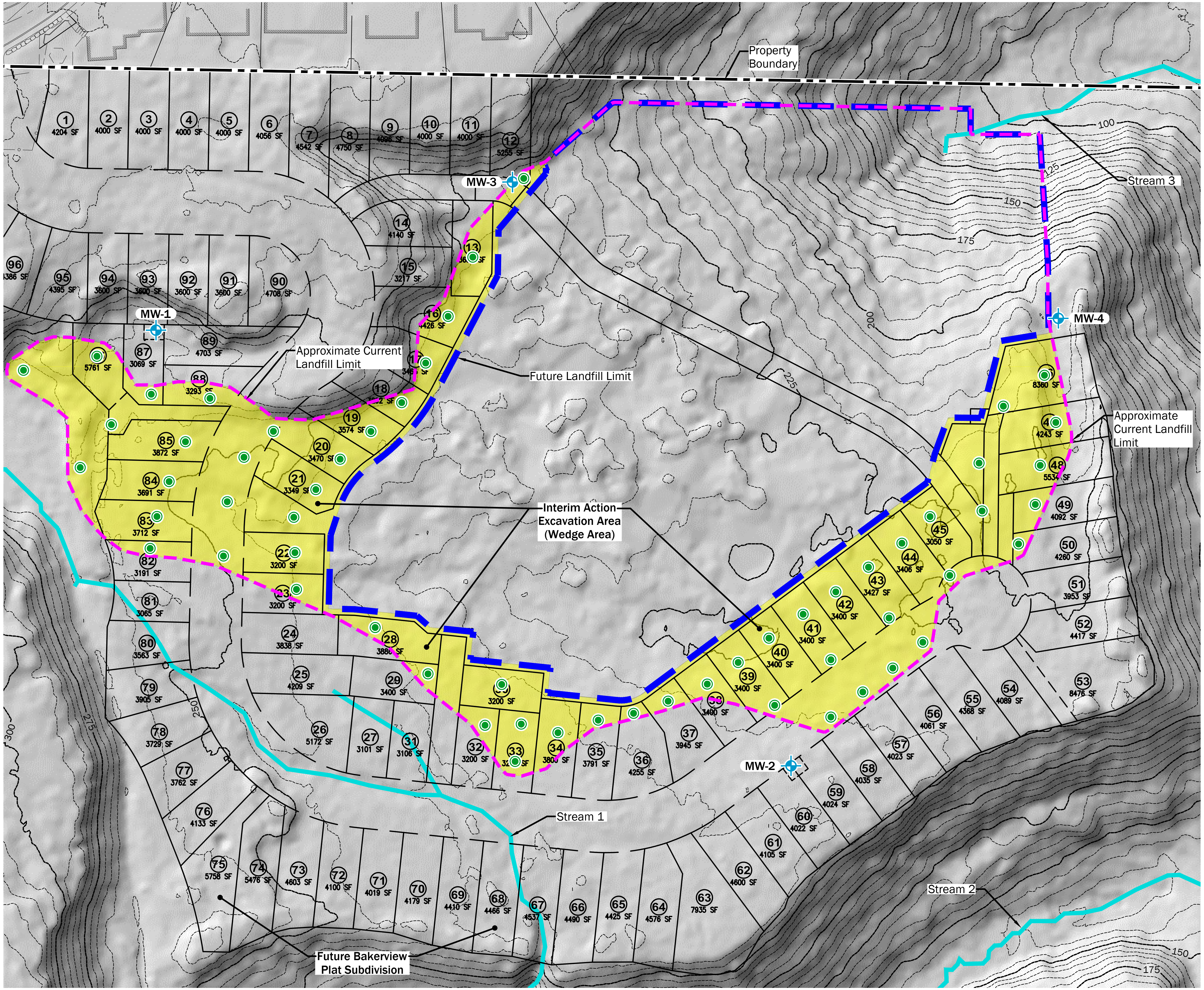
June 2019 and June 2020 Landfill Material, On-Site Fill Source, and Former Storage Tank Area Soil Sampling Locations

Go East Corp Landfill Site
Everett, Washington

GeoEngineers

Figure 7

\\geoengineers.com\WAN\Projects\6\6694002\CAD\03\Draft RI Work Plan\669400203_F04-F08_Site Plan.dwg TAB:F06 Date Exported: 03/30/21 - 15:09 by mwoods



Legend

- Property Boundary
- Interim Action Area (Wedge Area)
- Approximate Current Landfill Limit
- Future Landfill Limit
- ● Approximate Proposed Confirmation Soil Sampling Location
- Groundwater Monitoring Well (AESI, 2009)

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Property boundary survey from PACE Engineers, dated 1/27/2020. Lidar image and elevation contours from Puget Sound Lidar Consortium dated 2013.

Projection: HPGN (HARN) Washington State Planes, North Zone, US Foot

100 0 100

Feet

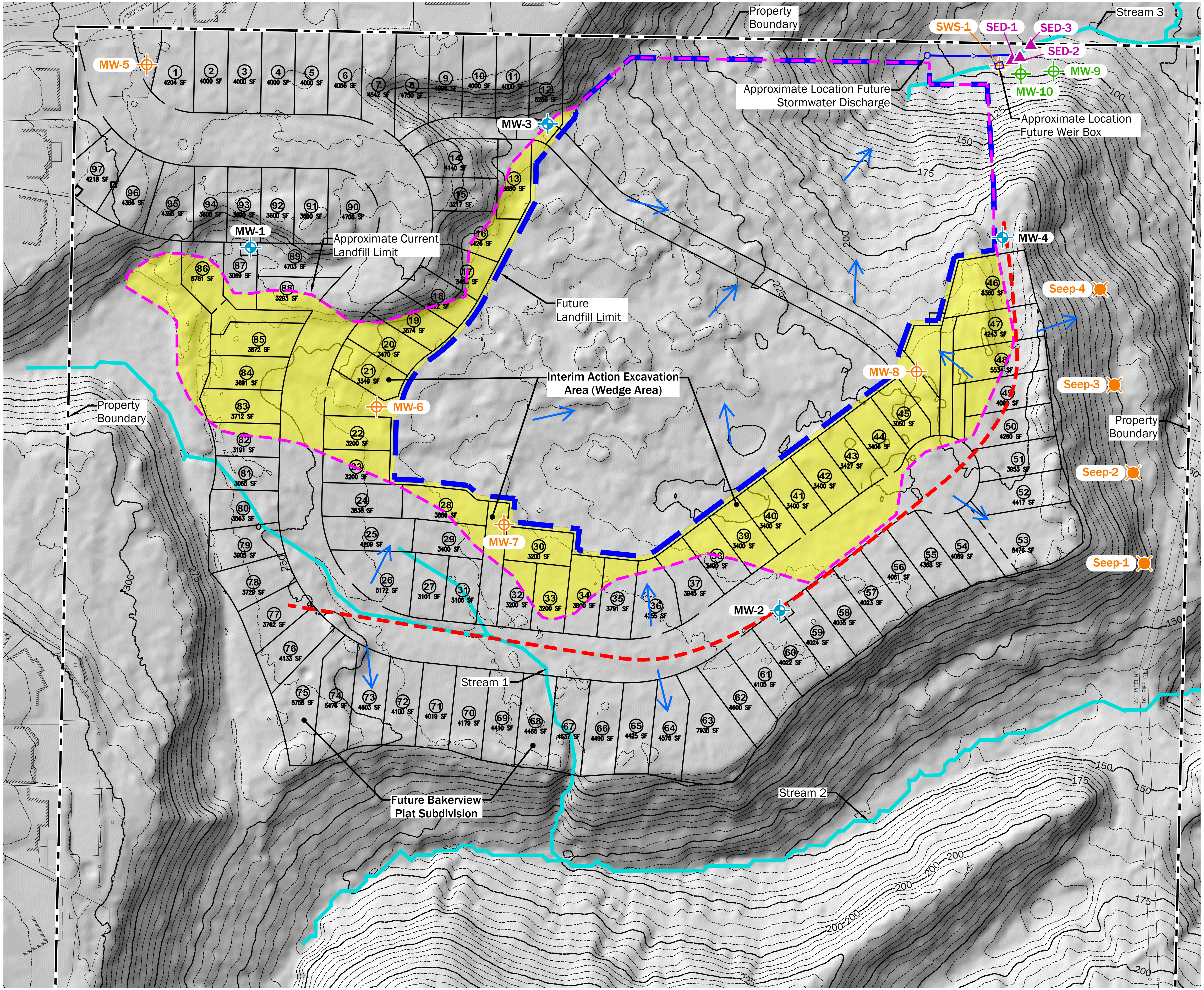
Proposed Interim Action Confirmation Soil Sampling Locations

Go East Corp Landfill Site
Everett, Washington

GEOENGINEERS

Figure 8

\\geoengineers.com\WAN\Projects\6\6694002\CAD\03\Draft RI Work Plan\669400203_F04-F08_Site Plan.dwg TAB:F07 Date Exported: 03/30/21 - 15:11 by mwoods



Legend

- ▬ · ▬ Property Boundary
- 🟨 Interim Action Excavation Area (Wedge Area)
- Approximate Current Landfill Limit
- Future Landfill Limit
- Inferred Groundwater Divide
- → Inferred Groundwater Flow Direction
- ⌖ Existing Groundwater Monitoring Well
- ⌖ Groundwater Monitoring Well to be Installed as part of RI and Landfill Closure
- ⌖ Proposed Groundwater Monitoring Well to be Installed as part of RI
- Proposed Stream 3 Surface Water Sampling Station
- Approximate Proposed Groundwater Seep Sampling Location
- ▲ Approximate Proposed Sediment Sampling Location

Notes:

1. The locations of all features shown are approximate.
2. The locations shown for MW-9, MW-10, and SED-1 through SED-3 are schematic and will be field fit based on installed locations of infrastructure.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Property boundary survey from PACE Engineers, dated 1/27/2020.
Lidar image and elevation contours from Puget Sound Lidar Consortium dated 2013.

Projection: HPGN (HARN) Washington State Planes, North Zone, US Foot

Proposed Remedial Investigation Sampling Locations

Go East Corp Landfill Site
Everett, Washington

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Figure 9

\\geoengineers.com\WAN\Projects\6\6694002\CAD\03\Draft RI Work Plan\669400203_F04-F09_Site Plan.dwg TAB:F09 Date Exported: 06/17/21 - 14:16 by mwoods

APPENDIX A
Monitoring Well Logs MW-1 through MW-4

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-1	1 of 3

Project Name Go East Landfill
Elevation (Top of Well Casing) ~262'
Water Level Elevation ~211'
Drilling/Equipment Cascade CME 75
Hammer Weight/Drop 140# / 30"

Location Snohomish County, WA
Surface Elevation (ft) ~259'
Date Start/Finish 8/11/09 8/12/09
Hole Diameter (in) 6 1/4" I.D.

WELL CONSTRUCTION

Depth (ft)	Blows/ 6"	DESCRIPTION
		Vashon Advance Outwash
5	8 12 28	Moist, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
10	14 28 40	Moist, brownish gray, fine to medium SAND, with silty zones and coarse sand beds.
15	10 15 25	Wet, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
20	8 18 21	Moist, bluish gray, SILT.
25	50/6"	Moist, brownish gray, fine to medium SAND.
30	25 50/5"	Moist, slightly rust-stained brownish gray, fine to medium SAND, with a silt lens containing trace charcoal.
35	18 33 34	Moist, brownish gray, fine to medium SAND, with siltier zones.

Sampler Type (ST):
- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ▯ Grab Sample
- ☐ No Recovery
- ▮ Ring Sample
- ▯ Shelby Tube Sample

M - Moisture
▽ Water Level (8/19/09)
▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

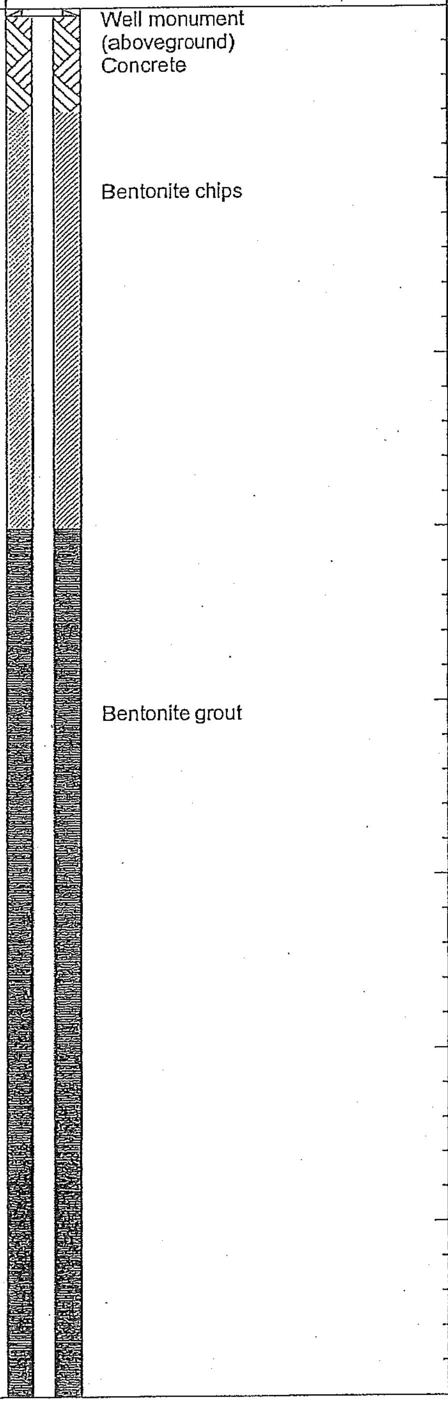
Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-1	1 of 3

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~262'
Water Level Elevation: ~211'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~259'
Date Start/Finish: 8/11/09 8/12/09
Hole Diameter (in): 6 1/4" I.D.



Depth (ft)	Water Level	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
					Vashon Advance Outwash
5		▯	8 12 28		Moist, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
10		▯	14 28 40		Moist, brownish gray, fine to medium SAND, with silty zones and coarse sand beds.
15		▯	10 15 25		Wet, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
20		▯	8 18 21		Moist, bluish gray, SILT.
25		▯	50/6"		Moist, brownish gray, fine to medium SAND.
30		▯	25 50/5"		Moist, slightly rust-stained brownish gray, fine to medium SAND, with a silt lens containing trace charcoal.
35		▯	18 33 34		Moist, brownish gray, fine to medium SAND, with siltier zones.

Sampler Type (ST):
- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ▯ Grab Sample
- ☐ No Recovery
- ▮ Ring Sample
- ▨ Shelby Tube Sample

M - Moisture
▽ Water Level (8/19/09)
▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

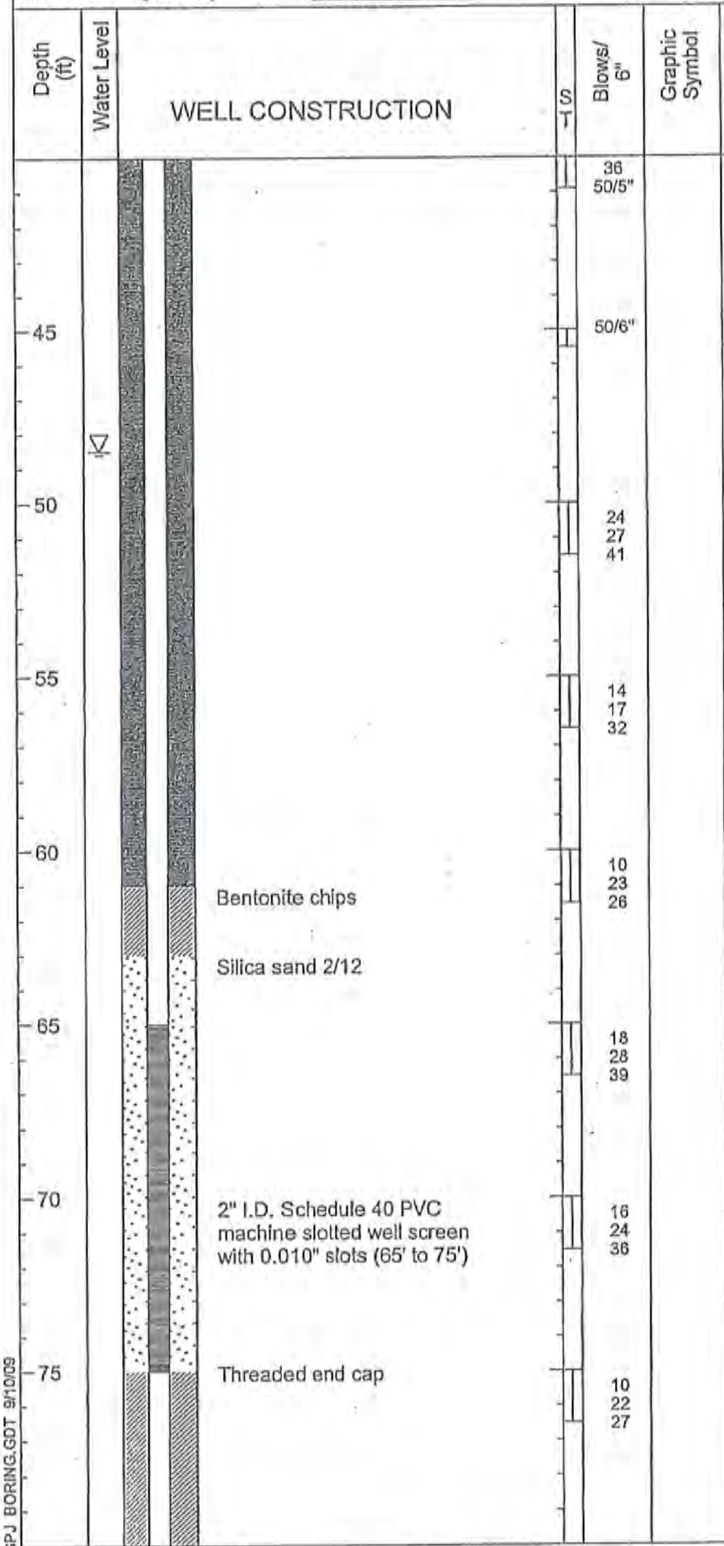
Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-1	2 of 3

Project Name Go East Landfill
Elevation (Top of Well Casing) ~262'
Water Level Elevation ~211'
Drilling/Equipment Cascade CME 75
Hammer Weight/Drop 140# / 30"

Location Snohomish County, WA
Surface Elevation (ft) ~259'
Date Start/Finish 8/11/09 8/12/09
Hole Diameter (in) 6 1/4" I.D.



Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/ 6"	DESCRIPTION
40			36 50/5"	Moist, bluish gray, fine to medium SAND, with siltier zones.
				Driller reports significant water.
45			50/6"	Above bottom 6": Same as above (filled sampler [heave?]). Bottom 6": Moist, bluish gray, SILT, with a few light gray, very fine sand partings.
	∇			
50			24 27 41	Moist, bluish gray, silty very fine SAND interbedded with sandy SILT.
55			14 17 32	Moist, bluish gray, SILT.
60		Bentonite chips	10 23 26	Moist to wet, bluish gray, fine SAND.
		Silica sand 2/12		
65			18 28 39	Wet, same.
70		2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (65' to 75')	16 24 36	Wet, bluish gray, silty very fine SAND interbedded with SILT, with fine sand.
				Pre-Vashon Glacial Lacustrine
75		Threaded end cap	10 22 27	Wet, bluish gray, SILT, with very fine sand, a few very fine sand partings and beds of fine to medium sand.

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture	Logged by: JPL
▯ 3" OD Split Spoon Sampler (D & M)	▮ Ring Sample	∇ Water Level (8/19/09)	Approved by:
▣ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)	

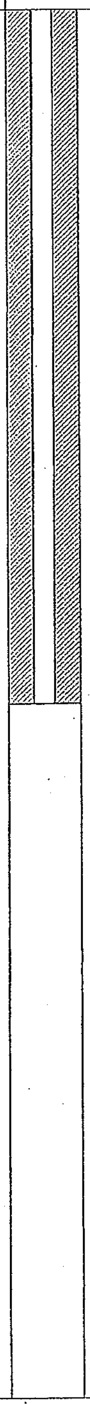
Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-1	3 of 3

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~262'
Water Level Elevation: ~211'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~259'
Date Start/Finish: 8/11/09 8/12/09
Hole Diameter (in): 6 1/4" I.D.



Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				14 22 28		Moist, bluish gray, SILT, with scattered white sand-sized grains.
85				18 23 24		Moist, bluish gray, SILT, with a few very fine sand partings.
90				15 21 25		Moist, bluish gray, SILT.
95				9 17 30		Moist, bluish gray, SILT, with a few very fine sand partings and a fine sand bed.
100				12 19 26		Moist, bluish gray, SILT, with a few very fine sand partings.
						Boring terminated at 101.5 feet on 8/12/09
105						
110						
115						

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	▯ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	▮ Ring Sample	▽ Water Level (8/19/09)
▯ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-2	1 of 2

Project Name Go East Landfill
Elevation (Top of Well Casing) ~234'
Water Level Elevation ~183'
Drilling/Equipment Cascade CME 75
Hammer Weight/Drop 140# / 30"

Location Snohomish County, WA
Surface Elevation (ft) ~232'
Date Start/Finish 8/12/09 8/12/09
Hole Diameter (in) 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	ST	Blows/ 6"	Graphic Symbol	DESCRIPTION
		Well monument (aboveground) Concrete				**Vashon Advance Outwash**
5		Bentonite chips		10 12 14		~4" moist, rust-stained brownish gray, fine to medium SAND over moist, brownish gray to bluish gray (with depth), SILT.
10				11 11 13		Moist, brownish gray, fine SAND.
15				9 19 29		Moist, brownish gray, fine SAND interbedded with brownish gray, SILT, rust staining at contacts.
20		Bentonite grout		8 12 17		Moist to wet, brownish gray, silty fine SAND, with a medium sand bed, interbedded with brownish gray, SILT.
25				5 14 22		Moist, brownish gray, fine SAND.
30				13 21 33		Wet, same, with slight rust staining.
35				21 26 33		Wet, same with siltier zones.

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
▽ Water Level (8/19/09)
▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

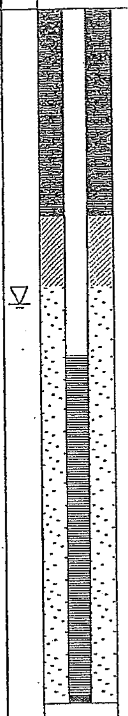
Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-2	2 of 2

Project Name Go East Landfill
Elevation (Top of Well Casing) ~234'
Water Level Elevation ~183'
Drilling/Equipment Cascade CME 75
Hammer Weight/Drop 140# / 30"

Location Snohomish County, WA
Surface Elevation (ft) ~232'
Date Start/Finish 8/12/09 8/12/09
Hole Diameter (in) 6 1/4" I.D.



48'

Depth (ft)	WELL CONSTRUCTION	ST	Blows/ 6"	DESCRIPTION
		▯	11 21 21	Moist to wet, brownish gray, SILT, with fine sand beds.
45	Bentonite chips	▯	12 26 37	Moist to wet, brownish gray to bluish gray, silty very fine SAND interbedded with SILT, with fine sand.
	Silica sand 2/12			
50	2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (50' to 60')	▯	11 19 22	Wet, bluish gray, fine SAND, medium sand laminae with organics at 50.5'.
55		▯	12 20 24	Wet, bluish gray, silty very fine SAND.
				Pre-Vashon Glacial Lacustrine
60	Threaded end cap	▯	7 19 22	Moist, bluish gray, SILT.
				Boring terminated at 61.5 feet on 8/12/09
65				
70				
75				

Sampler Type (ST):
▯ 2" OD Split Spoon Sampler (SPT)
▯ 3" OD Split Spoon Sampler (D & M)
▯ Grab Sample
▯ No Recovery
▮ Ring Sample
▱ Shelby Tube Sample

M - Moisture
▽ Water Level (8/19/09)
▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-3	1 of 2

Project Name Go East Landfill
Elevation (Top of Well Casing) ~245'
Water Level Elevation ~214'
Drilling/Equipment Cascade CME 75
Hammer Weight/Drop 140# / 30"
Location Snohomish County, WA
Surface Elevation (ft) ~243'
Date Start/Finish 8/13/09 8/13/09
Hole Diameter (in) 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	ST	Blows/ 6"	Graphic Symbol	DESCRIPTION
		Well monument (aboveground) Concrete				**Vashon Advance Outwash**
5		Bentonite chips		2 4 6		Wet, slightly rust-stained brownish gray, fine to medium SAND.
10				6 11 13		Moist, rust-stained bluish gray, bedded SILT. Bottom 3": Moist, brownish gray, fine to medium SAND, with trace gravel.
15				10 16 21		Moist, brownish gray, fine to medium SAND, with trace gravel.
20		Bentonite grout		8 13 13		Moist, brownish gray, fine to medium SAND.
25				10 13 16		Moist, same.
	∇					
30				20 29 22		Wet, brownish gray, fine SAND, with siltier zones.
35				11 18 29		Top 4": Wet, rust-stained brownish gray, fine to medium SAND, with silt. Wet, bluish gray, silty very fine SAND interbedded with SILT, with fine sand.

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)
▯ 3" OD Split Spoon Sampler (D & M)
▯ Grab Sample
▯ No Recovery
▮ Ring Sample
▯ Shelby Tube Sample
M - Moisture
∇ Water Level (8/19/09)
▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

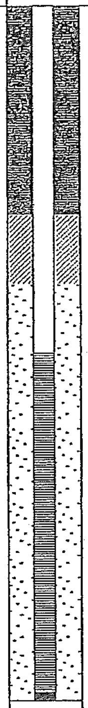
Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-3	2 of 2

Project Name Go East Landfill
Elevation (Top of Well Casing) ~245'
Water Level Elevation ~214'
Drilling/Equipment Cascade CME 75
Hammer Weight/Drop 140# / 30"

Location Snohomish County, WA
Surface Elevation (ft) ~243'
Date Start/Finish 8/13/09,8/13/09
Hole Diameter (in) 6 1/4" I.D.



Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				12 20 26		Moist, bluish gray, SILT.
45		Bentonite chips		12 21 29		Wet, bluish gray, fine SAND, with silt.
		Silica sand 2/12				
50				14 18 21		Wet, same.
		2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (50' to 60')				
55				12 24 30		Moist to wet, bluish gray, laminated SILT, with very fine sand.
						Pre-Vashon Glacial Lacustrine
60		Threaded end cap		14 24 28		Moist, bluish gray, SILT, with a few very fine sand partings and a bed of fine sand.
						Boring terminated at 61.5 feet on 8/13/09
65						
70						
75						

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)
▯ 3" OD Split Spoon Sampler (D & M)
▣ Grab Sample
☐ No Recovery
▮ Ring Sample
▱ Shelby Tube Sample

M - Moisture
▽ Water Level (8/19/09)
▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

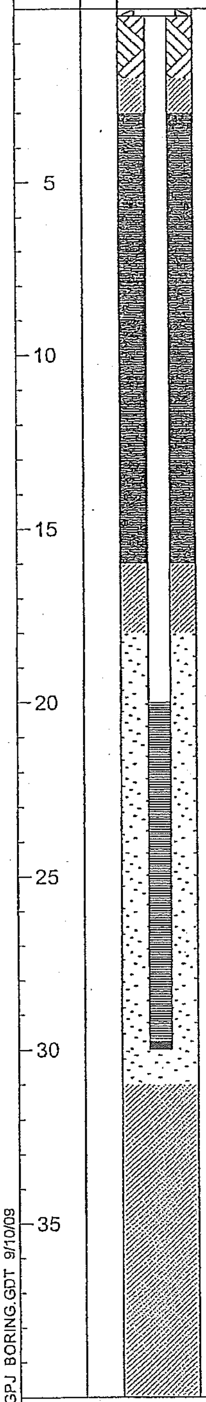
Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-4	1 of 2

Project Name Go East Landfill
Elevation (Top of Well Casing)
Water Level Elevation No water (8/19/09)
Drilling/Equipment Cascade CME 75
Hammer Weight/Drop 140# / 30"

Location Snohomish County, WA
Surface Elevation (ft) ~206'
Date Start/Finish 8/14/09 8/14/09
Hole Diameter (in) 6 1/4" I.D.



Depth (ft)	Water Level	WELL CONSTRUCTION	ST	Blows/ 6"	Graphic Symbol	DESCRIPTION
		Locking cap Concrete Bentonite chips				**Vashon Advance Outwash**
5		Bentonite grout		6 8 10		Moist, grayish brown, fine SAND, little silt (SM).
10		2" I.D. Schedule 40 PVC blank		7 9 10		Moist, grayish brown, fine SAND, few silt (SP).
15		Bentonite chips		7 11 12		Becomes slightly more gray, trace silt, trace rust mottling.
		#2/12 silica sand				Moist to very moist, grayish tan, silty fine SAND (SM).
20				9 15 18		
		2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (20' to 30')				
25				6 14 19		
						Pre-Vashon Glacial Lacustrine
30		Threaded end cap		6 8 16		Wet, grayish tan, SILT (ML); non-plastic, contains dilatant zones.
35		Bentonite chips		5 9 11		Becomes blue-gray and very moist to wet.

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	▮ Ring Sample	▽ Water Level ()
▨ Grab Sample	▧ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: TJP
Approved by:

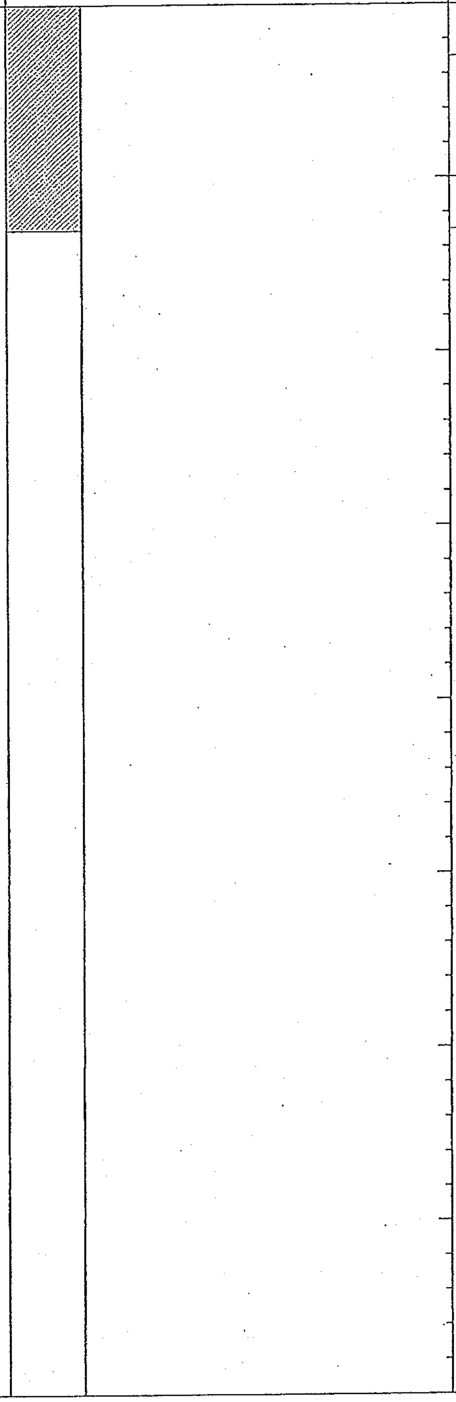
Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-4	2 of 2

Project Name Go East Landfill
Elevation (Top of Well Casing)
Water Level Elevation No water (8/19/09)
Drilling/Equipment Cascade CME 75
Hammer Weight/Drop 140# / 30"

Location Snohomish County, WA
Surface Elevation (ft) ~206'
Date Start/Finish 8/14/09 8/14/09
Hole Diameter (in) 6 1/4" I.D.



Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				11 13 17		
45				9 12 18		
						Boring terminated at 46.5 feet on 8/14/09
50						
55						
60						
65						
70						
75						

Sampler Type (ST):
- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ▯ Grab Sample
- ▯ No Recovery
- ▮ Ring Sample
- ▯ Shelby Tube Sample

M - Moisture
▽ Water Level ()
▼ Water Level at time of drilling (ATD)

Logged by: TJP
Approved by:

APPENDIX B
Sampling and Analysis Plan

Remedial Investigation Sampling and Analysis Plan

Go East Corp Landfill Site
Everett, Washington
Ecology Agreed Order No. DE 18121

for
Washington State Department of Ecology on Behalf of P&GE, LLC

June 30, 2021

GeoEngineers

2101 4th Avenue, Suite 950
Seattle, Washington 98121
206.728.2674

Table of Contents

1.0 INTRODUCTION

GeoEngineers, Inc. (GeoEngineers) has prepared this Remedial Investigation Sampling and Analysis Plan (SAP) for the Go East Corp Landfill Site (Site) as an appendix to the *Remedial Investigation Work Plan, Go East Corp Landfill Site, Everett, Washington* (GeoEngineers 2021) (Work Plan).

The Go East Corp Landfill (Landfill) is a 9.6-acre, inactive, limited purpose landfill as defined in Washington Administrative Code (WAC) Chapter 173-350, Section 400. The Landfill and the 40.9-acre property on which it is located (Property) are owned by P&GE, LLC (P&GE). P&GE will permanently close the Landfill and install an engineered capping system over the Landfill in 2021 as described in the *Go East Landfill Closure Plan* (PACE Engineers, Inc. [PACE] 2018). As part of Landfill closure, the Landfill footprint will be reduced by relocating landfill materials from the outer margin of the Landfill to the interior portion of the Landfill. The engineered capping system will prevent direct contact with landfill materials, reduce stormwater infiltration, and control landfill gas emissions. After the Landfill is closed and capped, the surrounding parcels to the west, south, and east on the Property will be developed as the Bakerview Plat Subdivision.

The Work Plan describes the Site history, previous remedial actions, and the objective and scope of the remedial investigation (RI). This SAP describes the field sampling activities and laboratory analyses that will be performed during the RI. The RI field sampling activities described in this SAP include:

- Soil sampling during the installation of four new groundwater monitoring wells (MW-5 through MW-8) to be installed during the RI.
- Groundwater sampling at existing groundwater monitoring wells MW-1 through MW-4, the four new monitoring wells to be installed during the RI (MW-5 through MW-8), and two new monitoring wells (MW-9 and MW-10) to be installed as part of the Landfill closure construction activities.
- Surface water and sediment sampling in Stream 3 near the northeastern corner of the Property.
- Surface water sampling at groundwater seep locations on the western wall of the ravine east-adjacent to the Landfill.

This SAP has been prepared in accordance with requirements of the Washington State Model Toxics Control Act (MTCA) Cleanup Regulation (WAC 173-340). A Quality Assurance Project Plan (QAPP) is included in Appendix C of the Work Plan.

1.1 Purpose

The purpose of this SAP is to describe the planned sampling and analytical testing of soil, groundwater, surface water, and sediment during the RI. The environmental sampling and related field activities are described in Sections 2.0 through 7.0. The project organization and responsibilities pertaining to the RI sampling activities are outlined below.

1.2 Project Organization and Responsibilities

GeoEngineers key personnel and responsibilities for the RI are identified below. These personnel are responsible for ensuring that the RI sampling activities are conducted in accordance with this SAP and the Work Plan.

1.2.1 Principal-in-Charge

Mr. Terry McPhetridge is the Principal-in-Charge and has overall responsibility for ensuring that the RI is implemented in accordance with this SAP and the Work Plan.

1.2.2 Project Manager

Mr. Garrett Leque is the Project Manager and will assign project team members, coordinate and schedule field and laboratory testing activities, coordinate subcontractors, and track the project schedule. Mr. Leque will also verify that SAP and QAPP objectives are achieved and that any deviations from the RI Work Plan, SAP, or QAPP are documented. Additionally, Mr. Leque will provide technical oversight and coordinate production and review of project deliverables.

1.2.3 Field Coordinator

The Field Coordinator will be identified before RI field work begins. The Field Coordinator is responsible for the daily management of field activities. Specific responsibilities include:

- Supervise and provide technical direction to GeoEngineers field personnel and subcontractors as needed under the supervision of the Project Manager.
- Develop schedules and allocate resources for field tasks.
- Coordinate field data collection and documentation activities.
- Supervise the compilation of field data and laboratory analytical results.
- Review field data for correct and complete reporting.
- Implement and oversee field sampling in accordance with the Work Plan including this SAP and the QAPP.
- Coordinate work with on-site subcontractors.
- Schedule sample shipments/delivery with the analytical laboratory.
- Monitor that appropriate sampling, testing, and measurement procedures are followed.
- Coordinate the transfer of field records (boring logs, sample tracking forms, field reports, etc.) to the Project Manager.
- Identify whether deviations from the SAP and QAPP procedures are necessary and appropriate to achieve the project goals and discuss deviations with the Project Manager.

1.2.4 Quality Assurance Leader

The Quality Assurance (QA) Leader is responsible for overseeing quality assurance/quality control for laboratory testing of field samples. Specific responsibilities of the QA Leader include the following:

- Serve as the GeoEngineers point of contact for laboratory QA questions and concerns.
- Confirm acceptability of the Laboratory QA Plan.
- Respond to laboratory data QA needs, answer laboratory requests for guidance and assistance, and resolve issues.

- Monitor laboratory compliance with data quality requirements outlined in the QAPP.
- Confirm that appropriate sampling and analysis procedures are followed including implementation of proper quality control (QC) checks.
- Coordinate the implementation of the QAPP and review the quality of the analytical data generated.
- Implement or direct corrective actions if necessary.
- Review project policies, procedures, and guidelines and review the project activities to verify that the QA program is being properly implemented.
- Provide oversight of the data development and review process and of subcontracted laboratories.
- Develop work scopes for subcontracted laboratories that incorporate QAPP requirements.
- Enter data into the Washington State Department of Ecology's (Ecology) Environmental Information Management system.

1.2.5 Laboratory Management

Subcontracted laboratories conducting analytical testing for this project are required to confirm with the QA Leader that laboratory procedures are consistent with the project QA objectives outlined in the QAPP.

The Laboratory QA Coordinator for each subcontracted laboratory administers the Laboratory QA Plan and is responsible for QC. Specific responsibilities of the Laboratory QA Coordinator include:

- Verify implementation of the Laboratory QA Plan.
- Serve as the laboratory point of contact.
- Implement corrective action as necessary when analytical QC limits are exceeded.
- Issue the final laboratory analytical report and QC data.
- Comply with the QAPP and contractual requirements for laboratory services.
- Participate in QA audits and compliance inspections as directed by the QA Leader, if needed.

OnSite Environmental, Inc. (OnSite) of Redmond, Washington, a Washington State accredited laboratory, will be the primary subcontracted analytical laboratory for the RI. Mr. David Baumeister is OnSite's Laboratory QA Coordinator. If other laboratories are used Ecology will be notified, and the names of the other Laboratory QA Coordinators will be provided as necessary.

2.0 ENVIRONMENTAL MEDIA SAMPLING AND ANALYTICAL TESTING

The planned RI sampling and analytical testing activities are described below. Details regarding sample containers, sample preservation, and sample holding times are provided in the QAPP (Appendix C of the Work Plan).

2.1 Soil

Soil samples will be collected during drilling for the installation of four new groundwater monitoring wells (MW-5 through MW-8) outside the future Landfill limit. Figure 8 of the Work Plan shows the proposed locations of the monitoring wells. The soil analytical results will be used to characterize the drill cuttings for disposal and to compare concentrations of hazardous substances in soil and groundwater at the new monitoring well locations. Groundwater sampling is described in Section 2.2.

The monitoring well borings will be drilled using hollow-stem auger or sonic drilling methods. The borings will be advanced to the contact between the Vashon glacial advance outwash deposits (Qva) and the underlying pre-Vashon glacial lacustrine silt deposits (i.e., the upper portion of the transitional beds stratigraphic sequence [Qtb]). This contact is anticipated to occur at a depth of approximately 45 feet below ground surface (bgs) at MW-8, 50 feet bgs at MW-7, 55 feet bgs at MW-6, and 100 feet bgs at MW-5.

Soil samples will be collected at a minimum frequency of every 5 feet during drilling using a split-spoon drive sampler or sonic core barrel sampler. The samples will be transferred to laboratory-supplied containers and placed in a cooler containing ice for delivery to the analytical laboratory. The sand-sized and finer fractions of the soil will be targeted for sample collection. Sample containers for volatile organic compound (VOC) analysis will be filled first to minimize loss of volatiles. Applicable sampling procedures of United States Environmental Protection Agency (EPA) Method 5035A will be followed for samples analyzed for VOCs, including the use of EasyDraw syringes or similar equipment.

Soil types encountered during drilling will be described on boring logs in general accordance with ASTM D 2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and classified according to the Unified Soil Classification System. In addition, soil samples obtained during drilling will be field screened for the potential presence of hazardous substances. Field screening will consist of visual screening, water sheen screening, and headspace vapor screening using a photoionization detector (PID). Field screening procedures are described in Section 3.0. Field screening results will be recorded on boring logs.

The vadose zone soil sample collected closest to the groundwater table at each boring location will be submitted for laboratory analysis. If field screening indicates that contaminants may be present in other soil samples, the sample(s) considered most likely to be contaminated based on the field screening results will be submitted for laboratory analysis.

The soil samples will be analyzed for the following parameters:

- Gasoline range organics (GRO) by Method NWTPH-Gx.
- Diesel range organics (DRO) and heavy oil range organics (ORO) by Method NWTPH-Dx without acid/silica gel cleanup. If DRO or ORO are detected, follow-up analysis with acid/silica gel cleanup may be performed to assess potential analytical interference by biogenic organics (e.g., tannins and lignins from woody debris).
- VOCs by EPA Method 5035A (unpreserved sample collection and preparation) and 8260D (analysis).
- Semivolatile organic compounds (SVOCs) with low-level polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270E/Selective Ion Monitoring (SIM).
- Polychlorinated biphenyls (PCBs) as Aroclors by EPA Method 8082A.
- Organochlorine pesticides by EPA Method 8081B.
- Chlorinated acid herbicides by EPA Method 8151A.

- Metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, and zinc) by EPA Methods 6010D/6020B/7471B.

2.2 Groundwater

Quarterly groundwater monitoring will be conducted for one year to evaluate groundwater quality as described in the Work Plan. Well MW-5 will be sampled more frequently than other wells to assist in evaluating background metals concentrations. This well will be sampled twice per quarter (i.e. 8 samples per year.) The goal will be to sample MW-5 approximately every 6 weeks to develop background metals concentrations. Existing and proposed groundwater monitoring wells are shown in Figure 8 of the Work Plan. Groundwater levels in existing monitoring wells MW-1 through MW-3, new wells MW-5 through MW-8, and wells MW-9 and MW-10 (to be installed during Landfill closure as described in the Work Plan) will be measured using an electronic water level indicator prior to sampling groundwater each quarter. After groundwater levels are measured, monitoring wells MW-1 through MW-10 will be sampled. Well MW-4 will be decommissioned because groundwater has not been encountered in the advanced outwash near the well.

Groundwater samples will be collected using a bladder pump and low-flow purging and sampling methods. A dedicated pump bladder and discharge tubing will be used at each well. The field water quality parameters temperature, pH, specific conductance, turbidity, dissolved oxygen (DO) and oxidation-reduction potential (ORP) will be measured during well purging using a portable multi-probe water quality meter and flow-through cell. After field parameters stabilize, groundwater samples will be collected in laboratory-supplied sample containers and placed in a cooler containing ice for delivery to the analytical laboratory. Both unfiltered and field-filtered samples will be collected for total and dissolved metals analysis, respectively. Field-filtered samples will be filtered using disposable 0.45-micron filter cartridges.

The groundwater samples collected each quarter will be analyzed for the following parameters:

- GRO by Method NWTPH-Gx.
- DRO and ORO by Method NWTPH-Dx without acid/silica gel cleanup. If DRO or ORO are detected, follow-up analysis with acid/silica gel cleanup may be performed to assess potential analytical interference by biogenic organics.
- VOCs by EPA Method 8260D.
- SVOCs with low-level PAHs by EPA Method 8270E/SIM.
- PCBs as Aroclors by EPA Method 8082A.
- Organochlorine pesticides by EPA Method 8081B.
- Chlorinated acid herbicides by EPA Method 8151A.
- Metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, and zinc) by EPA Methods 200.7/200.8/245.1/7470A.

Groundwater samples will also be analyzed for the following geochemical and leachate indicator parameters required by WAC 173-350-500(4)(h) for landfill post-closure care:

- Alkalinity and bicarbonate by SM 2320B.

- Dissolved calcium, dissolved potassium, total and dissolved magnesium, and dissolved sodium by EPA 200.7/200.8.
- Chloride by SM 4500-Cl.
- Nitrate by EPA 353.2.
- Sulfate by ASTM D516-11.
- Ammonia by SM4500-NH3.
- Total Dissolved Solids by SM 2540 C.

2.3 Surface Water and Sediment

Surface water and sediment sampling will be conducted in Stream 3 as discussed in the Work Plan. Surface water sampling will also be conducted at groundwater seep locations on the western wall of the ravine east-adjacent to the Landfill.

2.3.1 Surface Water

Surface water sampling will occur at the outlet of the weir structure to be built at the toe of the northeast slope at SWS-1. One surface water sample will be collected at the location during each of the four quarterly groundwater monitoring events. The surface water samples collected will be unfiltered and will be obtained using a disposable Teflon bailer, a peristaltic pump and disposable polyethylene tubing, or a stainless steel or polyethylene cup or ladle. Field water quality parameters (temperature, pH, specific conductance, turbidity, DO, and ORP) will be measured immediately prior to sample collection using a portable multi-probe water quality meter. The surface water samples will be transferred to laboratory-supplied sample containers and placed in a cooler containing ice for delivery to the analytical laboratory.

The surface water sample collected each quarter will be analyzed for the following parameters:

- GRO by Method NWTPH-Gx.
- DRO and ORO by Method NWTPH-Dx without acid/silica gel cleanup. If DRO or ORO are detected, follow-up analysis with acid/silica gel cleanup may be performed to assess potential analytical interference by biogenic organics.
- VOCs by EPA Method 8260D.
- SVOCs with low-level PAHs by EPA Method 8270E/SIM.
- PCBs as Aroclors by EPA Method 8082A.
- Organochlorine pesticides by EPA Method 8081B.
- Chlorinated acid herbicides by EPA Method 8151A.
- Metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, and zinc) by EPA Methods 200.7/200.8/245.1/7470A.
- Leachate indicator parameters that include ammonia, total organic carbon (TOC), total dissolved solids (TDS).

Groundwater seep sampling also will be conducted during the quarterly groundwater monitoring events, at spatially representative locations on the western wall of the ravine east-adjacent to the Landfill (see Figure 8 of the Work Plan). The goal is to collect 2 samples per quarter for 4 quarters as described in the Work Plan.. The seep sampling locations will be selected in the field based on field conditions at the time of sampling (e.g., observed seep locations and flow rates)..

The groundwater seep samples will be unfiltered and will be obtained using a stainless steel or polyethylene cup or ladle. Field water quality parameters (temperature, pH, specific conductance, turbidity, DO, and ORP) will be measured immediately prior to sample collection using a portable multi-probe water quality meter. The seep samples will be transferred to laboratory-supplied sample containers and placed in a cooler containing ice for delivery to the analytical laboratory.

The groundwater seep samples will be analyzed for the following parameters:

- Metals (arsenic, iron, and manganese) by EPA Methods 200.7/200.8.
- Leachate indicator parameters that include ammonia, total organic carbon (TOC), total dissolved solids (TDS)

2.3.2 Sediment

Three sediment samples will be collected from the bottom of Stream 3 prior to construction disturbance. The sediment samples will be collected at the surface water/sediment sampling stations SED-1 through SED-3(see Work Plan Figure 8) and will be obtained from the upper 4 inches of sediment using a manual coring device, spade, or stainless steel spoon. The sediment samples will be transferred to laboratory-supplied sample containers and placed in a cooler containing ice for delivery to the analytical laboratory.

The sediment samples will be analyzed for the following parameters:

- DRO and ORO by Method NWTPH-Dx without acid/silica gel cleanup. If DRO or ORO are detected, follow-up analysis with acid/silica gel cleanup may be performed to assess potential analytical interference by biogenic organics.
- SVOCs with low-level PAHs by EPA Method 8270E/SIM.
- PCBs as Aroclors by EPA Method 8082A.
- Organochlorine pesticides by EPA Method 8081B.
- Chlorinated acid herbicides by EPA Method 8151A.
- Metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, and zinc) by EPA Methods 6010D/6020B/7471B.
- Total organic carbon by EPA Method 9060A.

Analytical testing of the sediment samples for GRO and VOCs is not proposed because sediment screening levels for these constituents have not been established (see Work Plan Table 11).

2.4 Sample Identification

The soil, groundwater, surface water, and sediment samples will be assigned unique sample identification numbers. Examples are provided below.

- Soil samples: MW5-30-31.5, where "MW5" indicates the sample was collected from monitoring well boring MW-5 and "30-31.5" indicates the sample was obtained from a depth interval of 30 to 31.5 feet bgs.
- Groundwater samples: MW5-210915, where "MW5" indicates the sample was collected from monitoring well MW-5 and "210915" (YYMMDD) indicates the sample was collected on September 15, 2021.
- Weir box surface water sample: SWS1-210916, where "SWS1" indicates a surface water sample collected at station SWS-1 and "210916" (YYMMDD) indicates the sample was collected on September 16, 2021.
- Groundwater seep samples: Seep1-210916, where "Seep1" indicates the sample was collected from Seep-1 and "210916" (YYMMDD) indicates the sample was collected on September 16, 2021.
- Sediment samples: SED1-210916, where "SED1" indicates a sediment sample collected at station SED-1 and "210916" (YYMMDD) indicates the sample was collected on September 16, 2021.

The sample identification numbers will be written on the sample containers and chain-of-custody forms. Sample locations will be recorded in field notes, boring logs, and/or field sampling forms.

2.5 Sample Handling

2.5.1 Sample Containers and Preservation

Requirements for sample containers, sample preservation, and sample holding times are provided in the QAPP contained in Appendix C of the Work Plan.

2.5.2 Sample Packaging and Delivery to Analytical Laboratory

Samples will be packaged in a cooler containing ice for delivery to the analytical laboratory. The samples will be delivered to the laboratory under chain of custody by field personnel, courier, or commercial carrier (see Section 5.2).

Upon receipt of the sample coolers at the laboratory, the condition and temperature of the samples will be recorded, and the chain-of-custody forms will be signed to document transfer of sample custody. The chain-of-custody forms will be used internally by the laboratory to track sample handling and final disposition.

3.0 SOIL FIELD SCREENING

Soil samples obtained from groundwater monitoring well borings will be field-screened for evidence of potential contamination. Soil field screening will consist of visual screening, water sheen screening, and headspace vapor screening. Field screening results will be recorded on boring logs.

3.1 Visual Screening

Soil samples will be visually inspected for the presence of staining or anomalous coloring that may be indicative of contamination.

3.2 Water Sheen Screening

Water sheen screening is a qualitative field screening method that can help identify the presence or absence of petroleum hydrocarbons in soil. A portion of the collected soil sample is placed in a pan containing distilled water and the water surface is observed for signs of hydrocarbon sheen. The results are classified as follows:

Classification	Description
No Sheen (NS)	No visible sheen on the water surface
Slight Sheen (SS)	Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly
Moderate Sheen (MS)	Moderate sheen; may have color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on the water surface; sheen does not dissipate rapidly
Heavy Sheen (HS)	Heavy sheen with strong color/iridescence; spread is rapid; entire water surface may be covered with sheen; sheen does not dissipate

3.3 Headspace Vapor Screening

Headspace vapor screening is a semi-quantitative field screening method that can help identify the presence or absence of VOCs. As soon as possible after collecting a soil sample, a portion of the sample is placed in a resealable plastic bag and ambient air is captured in the bag. The bag is sealed to form a "headspace" of trapped air above the soil and the soil is gently agitated to expose the trapped air to the soil. If the ambient air temperature is low (e.g., below 45 degrees Fahrenheit), the sealed bag may be heated to accelerate partitioning of soil vapors into the headspace. Concentrations of VOCs present in the headspace (if any) are then measured by inserting the probe of a PID through a small opening in the bag. A PID measures the concentration of organic vapors ionizable by a 10.6 electron volt lamp (standard) in parts per million (ppm) and quantifies organic vapor concentrations in the range between 0.1 and 2,000 ppm (isobutylene-equivalent) with an accuracy of 1 ppm between 0 and 100 ppm.

The PID will be calibrated to 100 ppm isobutylene. The PID calibration will be checked at the start of each day. The PID calibration also will be checked at other times throughout the day as needed if anomalous or erratic instrument response is observed and a problem with the instrument is suspected.

4.0 EQUIPMENT DECONTAMINATION

Drilling equipment (e.g., augers, casings, drill rods) will be decontaminated after use at each drilling location using a pressure washer. Reusable sampling equipment (e.g., split-spoon soil sampler, bladder pump, electronic water level indicator, surface water and sediment sampling tools) will be decontaminated after each use by washing in a solution of potable water and Alconox or Liquinox and rinsing in distilled water. Used decontamination wash water and rinse water will be contained and stored on site in marked drums pending characterization and disposal.

5.0 FIELD DOCUMENTATION

Field documentation will consist of boring logs, sample collection forms, field notes, field reports, and georeferenced photographs. Field notes will be recorded in field notebooks and/or on maps. Field reports will include dates and times, summaries of field activities, names of field personnel and site visitors, weather conditions, field measurements, and other pertinent data.

Sample data recorded on field forms will include the sample date, time, location, sample identification number, sample matrix (e.g., soil, groundwater, etc.), sample collection method, field screening results, any associated QC samples collected, and the sampler's name.

The original field records will be kept in the project file following review by the Project Manager.

5.1 Sample Labels

Sample containers will be clearly labeled with indelible ink at the time of sampling. Sample labels will include the following information:

- Project name and/or number.
- Sampling date and time.
- Sample identification number.
- Sample preservative used, if any.
- Sampler's initials.

The same information entered on the sample label will be recorded on the chain-of-custody form.

5.2 Chain of Custody

Samples will be retained in the custody of field personnel until the samples are delivered (or released for delivery) to the analytical laboratory. The samples will be maintained using chain-of-custody procedures following sample collection and labeling. These procedures document the transfer of sample custody from the field to the laboratory. Each sample sent to the laboratory for analysis will be recorded on a chain-of-custody form.

The chain-of-custody form documents the sample identification number, sample matrix, sample collection date and time, and requested analyses for each sample, as well as all transfers of sample custody from the field to the analytical laboratory. The chain-of-custody form will be completed using indelible ink. Any corrections will be made by drawing a line through the information being corrected, entering the correct information, and initialing and dating the change.

The individuals relinquishing and receiving samples will sign, date, and note the time on the chain-of-custody form when transferring custody of samples. If sample coolers are shipped by commercial carrier, the chain-of-custody form will be enclosed in a resealable plastic bag and placed in the sample cooler prior to sealing the cooler for shipping. The commercial carrier will not sign the chain-of-custody forms as a receiver; instead, the laboratory will sign as a receiver when the samples are received. Internal laboratory records will document custody of the samples from the time they are received through final disposition.

6.0 DETERMINATION OF SAMPLING LOCATIONS

A professional land surveyor will survey the locations and elevations of the following:

- Groundwater monitoring wells MW-1 through MW-10
- Actual groundwater seep sampling locations
- Actual sediment sampling locations
- Proposed features at the toe of the northeast slope following their construction including the inlet and outlet inverts of the weir box.

7.0 INVESTIGATION DERIVED WASTE MANAGEMENT

Investigation derived waste will consist of drill cuttings from the monitoring well borings, equipment decontamination wash water and rinse water, and monitoring well development water and purge water. The investigation derived waste will be contained and stored on site in labeled drums pending waste designation and will be disposed of in accordance with applicable regulations. Disposable gloves and other incidental waste such as paper towels and plastic wrappers will be disposed of in off-site trash receptacles.

8.0 QUALITY ASSURANCE AND QUALITY CONTROL REQUIREMENTS

The QAPP contained in Appendix C of the RI Work Plan discusses QA/QC requirements for the RI field sampling activities.

9.0 REFERENCES

GeoEngineers, Inc. (GeoEngineers), 2021. Remedial Investigation Work Plan, Go East Corp Landfill Site, Everett, Washington. April 16, 2021.

PACE Engineers, Inc. (PACE), 2018. Go East Landfill Closure Plan, Go East Landfill, 4330 108th Street SE, Everett, Washington, 98208. Revised January 2018 with updates including Appendices H (April 30, 2018), I (May 1, 2018), and K (June 25, 2018).

APPENDIX C

Quality Assurance Project Plan

Remedial Investigation Quality Assurance Project Plan

Go East Corp Landfill Site
Everett, Washington
Ecology Agreed Order No. DE 18121

for
Washington State Department of Ecology
on Behalf of P&GE, LLC

June 30, 2021

GeoEngineers

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LIST OF TABLES

1.0 INTRODUCTION

GeoEngineers, Inc. (GeoEngineers) has prepared this Quality Assurance Project Plan (QAPP) for the Go East Corp Landfill Site (Site) as an appendix to the *Remedial Investigation Work Plan, Go East Corp Landfill Site, Everett, Washington* (GeoEngineers 2021) (Work Plan). The purpose and scope of the remedial investigation (RI) are presented in the Work Plan. The QAPP presents the quality objectives for environmental measurement data that will be generated during the RI activities and the quality assurance/quality control (QA/QC) procedures for achieving the quality objectives. The QAPP was developed based on guidelines contained in the Washington State Model Toxics Control Act (MTCA) Cleanup Regulation (Washington Administrative Code [WAC] Chapter 173-340) and Washington State Department of Ecology (Ecology) guidance contained in Ecology Publication No. 04-03-030, *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology 2016). Ecology's guidance is generally consistent with United States Environmental Protection Agency (EPA) guidance contained in EPA Document QA/G-5, *Guidance for Quality Assurance Project Plans*, EPA Publication No. EPA/240/R-02/009 (EPA 2002).

Environmental measurements will be performed throughout the project to produce data that are scientifically valid, of known and acceptable quality, and meet established objectives. QA/QC procedures will be implemented so that the precision, accuracy, representativeness, completeness, and comparability of the data generated meet the measurement quality objectives to the maximum extent possible.

2.0 SAMPLE COLLECTION, HANDLING, AND CUSTODY

The sample collection, handling, and custody procedures are described in the Sampling and Analysis Plan (SAP) contained in Appendix B of the Work Plan. The anticipated chemical analytical laboratory to be subcontracted for this project will be OnSite Environmental, Inc. (OnSite) in Redmond, Washington.

3.0 CHEMICAL ANALYSES/METHODS

Soil, groundwater, surface water, and sediment samples will be collected during field activities as described in the SAP. The samples will be analyzed for one or more of the following constituents:

- Petroleum hydrocarbons – gasoline range organics by Method NWTPH-Gx and diesel range organics and heavy oil range organics by Method NWTPH-Dx (potentially both with and without silica gel cleanup).
- Volatile organic compounds (VOCs) by EPA Method 8260D (unpreserved soil samples will be collected and prepared in accordance with EPA Method 5035A).
- Semivolatile organic compounds (SVOCs) with low-level polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8270E/Selective Ion Monitoring (SIM).
- Polychlorinated biphenyls (PCBs) as Aroclors by EPA Method 8082A.
- Organochlorine pesticides by EPA Method 8081B.
- Chlorinated acid herbicides by EPA Method 8151A.

- Metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, and zinc) by EPA Methods 6010D/6020B/7470A/7471B/200.7/200.8/245.1.
- Total organic carbon by EPA Method 9060A.
- Alkalinity and bicarbonate by SM 2320B.
- Calcium, potassium, magnesium, and sodium by EPA 200.7/200.8.
- Chloride by SM 4500-Cl.
- Nitrate by EPA 353.2.
- Sulfate by ASTM D516-11.
- Ammonia by SM4500-NH3.
- Total Dissolved Solids by SM 2540 C.

3.1 Sample Containers, Preservation, and Holding Times

Samples subject to chemical laboratory analyses will be containerized and preserved in the field according to the guidelines summarized in Tables C-1 and C-2. Samples will be kept on ice in coolers while at the Site. The samples generally will be hand-delivered to the laboratory by the field representative or a courier service. The samples will be kept on ice in coolers until the next day in cases where hand-delivery is not possible (inclement weather, after-hours sampling, etc.). The samples will remain in a refrigerated state at the laboratory until analyzed.

Sample holding times are defined as the method-specific recommended time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. The analytical results may be biased low if a sample exceeds a recommended holding time. For example, if the extraction holding time for volatile analysis of soil samples is exceeded, then the possibility exists that some of the organic constituents may have volatilized from the sample or degraded. Results for that analysis would be qualified as estimated to indicate that the reported results may be lower than actual site conditions. Recommended holding times are presented in Tables C-1 and C-2.

4.0 MEASUREMENT QUALITY OBJECTIVES

The quality objectives for measurement data are to collect environmental sampling data of known, acceptable, and documentable quality. The specific quality objectives established for the project are as follows:

- Implement the procedures outlined herein for field sampling, sample custody, equipment operation and calibration, laboratory analysis, and data reporting to ensure consistency and thoroughness of data generated.
- Achieve the level of QA/QC required to produce scientifically valid analytical data of known and documented quality. This will be accomplished by establishing acceptance and performance criteria for analytical data precision, accuracy, representativeness, completeness, and comparability, and by evaluating project data against these criteria.

The sampling design, field procedures, laboratory procedures, and quality control (QC) procedures established for this project were developed to provide defensible data. Specific analytical data quality factors that may affect data usability include quantitative factors (analytical sensitivity, precision, accuracy, bias, and completeness) and qualitative factors such as representativeness and comparability. These data quality factors and associated acceptance and performance criteria are discussed below. Method-specific acceptance and performance criteria (QC limits) for chemical analysis of soil, sediment, groundwater, and surface water samples are presented in Tables C-3 and C-4.

4.1 Analytical Sensitivity

Analytical methods have qualitative limitations regarding the level at which an analyte can be theoretically detected with a given statistical level of confidence that are often expressed as the method detection limit (MDL). These same methods also have quantitative thresholds at which an analyte can be quantified that are typically represented by the lowest point on a 5- to 7-point calibration curve (linear, response factors, weighted, etc.) generated prior to project sample analysis. In all cases, these latter real-world measurements are always greater (typically 3 to 5 times greater) than the MDL and are often expressed as the method reporting limit (MRL).

The detected concentration is identified as an estimate (i.e., “J” flagged) when an analyte is positively identified (i.e., detected) at a concentration greater than the MDL but less than the MRL. The analytical laboratory will provide numerical results for each analyte that is positively identified and report them as detected above the MRL or detected below the MRL but above the MDL.

Intended uses of project data such as risk assessment or comparison to numerical criteria typically dictate specific laboratory target MRLs necessary to fulfill stated objectives. The project laboratory target MRLs for the project are presented in Tables C-3 and C-4. (Laboratory target MRLs are also known as practical quantitation limits.) It may be possible to achieve MRLs less than the target MRLs under ideal conditions. However, the target MRLs presented in Tables C-3 and C-4 are considered targets because several factors may influence final MRLs. First, MRLs can be affected by the moisture content of soil and sediment samples and/or other physical conditions of samples. Second, analytical procedures may require sample dilutions or other practices to accurately quantify a particular analyte at concentrations above the range of the instrument. The effect of this is that other analytes could be reported as not detected but at a laboratory-adjusted, final MRL that is higher than a specified target MRL. Data users must be aware that elevated MRLs can bias statistical data summaries, and careful interpretation is required when using data sets with MRLs that exceed targets.

4.2 Precision

The precision of analytical data is a measure of the reproducibility among duplicate measurements of an analyte in a sample and applies to duplicate samples and duplicate spiked samples (matrix spikes/matrix spike duplicates [MS/MSDs]). The closer the measured values are to each other, the more precise the measurement process. Precision error may affect data usability. Precision is expressed as the relative percent difference (RPD) of duplicate sample or duplicate spiked sample results. The RPD is calculated as:

$$RPD(\%) = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} X\ 100,$$

Where:

D_1 = Reported concentration of analyte in primary sample/aliquot.

D_2 = Reported concentration of analyte in duplicate or duplicate spiked sample/aliquot.

The RPD will be calculated for duplicate measurements and compared to the project RPD QC limits. Examples of duplicate measurements for which RPD may be calculated include laboratory duplicates, field duplicates, laboratory control samples/laboratory control sample duplicates (LCS/LCSDs), and MS/MSDs. The RPD QC limit goals for field duplicate sample pairs (50% for soil, 30% for groundwater) are only applicable if the primary and duplicate sample concentrations are greater than 5 times the MRL. For results less than 5 times the MRL, the difference between the primary and duplicate samples should be less than 2 times the MRL for soil samples and less than 1 times the MRL for groundwater samples.

4.3 Accuracy and Bias

Accuracy is a measure of bias in the analytical process. The closer the measurement value is to the true value, the greater the accuracy. Accuracy is typically evaluated by adding a known concentration (a “spike”) of a target or surrogate compound to a sample prior to analysis. The detected concentration or percent recovery (%R) of the spiked compound reported in the sample provides a quantitative measure of analytical accuracy. Since most environmental data collected represent single points spatially and temporally rather than an average, accuracy is generally more important than precision in assessing the data. In general, if %R values are low, non-detect results may be reported for analytes of interest when in fact these analytes are present in the sample (i.e., false negative results), and results for detected analytes may be biased low. The reverse is true when %R values are high. In this case, non-detect results are considered accurate, whereas detected values may be higher than true values.

For this project, accuracy will be expressed as the %R of a known surrogate spike, matrix spike, or laboratory control sample (blank spike) concentration:

$$Recovery\ (\%R) = \frac{Spiked\ Result - Unspiked\ Result}{Known\ Spike\ Concentration}\ X\ 100$$

Accuracy (%R) criteria are presented in Tables C-3 and C-4.

4.4 Completeness, Representativeness, and Comparability

Completeness establishes whether enough valid measurements were obtained to meet project objectives. The number of samples and results expected establishes the comparative basis for completeness. The completeness goal is 90 percent useable data for the samples/analyses planned. If the completeness goal is not achieved, an evaluation will be performed to determine if the data are adequate to meet study objectives. The following equation is used to calculate percent completeness:

% Completeness = Number of valid results x 100/Number of possible results

Representativeness refers to the degree to which data accurately and precisely represent actual site conditions. Representativeness of the data will be evaluated by:

- Comparing actual field sampling procedures, including QC sampling activities, to those specified in the SAP and QAPP.
- Reviewing the RPD values for field primary/duplicate sample pairs to evaluate the precision of analytical results.
- Reviewing the data and identifying data that should be qualified as estimated, qualitative in nature, or rejected as not usable.

Only representative data will be used in subsequent data reduction, validation, and reporting activities.

Comparability refers to the confidence with which one set of data can be compared to another. Although numeric goals do not exist for comparability, the following items are evaluated when assessing data comparability:

- Whether each data set contains the same defining parameters.
- Whether the units used for each data set are convertible to a common metric scale.
- Whether similar analytical and quality assurance procedures were used to generate the data contained in each data set.
- Whether the analytical instruments used for each data set have similar detection levels.
- Whether the samples in each data set were selected and collected in a similar manner.

The overall usability of data sets generated during the project will be assessed based on the evaluation of the data quality factors discussed above and other QA/QC criteria described herein.

5.0 QUALITY CONTROL SAMPLES AND PROCEDURES

QC samples will be analyzed to ensure the precision, accuracy, representativeness, comparability, and completeness of the data. Table C-5 summarizes the types and frequency of QC samples to be analyzed during the project, including field QC samples and laboratory QC samples.

5.1 Field Quality Control Samples

Field QC samples serve as a control and check mechanism to monitor the consistency of sampling methods and potential influence of off-site factors on environmental samples. Examples of potential off-site factors include airborne VOCs and potable water used in drilling activities. As shown in Table C-5, field QC samples will generally consist of field duplicates, equipment rinsate blanks, and trip blanks.

5.1.1. Field Duplicates

Field duplicates serve as measures for precision. They are created by placing aliquots of an environmental sample in separate containers and identifying one of the aliquots as the primary sample and the other as the duplicate sample. Field duplicates measure the precision and consistency of laboratory analytical procedures and methods, as well as the consistency of the sample processing techniques used by field personnel and/or the relative homogeneity of sample matrices. The duplicate sample is submitted to gain precision information on sample homogeneity, handling, shipping, storage and preparation, and analysis. Field duplicates will be analyzed for the same parameters as the associated primary samples. Field duplicates will be collected at the frequencies specified in Table C-5.

5.1.2. Equipment Rinsate Blanks

Equipment rinsate blanks will be collected when reusable sampling equipment is used. Rinsate blanks will be collected by rinsing distilled or deionized water over or through the sampling equipment immediately after the equipment has been decontaminated. The rinsate water will be captured into the appropriate analysis-specific sample containers identified in Table C-2. Equipment rinsate blanks will be collected at the frequencies specified in Table C-5.

5.1.3. Trip Blanks

Laboratory-provided trip blanks will accompany samples collected for VOC analysis during field sampling and delivery to the laboratory. Trip blanks will be analyzed at a frequency of one trip blank per cooler containing samples for VOC analysis.

5.1.4. Other Field QC Samples

According to the *National Functional Guidelines for Organic Superfund Methods Data Review* (EPA 2017a), "The purpose of laboratory (or field) blank analysis is to assess the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples…" Field blanks will be used at the discretion of the QA Leader if there is a reason to suspect contamination introduced by ambient conditions in the field. Field blanks consist of samples of distilled or deionized water poured directly into sample containers in the field. Field blanks are analyzed for the same parameters as the associated project samples.

Analytical results for QC blanks, including field blanks, will be interpreted in general accordance with EPA's *National Functional Guidelines for Organic Superfund Methods Data Review* (EPA 2017a) and *National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA 2017b) and professional judgment.

5.2 Chemical Laboratory Quality Control

The analytical laboratory will follow standard analytical method procedures that include specified QC monitoring requirements. These requirements will vary by method, but generally include:

- Method blanks.
- Internal standards.
- Instrument calibrations.
- MS/MSDs.
- LCS/LCSDs.
- Laboratory replicates or duplicates.
- Surrogate spikes.
- Initial and continuing instrument calibrations.

5.2.1. Laboratory Blanks

Laboratory procedures employ the use of several types of blanks but the most commonly used blanks for QA/QC assessments are method blanks. Method blanks are laboratory QC samples that consist of either a soil-like material that has undergone a contaminant destruction process, or a sample of reagent water. Method blanks are extracted and analyzed with each batch of environmental samples undergoing analysis. Method blanks are particularly useful during volatiles analysis since VOCs can be transported in the laboratory through the vapor phase. If a substance is found in the method blank, it indicates that one (or more) of the following occurred:

- Measurement apparatus or containers were not properly cleaned and contained contaminants.

- Reagents used in the analytical process were contaminated with a substance(s) of interest.
- Contaminated analytical equipment was not properly cleaned.
- Volatile substances in the air with high solubility or affinities for the sample matrix contaminated the samples during preparation or analysis.

If method blank contamination occurs, it can be difficult to determine which of the above scenarios caused the contamination. However, it is assumed that the conditions that affected the blanks also likely affected the project samples. Validation guidelines assist in determining which substances detected in associated project samples are likely present in the samples and which substances are likely attributable to the analytical process.

5.2.2. Matrix Spikes/Matrix Spike Duplicates

MS/MSDs are used to assess influences or interferences caused by the physical or chemical properties of the sample itself. For example, extreme pH can affect the results of SVOC analyses. Additionally, the presence of a particular analyte in a sample may interfere with accurate quantitation of another analyte. MS/MSD data are reviewed in combination with other QC monitoring data to evaluate matrix effects. In some cases, matrix effects cannot be determined due to dilution and/or high levels of related substances in the sample.

An MS is created by spiking a known amount of one or more of the target analytes into a project sample, ideally at a concentration at least 5 to 10 times greater than the concentration in the unspiked sample. The %R is calculated by subtracting the unspiked sample result from the spiked sample result, dividing by the spike amount, and multiplying by 100.

The samples designated for MS/MSD analysis should be obtained from a sampling location that is suspected to not be highly contaminated. A sample from an area of low-level contamination is needed because the objective of MS/MSD analyses is to assess possible matrix interferences, which can best be achieved with low levels of contaminants. Additional sample volume generally will be collected for MS/MSD analysis for approximately every 20 primary samples collected for this project.

5.2.3. Laboratory Control Spikes/Laboratory Control Spike Duplicates

LCS/LCSDs (also known as blank spikes) are similar to MS/MSD samples in that a known amount of one or more of the target analytes is spiked into a prepared medium and the %R is calculated for the spiked substance(s). The primary difference between an MS and LCS is that the LCS spike medium is considered “clean” or contaminant-free. For example, reagent water is typically used for LCS water analyses. The purpose of an LCS is to help assess the overall accuracy and precision of the analytical process including sample preparation, instrument performance, and analyst performance. LCS data must be reviewed in context with other laboratory QC data to determine if corrective action is necessary for laboratory control limit exceedances.

5.2.4. Laboratory Duplicates

Laboratories often use MS/MSDs, LCS/LCSDs, and/or laboratory duplicates to assess precision. Laboratory duplicates are a second analysis of a field-collected environmental sample to assess internal laboratory precision.

5.2.5. Surrogate Spikes

Surrogate spikes are used to verify the accuracy of the analytical instrument and extraction procedures used for organic analysis methods. Surrogates are substances similar to the target analytes. A known concentration of surrogate is added to each project sample and passed through the instrument, noting the surrogate recovery. Each surrogate used has an acceptable range of %R. If a surrogate recovery is low, sample results may be biased low, and depending on the %R, a possibility of false negatives may exist. Conversely, a possibility of false positives exists when surrogate recoveries are biased high although non-detected results are considered accurate.

5.3 Calibration Procedures

5.3.1. Field Instrumentation

Field instrument calibration and calibration checks facilitate accurate and reliable field measurements. The calibration of the instruments will be checked and adjusted as necessary in general accordance with manufacturers' recommendations. Methods and frequency of calibration checks and instrument maintenance will be based on the type of instrument, stability characteristics, required accuracy, intended use, and environmental conditions.

5.3.2. Laboratory Instrumentation

The laboratory will be responsible for developing and implementing instrument calibration procedures. Several types of instrument calibrations are used, depending on the method, to determine whether the methodology is 'in control' by verifying the linearity of the calibration curve and to assure that the sample results reflect accurate and precise measurements. This is done by verifying that the relative standard deviations (%RSD), the percent difference (%D), or the correlation coefficients are within the control limits specified in the validation documents. The main calibrations used are initial calibrations and continuing calibrations.

Calibration procedures and their appropriate chemical standards for chemical analytical testing are to comply with the specific methods in EPA SW-846, *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, 3rd Edition*, December 1996 and the laboratory's Standard Operating Procedures. Calibration documentation will be retained at the laboratory for a minimum of 6 months.

6.0 LABORATORY DATA REPORTING AND DELIVERABLES

Laboratories will report data in formatted hardcopy and electronic form to the Project Manager and QA Leader. The laboratory will prepare electronic deliverables for data packages upon completion of analyses in accordance with project requirements. The laboratory will generally provide electronic data deliverable (EDD) files within 5 business days after delivering Portable Data Format (PDF) analytical results, including the appropriate QC documentation. Analytical laboratory measurements will be recorded in standard formats that display, at a minimum, the client/field sample identification, the laboratory sample identification, reporting units, analytical methods, analytes tested, analytical results, extraction and analysis dates, quantitation limits, and data qualifiers. Each sample delivery group will be accompanied by sample receipt forms and a case narrative identifying data quality issues.

GeoEngineers will establish EDD requirements with the analytical laboratories as part of subcontracting.

7.0 DATA REDUCTION AND ASSESSMENT PROCEDURES

This section describes data reduction and assessment procedures for field and laboratory analytical data.

7.1 Data Reduction

Data reduction involves the conversion or transcription of field and analytical data to a useable format. The laboratory personnel will reduce the analytical data for review by the QA Leader. This will involve generating both PDF forms and EDDs. The QA Leader will review both data formats to verify that the data are consistent between formats.

7.2 Review of Field Documentation and Laboratory Receipt Information

Documentation of field sampling data will be reviewed periodically for conformance with project QC requirements described in this QAPP. Field documentation will be checked for proper documentation of the following:

- Sample collection information (date, time, location, matrices, etc.).
- Field instruments used and calibration check data.
- Sample collection procedures.
- Sample containers, preservation, and volume.
- Field QC samples collected at the specified frequency.
- Chain-of-custody procedures.
- Sample delivery information.

Sample receipt forms provided by the laboratory will be reviewed for QC exceptions. The final laboratory data packages will describe (in the case narrative) the effects that any identified QC exceptions have on data quality. The laboratory will review transcribed sample collection and receipt information for correctness prior to delivering the final data packages.

7.3 Chemical Data Validation

Project decisions, conclusions, and recommendations will be based on validated data. The purpose of data validation is to ensure that data used for evaluations and calculations are scientifically valid, of known and documented quality, and defensible. Laboratory data validation will be used to identify data that should be rejected based on QA/QC deficiencies.

The QA Leader will validate data collected during the project to ensure that the data are valid and usable for their intended purpose. Data will be validated in general conformance with EPA functional guidelines for data validation (EPA 2017a, 2017b). At a minimum, the following items will be reviewed to validate the data as applicable:

- Documentation that a final review of the data was completed by the Laboratory QA Coordinator.
- Documentation of analytical and QC methodology.
- Documentation of sample preservation and transport.
- Sample receipt forms and case narratives.

- The following QC parameters:
    - Holding times and sample preservation.
    - Method blanks.
    - MS/MSDs.
    - LCS/LCSDs.
    - Surrogate spikes.
    - Duplicates.
    - Initial Calibrations.
    - Continuing Calibrations.
    - Internal Standards.

The accuracy and precision achieved will be compared to the laboratory's analytical QC limits. QC limits are presented in Tables C-3 and C-4. Additional specifications and professional judgment by the QA Leader may be incorporated when appropriate data from specific matrices and project samples are not available.

A data validation memorandum will be prepared to document the overall quality of the validated data relative to the measurement quality objectives. The data validation memorandum will include the following components:

- **Data Validation Summary.** Summarizes the data validation results for all sample delivery groups by analytical method. The summary identifies any systematic problems, data generation trends, general conditions of the data, and reasons for any data qualification.
- **QC Sample Evaluation.** Evaluates the results of QC sample analyses, and presents conclusions based on these results regarding the validity of the project data.
- **Assessment of measurement quality objectives.** An assessment of the quality of data measured and generated in terms of accuracy, precision, and completeness relative to objectives established for the project.
- **Summary of Data Usability.** Summarizes the usability of data based on the results of the data validation process.

The data validation will help to achieve an acceptable level of confidence in the decisions that are to be made based upon the project data.

The project analytical data will be submitted to Ecology's Environmental Information Management system after the data validation is completed.

8.0 REFERENCES

GeoEngineers, Inc. (GeoEngineers), 2021. Remedial Investigation Work Plan, Go East Corp Landfill Site, Everett, Washington. April 16, 2021.

United States Environmental Protection Agency (EPA), 2002. Document QA/G-5, Guidance for Quality Assurance Project Plans, EPA/240/R-02/009. December 2002.

EPA, 2017a. National Functional Guidelines for Organic Superfund Methods Data Review, EPA-540-R-2017-002. January 2017.

EPA, 2017b. National Functional Guidelines for Inorganic Superfund Methods Data Review, EPA-540-R-2017-001. January 2017.

Washington State Department of Ecology (Ecology), 2016. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies, Publication No. 04-03-030. July 2004, revised December 2016.

Table C-1

Soil and Sediment Analytical Methods, Sample Containers, Preservation, and Holding Times

Go East Corp Landfill Site

Everett, Washington

Analysis	Method	Type/Number of Sample Containers	Sample Preservation	Recommended Sample Holding Times[1]
Volatile Organic Compounds (VOCs) (soil only)	EPA 5035A/8260D	4 oz clear glass widemouth jar (1)	Cool to ≤6°C	Samples without chemical preservative to be delivered to laboratory within 48 hours of collection; 14 days to analysis
Gasoline Range Organics (GRO) (soil only)	NWTPH-Gx	4 oz clear glass widemouth jar (1)	Cool to ≤6°C	Samples without chemical preservative to be delivered to laboratory within 48 hours of collection; 14 days to analysis
Diesel & Heavy Oil Range Organics (DRO and ORO)	NWTPH-Dx	4 oz clear glass widemouth jar (1)	Cool to ≤6°C	14 days to laboratory extraction; 40 days to analysis after extraction
Semivolatile Organic Compounds (SVOCs)	EPA 8270E/Selective Ion Monitoring	4 oz clear glass widemouth jar (1)	Cool to ≤6°C	14 days to laboratory extraction; 40 days to analysis after extraction
Polychlorinated Biphenyls as Aroclors (PCBs)	EPA 8082A	4 oz clear glass widemouth jar (1)	Cool to ≤6°C	None
Organochlorine Pesticides	EPA 8081B	4 oz clear glass widemouth jar (1)	Cool to ≤6°C	14 days to laboratory extraction; 40 days to analysis after extraction
Chlorinated Acid Herbicides	EPA 8151A	4 oz clear glass widemouth jar (1)	Cool to ≤6°C	14 days to laboratory extraction; 40 days to analysis after extraction
Mercury	EPA 7471B	4 oz clear glass widemouth jar (1)	Cool to ≤6°C	28 days to analysis (Typically digestion & analysis occur on the same day)
Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Nickel, Selenium, and Zinc	EPA 6010D/6020B	4 oz clear glass widemouth jar (1)	Cool to ≤6°C	6 months to analysis (Typically digestion & analysis occur on the same day)
Total Organic Carbon (sediment only)	EPA 9060A	4 oz clear glass widemouth jar (1)	Cool to ≤6°C	28 days to analysis

Notes:

[1] Recommended holding times are based on elapsed time from date of sample collection unless otherwise noted.

°C = Degrees Celsius

oz = Ounce

Table C-2

Groundwater and Surface Water Analytical Methods, Sample Containers, Preservation, and Holding Times

Go East Corp Landfill Site
Everett, Washington

Analysis	Method	Type/Number of Sample Containers	Sample Preservation	Recommended Sample Holding Times[1]
Volatile Organic Compounds (VOCs)	EPA 8260D	40 mL glass VOA vial (3)	HCl pH <2, cool to ≤6°C	14 days to analysis
Gasoline Range Organics (GRO)	NWTPH-Gx	40 mL glass VOA vial (3)	HCl pH <2, cool to ≤6°C	14 days to analysis
Diesel & Heavy Oil Range Organics (DRO and ORO)	NWTPH-Dx	500 mL amber glass bottle (2)	HCl pH <2, cool to ≤6°C	14 days to laboratory extraction; 40 days to analysis after extraction
Semivolatile Organic Compounds (SVOCs)	EPA 8270E/Selective Ion Monitoring	1 L amber glass bottle (2)	Cool to ≤6°C	7 days to laboratory extraction; 40 days to analysis after extraction
Polychlorinated Biphenyls as Aroclors (PCBs)	EPA 8082A	1 L amber glass bottle (2)	Cool to ≤6°C	None
Organochlorine Pesticides	EPA 8081B	1 L amber glass bottle (2)	Cool to ≤6°C	7 days to laboratory extraction; 40 days to analysis after extraction
Chlorinated Acid Herbicides	EPA 8151A	1 L amber glass bottle (2)	Cool to ≤6°C	7 days to laboratory extraction; 40 days to analysis after extraction
Total and Dissolved Mercury	EPA 245.1/7470A	500 mL HDPE bottle (1)	HNO3 pH <2, cool to ≤6°C	28 days to analysis
Total and Dissolved Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Nickel, Selenium, Zinc, Calcium, Magnesium, Potassium, Sodium	EPA 200.7/200.8	500 mL HDPE bottle (1)	HNO3 pH <2, cool to ≤6°C	6 months to analysis
Alkalinity, Bicarbonate, Chloride, Nitrate, Sulfate, Total Dissolved Solids	SM 2320B, SM 4500-Cl, EPA 353.2, ASTM D516-11, SM 2540C	500 mL HDPE bottle (2)	Cool to ≤6°C	Alkalinity and Bicarbonate - 14 days to analysis Chloride and Sulfate - 28 days to analysis Nitrate - 48 hours to analysis Total Dissolved Solids - 7 days to analysis
Ammonia	SM 4500-NH3	250 mL HDPE bottle (1)	H2SO4 pH <2, cool to ≤6°C	28 days to analysis
Total Organic Carbon	SM 5310B	250 mL HDPE bottle (1)	HCl pH <2, cool to ≤6°C	28 days to analysis

Notes:

[1] Recommended holding times are based on elapsed time from date of sample collection unless otherwise noted.

°C = Degrees Celsius

HCl = Hydrochloric acid

HDPE = High-density polyethylene

HNO3 = Nitric acid

L = Liter

mL = Milliliter

VOA = Volatile organics analysis

Table C-3

Laboratory Target Method Reporting Limits and Quality Control Limits for Soil and Sediment Samples

Go East Corp Landfill Site

Everett, Washington

Analyte	Laboratory Target Method Reporting Limit (PQL)*	Quality Control Limits	
		RPD**	%R
Volatile Organic Compounds (VOCs) - EPA Method 8260D (µg/kg)			
1,1,1,2-Tetrachloroethane	1.0	NA	NA
1,1,1-Trichloroethane	1.0	NA	NA
1,1,2,2-Tetrachloroethane	1.0	NA	NA
1,1,2-Trichloroethane	1.0	NA	NA
1,1-Dichloroethane	1.0	NA	NA
1,1-Dichloroethene	1.0	17 (LCS); 25 (MS)	65-130 (LCS)
1,1-Dichloropropene	1.0	NA	NA
1,2,3-Trichlorobenzene	1.0	NA	NA
1,2,3-Trichloropropane	1.0	NA	NA
1,2,4-Trichlorobenzene	1.0	NA	NA
1,2,4-Trimethylbenzene	1.0	NA	NA
1,2-Dibromo-3-chloropropane	5.0	NA	NA
1,2-Dichlorobenzene	1.0	NA	NA
1,2-Dichloroethane	1.0	NA	NA
1,2-Dichloropropane	1.0	NA	NA
1,3,5-Trimethylbenzene	1.0	NA	NA
1,3-Dichloropropane	1.0	NA	NA
2,2-Dichloropropane	1.0	NA	NA
2-Butanone (Methyl ethyl ketone [MEK])	5.0	NA	NA
2-Chloroethyl Vinyl Ether	5.0	NA	NA
2-Chlorotoluene	1.0	NA	NA
2-Hexanone	5.0	NA	NA
4-Chlorotoluene	1.0	NA	NA
4-Isopropyltoluene (p-Isopropyltoluene)	1.0	NA	NA
Acetone	5.0	NA	NA
Benzene	1.0	16 (LCS); 28 (MS)	65-121 (LCS)
Bromobenzene	1.0	NA	NA
Bromochloromethane	1.0	NA	NA
Bromodichloromethane (Dichlorobromomethane)	1.0	NA	NA
Bromoform	5.0	NA	NA
Bromomethane	1.0	NA	NA
Carbon Disulfide	1.0	NA	NA
Carbon Tetrachloride	1.0	NA	NA
Chlorobenzene	1.0	15 (LCS); 31 (MS)	72-123 (LCS)
Chloroethane	5.0	NA	NA
Chloroform	1.0	NA	NA
Chloromethane	5.0	NA	NA
cis-1,2-Dichloroethene	1.0	NA	NA
cis-1,3-Dichloropropene	1.0	NA	NA
Dibromochloromethane	1.0	NA	NA

Analyte	Laboratory Target Method Reporting Limit (PQL)*	Quality Control Limits	
		RPD**	%R
Dibromomethane	1.0	NA	NA
Dichlorodifluoromethane (CFC-12)	1.0	NA	NA
Ethylbenzene	1.0	NA	NA
Ethylene dibromide (EDB) (1,2-Dibromoethane)	1.0	NA	NA
Isopropylbenzene	1.0	NA	NA
m,p-Xylene	2.0	NA	NA
Methyl Iodide (Iodomethane)	5.0	NA	NA
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	5.0	NA	NA
Methyl tert-Butyl Ether	1.0	NA	NA
Methylene Chloride	5.0	NA	NA
n-Butylbenzene	1.0	NA	NA
n-Propylbenzene	1.0	NA	NA
o-Xylene	1.0	NA	NA
sec-Butylbenzene	1.0	NA	NA
Styrene	1.0	NA	NA
tert-Butylbenzene	1.0	NA	NA
Tetrachloroethene	1.0	NA	NA
Toluene	5.0	16 (LCS); 26 (MS)	71-121 (LCS)
trans-1,2-Dichloroethene	1.0	NA	NA
trans-1,3-Dichloropropene	1.0	NA	NA
trans-1,4-Dichloro-2-butene	NA	NA	NA
Trichloroethene	1.0	16 (LCS); 24 (MS)	74-126 (LCS)
Trichlorofluoromethane	1.0	NA	NA
Vinyl Acetate	5.0	NA	NA
Vinyl Chloride	1.0	NA	NA
Go East Corp Landfill Site			
Gasoline Range Organics (GRO)	5.0	30	NA
Diesel Range Organics (DRO)	25	30	59-129 (LCS)
Heavy Oil Range Organics (ORO)	50	30	59-129 (LCS)
Semivolatile Organic Compounds (SVOCs) - EPA Method 8270E/Selective Ion Monitoring (µg/kg)			
(3+4)-Methylphenol (m,p-Cresol)	33	NA	NA
1,2,4-Trichlorobenzene	33	32 (LCS); 38 (MS)	42 - 111 (LCS) 34 - 115 (MS)
1,2-Dichlorobenzene	33	NA	NA
1,2-Dinitrobenzene	33	NA	NA
1,2-Diphenylhydrazine	33	NA	NA
1,3-Dichlorobenzene (m-Dichlorobenzene)	33	NA	NA
1,3-Dinitrobenzene	33	NA	NA
1,4-Dichlorobenzene (p-Dichlorobenzene)	33	32 (LCS); 35 (MS)	41- 105 (LCS) 24-116 (MS)
1,4-Dinitrobenzene	33	NA	NA
1,4-Dioxane	6.7	NA	NA
1-Methylnaphthalene	6.7	NA	NA
2,3,4,6-Tetrachlorophenol	33	NA	NA
2,3,5,6-Tetrachlorophenol	33	NA	NA
2,4,5-Trichlorophenol	33	NA	NA
2,4,6-Trichlorophenol	33	NA	NA
2,4-Dichlorophenol	33	NA	NA

Analyte	Laboratory Target Method Reporting Limit (PQL)*	Quality Control Limits	
		RPD**	%R
2,4-Dimethylphenol	33	NA	NA
2,4-Dinitrophenol	170	NA	NA
2,4-Dinitrotoluene	33	22 (LCS); 30 (MS)	57 - 107 (LCS) 32 - 114 (MS)
2,6-Dinitrotoluene	33	NA	NA
2-Chloronaphthalene	33	NA	NA
2-Chlorophenol	33	31 (LCS); 39 (MS)	45 - 108 (LCS) 30-113 (MS)
2-Methylnaphthalene	6.7	NA	NA
2-Methylphenol (o-Cresol)	33	NA	NA
2-Nitroaniline	33	NA	NA
2-Nitrophenol	33	NA	NA
3,3'-Dichlorobenzidine	170	NA	NA
3-Nitroaniline	33	NA	NA
4,6-Dinitro-2-methylphenol	170	NA	NA
4-Bromophenyl-phenylether	33	NA	NA
4-Chloro-3-methylphenol	33	25 (LCS); 26 (MS)	61 - 108 (LCS) 41 - 117 (MS)
4-Chloroaniline	170	NA	NA
4-Chlorophenyl-phenylether	33	NA	NA
4-Nitroaniline	33	NA	NA
4-Nitrophenol	33	24 (LCS); 32 (MS)	53 - 122 (LCS) 30 - 127 (MS)
Acenaphthene	6.7	23 (LCS); 21 (MS)	54 - 102 (LCS) 41 - 111 (MS)
Acenaphthylene	6.7	NA	NA
Aniline	170	NA	NA
Anthracene	6.7	NA	NA
Benzo(g,h,i)perylene	6.7	NA	NA
Benzoic acid	170	NA	NA
Benzyl alcohol	170	NA	NA
bis(2-Chloroethoxy)methane	33	NA	NA
bis(2-Chloroethyl)ether	33	NA	NA
bis(2-Ethylhexyl)phthalate	170	NA	NA
Butylbenzylphthalate	170	NA	NA
Carbazole	33	NA	NA
Dibenzofuran	33	NA	NA
Dibutylphthalate	170	NA	NA
Diethylphthalate	170	NA	NA
Dimethylphthalate	33	NA	NA
Di-n-butylphthalate	33	NA	NA
Di-n-octylphthalate	170	NA	NA
Fluoranthene	6.7	NA	NA
Fluorene	6.7	NA	NA
Hexachlorobenzene	33	NA	NA
Hexachlorobutadiene	33	NA	NA
Hexachlorocyclopentadiene	33	NA	NA
Hexachloroethane	33	NA	NA

Analyte	Laboratory Target Method Reporting Limit (PQL)*	Quality Control Limits	
		RPD**	%R
Isophorone	33	NA	NA
Naphthalene	6.7	NA	NA
Nitrobenzene	33	NA	NA
n-Nitrosodimethylamine	33	NA	NA
n-Nitroso-di-n-propylamine	33	28 (LCS); 34 (MS)	47 - 103 (LCS) 34-112 (MS)
n-Nitrosodiphenylamine	33	NA	NA
Pentachlorophenol	170	23 (LCS); 37 (MS)	44 - 132 (LCS) 36 - 147 (MS)
Phenanthrene	6.7	NA	NA
Phenol	33	30 (LCS); 37 (MS)	47 - 104 (LCS) 30-108 (MS)
Pyrene	6.7	21 (LCS); 33 (MS)	58 - 111 (LCS) 33 - 127 (MS)
Pyridine	330	NA	NA
Benzo(a)anthracene	6.7	NA	NA
Benzo(a)pyrene	6.7	NA	NA
Benzo(b)fluoranthene	6.7	NA	NA
Benzo(j,k)fluoranthene	6.7	NA	NA
Chrysene	6.7	NA	NA
Dibenz(a,h)anthracene	6.7	NA	NA
Indeno(1,2,3-cd)pyrene	6.7	NA	NA
Polychlorinated Biphenyls as Aroclors (PCBs) - EPA Method 8082A (µg/kg)			
Aroclor 1016	50	NA	NA
Aroclor 1221	50	NA	NA
Aroclor 1232	50	NA	NA
Aroclor 1242	50	NA	NA
Aroclor 1248	50	NA	NA
Aroclor 1254	50	NA	NA
Aroclor 1260	50	18 (LCS); 15 (MS)	50-134 (LCS)
Aroclor 1262	50	NA	NA
Aroclor 1268	50	NA	NA
Total Aroclors	50	NA	NA
Organochlorine Pesticides - EPA Method 8081B (µg/kg)			
4,4'-DDD	10	15 (LCS); 21 (MS)	50 - 120 (LCS)
4,4'-DDE	10	15 (LCS); 22 (MS)	57-119 (LCS)
4,4'-DDT	10	15 (LCS); 32 (MS)	47-128 (LCS)
Aldrin	5.0	15 (LCS); 22 (MS)	55-110 (LCS)
alpha-BHC	5.0	15 (LCS); 21 (MS)	48-117 (LCS)
beta-BHC	5.0	15 (LCS); 21 (MS)	48-116 (LCS)
cis-Chlordane (alpha-Chlordane)	10	15 (LCS); 23 (MS)	53-110 (LCS)
delta-BHC	5.0	15 (LCS); 23 (MS)	40-118 (LCS)
Dieldrin	10	15 (LCS); 23 (MS)	53-110 (LCS)
Endosulfan I	5.0	15 (LCS); 25 (MS)	49-114 (LCS)
Endosulfan II	10	15 (LCS); 22 (MS)	50-110 (LCS)
Endosulfan sulfate	10	15 (LCS); 21 (MS)	50-110 (LCS)
Endrin	5.0	15 (LCS); 28 (MS)	51-114 (LCS)
Endrin aldehyde	10	15 (LCS); 22 (MS)	42-110 (LCS)

Analyte	Laboratory Target Method Reporting Limit (PQL)*	Quality Control Limits	
		RPD**	%R
Endrin ketone	10	15 (LCS); 22 (MS)	47-114 (LCS)
gamma-BHC (Lindane)	5.0	15 (LCS); 21 (MS)	48-118 (LCS)
Heptachlor	5.0	15 (LCS); 24 (MS)	40-114 (LCS)
Heptachlor epoxide	5.0	15 (LCS); 22 (MS)	49 - 110 (LCS)
Methoxychlor	10	15 (LCS); 22 (MS)	46-124 (LCS)
Toxaphene	50	NA	NA
trans-Chlordane (beta- or gamma-Chlordane)	5.0	15 (LCS); 23 (MS)	54 - 110 (LCS)
Chlorinated Acid Herbicides - EPA Method 8151A (µg/kg)			
2,4,5-T	9.5	19 (LCS); 24 (MS)	24-144 (LCS)
2,4,5-TP (Silvex)	9.5	18 (LCS); 23 (MS)	38-127 (LCS)
2,4-D	9.4	24 (LCS); 29 (MS)	10-131 (LCS)
2,4-DB	9.5	22 (LCS); 28 (MS)	17-154 (LCS)
Dalapon	180	37 (LCS); 30 (MS)	10 - 105 (LCS)
Dicamba	9.4	20 (LCS); 23 (MS)	32-106 (LCS)
Dichlorprop	71	20 (LCS); 27 (MS)	19-123 (LCS)
Dinoseb	9.5	32 (LCS); 23 (MS)	10-124 (LCS)
MCPA	2,300	25 (LCS); 35 (MS)	17-128 (LCS)
MCPP	940	23 (LCS); 32 (MS)	19-143 (LCS)
Pentachlorophenol	4.8	21 (LCS); 30 (MS)	10-119 (LCS)
Metals - EPA Methods 6010D/6020B/7471B (mg/kg)			
Arsenic	10	20	80-120 (LCS)
Cadmium	0.50	20	80-120 (LCS)
Chromium	0.50	20	80-120 (LCS)
Copper	1.0	20	80-120 (LCS)
Iron	25	20	80-120 (LCS)
Lead	5.0	20	80-120 (LCS)
Manganese	0.50	20	80-120 (LCS)
Mercury	0.025	20	80-120 (LCS)
Nickel	2.5	20	80-120 (LCS)
Selenium	0.80	20	80-120 (LCS)
Zinc	2.5	20	80-120 (LCS)

Notes:

kg = Kilogram

LCS = Laboratory control sample

MS = Matrix spike

µg = Microgram

mg = Milligram

NA = Not applicable

%R = Percent recovery

PQL = Practical quantitation limit

RPD = Relative percent difference

*Listed values are for analytical results reported on a wet-weight basis. Method reporting limits for project samples may vary depending on the moisture content and matrix characteristics of the samples.

**Listed RPD limits are for LCS/MS duplicates or laboratory duplicates; RPD goal for soil field duplicates is 50%.

Table C-4

Laboratory Target Method Reporting Limits and Quality Control Limits for Groundwater and Surface Water Samples

Go East Corp Landfill Site

Everett, Washington

Analyte	Laboratory Target Method Reporting Limit (PQL)*	Quality Control Limits	
		RPD**	%R
Volatile Organic Compounds (VOCs) - EPA Method 8260D (µg/L)			
1,1,1,2-Tetrachloroethane	0.20	NA	NA
1,1,1-Trichloroethane	0.20	NA	NA
1,1,2,2-Tetrachloroethane	0.20	NA	NA
1,1,2-Trichloroethane	0.20	NA	NA
1,1-Dichloroethane	0.20	NA	NA
1,1-Dichloroethene	0.20	19 (LCS); 15 (MS)	65-126 (LCS) 68-122 (MS)
1,1-Dichloropropene	0.20	NA	NA
1,2,3-Trichlorobenzene	0.20	NA	NA
1,2,3-Trichloropropane	0.20	NA	NA
1,2,4-Trichlorobenzene	0.20	NA	NA
1,2,4-Trimethylbenzene	0.20	NA	NA
1,2-Dibromo-3-chloropropane	1.0	NA	NA
1,2-Dichlorobenzene	0.20	NA	NA
1,2-Dichloroethane	0.20	NA	NA
1,2-Dichloropropane	0.20	NA	NA
1,3,5-Trimethylbenzene	0.20	NA	NA
1,3-Dichloropropane	0.20	NA	NA
2,2-Dichloropropane	0.20	NA	NA
2-Butanone (Methyl ethyl ketone [MEK])	5.0	NA	NA
2-Chloroethyl Vinyl Ether	1.0	NA	NA
2-Chlorotoluene	0.20	NA	NA
2-Hexanone	2.0	NA	NA
4-Chlorotoluene	0.20	NA	NA
4-Isopropyltoluene (p-Isopropyltoluene)	0.20	NA	NA
Acetone	5.0	NA	NA
Benzene	0.20	16 (LCS); 16 (MS)	71-119 (LCS) 70-121 (MS)
Bromobenzene	0.20	NA	NA
Bromochloromethane	0.20	NA	NA
Bromodichloromethane (Dichlorobromomethane)	0.20	NA	NA
Bromoform	1.0	NA	NA
Bromomethane	0.20	NA	NA
Carbon Disulfide	0.20	NA	NA
Carbon Tetrachloride	0.20	NA	NA
Chlorobenzene	0.20	17 (LCS); 16 (MS)	80-120 (LCS) 80-120 (MS)
Chloroethane	0.20	NA	NA
Chloroform	0.20	NA	NA
Chloromethane	1.0	NA	NA
cis-1,2-Dichloroethene	0.20	NA	NA
cis-1,3-Dichloropropene	0.20	NA	NA

Analyte	Laboratory Target Method Reporting Limit (PQL)*	Quality Control Limits	
		RPD**	%R
Dibromochloromethane	0.20	NA	NA
Dibromomethane	0.20	NA	NA
Dichlorodifluoromethane (CFC-12)	0.20	NA	NA
Ethylbenzene	0.20	NA	NA
Ethylene dibromide (EDB) (1,2-Dibromoethane)	0.20	NA	NA
Isopropylbenzene	0.20	NA	NA
m,p-Xylene	0.40	NA	NA
Methyl Iodide (Iodomethane)	1.0	NA	NA
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	2.0	NA	NA
Methyl tert-Butyl Ether	0.50	NA	NA
Methylene Chloride	1.0	NA	NA
n-Butylbenzene	0.20	NA	NA
n-Propylbenzene	0.20	NA	NA
o-Xylene	0.20	NA	NA
sec-Butylbenzene	0.20	NA	NA
Styrene	0.20	NA	NA
tert-Butylbenzene	0.20	NA	NA
Tetrachloroethene	0.20	NA	NA
Toluene	1.0	18 (LCS); 19 (MS)	77-119 (LCS) 78-117 (MS)
trans-1,2-Dichloroethene	0.20	NA	NA
trans-1,3-Dichloropropene	0.20	NA	NA
trans-1,4-Dichloro-2-butene	0.50	NA	NA
Trichloroethene	0.20	18 (LCS); 17 (MS)	82-123 (LCS) 80-121 (MS)
Trichlorofluoromethane	0.20	NA	NA
Vinyl Acetate	1.0	NA	NA
Vinyl Chloride	0.20	NA	NA
Total Petroleum Hydrocarbons - Methods NWTPH-Gx/NWTPH-Dx (µg/L)			
Gasoline Range Organics (GRO)	100	30	NA
Diesel Range Organics (DRO)	200	30	57-129 (LCS)
Heavy Oil Range Organics (ORO)	200	30	NA
Semivolatile Organic Compounds (SVOCs) - EPA Method 8270E/Selective Ion Monitoring (µg/L)			
(3+4)-Methylphenol (m,p-Cresol)	2.0	NA	NA
1,2,4-Trichlorobenzene	1.0	25 (LCS); 34 (MS)	37-95 (LCS) 34-105 (MS)
1,2-Dichlorobenzene	1.0	NA	NA
1,2-Dinitrobenzene	1.0	NA	NA
1,2-Diphenylhydrazine	1.0	NA	NA
1,3-Dichlorobenzene (m-Dichlorobenzene)	1.0	NA	NA
1,3-Dinitrobenzene	1.0	NA	NA
1,4-Dichlorobenzene (p-Dichlorobenzene)	1.0	29 (LCS); 36 (MS)	30-88 (LCS) 24-100 (MS)
1,4-Dinitrobenzene	1.0	NA	NA
1,4-Dioxane	0.10	NA	NA
1-Methylnaphthalene	0.10	NA	NA
2,3,4,6-Tetrachlorophenol	1.0	NA	NA
2,3,5,6-Tetrachlorophenol	1.0	NA	NA
2,4,5-Trichlorophenol	1.0	NA	NA
2,4,6-Trichlorophenol	1.0	NA	NA

Analyte	Laboratory Target Method Reporting Limit (PQL)*	Quality Control Limits	
		RPD**	%R
2,4-Dichlorophenol	1.0	NA	NA
2,4-Dimethylphenol	1.0	NA	NA
2,4-Dinitrophenol	5.0	NA	NA
2,4-Dinitrotoluene	1.0	17 (LCS); 18 (MS)	52-103 (LCS) 45-106 (MS)
2,6-Dinitrotoluene	1.0	NA	NA
2-Chloronaphthalene	1.0	NA	NA
2-Chlorophenol	1.0	29 (LCS); 32 (MS)	38-92 (LCS) 24-105 (MS)
2-Methylnaphthalene	0.10	NA	NA
2-Methylphenol (o-Cresol)	1.0	NA	NA
2-Nitroaniline	1.0	NA	NA
2-Nitrophenol	1.0	NA	NA
3,3'-Dichlorobenzidine	1.0	NA	NA
3-Nitroaniline	1.0	NA	NA
4,6-Dinitro-2-methylphenol	5.0	NA	NA
4-Bromophenyl-phenylether	1.0	NA	NA
4-Chloro-3-methylphenol	1.0	17 (LCS); 15 (MS)	57-101 (LCS) 44-113 (MS)
4-Chloroaniline	1.0	NA	NA
4-Chlorophenyl-phenylether	1.0	NA	NA
4-Nitroaniline	1.0	NA	NA
4-Nitrophenol	5.0	34 (LCS); 37 (MS)	23-64 (LCS) 20-120 (MS)
Acenaphthene	0.10	18 (LCS); 19 (MS)	51-97 (LCS) 47-106 (MS)
Acenaphthylene	0.10	NA	NA
Aniline	5.0	NA	NA
Anthracene	0.10	NA	NA
Benzo(g,h,i)perylene	0.010	NA	NA
Benzoic acid	20	NA	NA
Benzyl alcohol	1.0	NA	NA
bis(2-Chloroethoxy)methane	1.0	NA	NA
bis(2-Chloroethyl)ether	1.0	NA	NA
bis(2-Ethylhexyl)phthalate	1.0	NA	NA
Butylbenzylphthalate	1.0	NA	NA
Carbazole	1.0	NA	NA
Dibenzofuran	0.010	NA	NA
Dibutylphthalate	5.0	NA	NA
Diethylphthalate	1.0	NA	NA
Dimethylphthalate	5.0	NA	NA
Di-n-butylphthalate	5.0	NA	NA
Di-n-octylphthalate	1.0	NA	NA
Fluoranthene	0.10	NA	NA
Fluorene	0.10	NA	NA
Hexachlorobenzene	1.0	NA	NA
Hexachlorobutadiene	1.0	NA	NA
Hexachlorocyclopentadiene	1.0	NA	NA
Hexachloroethane	1.0	NA	NA
Isophorone	1.0	NA	NA

Analyte	Laboratory Target Method Reporting Limit (PQL)*	Quality Control Limits	
		RPD**	%R
Naphthalene	0.10	NA	NA
Nitrobenzene	1.0	NA	NA
n-Nitrosodimethylamine	1.0	NA	NA
n-Nitroso-di-n-propylamine	1.0	22 (LCS); 30 (MS)	40-103 (LCS) 25-133 (MS)
n-Nitrosodiphenylamine	1.0	NA	NA
Pentachlorophenol	5.0	35 (LCS); 39 (MS)	40-124 (LCS) 20-136 (MS)
Phenanthrene	0.10	NA	NA
Phenol	1.0	25 (LCS); 24 (MS)	21-53 (LCS) 20-108 (MS)
Pyrene	0.10	19 (LCS); 15 (MS)	52-107 (LCS) 47-112 (MS)
Pyridine	1.0	NA	NA
Benzo(a)anthracene	0.010	NA	NA
Benzo(a)pyrene	0.010	NA	NA
Benzo(b)fluoranthene	0.010	NA	NA
Benzo(j,k)fluoranthene	0.010	NA	NA
Chrysene	0.010	NA	NA
Dibenz(a,h)anthracene	0.010	NA	NA
Indeno(1,2,3-cd)pyrene	0.010	NA	NA
Polychlorinated Biphenyls as Aroclors (PCBs) - EPA Method 8082A (µg/L)			
Aroclor 1016	0.050	NA	NA
Aroclor 1221	0.050	NA	NA
Aroclor 1232	0.050	NA	NA
Aroclor 1242	0.050	NA	NA
Aroclor 1248	0.050	NA	NA
Aroclor 1254	0.050	NA	NA
Aroclor 1260	0.050	12 (LCS); 17 (MS)	64-144 (LCS) 80-119 (MS)
Aroclor 1262	0.050	NA	NA
Aroclor 1268	0.050	NA	NA
Total Aroclors	0.050	NA	NA
Organochlorine Pesticides - EPA Method 8081B (µg/L)			
4,4'-DDD	0.0050	15 (LCS); 15 (MS)	50-130 (LCS) 48-122 (MS)
4,4'-DDE	0.0050	15 (LCS); 15 (MS)	50-130 (LCS) 41-127 (MS)
4,4'-DDT	0.0050	15 (LCS); 33 (MS)	27-140 (LCS) 38-141 (MS)
Aldrin	0.0050	15 (LCS); 20 (MS)	20-115 (LCS) 35-115 (MS)
alpha-BHC	0.0050	19 (LCS); 15 (MS)	50-130 (LCS) 42-113 (MS)
beta-BHC	0.0050	15 (LCS); 15 (MS)	50-130 (LCS) 40-118 (MS)
cis-Chlordane (alpha-Chlordane)	0.0050	15 (LCS); 15 (MS)	50-130 (LCS) 38-112 (MS)
delta-BHC	0.0050	15 (LCS); 15 (MS)	50-130 (LCS) 20-113 (MS)

Analyte	Laboratory Target Method Reporting Limit (PQL)*	Quality Control Limits	
		RPD**	%R
Dieldrin	0.0050	15 (LCS); 17 (MS)	45-120 (LCS) 46-115 (MS)
Endosulfan I	0.0050	15 (LCS); 15 (MS)	50-130 (LCS) 42-115 (MS)
Endosulfan II	0.0050	15 (LCS); 15 (MS)	50-130 (LCS) 44-114 (MS)
Endosulfan sulfate	0.0050	15 (LCS); 15 (MS)	50-130 (LCS) 48-112 (MS)
Endrin	0.0050	16 (LCS); 18 (MS)	34-137 (LCS) 52-117 (MS)
Endrin aldehyde	0.0050	15 (LCS); 15 (MS)	50-130 (LCS) 24-117 (MS)
Endrin ketone	0.020	15 (LCS); 15 (MS)	50-130 (LCS) 48-112 (MS)
gamma-BHC (Lindane)	0.0050	15 (LCS); 20 (MS)	24-118 (LCS) 45-110 (MS)
Heptachlor	0.0050	15 (LCS); 18 (MS)	22-123 (LCS) 41-113 (MS)
Heptachlor epoxide	0.0050	15 (LCS); 15 (MS)	50-130 (LCS) 54-107 (MS)
Methoxychlor	0.010	15 (LCS); 15 (MS)	50-130 (LCS) 51-135 (MS)
Toxaphene	0.050	NA	NA
trans-Chlordane (beta- or gamma-Chlordane)	0.0050	15 (LCS); 15 (MS)	50-130 (LCS) 43-110 (MS)
Chlorinated Acid Herbicides - EPA Method 8151A (µg/L)			
2,4,5-T	0.071	30 (LCS); 25 (MS)	22-111 (LCS) 40-140 (MS)
2,4,5-TP (Silvex)	0.048	20 (LCS); 25 (MS)	40-140 (LCS) 40-140 (MS)
2,4-D	0.094	30 (LCS); 25 (MS)	13-88 (LCS) 40-140 (MS)
2,4-DB	0.071	20 (LCS); 25 (MS)	21-127 (LCS) 40-140 (MS)
Dalapon	0.46	20 (LCS); 25 (MS)	5-140 (LCS) 5-140 (MS)
Dicamba	0.047	34 (LCS); 25 (MS)	10-86 (LCS) 40-140 (MS)
Dichlorprop	0.047	20 (LCS); 25 (MS)	40-140 (LCS) 40-140 (MS)
Dinoseb	0.047	20 (LCS); 25 (MS)	23-121 (LCS) 40-140 (MS)
MCPA	23	20 (LCS); 25 (MS)	40-140 (LCS) 40-140 (MS)
MCPP	9.4	20 (LCS); 25 (MS)	40-140 (LCS) 40-140 (MS)
Pentachlorophenol	0.0095	20 (LCS); 25 (MS)	15-116 (LCS) 40-140 (MS)
Metals - EPA Methods 200.7/200.8/245.1/7470A (mg/L)			
Arsenic	0.0033	20	80-120 (LCS) 75-125 (MS)
Cadmium	0.0044	20	80-120 (LCS) 75-125 (MS)

Analyte	Laboratory Target Method Reporting Limit (PQL)*	Quality Control Limits	
		RPD**	%R
Chromium	0.011	20	80-120 (LCS) 75-125 (MS)
Copper	0.011	20	80-120 (LCS) 75-125 (MS)
Iron	0.020	20	80-120 (LCS) 75-125 (MS)
Lead	0.0011	20	80-120 (LCS) 75-125 (MS)
Manganese	0.011	20	80-120 (LCS) 75-125 (MS)
Mercury	0.000025	20	80-120 (LCS) 75-125 (MS)
Nickel	0.022	20	80-120 (LCS) 75-125 (MS)
Selenium	0.0056	20	80-120 (LCS) 75-125 (MS)
Zinc	0.028	20	80-120 (LCS) 75-125 (MS)
Calcium	1.0	20	80-120 (LCS) 75-125 (MS)
Magnesium	1.0	20	80-120 (LCS) 75-125 (MS)
Potassium	1.0	20	80-120 (LCS) 75-125 (MS)
Sodium	1.0	20	80-120 (LCS) 75-125 (MS)
General Chemistry Parameters (mg/L)			
Alkalinity SM 2320B	15	10	89-110 (LCS)
Bicarbonate SM 2320B	15	10	89-110 (LCS)
Chloride SM 4500-Cl	2.0	15	86-115 (LCS) 85-115 (MS)
Nitrate EPA 353.2	0.050	16	90-121 (LCS) 92-125 (MS)
Sulfate ASTM D516-11	5.0	10	89-117 (LCS) 69-139 (MS)
Ammonia SM 4500-NH3	0.050	19	88-110 (LCS) 80-113 (MS)
Total Organic Carbon SM 5310B	1.0	12	80-119 (LCS) 80-125 (MS)
Total Dissolved Solids SM 2540C	13	29	84-110 (LCS)

Notes:

L = Liter

LCS = Laboratory control sample

MS = Matrix spike

µg = Microgram

mg = Milligram

NA = Not applicable

%R = Percent recovery

PQL = Practical quantitation limit

RPD = Relative percent difference

*Method reporting limits for project samples may vary depending on the matrix characteristics of the samples.

**Listed RPD limits are for LCS/MS duplicates or laboratory duplicates; RPD goal for groundwater field duplicates is 30%.

Table C-5

Quality Control Sample Types and Frequency

Go East Corp Landfill Site

Everett, Washington

Analysis	Field QC Samples			Laboratory QC Samples			
	Field Duplicates	Equipment Rinsate Blanks	Trip Blanks	Method Blanks	LCS	MS/MSD	Laboratory Duplicates
Volatile Organic Compounds (VOCs) (soil, groundwater, and surface water only)	1 soil duplicate from boring MW-5, MW-6, MW-7, or MW-8 1 groundwater duplicate during Q1 groundwater monitoring event 1 groundwater duplicate during Q3 groundwater monitoring event No sediment or surface water duplicates	1 rinsate blank from split-spoon soil sampler (if used) 1 rinsate blank from bladder pump per groundwater monitoring event No rinsate blanks from sediment or surface water sampling tools	1 per cooler containing samples for VOC analysis	1 per batch*	1 per batch*	1 per batch*	NA
Gasoline Range Organics (GRO) (soil, groundwater, and surface water only)			NA	1 per batch*	NA	NA	1 per batch*
Diesel & Heavy Oil Range Organics (DRO and ORO)			NA	1 per batch*	1 per batch*	NA	1 per batch*
Semivolatile Organic Compounds (SVOCs)			NA	1 per batch*	1 per batch*	1 per batch*	NA
Polychlorinated Biphenyls as Aroclors (PCBs)			NA	1 per batch*	1 per batch*	1 per batch*	NA
Organochlorine Pesticides			NA	1 per batch*	1 per batch*	1 per batch*	NA
Chlorinated Acid Herbicides			NA	1 per batch*	1 per batch*	1 per batch*	NA
Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, and Zinc			NA	1 per batch*	1 per batch*	1 per batch*	1 per batch*
Total Organic Carbon (sediment only)			NA	1 per batch*	1 per batch*	1 per batch*	1 per batch*

Notes:

*An analytical batch is defined as a group of samples taken through a preparation procedure and sharing a method blank, LCS, and MS/MSD (or MS and laboratory duplicate). No more than 20 samples are contained in one batch.

LCS = Laboratory control sample

MS = Matrix spike

MSD = Matrix spike duplicate

NA = Not applicable

QC = Quality control

VOC = Volatile organic compound