INTERIM ACTION WORK PLAN

Snopac Property, Uplands Source Control
Seattle, Washington

Prepared for: 5055 Properties LLC

Project No. 150054 • June 4, 2019 • Public Review Draft

Aspect CONSULTING

earth + water

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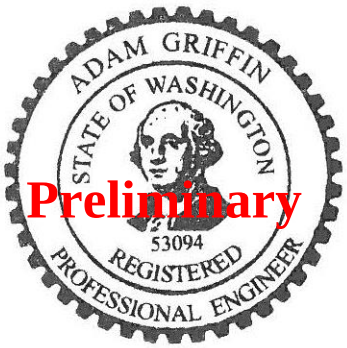

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Executive Summary

This Interim Action Work Plan (Work Plan) was prepared by Aspect Consulting, LLC (Aspect), on behalf of 5055 Properties LLC, to describe interim action cleanup activities to be completed landward (east) of the planned sheet pile shoring wall located immediately landward of the mean higher high water (MHHW) at the Snopac Site (Site). The Site is generally located at 5055 and 5053 East Marginal Way South in Seattle, Washington (Property), and borders the eastern portion of Slip 1 of the Lower Duwamish Waterway (LDW) (Figure 1). The Site, as defined by Washington State's Model Toxics Control Act (MTCA), includes all upland and in-water areas impacted by historical releases of hazardous substances from the Property. 5055 Properties LLC is entering an Agreed Order with the Washington State Department of Ecology (Ecology) and this Work Plan is prepared to satisfy the requirements of the Agreed Order.

The 1.33-acre Property has supported various industrial uses since the 1920s and currently includes an approximately 23,600-square-foot building used for storage and staging of construction equipment. A makeshift retaining wall comprised of vertical steel plates interwoven into pilings that once supported a dock structure extends the full length of the LDW shoreline. Fill materials, including spent sandblast grit (SBG), were placed landward of the retaining wall to bring the area to current grade.

Based on Site explorations, Site soil units include a shallow fill material (Fill Unit) overlying native soil consisting of estuarine deposits (Estuarine Unit) underlain by native alluvium. The native alluvium (Alluvium Unit) is underlain by overconsolidated glacial deposits first observed at a depth of approximately 158 feet bgs. The Fill Unit is an unconfined, water-bearing unit that is tidally influenced by the LDW. The Estuarine Unit functions as an aquitard, restricting but not preventing groundwater flow between the Fill Unit and underlying Alluvium Unit. The net (tidally averaged) groundwater flow direction in both units is to the west, with discharge to the LDW. However, during high-tide periods, the nearshore groundwater flow direction in both units temporarily reverses to an eastward (landward) direction.

Site groundwater, groundwater seeps, soil, and Slip 1 sediments have been impacted by historical releases of hazardous substances from the Site property. As early as 2004, seep sampling conducted on the Slip 1 shoreface (Seep 76) confirmed the presence of metals in seeps at concentrations exceeding applicable Washington State Water Quality Standards. Notably, the detected arsenic concentrations in this seep were the highest reported in any LDW seeps sampled in 2004.

The SBG-containing fill located in the uplands landward (east) of the planned sheet pile shoring wall (Figure 2) is targeted for removal in this interim action. Data collected during the Site investigation work indicate that fill soils containing spent SBG collected from the shoreline area and base of the existing retaining wall contained elevated concentrations of arsenic, copper, lead and zinc. Elevated concentrations of tributyl tin (TBT), gasoline-, diesel-, and/or oil-range total petroleum hydrocarbons (TPH), carcinogenic polycyclic aromatic hydrocarbons (cPAHs), and total polychlorinated biphenyls (PCBs) were also present in some of the soil samples. The estimated weight of SBG- containing fill soil to be excavated from the uplands during the interim action is approximately 3,500 tons.

The uplands interim action cleanup east of the shoring wall includes the following primary elements:

- **Shoring Wall Installation.** The sheet pile shoring wall will extend 32 feet below the estimated 13-foot-deep excavation bottom to support the excavation, for a total embedment depth of approximately 45 feet. Removal of subsurface obstructions (large debris) and localized regrading will likely be required for shoring wall construction.
- **Removal of Contaminated Fill Landward (East) of the Shoring Wall.** The excavation goal is to remove all fill materials containing SBG (to estimated depth of 13 feet bgs) and achieve soil remediation levels at the excavation limits. All excavated contaminated soil and debris will be disposed of off-Site at a permitted Subtitle D landfill. The removal will require excavation dewatering and strict adherence to project technical specifications. Means and methods for conducting the removal will be detailed in a separate Excavation and Dewatering Plan to be prepared by the Contractor and submitted to Ecology.
- **Engineering Controls.** Following completion of the interim action excavation and backfilling, 5055 Properties LLC will implement interim fencing and signage to restrict human access and use of the shoreface and tidelands until completion of the subsequent shoreface and in-water cleanup actions west of shoring wall.
- **Contingency Removal.** This interim action also includes a contingency to permanently remove any other upland contaminant source materials if encountered beneath the existing Site structure after it is demolished, and additional characterization is completed there.

The preliminary anticipated schedule of construction and Interim Action Work Plan milestones are as follows:

- **March through July 2019** – Complete remedial design and contracting, Agreed Order and Public Review Draft IAWP public review, Agreed Order execution and Final IAWP
- **July 2019** – Complete shoring wall installation
- **August through September 2019** – Excavation and disposal of contaminated fill materials, dewatering and water management, and excavation backfill

This schedule may be adjusted based on permitting, conditions encountered during the cleanup, and/or other factors. The implementation of interim action activities will not commence until Ecology approval of the Final IAWP. The completion of the Interim Action Work Plan is designed to satisfy the interim action requirements of the AO, and will be reported in the AO-deliverable, Interim Action Report.

1 Background and Goal for Interim Action

Aspect Consulting, LLC (Aspect) has prepared this Interim Action Work Plan (Work Plan), on behalf of 5055 Properties LLC, that describes interim action cleanup activities to be completed landward (east) of the planned sheet pile shoring wall located immediately landward of the mean higher high water (MHHW) at the Snopac Site (Site). The Site is generally located at 5055 and 5053 East Marginal Way South in Seattle, Washington (Property), and borders the eastern portion of Slip 1 of the Lower Duwamish Waterway (LDW) (Figure 1). The Site, as defined by Washington State's Model Toxics Control Act (MTCA), includes all upland and in-water areas impacted by historical releases of hazardous substances from the Property.

The 1.33-acre Property has supported various industrial uses since the 1920s. Physical improvements on the property include an approximately 23,600-square-foot building currently used for storage and staging of construction equipment. A makeshift retaining wall comprised of vertical steel plates interwoven into pilings that once supported a dock structure extends the full length of the LDW shoreline. Fill materials, including spent sandblast grit (SBG), were placed landward of the retaining wall to bring the area to current grade.

Site groundwater, groundwater seeps, soil, and Slip 1 sediments have been impacted by historical releases of hazardous substances from the Site. As early as 2004, seep sampling conducted on the Slip 1 shoreface (Seep 76) confirmed the presence of metals in seep discharge at concentrations exceeding applicable Washington State Water Quality Standards. Notably, the detected arsenic concentrations in this seep were the highest reported in any LDW seeps sampled in 2004 (Windward, 2004).

In June 2014, Ecology performed an Initial Investigation of the Site and completed a Site Hazard Assessment (SHA; Ecology, 2014a and 2014b). Ecology ranked the Site as a 2 on a scale of 1 to 5, where 1 indicates the highest relative risk and 5 the lowest. The exposure pathway that the SHA scored as the highest concern was the surface water to human and ecological receptors pathway. The data used to score this pathway were the Seep 76 arsenic results collected in 2004. Ecology subsequently notified 5055 Properties LLC via an Early Notice Letter that the Site was being added to Ecology's Confirmed and Suspected Contaminated Sites List (CSCSL) and was assigned a Cleanup Site ID #12463.

Since 2015, 5055 Properties LLC has been conducting independent remedial investigations at the Site. Aspect completed remedial investigations for the uplands portion of the Site. Integral Consulting, Inc. (Integral) conducted investigations and is assessing cleanup alternatives for the intertidal and subtidal portions of the Site, and the uplands soils on the shoreface that are seaward (west) of the planned sheet pile shoring wall. Considered collectively, Aspect's and Integral's Site investigations and cleanup plans have been intended to meet applicable requirements of Ecology's), MTCA Cleanup Regulations, Chapter 173-340 of the Washington Administrative Code (WAC), and the United States Environmental Protection Agency's (EPA) LDW Superfund Site Record of Decision (ROD). During the independent remedial action process, 5055 Properties LLC

met with and received informal technical consultation from Ecology LDW source control staff in accordance with MTCA 173-340-515(5), during a series of meetings held between 2016 and early 2018. Written opinions authorized pursuant to WAC 173-340-515(5)(a)-(c) were not provided by Ecology. 5055 Properties LLC and Ecology are currently negotiating an Agreed Order to complete a Remedial Investigation (RI), Feasibility Study (FS), and Draft Cleanup Action Plan for the Site.

5055 Properties LLC plans to redevelop the upland portion of the Site with a new commercial office building, with construction planned to start in summer 2019.[1] The planned footprint of the new building overlies part of the contaminated SBG-containing fill. The SBG-containing fill represents an ongoing source of contaminants to upland groundwater discharging to the sediments and surface waters of the LDW. Given the location of spent-SBG source material and Site-specific constraints including the instability of the existing shoreface, excavation and off-Site disposal of the SBG-containing fill is a well-demonstrated remedial approach for achieving permanent removal of the documented contaminant source.

Therefore, the removal of the SBG-containing fill will be conducted as an interim action in accordance with the purpose of an "Interim Action" defined in MTCA (WAC 173-340-430 (1)). MTCA allows for "Interim Actions" to occur "anytime during the cleanup process" as long as the interim action "does not foreclose reasonable alternatives for the cleanup action" per WAC 173-340-430 (3-4). This interim action permanently removes sources of contamination to groundwater and the LDW and will not conflict with reasonable alternatives for the final cleanup action as required by MTCA (WAC 173-340-430[3][b]).

Therefore, the interim action will proactively and permanently remove contaminated SBG-containing fill soils landward from the planned sheet pile shoring wall prior to start of the redevelopment project construction. This interim action also includes a contingency to permanently remove other potential upland contaminant source materials if encountered beneath the existing building after it is demolished and additional characterization is completed. The sampling and analysis plan for the additional characterization beneath the existing building will be submitted to Ecology under separate cover.

Prior to beginning of remedial excavation work, the existing building will be demolished, including its subsurface footings, leaving that area of the Site accessible for earthwork. Building demolition is not a component of this interim action.

This Work Plan is prepared as an exhibit to Agreed Order No. (16300) between 5055 Properties LLC and Ecology.

1.1 Work Plan Organization

The following sections of this Work Plan are as follows:

- **Section 2—Subsurface Conditions** presents a brief description of the subsurface conditions pertinent to the planned interim action.

[1] Demolition of the existing building will occur prior to the interim action and is not addressed in this Work Plan.

- **Section 3—Contaminated Fill to be Removed** describes the specific area and type of contaminated materials targeted for permanent removal during the interim action.
- **Section 4—Interim Action Remediation Levels** describes the constituents to be analyzed during performance monitoring and establishes the remediation levels for each analyte to be applied during the interim action.
- **Section 5—Interim Action Components** describes the various construction activities to be completed during the interim action.
- **Section 6—Permits and Other Requirements** describes permitting substantive requirements for conducting the interim action activities.
- **Section 7—Reporting** describes the reporting of interim action activities once completed.
- **Section 8—Schedule** describes the anticipated schedule milestones for accomplishing the interim action.
- **Section 9—References** lists the documents cited in this Work Plan.

Appendix A is a Sampling and Analysis Plan for Performance Monitoring that includes a Field Sampling Plan and Quality Assurance Project Plan (QAPP) for interim action performance monitoring in accordance with WAC 173-340-820. Appendix B includes a copy of the wastewater minor discharge authorization obtained from the King County Industrial Waste Program for the interim action. Appendix C includes the documentation for designation of the contaminated materials (waste) to be generated and disposed of during the interim action. Appendix D provides the basis for defining analytes for the interim action performance monitoring, and, as such, includes Site soil and groundwater quality data tables with comparison of data to screening levels.

2 Subsurface Conditions

This section provides a general description of the uplands subsurface conditions that have relevance for conducting the interim action activities.

The Duwamish River Valley is a subglacial valley created during the most recent glaciation by scour and erosion from meltwater channels beneath glacier ice. Dense/hard glacially consolidated deposits have been compacted beneath the weight of glacier ice and define the bottom of the valley. They are mantled by up to hundreds of feet of recent alluvium deposited by the Duwamish River, and by lahars/debris flows from Mt. Rainier. Locally, the recent alluvium is described as predominantly sandy with horizontal fine and coarse-grained lenses, including estuary peat and clay, deposited within the Duwamish River Valley. The deep geotechnical boring confirmed that the recent alluvium is underlain by glacially consolidated soils (Aspect, 2017).

In the early 20th century, the meandering Duwamish River was dredged, filled, and straightened to create a navigable waterway and associated developments. In areas where this filling took place, including at the Site, the recent alluvium is overlain by a variety of fill materials.

2.1 Hydrostratigraphic Units

Based on the Site explorations, four discrete, mappable soil units were identified at the Property. These soil units include a shallow unit comprised of fill material overlying native soil units consisting of estuarine deposits underlain by native alluvium. The native alluvium is underlain by overconsolidated glacial deposits observed at a depth of approximately 158 feet bgs (elevation -143 feet). Based on the existing information, the following three hydrostratigraphic units are identified as relevant to this interim action:

- **Fill Unit,** which across much of the Property consists of a heterogeneous mix of gravelly sand, silt, and silty sand with little or no anthropogenic debris (interpreted to be primarily hydraulic fill). In the western portion of the Property adjacent to the LDW, the Fill Unit consists of anthropogenic debris including spent SBG, railroad ties, coal fragments, glass shards, and brick or masonry fragments. This contaminated SBG-containing fill material generally extends to a depth of less than 10 feet bgs (elevation 6 feet) but extends to about 13 feet bgs (elevation 3 feet) in its western extent along the shoreline. The contaminated spent SBG-containing fill along the shoreline and east of the planned sheet pile shoring wall is the target for removal in this interim action.
- **Estuarine Unit** consists of very soft/loose organic silt and clay, with shells, abundant organic (wood) debris, and a sulfur-like odor. The Estuarine Unit is interpreted as generally laterally continuous across the Property, but with variable thickness (typically 3 to 6 feet). The thickness variation is attributed to west-draining alluvial channels incised into the intertidal estuarine surface prior to historical placement of the overlying fill. Based on this interpretation, there is a potential that the Estuarine Unit may have been fully eroded in localized areas, although it was observed every Site boring drilled to a depth greater than 10 feet.

The Estuarine Unit directly underlies the contaminated fill material where present and extends to a depth of about 16 feet bgs (elevation 0 feet).

- **Alluvium Unit** consists of interbedded very loose to medium dense sand, sandy to very sandy silt, and very soft to stiff low-plasticity clay and silt with variable organic content. The Alluvium Unit was observed to extend from the base of the Estuarine Unit to a depth of about 158 feet bgs, which is considerably below the base of the planned sheet pile shoring wall and the planned interim action excavation.

The hydrostratigraphic units are depicted in cross section on Figure 3.

2.2 Groundwater Conditions

The Fill Unit is a water table (unconfined), water-bearing unit that is tidally influenced by the LDW. Based on tidal study work conducted in 2017 and 2018, the tidally influenced water level elevations in the Fill Unit range from about 5 to 9 feet and an average elevation of approximately 7.5 feet NAVD88.[2]

The Estuarine Unit functions as an aquitard, restricting but not preventing groundwater flow between the Fill Unit and underlying Alluvium Unit. Although the aquitard does transmit groundwater and can thus be considered a leaky aquitard it's effective hydraulic separation of the two units is illustrated by the feet of head difference maintained between Fill Unit monitoring well MW-12 and Alluvium Unit MW-8 on the east side of the Property (see Figure 2). Based on the water level data from those two wells, there is a downward hydraulic gradient from the Fill Unit to the Alluvium Unit in the eastern portion of the Property. The magnitude of the vertical hydraulic gradient likely becomes less toward the west end of the Property, where both units discharge to the LDW.

A confined aquifer is present in the Alluvium Unit beneath the Estuarine Unit aquitard. The confined Alluvium Unit is also tidally influenced with water level elevations ranging from 4 to 7.5 feet and an average elevation of 6 feet NAVD88, based on the 2017 and 2018 tidal study work.

The net (tidally averaged) groundwater flow direction in both units is to the west, with discharge to the LDW. However, during high-tide periods, the nearshore groundwater flow direction in both units temporarily reverses to an eastward (landward) direction.

Following installation of the planned sheet pile shoring wall depicted on Figure 2, the hydraulic connection between the LDW and the Fill Unit east of it will largely be cut off other than limited connectivity through joints in the wall. However, the Fill Unit will remain in hydraulic communication with the LDW via flow north and south of the shoring wall. Because the Alluvium Unit extends below the bottom of the shoring wall, the Alluvium Unit will remain in hydraulic connection with the LDW, although the wall will create localized changes in groundwater flow directions.

[2] Elevations in this report referenced to North American Vertical Datum of 1988 (NAVD88).

2.3 Geotechnical Considerations During Excavation

The removal of soils in this setting present unique design considerations. This section discusses potential conditions that may occur during the interim action implementation and warrant conservative design analysis. This design consideration is necessary for establishing contractor project specifications that prevent or minimize these conditions.

The interim action approach will require, in some areas, fully excavating contaminated fill materials down to the top of the Estuarine Unit aquitard (estimated depth 13 feet; see Section 5), which potentially increases artesian pressures in the underlying Alluvium Unit. Fully removing the overlying weight of soil creates the potential that the bottom of the excavation (Estuarine Unit) will "heave" when advanced near or at its full depth. Heave occurs when the weight of the in-place soil layer at the excavation base is less than the artesian pressure pushing up on it from below, thus turning that native soil into a slurry (liquefies) with essentially no shear strength. Conducting the excavation to minimize potential for bottom heave, to the extent practical, is a performance criterion for the interim action.

The presence of the shoring wall is expected to have little influence on the potential for excavation bottom heave, because the artesian pressure is provided by the Alluvium that extends below the bottom of the shoring wall. Therefore, the Alluvium Unit will remain in hydraulic connection with the LDW tides and its tidally-influenced artesian pressures will be maintained.

The greatest potential for heave occurs where the greatest depth of excavation will occur, which is at the shoring wall face defining the western edge of excavation, and during times when Alluvium Unit water levels are highest in response to tidal fluctuations. The potential heave condition can be mitigated by conducting excavation when the underlying Alluvium Unit's artesian pressure (as expressed by groundwater elevation or "head") is below a threshold value, incorporating a factor of safety.[3] The alternative of installing/operating a separate dewatering system solely to depressurize the Alluvium Unit throughout excavation is not practicable in our judgement because it would require use of several deep, high-capacity wells along the landward perimeter of the excavation pumping large quantities of groundwater (attempting to suppress artesian pressures created by the LDW).

Based on an analysis of the potential for excavation bottom heave, excavation below elevation 7 feet NAVD88 will be constrained to times when the LDW tide is below elevation 1 feet NAVD88.

For purposes of remedial construction, LDW tide data could be used from either the Lockheed Shipyard tide station on Harbor Island (National Oceanic and Atmospheric Administration [NOAA] station 9447110, about two miles downstream of Property) or the Duwamish Waterway at 8th Avenue South tide station (NOAA station 9447029, about two miles upstream of Property). Based on review of data from the two stations, their concurrent tide elevations are consistently within 0.4 feet of each other, and tidal peaks

[3] Applying conservative assumptions and an engineering factor of safety of 1.25, the threshold Alluvium Unit groundwater elevation was calculated as elevation 5 feet NAVD88. Based on the available tidal study information, this groundwater elevation occurs when the LDW tide is at or below elevation 1 feet NAVD88.

occur within 12 minutes of each other, both of which are within the resolution of this analysis.

These design considerations are defined in the project technical specifications to be submitted to Ecology under separate cover. In addition, these project technical specifications require the contractor to submit an Excavation and Dewatering Plan to describe means and methods for meeting the project technical specifications. This contractor's Excavation and Dewatering Plan will also be submitted to Ecology. The submittal schedule is provided in Section 8.

3 Contaminated Fill to be Removed

The SBG-containing fill located in the uplands landward (east) of the planned sheet pile shoring wall (Figure 2) is targeted for removal in this interim action.

Data collected during the Site investigation work to date indicate that fill soils containing primarily contaminated spent SBG collected from the shoreline area and base of the existing retaining wall contained elevated concentrations of arsenic, copper, lead and zinc. Elevated concentrations of tributyl tin (TBT), gasoline-, diesel-, and/or oil-range total petroleum hydrocarbons (TPH), carcinogenic polycyclic aromatic hydrocarbons (cPAHs), and total polychlorinated biphenyls (PCBs) were also present in some of the soil samples.

Based on the collective Site data, maximum contaminant concentrations detected in the SBG-containing fill targeted for removal in this interim action are as follows:

- Arsenic = 3,880 mg/kg
- Copper = 2,540 mg/kg
- Lead = 2,780 mg/kg
- Zinc = 9,700 mg/kg
- TBT = 5.6 mg/kg
- Gasoline-range TPH = 420 mg/kg
- Diesel-/oil-range TPH = 8,700 mg/kg
- Total cPAHs (TEC)[4] = 58 mg/kg
- Naphthalene = 24 mg/kg
- Total PCBs = 0.5 mg/kg

The sampling data indicate that elevated concentrations of metals (arsenic, copper, lead and zinc) are the most reliable indicators of contaminated spent SBG and paint wastes in the nearshore fill soil, with TBT, PAHs, and PCBs as secondary indicators. Appendix D contains existing Site soil and groundwater quality data tables, with data compared against screening levels. The soil and groundwater screening levels applied are the most stringent preliminary cleanup levels (PCULs) established in the 2019 LDW Preliminary Cleanup Level Workbook and Supplemental Information (Ecology, 2019).

Based on the results of a supplemental waste characterization sampling program completed in November 2018, the contaminated fill soil in the planned excavation area has been designated as non-dangerous solid waste and can therefore be disposed of in a non-hazardous waste (Subtitle D) landfill.

[4] Total toxic equivalent concentration of benzo(a)pyrene calculated in accordance with MTCA (WAC 173-340-708(8)).

To supplement the completed investigation data presented in Appendix D, the waste designation program included the following additional waste characterization steps:

- Aspect performed additional characterization of soil within the planned excavation area in accordance with a waste designation sampling and analysis plan prepared by DH Environmental (Attachment 6 in Appendix C). Random sample locations and depths were determined using the statistical sampling plan developed with Visual Sampling Plan (VSP), a software package developed by the U.S. Department of Energy's Pacific Northwest National Laboratory (Appendix C).
- Samples were collected from test pits at 15 locations within the estimated extent of excavation. One sample of the SBG-containing fill material was collected from each test pit and analyzed using the Toxicity Characteristic Leaching Procedure (TCLP) for RCRA 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) and select samples were analyzed for PCBs as required by the subtitle D landfill facilities. Leachable metals by the TCLP test were not detected in any sample. Each sample was also analyzed for selected total metals (arsenic, copper, lead, nickel, and zinc). The analytical results from the November 2018 waste designation samples are included in Table 1.
- To evaluate the fill soil relative to Washington state-only dangerous waste criteria, a dangerous waste characterization fish bioassay was conducted by Rainier Environmental on the soil sample (VSP-12-3.3) exhibiting the highest total metals concentrations (bioassay report provided as Attachment 5 in Appendix C). There was no fish mortality during the test.

Using results of the robust waste characterization sampling program and the investigation data in Appendix D, DH Environmental concluded that the target contaminated fill soils designate as non-dangerous solid waste upon excavation (Appendix C).

Based on the current data, the estimated length of the SBG-containing fill (parallel to the shoring wall) to be removed is roughly 240 feet and the estimated width (perpendicular to the shoring wall) averages approximately 40 feet. The depth of removal is greatest at the shoring wall with an estimated maximum depth of 13 feet bgs with the depth of removal decreasing to zero to the east (Figure 3). On this basis, the in-place volume of contaminated fill material to be removed is estimated at roughly 2,100 bank cubic yards (BCY). Assuming an in-place unit weight of 1.65 tons/BCY,[5] the estimated weight of contaminated fill soil to be excavated from the uplands during the interim action is approximately 3,500 tons.

[5] Assuming a bulking factor of 1.1, 1.65 tons/BCY is equivalent to a loose cubic yard (LCY) unit weight of 1.5 tons/LCY.

4 Interim Action Remediation Levels

Appendix D presents existing Site soil and groundwater quality data, and an analysis of the data to define the constituents to be analyzed for (analytes) during the interim action performance monitoring. The interim action performance monitoring analytes are:

- Metals (arsenic, copper, lead, mercury, and zinc)
- PAHs
- PCBs

In addition, TPH as gasoline-, diesel-, and oil-range organics will be analyzed for in the area around MW-2, where soil TPH concentrations exceed a generic direct contact soil cleanup level of 1,500 mg/kg (Ecology, 2017).

Because cleanup levels have not yet been determined for the Site, contaminated fill soil will be removed to comply with remediation levels defined for the interim action in accordance with WAC 173-340-355. The soil remediation levels for the analytes are the most stringent PCULs established in Ecology (2019) and the generic direct contact cleanup level for combined TPH (Ecology, 2017). Table 2 presents the soil remediation levels for the interim action.

5 Interim Action Components

The uplands interim action cleanup east of the shoring wall includes the following primary elements:

Shoring Wall Installation. A sheet pile shoring wall will be installed on the landward (east) side of the existing makeshift retaining wall to facilitate full removal of the spent SBG-contaminated fill to the east of it.[6] The proposed shoring wall alignment depicted on Figure 2 is based on the expected setback requirements relative to the ordinary high-water mark (OHWM) and adjacent property boundaries.

Removal of Contaminated Fill Landward (East) of the Shoring Wall. Removal of spent SBG-contaminated fill landward of the shoring wall will be accomplished using conventional earthwork equipment. Figure 2 shows the estimated lateral extent of excavation in plan view, and Figure 3 provides five interpreted cross sections through the planned excavation area. Based on the existing data, spent SBG-contaminated fill extends down to approximately 13 feet (maximum) below ground surface (bgs) at the shoring wall alignment.

Given the shallow water table at the Site and proximity to the LDW, dewatering of the excavation will be required to facilitate handling of soils, performance monitoring (excavation verification soil sampling), and excavation backfill. During excavation, soils will be monitored in the field for visual presence of spent SBG and/or paint wastes, and soil samples will be collected for chemical analysis from the excavation bottom and sidewalls without visual indications of SBG or paint wastes.

The excavation goal is to remove all fill materials containing SBG and paint wastes and achieve soil remediation levels at the excavation limits, and all excavated contaminated soil and debris will be disposed of off-Site at a permitted Subtitle D landfill. The completed excavation will be backfilled with imported clean aggregate and/or excavated soil that meets remediation levels and is geotechnically suitable for reuse, as further described below.

Engineering Controls. Following completion of the interim action excavation and backfilling, 5055 Properties LLC will implement interim fencing and signage to restrict human access and use of the shoreface and tidelands until completion of the subsequent shoreface and in-water source-removal actions west of shoring wall.

Contingency Removal. As stated in Section 1, this interim action also includes a contingency to permanently remove any other upland contaminant source materials if encountered beneath the existing Site structure after it is demolished, and additional characterization is completed there. If the additional characterization identifies any soil warranting removal during the interim action, the removal of the additional soil is expected to be conducted using the same procedures included in this Work Plan.

[6] The shoring wall will also facilitate removal of SBG-containing fill material from the shoreface and intertidal area immediately west of it in subsequent cleanup efforts.

The interim action activities other than the contingency action (which is uncertain) are described in greater detail below.

5.1 Mobilization and Site Preparation

Prior to the start of interim action earthwork, the contractor's pre-construction submittals to be prepared for owner approval include:

- **Temporary Erosion and Sedimentation Control (TESC) Plan** describing erosion and sedimentation control Best Management Practices (BMPs) to be installed to manage and prevent stormwater and fugitive dust emissions from leaving the Site. The TESC Plan and BMPs implemented shall comply with City of Seattle and King County requirements.
- **Excavation and Dewatering Plan** that describes in detail the contractor's planned means and methods for completing concurrent excavation, dewatering, and backfill to meet specified performance criteria, including treating and discharging extracted water to sanitary sewer and disposing of contaminated materials off-Site. The Excavation and Dewatering Plan will be submitted to Ecology according to the schedule in Section 8.

  The project technical specifications are largely "performance-based," in that they specify required outcomes but rely on the contractor to propose the most efficient means and methods (within specified constraints) of achieving those outcomes. This approach takes advantage of the contractor's previous experience with similar projects and places the contractor in more of an "ownership" role with respect to the construction means and methods to be employed.

Mobilization and construction site preparation activities include:

- Mobilize construction equipment, materials, and utilities (e.g., electrical generators)
- Mobilize, install, and test dewatering and water treatment systems (refer to Sections 4.3.1 and 4.3.2)
- Construct bermed and lined soil stockpile area(s) for contaminated materials, and a separate stockpile area for potentially clean soil excavated to access contaminated soil
- Construct temporary erosion and sedimentation controls
- Remove or reroute any active utilities that may be impacted by the cleanup activities
- Decommission monitoring wells that are within the footprint of the planned excavation (refer to Figure 2). Monitoring wells located outside of the planned excavation footprint will be protected if practicable; otherwise, they will be decommissioned and replaced. Monitoring well decommissioning will be performed in accordance with the provisions of Chapter 173-160 WAC.

5.2 Sheet Pile Shoring Wall

The proposed shoring wall alignment shown on Figure 2 extends approximately 290 feet laterally to the north and south Property boundaries, or roughly 20 feet beyond the long dimension of the anticipated excavation limits. On a preliminary basis, the shoring wall will need to extend some 32 feet below the estimated 13-foot-deep excavation bottom to support the excavation, for a total embedment depth of approximately 45 feet (elevation -29 feet NAVD88; the upper portion of the wall is depicted on Figure 3). Removal of subsurface obstructions (large debris) and localized regrading will likely be required to install the shoring wall. Any contaminated materials generated during these activities will be handled with the contaminated fill soils generated during the interim action excavation.

KPFF Consulting Engineers is the engineer of record for the shoring wall design. The contractor will be responsible for the installation of the shoring wall, and the geotechnical engineer of record will be responsible for its installation oversight. The shoring wall engineering plans prepared by others will be submitted to Ecology under separate cover according to the submittal schedule in Section 8.

5.3 Soil Excavation and Backfilling

As stated above, the interim action involves excavation and proper off-Site disposal of all contaminated SBG-containing fill located east of shoring wall, with concurrent dewatering to facilitate soil removal and handling. Once the interim action cleanup goals are achieved, the excavation will be backfilled with imported clean aggregate and compacted as specified by the project geotechnical engineer of record.

5.3.1 Excavation and Dewatering

The estimated 3,500 tons of contaminated fill soil to be excavated extends from ground surface (nominal elevation 16 feet NAVD88) to depths ranging from approximately 5 feet bgs on the east side, at the western limit of the existing building, to 13 feet bgs adjacent to the new shoring wall on the west side (bottom elevations ranging from 11 to 3 feet NAVD88 from east to west). The tidally influenced water levels in the excavation area are estimated range in elevation from about 5 to 9 feet and average approximately 7.5 feet NAVD88. To minimize water handling requirements and reduce the risk of bottom heave in the deepest portions of the excavation[7], the contractor will comply with the following performance criteria during the excavation and dewatering work:

- Dewater excavations as needed to maintain unsaturated conditions to facilitate soil excavation/handling/loading for transport, verification soil sampling in the excavation, and excavation backfilling.
- To limit the potential for heave of the excavation bottom, conduct excavation below elevation 7 feet only during time periods when the LDW tide is below elevation 1 foot NAVD88.
- Minimize the area of open excavation below elevation 7 feet at any one time.

[7] Refer to Section 2.3.

The contractor will be responsible for final design in their Excavation and Dewatering Plan they will submit for owner approval prior to start of construction, and for implementation of a dewatering system that is compatible with the soil excavation methods. Depending on observed groundwater conditions during excavation near the north/south ends of the excavation, the contractor has the option to install supplemental groundwater cutoff walls ("wing walls") tied into the shoring wall to further reduce the flow of groundwater coming from the LDW around the north/south ends of the shoring wall.

If excavated soils are saturated, they will be drained directly back into the excavated area prior to loading. Care will be taken so that groundwater from the excavation bucket flows back into the excavation and not to adjacent areas.

5.3.2 Water Management

All construction-generated wastewater will be pretreated on-Site and discharged to sanitary sewer under King County Industrial Waste (KCIW) Issuance of Wastewater Discharge Authorization No. 1092-01 (discharge authorization) obtained for the project and attached as Appendix B. Sources of water to be managed include the excavation dewatering system and stormwater generated within the project site. On-Site pretreatment will include retention in holding tank(s) for removal of settleable solids. The water treatment system will include flow metering and conveyance piping from the source areas to the treatment system inlet and from the treatment system outlet to the point of sanitary sewer discharge.

The KCIW discharge authorization for the project constrains the rate of discharge to sewer to a maximum instantaneous rate of 100 gallons per minute (gpm) and a maximum daily rate of 72,000 gallons per day (gpd). All pre-treatment, discharge monitoring and reporting will be in accordance with the requirements of the KCIW discharge authorization in Appendix B.

5.3.3 On-Site Materials Excavation and Segregation

The estimated extents of excavation for the interim action are shown on Figure 2 and in five cross-sections on Figure 3. Figure 2 depicts the estimated lateral extent of the contaminated fill east of the shoring wall (gray dashed line), which is the anticipated remedial excavation area bottom based on the current understanding of subsurface conditions. Temporary excavation sidewalls will be sloped and extend laterally beyond the excavation bottom as needed to maintain a stable excavation, and the corresponding estimated total extent of excavation (excavation top) is depicted in green hatching on Figure 2.

Throughout excavation of the known contaminated fill soils east of the shoring wall, the engineer will conduct field screening and direct segregation of all excavated materials according to the following types:

1. Potential Clean Soil
2. Contaminated Soil
3. Contaminated Debris

Visual field screening will rely on the visual presence of spent SBG that contains paint chips, which are visually apparent based on the November 2018 test pit work. Soils with no visual presence of SBG can be segregated as potential clean soil, to be stockpiled on-Site and verified as clean or not with analytical testing. If any SBG is visually present in the soil it will be segregated as contaminated soil. Where the contaminated soil extends to the top of the Estuarine unit (Figure 3), visual screening will also include the organic content of Estuarine unit soils to determine the excavation bottom.

Soils that are judged by the engineer to be contaminated based on field screening do not require sampling/analysis prior to load-out for off-Site treatment/disposal, if there are no free-draining liquids which warrant additional dewatering. However, if the contractor chooses to stockpile contaminated soil prior to loading for off-Site disposal, the ground surface in that stockpile area will be lined/sealed to prevent contaminated soil from contacting underlying materials. Stockpile management is discussed in Section 5.3.3.3.

5.3.3.1 Potential Clean Soil

The potential clean soil will be stockpiled on site pending completion of analysis of interim action analytes (Table 2) by an Ecology-accredited laboratory to confirm its designation as contaminated soil or not. Stockpiles of potential clean soil will not exceed 20 cubic yards in size for the purpose of designation testing for disposition, and each stockpile will have one representative five-point composite sample to determine its compliance with the remediation levels and thus its disposition.

Potential clean soil stockpiles containing a detected interim action analyte concentration exceeding the soil remediation levels will be properly disposed of off Site as contaminated soil. Stockpiles of potential clean soil with no detections, or detections below soil remediation levels will be evaluated for reuse by the geotechnical engineer of record. If unsuitable for reuse, the clean soil will be transported off Site by the contractor.

5.3.3.2 Contaminated Debris

During excavation to remove soil, subsurface debris will be encountered. Contaminated soil stockpiles cannot contain any non-wood debris whose largest dimension exceeds 1 foot, wood debris whose largest dimension exceeds 6 feet, or a total debris content that exceeds 10 percent by volume of the total waste stream based on disposal facility acceptance requirements. Any debris that does not meet these criteria will be segregated and managed as contaminated debris as directed by the engineer, and in accordance with the Specifications.

5.3.3.3 Stockpile Management

If temporary stockpiling of excavated materials is needed during the interim action activities, the contractor will stockpile the excavated material in a location that will not hinder completion of the cleanup activities. Stockpiles will be located away from storm-drain catch basins and more than 50 feet from the LDW shoreline. Materials will be transported on Site in a way to limit spillage of materials between the excavation location and the stockpile location.

Stockpiles of Potential Clean Soil, Contaminated Soil, and Contaminate Debris will be segregated such that intermixing does not occur.

Each stockpile will be underlain by plastic sheeting with a minimum 10-mil thickness, with adjacent sheeting sections continuously overlapped by a minimum of 3 feet. The ground surface on which the sheeting will be placed will be free of objects that could damage the sheeting. Alternatively, a layer of geotextile or plywood may be placed beneath the sheeting to protect it. The stockpile area will be surrounded by straw bales or equivalent to limit transport of sediment potentially generated from the stockpiles.

Each stockpile will be covered by plastic sheeting of minimum 10-mil thickness to prevent precipitation from entering the stockpiled material. Each stockpile cover will be anchored (e.g., using sand bags) sufficiently to prevent it from being removed by wind. All stockpiles will be covered when not in use, and as needed, during periods of rain and wind to prevent transport of soil.

Water accumulating in the stockpile area will be pumped to the contractor's on-Site water treatment system and handled according to conditions of the KCIW discharge authorization.

5.3.4 Performance Monitoring and Over-Excavation

When field screening indicates that contaminated fill soils have been removed from a portion of the excavation, excavation sidewall and bottom verification soil samples will be collected for laboratory analysis to confirm compliance with the soil remediation levels defined in Table 2. The soil samples will be collected from within the excavation using the excavator bucket, or by hand if safely accessible to a worker.

Excavation bottom samples will be collected on a systematic 20-foot grid (one representative sample per 20-foot by 20-foot square), or at least 12 bottom samples along the approximately 240-foot-long (parallel to the shoreline) excavation to verify soil remediation levels are achieved at the bottom of the excavation.

Excavation sidewall sampling will be conducted to document that the lateral extent of soil exceeding remediation levels has been removed on the northern, eastern, and southern extents of the remedial excavation area. The excavation will be advanced to the planned shoring wall to the west and therefore no sidewall samples will be collected from the western sidewall of the excavation. Sidewall samples will be collected at a horizontal spacing of approximately 20 feet and at 4-foot-depth intervals of 0 to 4 feet and 4 to 8 feet (depths below 8 feet will be verified with bottom samples based on estimated depth of excavation away from the shoring wall). One representative soil sample will be collected from each sidewall grid location at each depth interval. A total of 28 sidewall samples are estimated based on this sampling frequency. Field sampling and analytical procedures for the performance monitoring program are described in the Sampling and Analysis Plan included as Appendix B.

Where the concentration of any interim action analyte in an excavation sidewall sample exceeds the remediation level, the length of sidewall represented by the sample will be over-excavated at least 1 foot laterally, if practicable, subject to the requirements in the plans and specifications. If field screening at the new sidewall location indicates the remediation levels are met, then a new sidewall verification sample will be collected at that location and submitted for analysis.

Where the concentration of any interim action analyte in an excavation bottom sample exceeds the remediation level, the excavation will be deepened in the area represented by

the sample by at least 1 foot, if feasible, followed by collection of a new bottom verification sample. Unmanageable dewatering rates, excavation bottom heaving, and/or other unstable excavation conditions could all affect the feasibility of over-excavation.

5.3.5 Off-Site Disposal of Contaminated Materials

All soil and debris removed that is designated by engineer as contaminated will be loaded and transported off-Site for disposal at a permitted Subtitle D landfill. Trucks transporting contaminated materials from the Site will comply with applicable state and federal regulations and local ordinances and will be covered from the time they are loaded on-Site until they off-load at the designated off-Site disposal facility.

5.3.6 Backfilling the Excavation

Once the interim action goal is met, the completed excavation will be backfilled to a predetermined final grade with a combination of excavated "clean" soils (stockpiled on site) and virgin aggregate imported from a Washington State Department of Transportation (WSDOT)-approved source. Imported backfill and compaction requirements will be determined by the geotechnical engineer of record.

6 Permits and Other Requirements

The interim action will be performed under the Agreed Order, and it is therefore exempt from the procedural requirements of Chapters 70.94 (Washington Clean Air Act), 70.95 (Solid Waste Management Act), 70.105 (Hazardous Waste Management Act), 90.48 (Water Pollution Control), and 90.58 (Shoreline Management Act) Revised Code of Washington (RCW), and of laws requiring or authorizing local government permits or approvals. However, the interim action must still comply with the substantive requirements of such permits or approvals (WAC 173-340-520). In addition, the interim action is not exempt from federal permits.

The starting point for Applicable or Relevant and Appropriate Requirements (ARARs) is MTCA regulations (Chapter 173-340 WAC) that address implementation of a cleanup and define cleanup standards under the MTCA statute (Chapter 173.105D RCW). Other ARARs include, but is not limited, to the following:

1. State Water Pollution Control Act (Chapter 90.48 RCW)
2. Water Resources Act (Chapter 90.54 RCW)
3. Applicable surface water quality criteria published in the water quality standards for surface waters of the State of Washington (Chapter 173-201A WAC)
4. Applicable surface water quality criteria published under Sections 303(c) and 304 of the Clean Water Act
5. Washington State Hazardous Waste Management Act (Chapter 70.105 RCW)
6. State Dangerous Waste Regulations (Chapter 173-303 WAC)
7. Solid Waste Management-Reduction and Recycling (Chapter 70.95 RCW)
8. Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 RCW)
9. Washington Clean Air Act (Chapter 70.94 RCW)
10. Puget Sound Clean Air Agency Regulations (http://www.pscleanair.org)
11. Occupational Safety and Health Act (OSHA), 29 CFR Subpart 1910.120
12. Washington Industrial Safety and Health Act (WISHA)
13. Shoreline Management Act (Chapter 90.58 RCW)
14. Archaeological and Cultural Resources Act (Chapter 27.53 RCW)
15. State Environmental Policy Act (SEPA; Chapter 43.21C RCW, Chapter 197-11 WAC, and Chapter WAC 173-802)

Section 6.1 describes the State Environmental Policy Act (SEPA) and permit substantive requirements applicable to conducting the interim action activities. No federal permits will be required because the interim action will be limited to the uplands (above MHHW)

and will not include any in-water work. Section 6.2 describes other requirements for conducting the interim action.

6.1 Permitting and Substantive Requirements

6.1.1 City of Seattle Master Use Permit

Because Site redevelopment activities will occur quickly following completion of the interim action cleanup, 5055 Properties LLC has applied for a City of Seattle (City) Master Use Permit (MUP) for the demolition of the existing building, the interim action, and initial redevelopment activities. The City's MUP process incorporates City of Seattle Shoreline Master Program (SMP) requirements and zoning requirements, and it includes public notice. The pending MUP covers demolition of the existing on-Site building, installation of the sheet pile shoring wall along the shoreline, the interim action (soil removal landward of shoring wall), and ground improvement and subgrade preparation to meet current seismic standards for the redevelopment. Construction of the new building is covered under a subsequent MUP. 5055 Properties LLC will obtain and comply with all provisions of the MUP.

6.1.2 State Environmental Policy Act (SEPA)

Compliance of the interim action activities with SEPA, Chapter 43.21C RCW, will be achieved by conducting a SEPA review in accordance with applicable regulatory requirements, including WAC 197-11-268, and Ecology guidance as presented in Ecology Policy 130A (Ecology, 2004). In accordance with the City of Seattle MUP permitting for this project, 5055 Properties LLC has undergone the preparation of a SEPA Checklist and SEPA review, which will be completed prior to interim action implementation, and will include a SEPA determination by the City of Seattle.

6.1.3 KCIW Discharge Authorization

5505 Properties LLC has obtained a KCIW minor discharge authorization to allow discharge to sanitary sewer of industrial wastewater (excavation dewatering water and stormwater runoff) generated during the interim action (Appendix B). The discharge authorization imposes maximum instantaneous and daily discharge volume limitations and numerical water quality limits for wastewater discharged. It also requires monitoring of the quantities and chemical quality of water discharged and submittal of the monitoring data to King County to demonstrate permit compliance. The discharge authorization is predicated on discharge during the dry season and is valid for the time period of June 1 through August 31, 2019. All project-generated wastewater will either infiltrate or be discharged to sanitary sewer; the project will not result in discharge to surface waters of Washington State.

6.1.4 City of Seattle Grading Permit

Soil excavations exceeding 50 cubic yards are subject to a grading permit from the City of Seattle Department of Construction and Inspections (SDCI). The grading permit is incorporated into the MUP. Substantive requirements of the grading permit include erosion control, which is addressed by implementation BMPs in accordance with the project-specific TESC Plan.

6.2 Other Requirements

This subsection provides a description of additional requirements that will be addressed during planning and execution of the interim action.

6.2.1 Monitoring Well Decommissioning

Groundwater monitoring wells located within the footprints of interim action excavation will be properly decommissioned, prior to start of excavation, in accordance with the requirements of Chapter 173-160 WAC. The need for replacement monitoring wells in the interim action area will be determined in consultation with Ecology when preparing the plan for groundwater compliance monitoring in accordance with the final Cleanup Action Plan (CAP) for the Site under the Agreed Order.

6.2.2 Archaeological Resources

The interim action excavation work will occur in the non-native fill underlain by native soils (Estuarine Unit). Therefore, there is a low likelihood for encountering archaeological materials. However, if the Estuarine Unit native soil horizon is encountered, the materials excavated from it and immediately above it will be observed closely by the environmental professional overseeing the interim action activities, with attention paid to looking for evidence of potential archaeological materials (e.g., animal bone, fire-modified rock (FMR), concentrations of shell, ground/flaked stone tools and flaked stone tool-making debris, burned earth, cordage or fiber, organically stained sediments, charcoal, ash, and exotic rocks and minerals).

According to the schedule in Section 8, a Cultural Resources Assessment and Inadvertent Discovery Plan will be submitted to Ecology prior to the interim action. If potential archaeological materials are observed in the excavation, work will be stopped, and 5055 Properties LLC will mobilize a professional archaeologist to the excavation location to observe and assess the materials encountered and determine the appropriate path forward in accordance with applicable laws and regulations.

7 Reporting

Within 90 days of completing the interim action construction activities and receipt of all construction reporting and laboratory analytical data, 5055 Properties LLC will submit to Ecology an Interim Action Report as required by the Agreed Order. Information provided in the Interim Action Report will include a description of the lateral and vertical limits of excavations, the volume of contaminated material removed/landfilled, how the contaminated media was managed, volume of groundwater pumped during excavation dewatering, and the performance monitoring data. Certificates of Disposal for the waste disposition will also be included.

The analytical data collected during the interim action will also be uploaded to Ecology's Environmental Information Management (EIM) database within 60 days after it being validated. The results of the interim action will also subsequently be incorporated into the Site RI and FS.

8 Schedule

The interim action includes design-related information to be submitted to Ecology. The submittals and their respective schedule for submitting to Ecology are listed below. The interim action will proceed after all project permitting is completed and after Ecology has reviewed and provided feedback (approval or acknowledgement of receipt) on all documents as follows:

Interim Action Submittal	**Submittal Schedule**
Project Plans and Technical Specifications	No more than 10 days after effective date of Agreed Order.
Excavation and Dewatering Plan (by Contractor)	No more than 10 days after effective date of Agreed Order.
Sampling and Analysis Plan for Additional Characterization	At least 30 days prior to sampling activities.
Shoring Design Plans (by Others)	No more than 10 days after effective date of Agreed Order.
Imported Fill Quality	At least 30 days prior to placement of any imported backfill.
Cultural Resources Assessment and Inadvertent Discovery Plan	No more than 10 days after effective date of Agreed Order.
Health and Safety Plan	No more than 10 days after effective date of Agreed Order.

The preliminary anticipated schedule of construction and Interim Action Work Plan milestones for the interim action are as follows:

- **March through July 2019** – Complete remedial design and contracting, Agreed Order and Public Review Draft IAWP public review, Agreed Order execution and Final IAWP.
- **July 2019** – Complete shoring wall installation.
- **August through September 2019** – Excavation and disposal of contaminated fill materials, dewatering and water management, and excavation backfill.

The implementation of interim action activities will not commence until Ecology approval of the Final IAWP. This schedule may be adjusted based on permitting, conditions encountered during the cleanup, and/or other factors.

9 References

Aspect Consulting, LLC (Aspect), 2017, Conceptual Phase Geotechnical Report, 5055 East Marginal Way S, July 20, 2017

Washington State Department of Ecology (Ecology), 2004, Toxics Cleanup Program Policy 130A, Coordination of SEPA and MTCA, Revised July 28, 2004.

Washington State Department of Ecology (Ecology), 2009, Lower Duwamish Waterway RM 0.9 to 1.0 East (Slip 1) Source Control Action Plan, May 2009.

Washington State Department of Ecology (Ecology), 2014a, Letter to Sir or Madam, Snopac Property, RE: Early Notice Letter: Facility Site # 1523145, Snopac Property. October 10, 2014.

Washington State Department of Ecology (Ecology), 2014b, Letter to Sir of Madam, Snopac Property, RE: Site Hazard Assessment – Snopac Property, Ecology FS ID: 1523145 / CD ID: 12463. November 26, 2014.

Washington State Department of Ecology (Ecology), 2016, Lower Duwamish Waterway Source Control Strategy, June 2016.

Washington State Department of Ecology (Ecology), 2017, Model Remedies for Sites with Petroleum Contaminated Soils, Revised December 2017.

Washington State Department of Ecology (Ecology), 2019, Lower Duwamish Waterway Preliminary Cleanup Level Workbook – Supplemental Information, April 5, 2019.

Windward Environmental (Windward), 2004, Data Report: Survey and Sampling of Lower Duwamish Waterway Seeps Final, November 18, 2004.

10 Limitations

Work for this project was performed for 5055 Properties LLC (Client), and this report was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

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TABLES

Table 1. Waste Characterization - Soil Analytical Results

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Project No. 150054, Snopac Site, Seattle, WA

Analyte	Units	Soil Cleanup Level (mg/kg)	Location: VSP-01 Sample Date: 11/12/2018 Sample Name: VSP-1-2.2 Sample Depth: 2.2 ft	VSP-02 11/12/2018 VSP-2-5.1 5.1 ft	VSP-03 11/12/2018 VSP-3-3.6 3.6 ft	VSP-04 11/12/2018 VSP-4-4.5 4.5 ft	VSP-05 11/12/2018 VSP-5-2.6 2.6 ft	VSP-06 11/13/2018 VSP-6-6.2 6.2 ft	VSP-07 11/12/2018 VSP-7-8.2 8.2 ft	VSP-08 11/12/2018 VSP-8-5.6 5.6 ft	VSP-09 11/12/2018 VSP-9-3.2 3.2 ft	VSP-10 11/13/2018 VSP-10-4.6 4.6 ft	VSP-11 11/12/2018 VSP-11-5.6 5.6 ft	VSP-12 11/12/2018 VSP-12-3.3 3.3 ft	VSP-13 11/13/2018 VSP-13-2.2 2.2 ft	VSP-14 11/12/2018 VSP-14-4.1 4.1 ft	VSP-15 11/12/2018 VSP-15-4.8 4.8 ft
Total Metals																	
Arsenic	mg/kg	7.3	**816**	**15.5**	**2.54**	**337**	**15.4**	**17.5**	**1.95**	**207**	**57**	**135**	**17.3**	**3880**	**1340**	**95.4**	**3.3**
Copper	mg/kg	36	**603**	**51.8**	**85.3**	**214**	**51.1**	**52.2**	**124**	**154**	**72.2**	**87.7**	**33.1**	**2540**	**803**	**107**	**21.7**
Lead	mg/kg	81	**605**	**221**	**5.08**	**268**	**99.9**	**69.7**	**4.88**	**179**	**154**	**124**	**52.5**	**2780**	**1130**	**157**	**22.9**
Nickel	mg/kg		< 50 U	**17.1**	**13 J**	< 25 U	**17.6**	**7.46**	**15.7 J**	**10.9**	**16.3**	**21**	**5.98**	< 125 U	< 50 U	**19.7**	**5.44**
Zinc	mg/kg	86	**2250**	**221**	**38.2**	**923**	**151**	**77.6**	**49.6**	**626**	**284**	**401**	**97.6**	**9700**	**3630**	**393**	**21.7**
PCB Aroclors																	
Aroclor 1016	mg/kg		--	< 0.02 U	--	--	--	< 0.02 U	--	< 0.02 U	--	--	--	--	--	< 0.02 U	--
Aroclor 1221	mg/kg		--	< 0.02 U	--	--	--	< 0.02 U	--	< 0.02 U	--	--	--	--	--	< 0.02 U	--
Aroclor 1232	mg/kg		--	< 0.02 U	--	--	--	< 0.02 U	--	< 0.02 U	--	--	--	--	--	< 0.02 U	--
Aroclor 1242	mg/kg		--	< 0.02 U	--	--	--	< 0.02 U	--	< 0.02 U	--	--	--	--	--	< 0.02 U	--
Aroclor 1248	mg/kg		--	< 0.02 U	--	--	--	< 0.02 U	--	< 0.02 U	--	--	--	--	--	< 0.02 U	--
Aroclor 1254	mg/kg		--	**0.044**	--	--	--	< 0.02 U	--	**0.24**	--	--	--	--	--	**0.37**	--
Aroclor 1260	mg/kg		--	**0.064**	--	--	--	< 0.02 U	--	< 0.02 U	--	--	--	--	--	< 0.02 U	--
Aroclor 1262	mg/kg		--	< 0.02 U	--	--	--	< 0.02 U	--	< 0.02 U	--	--	--	--	--	< 0.02 U	--
Aroclor 1268	mg/kg		--	< 0.02 U	--	--	--	< 0.02 U	--	< 0.02 U	--	--	--	--	--	< 0.02 U	--
Total PCB Aroclors	mg/kg	0.2	--	**0.11**	--	--	--	na	--	**0.24**	--	--	--	--	--	**0.37**	--
TCLP Metals																	
Arsenic	mg/L		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Barium	mg/L		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Cadmium	mg/L		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Chromium	mg/L		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Lead	mg/L		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Mercury	mg/L		< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U	< 0.1 U
Selenium	mg/L		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Silver	mg/L		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U

Notes

Bold - detected

Blue highlight - exceeded soil cleanup level

U - not detected at or above the reporting limit shown

J - estimated concentration

Table 2. Soil Remediation Levels for Interim Action

DRAFT

Project 150054 - Snopac Site, Seattle, WA

Indicator Hazardous Substance	Soil Remediation Levels (mg/kg)	
	Vadose Zone Soil	Saturated Zone Soil
Metals		
Arsenic	7.3	7.3
Copper	36	36
Lead	250	250
Mercury	0.07	0.07
Zinc	100	85
Polycyclic Aromatic Hydrocarbons (PAH)		
1-Methylnaphthalene	29	29
2-Methylnaphthalene	0.67	0.67
Acenaphthene	0.5	0.028
Acenaphthylene	1.3	1.3
Anthracene	0.96	0.051
Chrysene	0.13	0.13
Fluoranthene	1.7	0.09
Fluorene	0.54	0.029
Naphthalene	0.039	0.0021
Phenanthrene	1.5	1.5
Pyrene	2.6	0.14
Total HPAHs	12	12
Total LPAHs	5.2	5.2
Total cPAHs TEQ	0.00031	0.000016
Polychlorinated Biphenyls (PCB)		
Total PCB Aroclors	0.000043	0.0000022
Total Petroleum Hydrocarbons (TPH)[4]		
Gasoline Range Organics	1,500	1,500
Diesel Range Organics		
Motor Oil Range Organics		

Notes

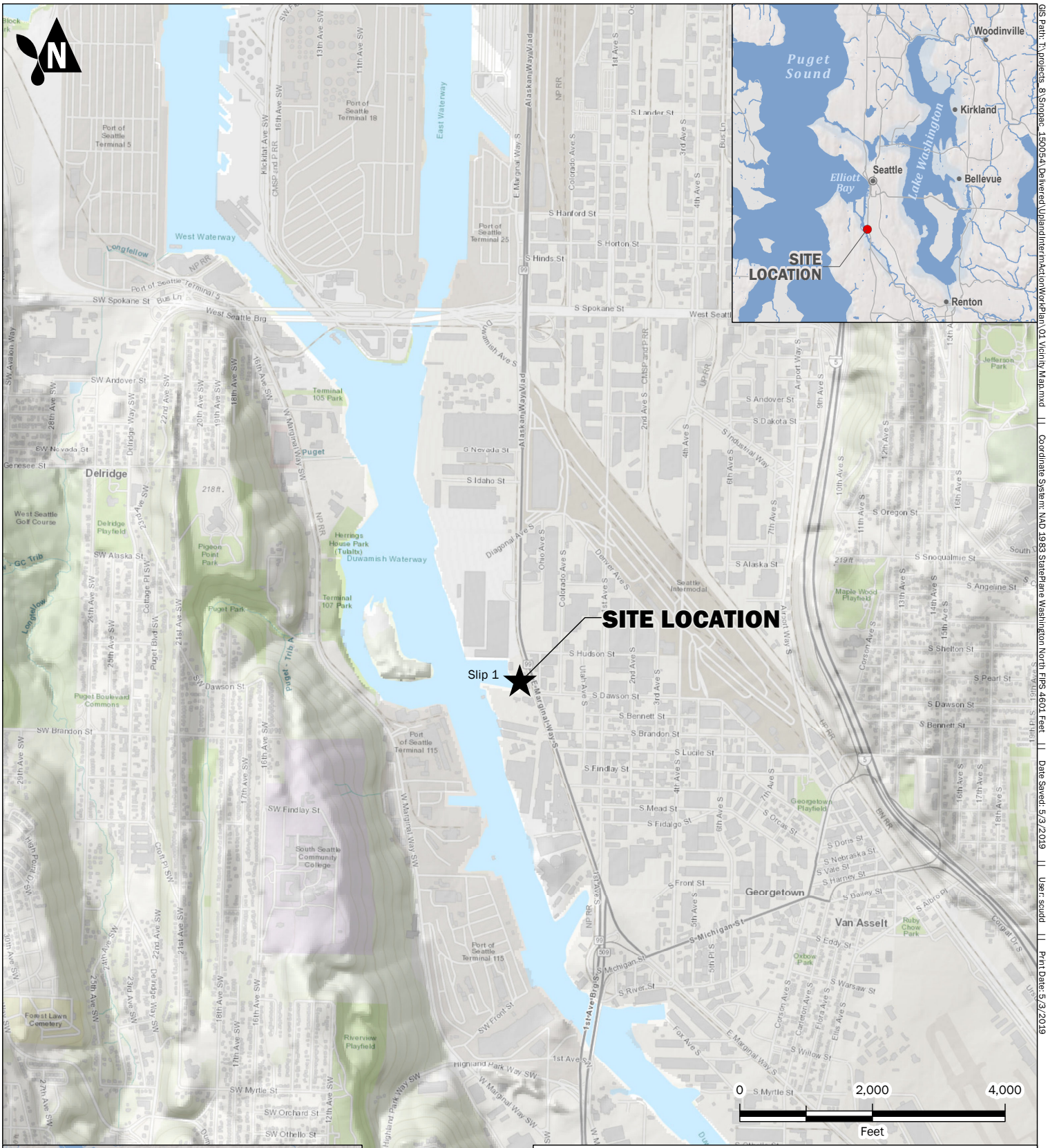
1. All concentrations are in milligrams per kilogram (mg/kg).

2. Remediation levels are based on the Preliminary Cleanup Levels Workbook for the Lower Duwamish Waterway (Ecology, 2018). A combined TPH remediation level is based on the generic direct contact cleanup level of 1,500 mg/kg. (Ecology, 2017).

3. TEQ: Total toxic equivalent concentration of benzo(a)pyrene, calculated in accordance with WAC 173-340-708(8)(e).

4. Performance samples will only analyzed in the area of MW-2, the only location where results exceeded the direct contact TPH combined cleanup level.

FIGURES



Vicinity Map

Snopac Site
Interim Action Work Plan
5055 Properties, LLC
Seattle, Washington

Aspect CONSULTING	MAY-2019	BY: MLK / RAP / SCC	FIGURE NO. 1
	PROJECT NO. 150054	REVISED BY: SCC	

Basemap Layer Credits | | Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community
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GIS Path: T:\projects_8\Snopac_150054\Delivered\Upland\InterimActionWorkPlan\01 Vicinity Map.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 5/3/2019 || User: scudd || Print Date: 5/3/2019

LEGEND

- A — A' : CROSS-SECTION LOCATION
- EXISTING MONITORING WELL TO BE DECOMMISSIONED
- EXISTING MONITORING WELL TO BE PROTECTED OR DECOMMISSIONED AND REPLACED
- WASTE CHARACTERIZATION TEST PIT LOCATION
- ESTIMATED EXTENT OF EXCAVATION (NOTE 1)
- PROPERTY BOUNDARY
- PARCEL LINE
- SHEET PILE SHORING WALL
- OHW — OHW : ORDINARY HIGH WATER MARK
- SD : EXISTING STORM DRAIN LINE
- 18 : EXISTING TOPOGRAPHY

NOTE: ESTIMATED EXTENT OF EXCAVATION EAST OF SHEET PILE WALL IS BASED ON A MAXIMUM EXCAVATION DEPTH OF 13 FEET AND THE GEOTECHNICAL ENGINEER'S RECOMMENDED MAXIMUM SLOPE OF 1.5H:1V FOR EXCAVATION SIDEWALLS.

0 40 80 Feet

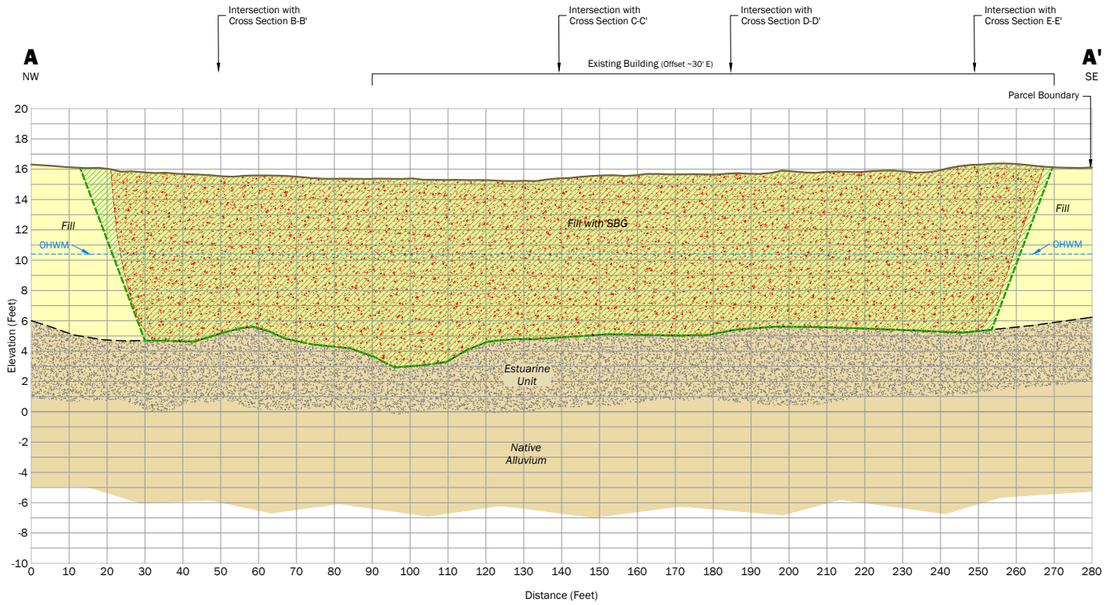
SCALE: 1" = 40'

Removal Action Plan

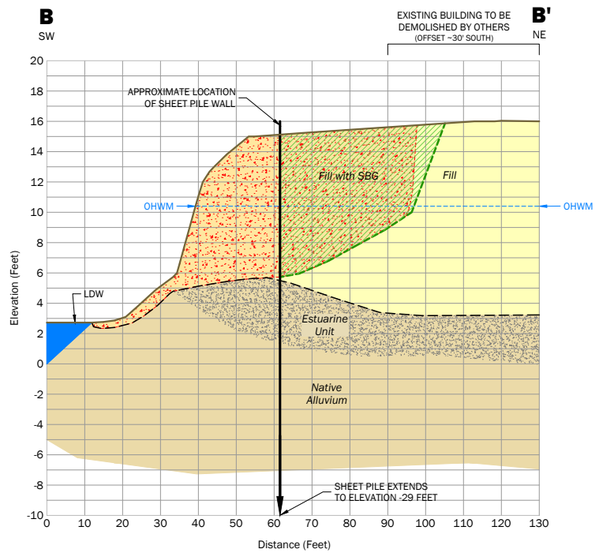
Snopac Site
Interim Action Work Plan
5055 Properties, LLC
Seattle, Washington

Aspect Consulting	May-2019	BY: DAH/SCC	FIGURE NO. 2
	PROJECT NO. 150054	REVISED BY: SCC	

CAD Path: Q:\Snopac Products\150054 Snopac Mansion\2019-03 Upland Interim Action Work Plan\150054-02.dwg 02 Removal Action Plan || Date Saved: May 08, 2019 3:11pm || User: scudd



CROSS SECTION A-A'



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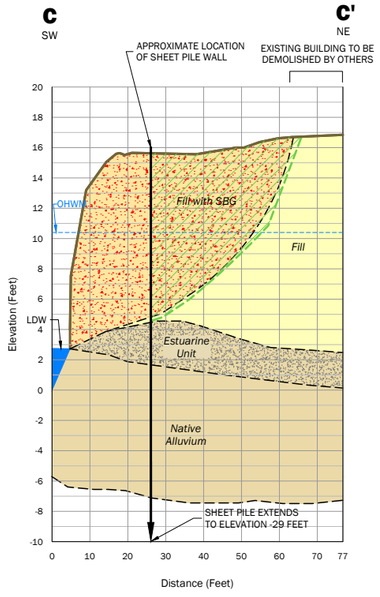

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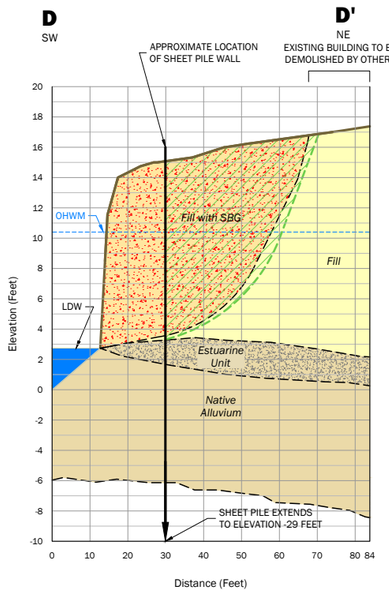

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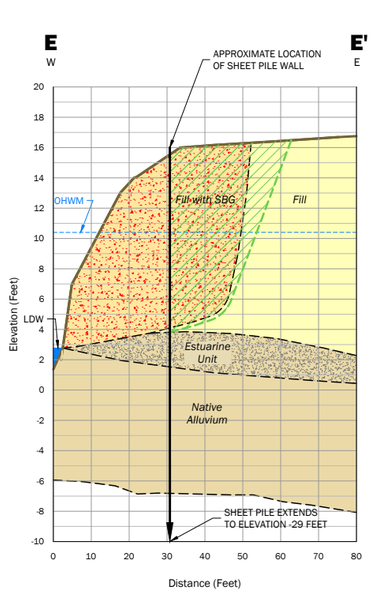


CROSS SECTION E-E'

EXISTING GRADE

GEOLOGIC CONTACT

OHWM — ORDINARY HIGH WATER MARK (ESA, 2018)

LDW — LOWER DUWAMISH WATERWAY

SBG — SANDBLAST GRIT

ESTIMATED EXTENT OF SOILS TO BE EXCAVATED AND DISPOSED OFF-SITE

FILL UNIT
BLACK TO BROWN, GRAVELLY, SILTY, SAND WITH INTERSPERSED BRICK, WOOD CHIPS, GLASS, AND TRACE PAINT CHIPS AND COAL

FILL WITH SANDBLAST GRIT

ESTUARINE UNIT
BROWN, SILTY SAND WITH ABUNDANT WOODY DEBRIS AND SLIGHT SULFUR-LIKE ODOR

NATIVE ALLUVIUM UNIT
BROWN TO GRAY, POORLY GRADED SAND TO SILTY SAND WITH TRACE ORGANICS

NOTE: DEPICTIONS OF LITHOLOGY AND EXTENT OF FILL AND FILL CONTAINING SANDBLAST GRIT ARE BASED ON DATA FROM PREVIOUS SITE EVALUATIONS.

Horizontal Scale: 1" = 40'
Vertical Scale: 1" = 8'
Vertical Exaggeration 5x

0 40 80 Feet

Removal Action Cross Sections

Snopac Site
Interim Action Work Plan
5055 Properties, LLC
Seattle, Washington

Aspect Consulting	May-2019	BY: DAH/SCC	FIGURE NO. 3
	PROJECT NO. 150054	REVISED BY: -	

Date Saved: May 08, 2019 3:08pm || User: scudd

CAD Path: Q:\Snopac Products\150054 Snopac Manson\2019-03 Upland Interim Action Work Plan\150054-02.dwg 03 Removal Action Cross Sections || Date Saved:

APPENDIX A

Sampling and Analysis Plan for Performance Monitoring

A. Sampling and Analysis Plan

The purpose of this Sampling and Analysis Plan (SAP) is to ensure that field sample collection, handling, and laboratory analysis conducted during performance monitoring for the interim action soil remediation will generate data to meet project-specific data quality objectives in accordance with Model Toxics Control Act (MTCA) requirements (WAC 173-340-350).

This SAP is comprised of two major components: a Field Sampling Plan (FSP; Section 1) defining field sampling protocols and a Quality Assurance Project Plan (QAPP; Section 2) defining analytical protocols. It is the responsibility of the Aspect Consulting, LLC (Aspect) personnel and subcontracted analytical laboratory personnel performing the compliance monitoring activities to adhere to the requirements of the FSP and QAPP.

A.1. Field Sampling Plan

A.1.1. Soil Sampling Procedures

As described in Section 5.3 of this Interim Action Work Plan, Aspect will collect two types of soil samples during the interim action: (1) verification soil samples from the excavation perimeter to determine compliance with soil cleanup levels (performance monitoring) and (2) samples of soil lacking evidence of contamination (in the course of excavating contaminated fill soil), termed potential clean soil, to determine whether it meets remediation levels and thus be used as excavation backfill. Both types of soil samples will be submitted for chemical analysis of analytes proposed for interim action performance monitoring (Section 4).

Potential Clean Soil. Stockpiles of potential clean soil will not exceed 20 cubic yards in size for the purpose of designation testing for disposition. Each stockpile will have one representative five-point composite sample collected by hand using a decontaminated stainless-steel spoon or disposable spoon to determine its disposition as clean soil or contaminated soil for off-Site disposal. The five subsamples being composited will be collected from a minimum of 6 inches below the outer surface of the stockpile at each location. The subsample volumes will be homogenized in a decontaminated stainless-steel bowl prior to placement of the representative composite sample into laboratory-supplied containers.

Excavation Performance Monitoring Samples. Excavation sidewall and bottom verification soil samples will be collected for laboratory analysis to confirm compliance with the cleanup levels. The performance samples will be discrete grab samples of soil collected from within the excavation using the excavator bucket, or, if safely accessible to a worker, by hand using a decontaminated stainless-steel spoon or disposable spoon. Locations for the excavation verification samples to be collected are as follows:

- The excavation bottom verification samples will be collected on a systematic 20-foot grid (one sample per 20-foot by 20-foot square), with a minimum of 12 bottom samples, to document that the remediation level is met at depth.
- The excavation sidewall verification samples will be collected at the same 20-foot grid spacing and at 4-foot depth intervals of 0 to 4 feet and 4 to 8 feet. Depths below 8 feet will be verified with bottom samples based on estimated depth of excavation away from the shoring wall. All soil will be removed up to the shoring wall forming the west side of the excavation, and therefore there will be no verification samples collected from the western excavation sidewall.
- The TPH results exceeded the direct contact TPH remediation level at one location: MW-2. Therefore, only performance monitoring samples in the vicinity of the MW-2 location will be analyzed for TPH.

A.1.2. Investigation-Derived Waste and Decontamination

All non-disposable sampling equipment (stainless steel spoons and bowls) will be decontaminated before collection of each sample. The decontamination sequence consists of a scrub with a non-phosphate (Alconox) solution, followed by tap water (potable) rinse, and finished with thorough spraying with deionized or distilled water. A solvent rinse—methanol or hexane—may be used to remove heavy petroleum product, if present, from sampling equipment prior to the decontamination procedure described above.

All investigation-derived waste (IDW) including personal protective equipment (PPE) from the interim action will be placed in labeled DOT-approved drums pending the analytical results to determine appropriate disposal. Each drum will be labeled with the following information:

- Non-Classified IDW
- Content of the drum
- Date IDW was generated; and
- Name and telephone number of the contact person.

The drums of IDW will be temporarily consolidated on-site, profiled (in accordance with applicable waste regulations) based on available analytical data, and disposed of appropriately at a permitted off-site disposal facility. Containers of IDW will be on site less than 90 days from date of generation. Documentation for off-site disposal of IDW will be maintained in the project file.

A.1.3. Sampling Documentation Procedures

A.1.3.1. Field Documentation

While conducting field work, the field representative will document pertinent observations and events on field forms specific to each activity in a field notebook, and, when warranted, provide photographic documentation of specific sampling efforts. Field notes will include a description of each field activity, sample descriptions, and associated details such as the date, time, and field conditions.

A.1.3.2. Sample Labeling and Nomenclature

Sample labels will clearly indicate the soil sample identification (which will include the soil sample number and sample date), sampler's initials, and any pertinent comments.

A.1.3.3. Sample Handling and Custody

Upon collection, each sample collected for chemical analysis will be placed in a laboratory-provided sample container and placed upright in a cooler. Ice or Blue Ice will be placed in each cooler to meet sample preservation requirements. Inert cushioning material will be placed in the remaining space of the cooler as needed to limit movement of the sample containers. Once the samples and completed chain-of-custody form (described below) are in the cooler, it will be taped shut prior to transport to the laboratory.

After collection, samples will be maintained in the consultant's custody until formally transferred to the analytical laboratory. For purposes of this work, custody of the samples will be defined as follows:

- In plain view of the field representatives;
- Inside a cooler that is in plain view of the field representative; or
- Inside any locked space such as a cooler, locker, car, or truck to which the field representative has the only immediately available key(s).

A chain-of-custody record provided by the laboratory will prepared for all samples collected, and it will be signed by the field representative and others who subsequently take custody of the sample. Couriers or other professional shipping representatives are not required to sign the chain-of-custody form; however, shipping receipts will be collected and maintained as a part of custody documentation in project files. The analytical laboratory's data report will include a copy of the fully executed chain-of-custody form for the samples in the report.

Upon sample receipt, the laboratory will fill out a cooler receipt form to document sample delivery conditions. A designated sample custodian will accept custody of the shipped samples and will verify that the chain-of-custody form matches the samples received. The laboratory will notify the consultant project manager of any issues noted with the sample shipment or custody as soon as possible.

A.2. Quality Assurance Project Plan

The purpose of the QAPP is to define, in specific terms, the quality assurance (QA) and quality control (QC) objectives, organization, and functional activities associated with the sampling and analysis of soil samples collected during the remedial excavation and groundwater compliance monitoring samples.

Friedman & Bruya Inc. of Seattle, Washington, is the Washington Department of Ecology (Ecology)-accredited analytical laboratory that will conduct the analyses of soil samples collected during the interim action. Friedman & Bruya will subcontract to ALS-Kelso analytical laboratory to conduct the tributyl tin analyses.

A.2.1. Analytes and Analytical Procedures

Soil samples for the interim action will be analyzed for the interim action analytes: metals (arsenic, copper, lead, mercury, and zinc), polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). Select samples in the vicinity of the MW-2 location will be analyzed for TPH. Table A-1 lists the laboratory analytical methods for soil analyses to be performed during the interim action, along with samples containers, preservation, and analytical holding times for each analysis.

A.2.2. Data Quality Objective and Indicators

The data quality objective for this project is to reliably document compliance with the interim action soil remediation levels at the end of the remedial excavation.

Data quality indicators (DQIs), including precision, accuracy, representativeness, comparability, and completeness (PARCC parameters), and data RLs are dictated by the data quality objectives, project requirements, and intended uses of the data. An assessment of data quality is based upon quantitative (precision, accuracy, and completeness) and qualitative (representativeness and comparability) indicators. Definitions of these parameters and the applicable QC procedures are presented below.

A.2.2.1. Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements compared with their average values. Analytical precision measurements will be carried out at a minimum frequency of 1 per 20 samples or one per laboratory analysis group. Laboratory precision will be evaluated against laboratory quantitative RPD performance criteria provided with the lab's analytical data report.

A.2.2.2. Accuracy

Accuracy measures the closeness of the measured value to the true value. The accuracy of chemical test results is assessed by "spiking" samples with known surrogates and establishing the recovery. Surrogate recoveries will be determined for each sample analyzed. Laboratory accuracy will be evaluated against the lab's quantitative surrogate recovery performance criteria as provided with the lab's analytical data report.

A.2.2.3. Representativeness

Representativeness measures how closely the measured results reflect the actual concentration or distribution of the chemical compounds in the matrix sampled. The sampling plan design, sampling techniques, and sample handling protocols (e.g., homogenizing, storage, and preservation) have been developed to ensure representative samples.

A.2.2.4. Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The use of standard techniques for both sample collection and laboratory analysis should make data collected comparable to internal data generated for this project as well as preexisting analytical data that may exist.

A.2.2.5. Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid measurements. Results will be considered valid if all the precision, accuracy, and representativeness objectives are met and if RLs are sufficient for the intended uses of the data. The target completeness goal for this project is 95 percent.

Laboratory internal QC checks, preventive maintenance, and corrective action, as described in other sections of this document, will be implemented to help meet the QA objectives established for these analyses.

A.2.3. Quality Control Procedures

Field and laboratory QC procedures are outlined below.

A.2.3.1. Field Quality Control

The use of standardized field sampling protocols is defined in Section A.1, no additional field QC procedures are planned for this project.

A.2.3.2. Laboratory Quality Control

The laboratory's QA officers are responsible for ensuring that the laboratory implements all routine internal QC and QA procedures. The laboratory QC procedures used for this project will consist of the following at a minimum:

- Instrument calibration and standards as defined in the laboratory standard operating procedures (SOPs)
- Laboratory blank measurements at a minimum frequency of 5 percent or one per twenty samples
- Accuracy and precision measurements as defined above, at a minimum frequency of 5 percent or one per twenty samples per matrix

A.2.4. Corrective Actions

If routine QC audits by the laboratory detect unacceptable conditions or data, actions specified in the laboratory SOPs will be taken. Specific corrective actions are outlined in each SOP used and can include the following:

- Identifying the source of the violation
- Reanalyzing samples if holding time criteria permit
- Resampling and analyzing
- Evaluating and amending sampling and analytical procedures
- Accepting, but qualifying data to indicate the level of uncertainty

If unacceptable conditions occur, the laboratory will contact the consultant's project manager to discuss the issues and determine the appropriate corrective action. All corrective actions taken by the laboratory during analysis of samples for this project will be documented by the laboratory in the case narrative associated with the affected samples.

A.2.5. Data Quality Review and Reporting

All data will undergo two levels of QA/QC evaluation: one at the laboratory and one by a validator independent of the laboratory. Initial data QC evaluation and reporting at the laboratory will be carried out as described in the appropriate analytical protocols. Quality control data resulting from methods and procedures described in this document will also be reported.

A.2.5.1. Minimum Data Reporting Requirements

The following sections describe the minimum data reporting requirements necessary to allow proper QA/QC reporting.

Sample Receipt. Cooler receipt forms will be filled out for all sample shipments to document problems in sample packaging, chain of custody, and sample preservation.

Reporting. For each analytical method run, analytes for each sample will be reported as a detected concentration or as less than the specific RL. The laboratory will report dilution factors for each sample as well as date of extraction (if applicable), date of analysis, extraction method, additional sample preparation methods performed if any, and confirmation results where required.

Internal Quality Control Reporting. The following internal quality control samples will be analyzed at the rates specified in the applicable method:

- *Laboratory Method Blanks.* Analytes will be reported for each laboratory blank. Nonblank sample results will be designated as corresponding to a particular laboratory blank in terms of analytical batch processing.
- *Surrogate Spike Samples.* Surrogate spike recoveries will be reported for each sample analyzed for TBT, PAHs, and PCBs. The report shall also specify the control limits for surrogate spike results as well as the spiking concentration.

Spike recoveries outside of specified control limits (as defined in the laboratory SOP) will result in the sample being rerun.

- *Laboratory Duplicate Pairs*. Relative percent differences will be reported for duplicate pairs relative to analyte/matrix-specific control limits defined in the laboratory SOP.

A.2.5.2. Data Quality Review

Reported analytical results will be qualified by the laboratory to identify QC concerns in accordance with the specifications of the analytical methods and the laboratory's SOPs. Additional laboratory data qualifiers may be defined and reported by the laboratory to more completely explain QC concerns regarding a particular sample result. All additional data qualifiers will be defined in the laboratory's narrative reports associated with each case.

Aspect will prepare an independent Stage 2A data quality review for all analytical data generated for this project. The data quality review will be performed in accordance with U.S. Environmental Protection Agency (EPA) *National Functional Guidelines for Inorganic Data Review* (EPA, 2017a), *National Functional Guidelines for Organic Data Review* (EPA, 2017b), and laboratory-defined QC limits, with regard to the following, as appropriate to the particular analysis:

- Sample documentation/custody
- Holding times
- Method blanks (representativeness)
- Reporting limits
- Surrogate percent recoveries (accuracy)
- Laboratory duplicate pair RPDs (precision)
- Comparability
- Completeness

Data qualifiers will be assigned based on outcome of the data validation. Data qualifiers are limited to and defined as follows:

- U – The analyte was analyzed for but was determined to be nondetect above the reported sample quantitation limit, or the quantitation limit was raised to the concentration found in the sample due to blank contamination.
- J – The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
- UJ – The analyte was not detected above the reported quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

- R – The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the analyte cannot be verified.
- DNR – Do not report from this analysis; the result for this analyte is to be reported from an alternative analysis.

In cases of multiple analyses (such as an undiluted and a diluted analysis) performed on one sample, the optimal result will be determined and only the determined result will be reported for the sample.

A.2.6. Preventative Maintenance Procedures and Schedules

Preventative maintenance in the laboratory will be the responsibility of the laboratory personnel and analysts. This maintenance includes routine care and cleaning of instruments, and inspection and monitoring of carrier gases, solvents, and glassware used in analyses. Details of the maintenance procedures are addressed in the respective laboratory SOPs.

Precision and accuracy data are examined for trends and excursions beyond control limits to determine evidence of instrument malfunction. Maintenance will be performed when an instrument begins to change as indicated by the degradation of peak resolution, shift in calibration curves, decrease in sensitivity, or failure to meet one or another of the method-specific QC criteria.

A.2.7. Performance and Systems Audits

The consultant's project manager has responsibility for performance of the laboratory QA program. This will be achieved through regular contact with the analytical laboratory's project manager. To ensure comparable data, all samples of a given matrix to be analyzed by each specified analytical method will be processed consistently by the same analytical laboratory.

A.3. References for Appendix A

U.S. Environmental Protection Agency (EPA), 2017a, National Functional Guidelines for Inorganic Superfund Methods Data Review, Office of Superfund Remediation and Technical Innovation, U.S. Environmental Protection Agency, USEPA-540- R-2017-001, January 2017.

U.S. Environmental Protection Agency (EPA), 2017b, National Functional Guidelines for Organic Superfund Methods Data Review, Office of Superfund Remediation and Technical Innovation, U.S. Environmental Protection Agency, USEPA-540-R- 2017-002, January 2017.

TABLES

Table A-1. Analytical Methods, Sample Containers, Preservation, and Holding Times

Project No. 150054, Snopac Site, Seattle, WA

Sample Matrix	Analytical Parameter	Analytical Method	Sample Container	No. Containers	Preservation Requirements	Holding Time
Soil	Total Metals (As, Cu, Pb, Hg, Zn)	Method 200.8	4 ounce jar	1	4°C ±2°C	6 months
	Low-level PAHs	Method 8270D-SIM	4 ounce jar	1	4°C ±2°C	14 days for extraction; 40 days
	PCBs	Method 8082A	4 ounce jar	1	4°C ±2°C	14 days for extraction; 40 days
	Gasoline-range TPH	NWTPH-Gx	Method 5035A, 40-mL vials	4	4°C ±2°C	14 days
	Diesel and Motor Oil-range TPH	NWTPH-Dx	4 ounce jar	1	4°C ±2°C	14 days for extraction; 40 days for analysis

APPENDIX B

King County Industrial Waste Program Issuance of Wastewater Authorization No. 1092-01

King County
Wastewater Treatment Division
Industrial Waste Program
Department of Natural Resources and Parks
201 South Jackson Street, Suite 513
Seattle, WA 98104-3855
206-477-5300 Fax 206-263-3001
TTY Relay: 711

March 18, 2019

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Gary Hendricks
Manson Construction Co.
5209 E Marginal Way S
Seattle,WA 98134

Issuance of Wastewater Discharge Authorization No. 1092-01 to 5055 Properties, LLC

Dear Mr. Hendricks:

The King County Industrial Waste Program (KCIW) has reviewed your application to discharge construction dewatering to the sewer system from the 5055 Properties, LLC located at 5055 E Marginal Way S, Seattle, Washington, and has issued the enclosed Minor Discharge Authorization.

This authorization permits you to discharge limited amounts of industrial wastewater into King County's sewer system in accordance with the effluent limitations and other requirements and conditions set forth in the document and the regulations outlined in King County Code 28.84.060 (enclosed). As long as you maintain compliance with regulations and do not change the nature and volume of your discharge, KCIW will not require you to apply for an industrial wastewater discharge permit, a type of approval that would result in additional requirements and increased fees.

If you propose to increase the volume of your discharge or change the type or quantities of substances discharged, you must contact KCIW at least 60 days before making these changes.

King County Code 28.84 authorizes a fee for each Minor Discharge Authorization issued by the King County Department of Natural Resources and Parks. The current fee for issuance of a Minor Discharge Authorization is $1750. King County will send you an invoice for this amount.

If you have any questions about this discharge authorization or your wastewater discharge, please call me at 206-477-5426 or email me at todd.gowing@kingcounty.gov. You may also wish to visit our program's Internet pages at: www.kingcounty.gov/industrialwaste.

Thank you for helping support our mission to protect public health and enhance the environment.

Sincerely,

Todd Gowing
Compliance Investigator

Enclosures

cc: Jim Mahady, Seattle Public Utilities
Mark Lampard, King County

King County

MINOR DISCHARGE AUTHORIZATION
King County Industrial Waste Program
201 S. Jackson Street, Suite 513
Seattle, WA 98104-3855

NUMBER 1092-01
for

5055 Properties, LLC

Site address: 5055 E Marginal Way S
Seattle, Washington

Mailing address: 5209 E Marginal Way S
Seattle,WA 98134

Phone: 206-762-0850

Emergency (24-hour) phone: 206-780-7746

Industry type: Construction Dewatering

Discharge to: West Point

*Note: This authorization is valid only for the specific discharges shown below:

Discharge process: Wastewater generated by Construction Dewatering operation

Pretreatment process: Gravity separation

Maximum discharge volume: 72,000 gallons per day
Maximum discharge rate: 100 gallons per minute

Effective date: June 1, 2019
Expiration date: August 31, 2019

Permission is hereby granted to discharge industrial wastewater from the above-identified facility into the King County sewer system in accordance with the effluent limitations and monitoring requirements set forth in this authorization.

If the industrial user wishes to continue to discharge after the expiration date, an application must be filed for re-issuance of this discharge authorization at least 90 days prior to the expiration date. For information concerning this King County Discharge Authorization please call Industrial Waste Compliance Investigator Todd Gowing at 206-477-5426.

24-HOUR EMERGENCY NOTIFICATION
West Point Treatment Plant: 206-263-3801
Washington State Department of Ecology: 425-649-7000

SPECIAL CONDITIONS

A. Discharge point is manhole number KCMH EBI3.04 of the King County Elliot Bay Interceptor. The contractor shall take the following safety precautions:

1. The discharge from the settling tank to manhole number KCMH EBI3.04 must be hard-plumbed and fitted with a 90-degree pipe and must extend at least three feet into the manhole.

2. A temporary cover must be placed over the manhole.

3. Temporary fencing must be placed around the manhole to restrict accessibility.

B. The engineering report or dewatering plan submitted with the permit application lacked sufficient details on wastewater pretreatment. Before discharge to the sanitary sewer begins, the permittee shall resubmit the 5055 Properties, LLC engineering report or dewatering plan for KCIW review and approval. The engineering report or dewatering plan needs to be revised to provide additional detail on the following aspects of pretreatment:

1. A schematic flow diagram for the proposed wastewater pretreatment system(s) illustrating the system piping, tanks, and control features. This diagram(s) should clearly indicate how each waste stream will be treated, plumbed, and discharged to the sewer.

2. Basic design data and sizing calculations of the pretreatment system components; for example, pump specifications, including maximum discharge rate in gallons per minute (the maximum discharge rate of the piping-pump system must be compatible with the instantaneous maximum flow rate for the pretreatment system), tanks, oil/water separator, GAC media, mixers, etc.

3. Description of your treatment process including the amount and kind of chemicals used in the treatment process (if applicable)

4. The general operations and the set points of all control features

5. A discussion of the method of final sludge or solid waste disposal selected

6. Provide contingency actions(s) to be taken if dewatering volumes exceed the permitted daily discharge volumes specified in this permit. Please note that violating the permitted discharge volume limitations is not an acceptable contingency.

C. No later than June 15, 2019, the permittee must submit a list of 5055 Properties, LLC and contractor personnel responsible for dewatering activities, including operation and maintenance of the wastewater treatment system and monitoring of the discharge to the sanitary sewer. The list shall include the site contacts' name, title, company, and phone numbers (office and cell).

D. Discharge to the sanitary sewer shall not begin until KCIW has conducted a preoperative inspection of the pretreatment facilities and has sent written notification (email is sufficient) to the permittee that discharges may begin.

E. All persons responsible for monitoring the discharge to the sanitary sewer shall review a copy of this authorization.

F. A copy of this authorization shall be on site at all times for review and reference.

G. This authorization grants the discharge of limited amounts of wastewater from the following waste streams:

1. Contaminated stormwater runoff
2. Excavation dewatering

Wastes or contaminants from sources other than permitted herein shall not be discharged to the sanitary sewer without prior approval from KCIW.

H. The discharge shall not cause hydraulic overloading conditions of the sewerage conveyance system. During periods of peak hydraulic loading KCIW and Seattle Public Utilities representatives reserve the authority to request that discharge to the sewer be stopped.

I. All wastewater shall be collected and treated in accordance with treatment methods approved by KCIW. Wastewater shall not bypass treatment systems. Modifications to wastewater treatment systems shall not occur without prior approval from KCIW.

J. Totalizing and non-resettable flow meters must be installed on all permitted discharge pipes to the sewer.

K. An accessible sampling spigot must be installed on the discharge pipe from the last treatment unit of the wastewater treatment system. The sample site shall be representative of all industrial waste streams discharged to the sewer from this site. Each sample site shall be accessible to KCIW representatives when discharge to the sewer is occurring.

L. The contractor shall implement erosion control best management practices to minimize the amount of solids discharged to the sanitary sewer system. As a minimum precaution, the wastewater must be pumped to an appropriately sized settling tank(s) prior to entering the sewer system.

M. The permittee shall properly operate and maintain all wastewater treatment units to ensure compliance with established discharge limits. Solids accumulation in tanks used for solids settling shall not exceed 25 percent of the tank's working hydraulic capacity. Each tank's working hydraulic capacity is based on the water column height as measured from the bottom of the tank to either the invert elevation of the tank's outlet pipe (gravity discharges) or discharge pump intake (pumped discharges).

N. Results of all required self-monitoring sampling must be recorded daily. Recorded information for each discharge site must include:

1. Sample date
2. Sample time
3. Sample results
4. Operator name
5. Comments (if applicable)

These records shall be maintained on site and shall be available for review by KCIW personnel during normal business hours.

O. The permittee must establish a sewer account with Seattle Public Utilities and provide necessary reports to ensure accurate assessment of sewer charges for all construction dewatering discharge sites associated with this project.

SELF-MONITORING REQUIREMENTS

A. The following self-monitoring requirements shall be met for this discharge authorization:

Parameter	Frequency	Sample Type/Method
Discharge volume	Daily	In-line flow meter
Discharge rate	Daily	In-line flow meter
Settleable solids	Daily	Grab by Imhoff cone
pH	Daily	Hand-held meter
Nonpolar FOG	Daily	3 Grabs
Arsenic	Weekly	Composite
Chromium	Weekly	Composite
Copper	Weekly	Composite
Lead	Weekly	Composite
Mercury	Weekly	Composite
Nickle	Weekly	Composite
Zinc	Weekly	Composite
PAH	Monthly	Composite

B. The settleable solids field test by Imhoff cone must be performed as follows:

1. Fill cone to one-liter mark with well-mixed sample
2. Allow 45 minutes to settle
3. Gently stir sides of cone with a rod or by spinning; settle 15 minutes longer
4. Record volume of settleable matter in the cone as ml/L

C. The three nonpolar fats, oils, and grease (FOG) grab samples shall be of equal volume, collected at least five minutes apart, and analyzed separately. When using U.S. Environmental Protection Agency approved protocols specified in 40 CFR Part 136, the individual grab samples may be composited (at the laboratory) prior to analysis. The result of the composite sample or the average of the concentrations of the three grab samples may be reported as Total FOG unless the value is 100 mg/L or greater, in which case the concentration of nonpolar FOG must be reported.

D. If a violation of any discharge limits or operating criteria is detected in monitoring, you shall notify KCIW immediately upon receipt of analytical data.

E. You shall submit an end-of project self-monitoring report (form enclosed) within 15 days from completion of all construction dewatering activities to the sewer or by **September 15, 2019**, whichever comes first. The report must contain results of required self-monitoring and total volume discharged to the sewer.

F. All self-monitoring data submitted to KCIW, which required a laboratory analysis, must have been performed by a laboratory accredited by the Washington State Department of Ecology for each parameter tested, using procedures approved by 40 CFR 136. This does not apply to field measurements performed by the industrial user such as pH, temperature, flow,

atmospheric hydrogen sulfide, total dissolved sulfides, total settleable solids by Imhoff cone, or process control information.

G. All sampling data collected by the permittee and analyzed using procedures approved by 40 CFR 136, or approved alternatives, shall be submitted to KCIW whether required as part of this authorization or done voluntarily by the permittee.

H. Self-monitoring reports shall be signed by an authorized representative of the industrial user. The authorized representative of the industrial user is defined as:

1. The president, secretary, treasurer, or a vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation

2. The manager of one or more manufacturing, production, or operating facilities, but only if the manager:

    a. Is authorized to make management decisions that govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiate and direct other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations
    b. Can ensure that the necessary systems are established or actions taken to gather complete and accurate information for control mechanism requirements and knowledgeable of King County reporting requirements
    c. Has been assigned or delegated the authority to sign documents, in accordance with corporate procedures

3. A general partner or proprietor if the industrial user is a partnership or proprietorship, respectively

4. A director or highest official appointed or designated to oversee the operation and performance of the industry if the industrial user is a government agency

5. The individuals described in one through four above may designate an authorized representative if:

    a. The authorization is submitted to King County in writing
    b. The authorization specifies the individual or position responsible for the overall operation of the facility from which the discharge originates or having overall responsibility for environmental matters for the company or agency

GENERAL DISCHARGE LIMITATIONS

Operating criteria

There shall be no odor of solvent, gasoline, or hydrogen sulfide (rotten egg odor), oil sheen, unusual color, or visible turbidity. The discharge must remain translucent. If any of the discharge limits are exceeded, you must stop discharging and notify KCIW at 206-477-5300.

Corrosive substances

Limits

Maximum:	pH 12.0 (s.u.)
Instantaneous minimum[1]:	pH 5.0 (s.u.)
Daily minimum[2]:	pH 5.5 (s.u.)

The instantaneous minimum pH limit is violated whenever any single grab sample or any instantaneous recording is less than pH 5.0. The daily minimum pH limit is violated whenever any continuous recording of 15 minutes or longer remains below pH 5.5 or when each pH value of four consecutive grab samples collected at 15-minute intervals or longer within a 24-hour period remains below pH 5.5.

Discharges of more than 50 gallons per day of caustic solutions equivalent to more than 5 percent NaOH by weight or greater than pH 12.0 are prohibited unless authorized by KCIW and subject to special conditions to protect worker safety, the collection system, and treatment works.

Fats, oils, and grease

Discharge of FOG shall not result in significant accumulations that either alone or in combination with other wastes are capable of obstructing flow or interfere with the operation or performance of sewer works or treatment facilities.

Dischargers of polar FOG (oil and grease from animal and/or vegetable origin) shall minimize free-floating polar FOG. Dischargers may not add emulsifying agents exclusively for the purpose of emulsifying free-floating FOG.

Nonpolar FOG limit: 100 mg/L

The limit for nonpolar FOG is violated when the arithmetic mean of the concentration of three grab samples, taken no more frequently than at five minute intervals, or when the results of a composite sample exceed the limitation.

[1] The instantaneous minimum pH limit is violated whenever any single grab sample or any instantaneous recording is less than pH 5.0.

[2] The daily minimum pH limit is violated whenever any continuous recording of 15 minutes or longer remains below pH 5.5 or when each pH value of four consecutive grab samples collected at 15-minute intervals or longer within a 24-hour period remains below pH 5.5.

Flammable or explosive materials

No person shall discharge any pollutant, as defined in 40 CFR 403.5, that creates a fire or explosion hazard in any sewer or treatment works, including, but not limited to, waste streams with a closed cup flashpoint of less than 140° Fahrenheit or 60° Centigrade using the test methods specified in 40 CFR 261.21.

At no time shall two successive readings on an explosion hazard meter, at the point of discharge into the system (or at any point in the system), be more than 5 percent nor any single reading be more than 10 percent of the lower explosive limit (LEL) of the meter.

Pollutants subject to this prohibition include, but are not limited to, gasoline, kerosene, naphtha, benzene, toluene, xylene, ethers, alcohols, ketones, aldehydes, peroxides, chlorates, perchlorates, bromates, carbides, hydrides, and sulfides, and any other substances that King County, the fire department, Washington State, or the U.S. Environmental Protection Agency has notified the user are a fire hazard or a hazard to the system.

Petroleum Compounds	Maximum Concentration ppm (mg/L)
Benzene	0.07
Ethylbenzene	1.7
Toluene	1.4
Total xylenes	2.2

Heavy metals/cyanide

The industrial user shall not discharge wastes, which exceed the following limitations:

Heavy Metals & Cyanide	Instantaneous Maximum ppm (mg/L)[1]	Daily Average ppm (mg/L)[2]
Arsenic	4.0	1.0
Cadmium	0.6	0.5
Chromium	5.0	2.75
Copper	8.0	3.0
Lead	4.0	2.0
Mercury	0.2	0.1
Nickel	5.0	2.5
Silver	3.0	1.0
Zinc	10.0	5.0
Cyanide	3.0	2.0

[1]The instantaneous maximum is violated whenever the concentration of any sample, including a grab within a series used to calculate daily average concentrations, exceeds the limitation.

[2]The daily average limit is violated: a) for a continuous flow system when a composite sample consisting of four or more consecutive samples collected during a 24-hour period over intervals of 15 minutes or greater exceeds the limitation, or b) for a batch system when any sample exceeds the limitation. A composite

sample is defined as at least four grab samples of equal volume taken throughout the processing day from a well-mixed final effluent chamber, and analyzed as a single sample.

High temperature

The industrial user shall not discharge material with a temperature in excess of 65° C (150° F).

Hydrogen sulfide

Atmospheric hydrogen sulfide: 10.0 ppm
(As measured at a monitoring manhole designated by KCIW)

Soluble sulfide limits may be established on a case-by-case basis depending upon volume of discharge and conditions in the receiving sewer, including oxygen content and existing sulfide concentrations.

Organic compounds

No person shall discharge any organic pollutants that result in the presence of toxic gases, vapors, or fumes within a public or private sewer or treatment works in a quantity that may cause worker health and safety problems.

Organic pollutants subject to this restriction include, but are not limited to: Any organic pollutants compound listed in 40 CFR Section 433.11 (e) (total toxic organics [TTO] definition), acetone, 2-butanone (MEK), 4-methyl-2-pentanone (MIBK), and xylenes.

Settleable solids

Settleable solids concentrations: 7.0 ml/L

GENERAL CONDITIONS

A. All requirements of King County Code pertaining to the discharge of wastes into the municipal sewer system are hereby made a condition of this discharge authorization.

B. The industrial discharger shall implement measures to prevent accidental spills or discharges of prohibited substances to the municipal sewer system. Such measures include, but are not limited to, secondary containment of chemicals and wastes, elimination of connections to the municipal sewer system, and spill response equipment.

C. Any facility changes, which will result in a change in the character or volume of the pollutants discharged to the municipal sewer system, must be reported to your KCIW representative. Any changes that will cause the violation of the effluent limitations specified herein will not be allowed.

D. In the event the permittee is unable to comply with any of the conditions of this discharge authorization because of breakdown of equipment or facilities, an accident caused by human error, negligence, or any other cause, such as an act of nature the company shall:

1. Take immediate action to stop, contain, and clean up the unauthorized discharges and correct the problem.
2. Immediately notify KCIW and, if after 5 p.m. weekdays and on weekends, call the emergency King County treatment plant phone number on Page 1 so steps can be taken to prevent damage to the sewer system.
3. Submit a written report within 14 days of the event (*14-Day Report*) describing the breakdown, the actual quantity and quality of resulting waste discharged, corrective action taken, and the steps taken to prevent recurrence.

E. Compliance with these requirements does not relieve the permittee from responsibility to maintain continuous compliance with the conditions of the discharge authorization or the resulting liability for failure to comply.

F. The permittee shall, at all reasonable times, allow authorized representatives of KCIW to enter that portion of the premises where an effluent source or disposal system is located or in which any records are required to be kept under the terms and conditions of this authorization.

G. Nothing in this discharge authorization shall be construed as excusing the permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations including discharge into waters of the state. Any such discharge is subject to regulation and enforcement action by the Washington State Department of Ecology.

H. This discharge authorization does not authorize discharge after its expiration date. If the permittee wishes to continue to discharge after the expiration date, an application must be filed for reissuance of this discharge authorization at least 90 days prior to the expiration date. If the permittee submits its reapplication in the time specified herein, the permittee shall be deemed to have an effective wastewater discharge authorization until KCIW issues or denies the new wastewater discharge authorization. If the permittee fails to file its reapplication in the time period specified herein, the permittee will be deemed to be discharging without authorization.

Compliance Investigator:_____ Date: March 18, 2019
Todd Gowing

King County

Industrial Waste Program Self-Monitoring Report

Send to: King County Industrial Waste Program
201 S. Jackson Street, Suite 513
Seattle, WA 98104-3855
Phone 206-477-5300 / FAX 206-263-3001
Email: info.KCIW@kingcounty.gov

Project Name: 5055 Properties, LLC **Authorization No.:** 1092-01

Project Location: 5055 E Marginal Way S, Seattle

Sample Date	pH (s.u.)		Settleable Solids (mL/L)	Nonpolar FOG (mg/L)	Arsenic (mg/L)	Chromium (mg/L)	Copper (mg/L)	Lead (mg/L)	Mercury (mg/L)	Discharge Volume (gallons)	Name or initials of person collecting and recording samples and volume each day. If permitted for relief only, explain why you did not discharge to surface water for each day of discharge.
	Min.	Max.									
Total Discharge Volume:											

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I further certify that all data requiring a laboratory analysis were analyzed by a Washington State Department of Ecology accredited laboratory for each parameter tested.

Signature of Principal Executive or Authorized Agent

Date

The authorization holder is responsible for monitoring the discharge in accordance with the monitoring requirements specified in King County Discharge Authorization No. 1092-01. This report form must be completed, signed, and submitted to KCIW by **September 15, 2019**.

Your King County Industrial Waste Program Contact: Todd Gowing, 206-477-5426

Industrial Waste Program Self-Monitoring Report

King County

Send to: King County Industrial Waste Program
201 S. Jackson Street, Suite 513
Seattle, WA 98104-3855
Phone 206-477-5300 / FAX 206-263-3001
Email: info.KCIW@kingcounty.gov

Project Name: 5055 Properties, LLC **Authorization No.:** 1092-01

Project Location: 5055 E Marginal Way S, Seattle

Sample Date			Nickle (mg/L)	Zinc (mg/L)	PAHs (mg/L)						Name or initials of person collecting and recording samples and volume each day. If permitted for relief only, explain why you did not discharge to surface water for each day of discharge.
Total Discharge Volume:											

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I further certify that all data requiring a laboratory analysis were analyzed by a Washington State Department of Ecology accredited laboratory for each parameter tested.

Signature of Principal Executive or Authorized Agent

Date

The authorization holder is responsible for monitoring the discharge in accordance with the monitoring requirements specified in King County Discharge Authorization No. 1092-01. This report form must be completed, signed, and submitted to KCIW by **September 15, 2019**.

Your King County Industrial Waste Program Contact: Todd Gowing, 206-477-5426

APPENDIX C

Waste Designation Package

December 17, 2018

1011 SW Klickitat Way, Suite 107
Seattle, WA 98134

Mr. Chad Hearn, PE
Aspect Consulting, LLC
710 2nd Avenue, Suite 550
Seattle, Washington 98104

Re: Snopac Property Waste Designation

Dear Mr. Hearn,

This letter and attachments comprise the Waste Designation Package for soil identified for removal at the Snopac Property Uplands Source Control project located at 5055 East Marginal Way South in Seattle, Washington. We recommend the soil identified for removal to be designated as Non-Dangerous Solid Waste. A summary of the analytical methods, results, and assumptions supporting the waste designation is provided below. A copy of the Dangerous Waste Designation Form is included in Attachment 1.

DH Environmental, Inc. developed a Waste Characterization Sampling and Analysis Plan (SAP; DH Environmental, 2018) incorporating statistical analysis with the objective of designating, in situ, approximately 2,240 cubic yards of soil. Previous sampling indicated the soil may have been impacted by lead resulting in lead concentrations greater than 100 milligrams per kilogram (mg/kg). Soils with concentrations greater than 100 mg/kg are at risk of "failing" the Toxicity Characteristic Leachate Procedure (TCLP) test (Environmental Protection Agency [EPA] Method 1311) for lead and designating as Dangerous Waste characteristic of lead toxicity. Therefore, the objective of the sample design was to determine if the soil designates as Dangerous Waste in accordance with Washington Administrative Code (WAC) 173-303-070. Sample collection was conducted by Aspect Consulting on the 12th and 13th of November 2018.

Based on sampling results from the Remedial Investigation (Aspect, 2018) and the November 2018 waste characterization sampling, additional contaminants were evaluated as part of this designation as described below.

Characteristic Waste (RCRA D Series)

To characterize the entire waste profile for soil to be removed, a statistical evaluation of the concentration of leachable lead was conducted using the Visual Sample Plan (VSP) software package as described in the Waste Characterization SAP. The sample design incorporated 15 sample locations chosen randomly within the soil volume identified for removal. Lead was not detected in the TCLP extract for any of the 15 samples at concentrations greater than the laboratory reporting limit of 1 milligram per liter (mg/L). However, for the purpose of numerical analysis, the laboratory reporting limit was used as the leachable lead concentration for each sample. Based on a MARSSIM Sign Test of the TCLP extract data set, the null hypothesis can be rejected with 95% confidence, thus concluding that the mean concentration of leachable lead in soil within the defined removal area is less than 5.0 mg/L. Similarly, the null hypothesis can be

rejected for the concentration of leachable arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver, because the reported concentration of leachable metals in all samples was less than the respective regulatory levels defined in WAC 173-303-090 (Maximum Concentration of Contaminants for the Toxicity Characteristic). Therefore, soil within the defined removal area should not be considered a characteristic Dangerous Waste for any of the Resource Conservation and Recovery Act (RCRA) list of 8 metals (i.e., the "RCRA 8 metals"). A copy of the VSP statistical evaluation report for the analysis of TCLP lead concentrations is included as Attachment 2.

Discarded Chemical Products List (U, P Series)

Previous analytical results provided by Aspect Consulting[1] indicated trace constituents listed in WAC 173-303-9903, discarded commercial chemical products, off-specification species, container residues and spill residues. However, the original processes generating any of these trace constituents are unknown and any previously applicable waste codes are unknown. Therefore, none of the RCRA U and P Series listings are applicable[2]. A copy of the previous analytical results for soil samples collected by Aspect Consulting as part of the Remedial Investigation are included in Attachment 3.

Non-Specific Sources (RCRA F Series)

Sample analysis indicated trace constituents listed in WAC 173-303-9904, Wastes from Non-Specific Sources. However, the original processes generating any of these trace constituents are unknown and any previously applicable waste codes are unknown. Therefore, none of the RCRA F Series listings are applicable.

Specific Sources (RCRA K Series)

The original processes generating any trace constituents at the site are unknown and any previously applicable waste codes are unknown. Therefore, none of the RCRA K Series listings are applicable.

Washington State Toxic Criteria

A book designation based on the concentration of total metals resulted in an Equivalent Concentration exceeding 0.001%. Therefore, in accordance with WAC 173-303-100(5)(c), a fish bioassay was conducted on sample 'VSP-12-3.3', which contained the highest concentration of total metals from the waste characterization samples (VSP-1 through VSP-15) collected in November 2018. The fish bioassay resulted in zero mortality of the population tested. The results of the fish bioassay concluded that the soil is not a toxic Dangerous Waste under WAC 173-303-100. The analytical results from the waste characterization sampling event are included in Attachment 4. A copy of the Dangerous Waste Fish Bioassay Report is included as Attachment 5.

[1] Remedial Investigation/Feasibility Study, Aspect Consulting, 2018

[2] Where a facility owner/operator makes a good faith effort to determine if a material is a listed hazardous waste but cannot make such a determination because documentation regarding a source of contamination, contaminant, or waste is unavailable or inconclusive, EPA has stated that one may assume the source, contaminant or waste is not listed hazardous waste. Management of Remediation Waste Under RCRA, EPA530-F-98-026.

Persistent Dangerous Waste, HOCs

In accordance with WAC-173-303-100, a waste will designate as a persistent dangerous waste and carry a Washington State Dangerous Waste code of WP02 if it contains a halogenated organic compound (HOC) total concentration of 0.01% - 1.0 % (100 – 10,000 parts per million [ppm]), and a Washington State Dangerous Waste code of WP01 if HOCs exceed 1.0% (10,000 ppm). Based on previous screening data, the concentration of HOCs was well below 100 ppm.

Persistent Dangerous Waste, PAHs

In accordance with WAC-173-303-100, a waste will designate as a persistent dangerous waste and carry a Washington State Dangerous Waste code of WP03 if it contains a total carcinogenic polycyclic aromatic hydrocarbon (cPAH) concentration of greater than 1.0% (10,000 ppm). Based on previous screening data, the concentration of cPAH was well below 10,000 ppm.

PCB Source Waste

Sample analysis indicated trace concentrations of polychlorinated biphenyls (PCBs) in the soil at concentrations far less than the generally regulated federal threshold concentration of 50 ppm. Further, the original processes generating the PCBs are unknown and therefore not subject to the Washington State PCB source designation WPCB, which only applies to discarded transformers, capacitors or bushings containing PCBs at concentrations of 2 ppm or greater (except when drained of all free flowing liquid) and cooling and insulating fluids and cores, including core papers, generated from the salvaging, rebuilding, or discarding of transformers, capacitors or bushings containing PCBs at concentrations of 2 ppm or greater.

Summary

DH Environmental, Inc. developed a SAP to determine if the contaminated soil identified for removal from the SnoPac Property designates as Dangerous Waste in accordance with WAC 173-303-070. The soil was sampled, and the sampling plan was implemented by Aspect Consulting. A copy of the SAP is included as Attachment 6. The results have been applied to the Dangerous Waste Regulations as documented in this Designation Package. Based on these results, we recommend the soil be designated as Non-Dangerous Solid Waste suitable for disposal at a RCRA Subtitle D landfill.

If you have any questions regarding this designation, please do not hesitate to call.

Sincerely,

David J. Hill

David J. Hill, PE, CHMM, CPEA
Principal Engineer
DH Environmental, Inc.
206-293-3126

Attachments

1. Dangerous Waste Designation Form
2. Visual Sample Plan Output for TCLP Lead
3. 2017 Soil Screening Laboratory Analytical Reports (Aspect, 2018; Friedman & Bruya Lab reports 701260, 701295, 701300, 701333, and 701359)
4. 2018 Waste Characterization Sampling Laboratory Analytical Report (Friedman & Bruya report # 811213)
5. Dangerous Waste Fish Bioassay Report, Sample ID: VSP-12-3.3 (Rainier Environmental, 2018)
6. Waste Characterization Sampling and Analysis Plan (DH Environmental, 2018)

ATTACHMENT 1 DANGEROUS WASTE DESIGNATION FORM

DANGEROUS WASTE DESIGNATION FORM

Snopac Property, Uplands Source Control
5055 East Marginal Way South
Seattle, Washington

A. WASTE STREAM NAME AND GENERATION INFORMATION

Waste Stream Name: Uplands Soil

Generation Process: Excavation

RCRA ID Number that waste will be managed under:	**Total Quantity and/or Estimated Generation rate:**
Not applicable	Approximately 4,500 tons
Other Descriptions (i.e. Shop, Project, Etc.):	

B. WASTE PROPERTIES, CHARACTERISTICS, and CONSTITUENTS:

Physical State:
- ☐Solid (pass paint filter)
- ☒Solid w/freestanding or absorbed liquid
- ☐Liquid (If liquid, indicate if the liquid is:
  - ☐Single Layer
  - ☐Multi-layer

pH:
- ☐< 2 [D002]
- ☐> 2 but < 12.5
- ☒N/A
- ☐> 12.5 [D002]

Flashpoint:
- ☐< 140 °F [D001]
- ☒N/A
- ☐> 140 °F but < 200 °F
- ☐> 200 °F

Characteristic

- ☐Ignitable [D001]
- ☐Corrosive [D002]
- ☐Reactive [D003]
- ☐Toxic [D004 – D043]

List Here:

PCB Content

- ☐Not Detected [non TSCA or State Regulated]
- ☐Not Sampled
- ☐≥ 2 ppm and < 50 ppm [Potentially TSCA Regulated or State Regulated PCB Waste-WPCB]
- ☐≥ 50 ppm [TSCA Regulated]
- ☒< 1 ppm

Note:
IF WASTE STREAM IS BEING MANAGED AS TSCA WASTE, DO NOT USE WPCB STATE CODE PER WAC 173-303-071(3)(k)

TCLP Metals

- ☐Arsenic ≥ 5.0 mg/L [D004]
- ☐Barium ≥ 100.0 mg/L [D005]
- ☐Cadmium ≥ 1.0 mg/L [D006]
- ☐Chromium ≥ 5.0 mg/L [D007]
- ☐Lead ≥ 5.0 mg/L [D008]
- ☐Mercury ≥ 0.2 mg/L [D009]
- ☐Selenium ≥ 1.0 mg/L [D010]
- ☐Silver ≥ 5.0 mg/L [D011]

Check if:
- ☐Assumed
- ☒TCLP Conducted
- ☐TCLP Not Conducted

Comments:

Total Metals
☒mg/kg ☐ug/kg ☐mg/L ☐ug/L

Arsenic:	3,880	☐ND
Barium:	--	☐ND
Cadmium:	--	☐ND
Chromium:	--	☐ND
Lead:	2,780	☐ND
Mercury:	--	☐ND
Selenium:	--	☐ND
Silver:	--	☐ND
Copper:	2,540	☐ND
Nickel:	125	☐ND
Zinc:	9,700	☐ND

Comments: Soil sample 'VSP-12-3.3'

Physical Composition (list all constituents, including debris, any absorbents, liquid range, etc.).

Constituent	Volume (Range %)
Solid	90-100
liquid	0-10

DANGEROUS WASTE DESIGNATION FORM

C. LISTED WASTE

☐ **Discarded Listed Chemical Product (U or P List):**
☐ **Listed Source Waste (F or K List):**
☒ **Not Applicable:**

D. WA STATE CRITERIA WASTE

☐**Not applicable per WAC 173-303-070(5): Further designation will not change the generator status or change the way the waste must be managed.**

WA Toxic Criteria Equivalent Concentration (E.C):		WA Persistent Criteria Total HOC		WA Persistent Criteria Total PAH	
☐ < 0.001 %	[not a Toxic Criteria DW]	☒ < 0.01 %	[NOT APPLICABLE]	☒ < 1.0%	[NOT APPLICABLE]
☒ 0.001 ≥ 1.0 %	[WT02 – DW]	☐ 0.01 to 1.0%	[WP02 – DW]	☐ > 1.0%	[WP03 – EHW]
☐ ≥ 1.0%	[WT01 – EHW]	☐ > 1.0 %	[WP01 – EHW]		

DW: Dangerous Waste EHW: Extremely Hazardous Waste HOC: Halogenated Organic Compounds PAH: Polycyclic Aromatic Hydrocarbons

E. ADDITIONAL INFORMATION (Describe any additional information about the waste (e.g. process knowledge statement, regulatory exemptions, assumptions made, etc.)

Washington state toxic criteria book designation calculated an equivalent concentration of .0393%, resulting in a book designation of Toxic, WT02.

This book designation was refuted by a fish bioassay test in accordance with WAC 173-303-110(3)(b), Biological Testing Methods for the Designation of Dangerous Waste Method 80-12. The fish bioassay demonstrated zero fish mortality and this waste stream is therefore designated as non-dangerous waste.

Attachments:
☐**Field Report**
☐**Sample Log**
☒**Laboratory Data [Friedman & Bruya, Inc., Lab Report 811213]**
☒**Dangerous Waste Toxic Equivalent Concentration Calculation**
☒**Biological Testing Method 80-12 (Fish Bioassay – included as part of lab report 811213)**
☐**Other:**

F. WASTE DESIGNATION SUMMARY

☐ **RCRA Hazardous Waste**
USDOT Proper Shipping Name:
RCRA Waste Codes:

☐ **TSCA Regulated Waste**
TSCA Description:

☒ **Non-Hazardous Solid Waste/RCRA Exempt/RCRA Excluded**
Description: Non-Hazardous Solid Waste, uplands soil

Designation Performed by: Nathan Moxley, LHG
Title: Senior Project Geologist Date: 12-19-2018

Designation Reviewed by: Dave Hill, PE, CHMM, CPEA
Title: Principal Date: 12-19-2018

ATTACHMENT 2 VISUAL SAMPLE PLAN OUTPUT FOR TCLP LEAD

Attachment 2 - VSP Statistical Evaluation Report

Random sampling locations for comparing a median with a fixed threshold (nonparametric - MARSSIM)

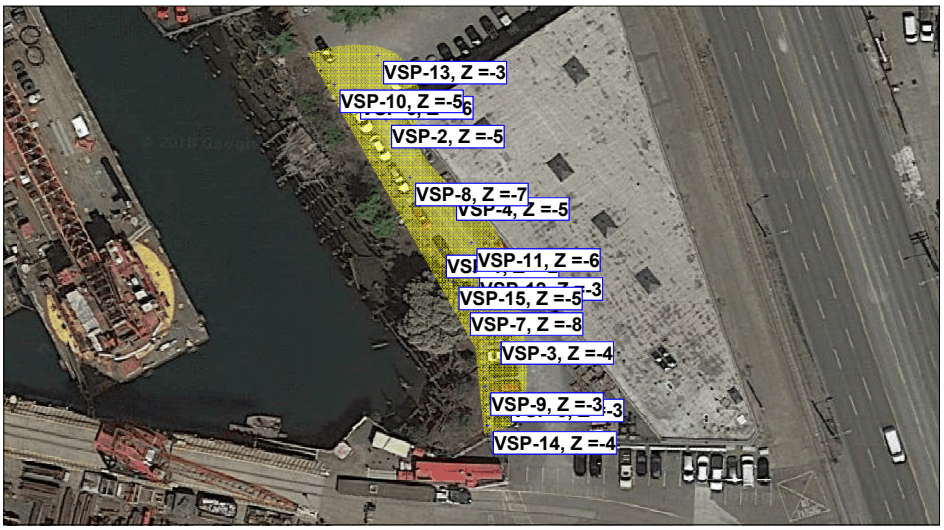
Summary

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Simple random sampling
Working (Null) Hypothesis	The median(mean) value at the site exceeds the threshold
Formula for calculating number of sampling locations	Sign Test - MARSSIM version
Calculated number of samples	12
Number of samples adjusted for EMC	12
Number of samples with MARSSIM Overage	15
Number of samples on map [a]	15
Number of selected sample areas [b]	1
Specified sampling area [c]	8103.01 ft^2

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.



Area: ProposedExcavationExtent

X Coord	Y Coord	Label	Value	Type	Historical	Sample Area
1268569.9718	206525.8071	VSP-1, Z =-2	1	Random		
1268539.4602	206598.0294	VSP-2, Z =-5	1	Random		
1268600.4834	206477.6589	VSP-3, Z =-4	1	Random		
1268575.6927	206557.9059	VSP-4, Z =-5	1	Random		
1268606.2043	206445.5600	VSP-5, Z =-3	1	Random		
1268522.2974	206614.0789	VSP-6, Z =-6	1	Random		
1268583.3206	206493.7083	VSP-7, Z =-8	1	Random		
1268552.8090	206565.9306	VSP-8, Z =-7	1	Random		
1268594.7624	206449.1266	VSP-9, Z =-3	1	Random		
1268510.8555	206617.6454	VSP-10, Z =-5	1	Random		
1268587.1345	206529.3736	VSP-11, Z =-6	1	Random		
1268588.5648	206513.3242	VSP-12, Z =-3	1	Random		
1268535.1695	206633.6948	VSP-13, Z =-3	1	Random		
1268596.1927	206427.7274	VSP-14, Z =-4	1	Random		
1268577.1229	206507.9744	VSP-15, Z =-5	1	Random		

Primary Sampling Objective
The primary purpose of sampling at this site is to compare a site median or mean value with a fixed threshold. The working hypothesis (or 'null' hypothesis) is that the median(mean) value at the site is equal to or exceeds the threshold. The alternative hypothesis is that the median(mean) value is less than the threshold. VSP calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

Selected Sampling Approach
A nonparametric random sampling approach was used to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that typical parametric assumptions may not be true.

Both parametric and non-parametric equations rely on assumptions about the population. Typically, however, non-parametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a non-parametric equation was used.

VSP offers many options to determine the locations at which measurements are made or samples are collected and subsequently measured. For this design, simple random point sampling was chosen. Locating the sample points randomly provides data that are separated by varying distances, providing good information about the spatial structure of the potential contamination. Knowledge of the spatial structure is useful for geostatistical analysis. However, it may not ensure that all portions of the site are equally represented.

Nuclides
The following table summarizes the analyzed nuclides.

Nuclides Analyzed by Study		
Nuclide	**$DCGL_W$**	**$DCGL_{EMC}$**
TCLP lead	250	

Analyte 2		

Number of Total Samples: Calculation Equation and Inputs
The equation used to calculate the number of samples is based on a Sign test (see PNNL 13450 for discussion). For this site, the null hypothesis is rejected in favor of the alternative one if the median(mean) is sufficiently smaller than the threshold. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The formula used to calculate the number of samples is:

$$n = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(SignP - 0.5)^2}$$

where

$$SignP = \Phi\left(\frac{\Delta}{s_{total}}\right)$$

$\Phi(z)$ is the cumulative standard normal distribution on $(-\infty,z)$ (see PNNL-13450 for details),
n is the number of samples,
S_{total} is the estimated standard deviation of the measured values including analytical error,
Δ is the width of the gray region,
α is the acceptable probability of incorrectly concluding the site median(mean) is less than the threshold,
β is the acceptable probability of incorrectly concluding the site median(mean) exceeds the threshold,
$Z_{1-\alpha}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\alpha}$ is $1-\alpha$,
$Z_{1-\beta}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\beta}$ is $1-\beta$.

Note: MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of n. VSP allows a user-supplied percent overage as discussed in MARSSIM (EPA 2000, p. 5-33).

For each nuclide in the **Nuclides Analyzed by Study** table, the values of these inputs that result in the calculated number of sampling locations are:

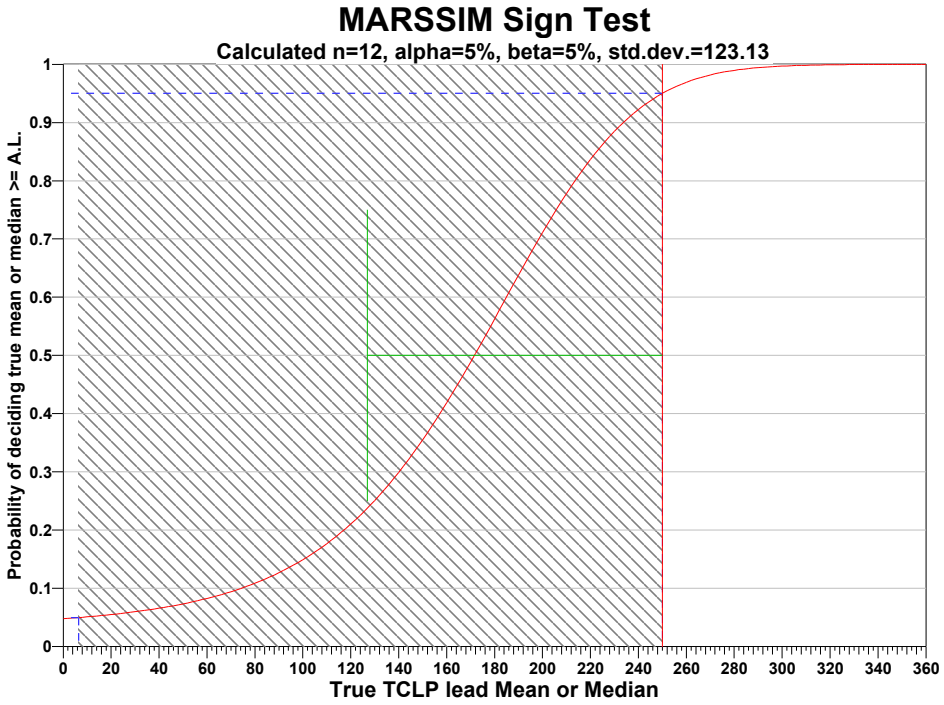
Nuclide	n[a]	n[b]	n[c]	Parameter					
				S	Δ	α	β	$Z_{1-\alpha}$ [d]	$Z_{1-\beta}$ [e]
TCLP lead	12	12	15	123.13	243.5	0.05	0.05	1.64485	1.64485
Analyte 2	0	0	0						

[a] The number of samples calculated by the formula.
[b] The number of samples increased by EMC calculations.
[c] The final number of samples increased by the MARSSIM Overage of 20%.
[d] This value is automatically calculated by VSP based upon the user defined value of α.
[e] This value is automatically calculated by VSP based upon the user defined value of β.

Performance
The following figure is a performance goal diagram, described in EPA's QA/G-4 guidance (EPA, 2000). It shows the probability of concluding the sample area is dirty on the vertical axis versus a range of possible true median(mean) values for the site on the horizontal axis. This graph contains all of the inputs to the number of samples equation and pictorially represents the calculation.

The red vertical line is shown at the threshold (action limit) on the horizontal axis. The width of the gray

shaded area is equal to Δ; the upper horizontal dashed blue line is positioned at 1-α on the vertical axis; the lower horizontal dashed blue line is positioned at β on the vertical axis. The vertical green line is positioned at one standard deviation below the threshold. The shape of the red curve corresponds to the estimates of variability. The calculated number of samples results in the curve that passes through the lower bound of Δ at β and the upper bound of Δ at 1-α. If any of the inputs change, the number of samples that result in the correct curve changes.



Statistical Assumptions

The assumptions associated with the formulas for computing the number of samples are:

1. the computed sign test statistic is normally distributed,
2. the variance estimate, S^2, is reasonable and representative of the population being sampled,
3. the population values are not spatially or temporally correlated, and
4. the sampling locations will be selected randomly.

The first three assumptions will be assessed in a post data collection analysis. The last assumption is valid because the sample locations were selected using a random process.

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the standard deviation, delta, beta (%), probability of mistakenly concluding that μ > action level and alpha (%), probability of mistakenly concluding that μ < action level. The following table shows the results of this analysis.

Number of Samples							
		α=5		α=10		α=15	
		s=246.26	s=123.13	s=246.26	s=123.13	s=246.26	s=123.13
Δ=121.75	β=5	92	29	72	23	62	20
	β=10	72	23	56	18	46	15
	β=15	62	20	46	15	36	12
Δ=243.5	β=5	29	15	23	12	20	10
	β=10	23	12	18	10	15	8
	β=15	20	10	15	8	12	6
Δ=365.25	β=5	18	14	15	11	12	10

β=10	15	11	11	9	10	8
β=15	12	10	10	8	8	6

s = Standard Deviation
Δ = Delta
β = Beta (%), Probability of mistakenly concluding that μ > action level
α = Alpha (%), Probability of mistakenly concluding that μ < action level

Note: Values in table are not adjusted for EMC.

Data Analysis for TCLP lead
The following data points were entered by the user for analysis.

TCLP lead										
Rank	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
0	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1					

SUMMARY STATISTICS for TCLP lead	
n	15
Min	1
Max	1
Range	0
Mean	1
Median	1
Variance	0
StdDev	0
Std Error	0
Skewness	-1.#IND
Interquartile Range	0

Percentiles								
1%	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**	**99%**
1	1	1	1	1	1	1	1	1

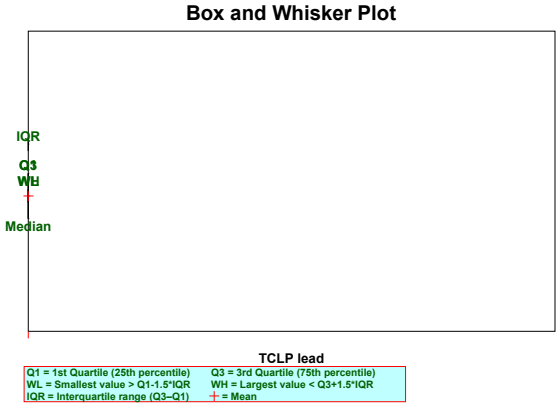
Data Plots
Three graphical displays of the data are shown below: the Histogram, the Box and Whiskers plot, and the Quantile-Quantile (Q-Q) plot.

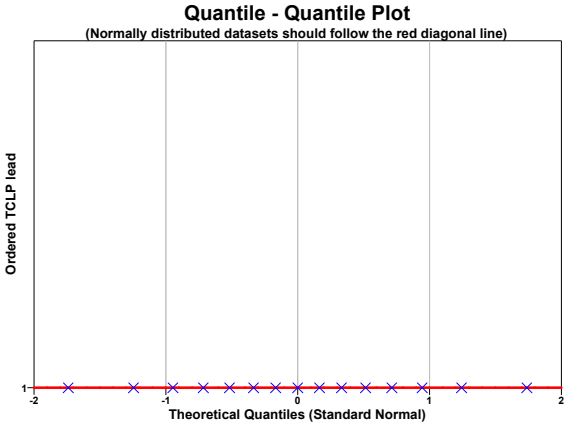
The Histogram is a plot of the fraction of the n observed data that fall within specified data bins. A histogram is generated by dividing the x axis (range of the observed data values) into "bins" and displaying the number of data in each bin as the height of a bar for the bin. The area of the bar is the fraction of the n data values that lie within the bin. The sum of the fractions for all bins equals one. A histogram is used to assess how the n data are distributed (spread) over their range of values. If the histogram is more or less symmetric and bell shaped, then the data may be normally distributed.

The Box and Whiskers plot is composed of a central box divided by a line, and with two lines extending out from the box, called the "whiskers". The line through the box is drawn at the median of the n data observed. The two ends of the box represent the 25^{th} and 75^{th} percentiles of the n data values, which are also called the lower and upper quartiles, respectively, of the data set. The sample mean (mean of the n

data) is shown as a "+" sign. The upper whisker extends to the largest data value that is less than the upper quartile plus 1.5 times the interquartile range (upper quartile minus the lower quartile). The lower whisker extends to the smallest data value that is greater than the lower quartile minus 1.5 times the interquartile range. Extreme data values (greater or smaller than the ends of the whiskers) are plotted individually. A Box and Whiskers plot is used to assess the symmetry of the distribution of the data set. If the distribution is symmetrical, the box is divided into two equal halves by the median, the whiskers will be the same length, and the number of extreme data points will be distributed equally on either end of the plot.

The Q-Q plot graphs the quantiles of a set of n data against the quantiles of a specific distribution. We show here only the Q-Q plot for an assumed normal distribution. The p^{th} quantile of a distribution of data is the data value, x_n, for which a fraction p of the distribution is less than x_n. If the data plotted on the normal distribution Q-Q plot closely follow a straight line, even at the ends of the line, then the data may be assumed to be normally distributed. If the data points deviate substantially from a linear line, then the data are not normally distributed.





For more information on these three plots consult Guidance for Data Quality Assessment, EPA QA/G-9, pgs 2.3-1 through 2.3-12. (http://www.epa.gov/quality/qa-docs.html).

Tests for TCLP lead

MARSSIM Sign Test

The Sign test was performed in accordance with the guidance given in section 8.3.2 of MARSSIM. Each measurement was subtracted from the action level to obtain *n* differences $d_i = AL - X_i$. Any differences of zero were discarded from consideration and the sample size was reduced accordingly.
The test statistic S+ was calculated by counting the positive differences. S+ was then compared with the critical value *k*, which was obtained from Table I.3 in Appendix I of MARSSIM.

If $S+ > k$, then the null hypothesis is rejected.

MARSSIM SIGN TEST		
Test Statistic S+	**95% Critical Value**	**Null Hypothesis**
15	11	Reject

The test rejected the null hypothesis that the mean value at the site exceeds the threshold, so conclude the site is clean.

Recommended Data Analysis Activities
Post data collection activities generally follow those outlined in EPA's Guidance for Data Quality Assessment (EPA, 2000). The data analysts will become familiar with the context of the problem and goals for data collection and assessment. The data will be verified and validated before being subjected to statistical or other analyses. Graphical and analytical tools will be used to verify to the extent possible the assumptions of any statistical analyses that are performed as well as to achieve a general understanding of the data. The data will be assessed to determine whether they are adequate in both quality and quantity to support the primary objective of sampling.

Because the primary objective for sampling for this site is to compare the site median(mean) value with a threshold value, the data will be assessed in this context. Assuming the data are adequate, at least one statistical test will be done to perform a comparison between the data and the threshold of interest. Results of the exploratory and quantitative assessments of the data will be reported, along with conclusions that may be supported by them.

ATTACHMENT 3 2017 SOIL SCREENING LABORATORY ANALYTICAL REPORTS

NOTE: The 2017 Soil Screening Laboratory Analytical Reports are provided as Appendix E to the *Snopac Property Upland Source Control Remedial Investigation and Feasibility Study* prepared by Aspect Consulting, LLC, and are therefore not included in this *Engineering Design Report* appendix.

ATTACHMENT 4 2018 WASTE CHARACTERIZATION SAMPLING LABORATORY ANALYTICAL REPORT

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

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fbi@isomedia.com
www.friedmanandbruya.com

November 28, 2018

Adam Griffin, Project Manager
Aspect Consulting, LLC
350 Madison Ave. N.
Bainbridge Island, WA 98110-1810

Dear Mr Griffin:

Included are the results from the testing of material submitted on November 13, 2018 from the Snopac 150054, F&BI 811213 project. There are 45 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
c: Data Aspect, Chad Hearn
ASP1128R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on November 13, 2018 by Friedman & Bruya, Inc. from the Aspect Consulting, LLC Snopac 150054, F&BI 811213 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Aspect Consulting, LLC
811213 -01	VSP-14-4.1
811213 -02	VSP-9-3.2
811213 -03	VSP-5-2.6
811213 -04	VSP-3-3.6
811213 -05	VSP-7-8.2
811213 -06	VSP-15-4.8
811213 -07	VSP-11-5.6
811213 -08	VSP-12-3.3
811213 -09	VSP-1-2.2
811213 -10	Dup-1
811213 -11	VSP-4-4.5
811213 -12	VSP-8-5.6
811213 -13	VSP-2-5.1
811213 -14	VSP-10-4.6
811213 -15	VSP-6-6.2
811213 -16	VSP-13-2.2

A 6020A internal standard failed the acceptance criteria for samples VSP-3-3.6, VSP-7-8.2 due to matrix interferences. The data were flagged accordingly. The samples were diluted and reanalyzed.

All other quality control requirements were acceptable.

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-14-4.1	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-01
Date Analyzed:	11/21/18	Data File:	811213-01.118
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	95.4
Copper	107
Lead	157
Nickel	19.7
Zinc	393

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-9-3.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-02
Date Analyzed:	11/21/18	Data File:	811213-02.121
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	57.0
Copper	72.2
Lead	154
Nickel	16.3
Zinc	284

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-5-2.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-03
Date Analyzed:	11/21/18	Data File:	811213-03.122
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	15.4
Copper	51.1
Lead	99.9
Nickel	17.6
Zinc	151

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-3-3.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-04
Date Analyzed:	11/21/18	Data File:	811213-04.125
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	2.54
Copper	67.6 J
Lead	5.08
Nickel	13.0 J
Zinc	31.5 J

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-3-3.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-04 x5
Date Analyzed:	11/26/18	Data File:	811213-04 x5.040
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Copper	85.3
Nickel	<25
Zinc	38.2

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-7-8.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-05
Date Analyzed:	11/21/18	Data File:	811213-05.126
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	1.95
Copper	90.6 J
Lead	4.88
Nickel	15.7 J
Zinc	36.2 J

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-7-8.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-05 x5
Date Analyzed:	11/26/18	Data File:	811213-05 x5.041
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Copper	124
Nickel	<25
Zinc	49.6

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-15-4.8	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-06
Date Analyzed:	11/21/18	Data File:	811213-06.127
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	3.30
Copper	21.7
Lead	22.9
Nickel	5.44
Zinc	21.7

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-11-5.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-07
Date Analyzed:	11/21/18	Data File:	811213-07.128
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	17.3
Copper	33.1
Lead	52.5
Nickel	5.98
Zinc	97.6

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-12-3.3	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-08 x25
Date Analyzed:	11/26/18	Data File:	811213-08 x25.044
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	3,880
Copper	2,540
Lead	2,780
Nickel	<125
Zinc	9,700

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-1-2.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-09 x10
Date Analyzed:	11/26/18	Data File:	811213-09 x10.045
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	816
Copper	603
Lead	605
Nickel	<50
Zinc	2,250

Analysis For Total Metals By EPA Method 6020B

Client ID:	Dup-1	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-10
Date Analyzed:	11/21/18	Data File:	811213-10.131
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	16.3
Copper	43.1
Lead	83.9
Nickel	14.7
Zinc	135

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-4-4.5	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-11 x5
Date Analyzed:	11/26/18	Data File:	811213-11 x5.092
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	337
Copper	214
Lead	268
Nickel	<25
Zinc	923

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-8-5.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-12
Date Analyzed:	11/21/18	Data File:	811213-12.133
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	207
Copper	154
Lead	179
Nickel	10.9
Zinc	626

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-2-5.1	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-13
Date Analyzed:	11/21/18	Data File:	811213-13.134
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	15.5
Copper	51.8
Lead	221
Nickel	17.1
Zinc	221

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-10-4.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-14
Date Analyzed:	11/21/18	Data File:	811213-14.139
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	135
Copper	87.7
Lead	124
Nickel	21.0
Zinc	401

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-6-6.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-15
Date Analyzed:	11/21/18	Data File:	811213-15.140
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	17.5
Copper	52.2
Lead	69.7
Nickel	7.46
Zinc	77.6

Analysis For Total Metals By EPA Method 6020B

Client ID:	VSP-13-2.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	811213-16 x10
Date Analyzed:	11/26/18	Data File:	811213-16 x10.047
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	1,340
Copper	803
Lead	1,130
Nickel	<50
Zinc	3,630

Analysis For Total Metals By EPA Method 6020B

Client ID:	Method Blank	Client:	Aspect Consulting, LLC
Date Received:	Not Applicable	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/21/18	Lab ID:	I8-801 mb
Date Analyzed:	11/21/18	Data File:	I8-801 mb.116
Matrix:	Soil	Instrument:	ICPMS2
Units:	mg/kg (ppm) Dry Weight	Operator:	SP

Analyte:	Concentration mg/kg (ppm)
Arsenic	<1
Copper	<5
Lead	<1
Nickel	<5
Zinc	<5

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-14-4.1	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-01
Date Analyzed:	11/20/18	Data File:	811213-01.106
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-9-3.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-02
Date Analyzed:	11/20/18	Data File:	811213-02.109
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-5-2.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-03
Date Analyzed:	11/20/18	Data File:	811213-03.110
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-3-3.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-04
Date Analyzed:	11/20/18	Data File:	811213-04.111
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-7-8.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-05
Date Analyzed:	11/20/18	Data File:	811213-05.112
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-15-4.8	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-06
Date Analyzed:	11/20/18	Data File:	811213-06.113
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-11-5.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-07
Date Analyzed:	11/20/18	Data File:	811213-07.114
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-12-3.3	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-08
Date Analyzed:	11/20/18	Data File:	811213-08.115
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-1-2.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-09
Date Analyzed:	11/20/18	Data File:	811213-09.118
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	Dup-1	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-10
Date Analyzed:	11/20/18	Data File:	811213-10.119
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-4-4.5	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-11
Date Analyzed:	11/20/18	Data File:	811213-11.120
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-8-5.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-12
Date Analyzed:	11/20/18	Data File:	811213-12.121
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-2-5.1	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-13
Date Analyzed:	11/20/18	Data File:	811213-13.122
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-10-4.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-14
Date Analyzed:	11/20/18	Data File:	811213-14.123
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-6-6.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-15
Date Analyzed:	11/20/18	Data File:	811213-15.124
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	VSP-13-2.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	811213-16
Date Analyzed:	11/20/18	Data File:	811213-16.125
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis for TCLP Metals By EPA Method 6020B and 1311

Client ID:	Method Blank	Client:	Aspect Consulting, LLC
Date Received:	Not Applicable	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/19/18	Lab ID:	I8-794 mb
Date Analyzed:	11/20/18	Data File:	I8-794 mb.134
Matrix:	Soil/Solid	Instrument:	ICPMS2
Units:	mg/L (ppm)	Operator:	SP

Analyte:	Concentration mg/L (ppm)	TCLP Limit
Arsenic	<1	5.0
Barium	<1	100
Cadmium	<1	1.0
Chromium	<1	5.0
Lead	<1	5.0
Mercury	<0.1	0.2
Selenium	<1	1.0
Silver	<1	5.0

Analysis For PCBs By EPA Method 8082A

Client Sample ID:	VSP-14-4.1	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/14/18	Lab ID:	811213-01 1/6
Date Analyzed:	11/14/18	Data File:	111417.D
Matrix:	Soil	Instrument:	GC7
Units:	mg/kg (ppm) Dry Weight	Operator:	VM

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
TCMX	57	29	154

Compounds:	Concentration mg/kg (ppm)
Aroclor 1221	<0.02
Aroclor 1232	<0.02
Aroclor 1016	<0.02
Aroclor 1242	<0.02
Aroclor 1248	<0.02
Aroclor 1254	0.37
Aroclor 1260	<0.02
Aroclor 1262	<0.02
Aroclor 1268	<0.02

Analysis For PCBs By EPA Method 8082A

Client Sample ID:	VSP-8-5.6	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/14/18	Lab ID:	811213-12 1/6
Date Analyzed:	11/14/18	Data File:	111418.D
Matrix:	Soil	Instrument:	GC7
Units:	mg/kg (ppm) Dry Weight	Operator:	VM

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
TCMX	79	29	154

Compounds:	Concentration mg/kg (ppm)
Aroclor 1221	<0.02
Aroclor 1232	<0.02
Aroclor 1016	<0.02
Aroclor 1242	<0.02
Aroclor 1248	<0.02
Aroclor 1254	0.24
Aroclor 1260	<0.02
Aroclor 1262	<0.02
Aroclor 1268	<0.02

Analysis For PCBs By EPA Method 8082A

Client Sample ID:	VSP-2-5.1	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/14/18	Lab ID:	811213-13 1/6
Date Analyzed:	11/14/18	Data File:	111419.D
Matrix:	Soil	Instrument:	GC7
Units:	mg/kg (ppm) Dry Weight	Operator:	VM

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
TCMX	78	29	154

Compounds:	Concentration mg/kg (ppm)
Aroclor 1221	<0.02
Aroclor 1232	<0.02
Aroclor 1016	<0.02
Aroclor 1242	<0.02
Aroclor 1248	<0.02
Aroclor 1254	0.044
Aroclor 1260	0.064
Aroclor 1262	<0.02
Aroclor 1268	<0.02

Analysis For PCBs By EPA Method 8082A

Client Sample ID:	VSP-6-6.2	Client:	Aspect Consulting, LLC
Date Received:	11/13/18	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/14/18	Lab ID:	811213-15 1/6
Date Analyzed:	11/14/18	Data File:	111420.D
Matrix:	Soil	Instrument:	GC7
Units:	mg/kg (ppm) Dry Weight	Operator:	VM

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
TCMX	58	29	154

Compounds:	Concentration mg/kg (ppm)
Aroclor 1221	<0.02
Aroclor 1232	<0.02
Aroclor 1016	<0.02
Aroclor 1242	<0.02
Aroclor 1248	<0.02
Aroclor 1254	<0.02
Aroclor 1260	<0.02
Aroclor 1262	<0.02
Aroclor 1268	<0.02

Analysis For PCBs By EPA Method 8082A

Client Sample ID:	Method Blank	Client:	Aspect Consulting, LLC
Date Received:	Not Applicable	Project:	Snopac 150054, F&BI 811213
Date Extracted:	11/14/18	Lab ID:	08-2603 mb 1/6
Date Analyzed:	11/14/18	Data File:	111411.D
Matrix:	Soil	Instrument:	GC7
Units:	mg/kg (ppm) Dry Weight	Operator:	VM

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
TCMX	93	29	154

Compounds:	Concentration mg/kg (ppm)
Aroclor 1221	<0.02
Aroclor 1232	<0.02
Aroclor 1016	<0.02
Aroclor 1242	<0.02
Aroclor 1248	<0.02
Aroclor 1254	<0.02
Aroclor 1260	<0.02
Aroclor 1262	<0.02
Aroclor 1268	<0.02

Date of Report: 11/28/18
Date Received: 11/13/18
Project: Snopac 150054, F&BI 811213

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL/SOLID SAMPLES FOR TCLP METALS USING EPA METHODS 6020B AND 1311

Laboratory Code: 811213-01 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Arsenic	mg/L (ppm)	1.0	<1	95	92	75-125	3
Barium	mg/L (ppm)	5.0	<1	110	107	75-125	3
Cadmium	mg/L (ppm)	0.5	<1	108	106	75-125	2
Chromium	mg/L (ppm)	2.0	<1	101	100	75-125	1
Lead	mg/L (ppm)	1.0	<1	94	93	75-125	1
Mercury	mg/L (ppm)	1.0	<0.1	76	80	75-125	5
Selenium	mg/L (ppm)	0.5	<1	100	98	75-125	2
Silver	mg/L (ppm)	0.5	<1	92	95	75-125	3

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Arsenic	mg/L (ppm)	1.0	92	80-120
Barium	mg/L (ppm)	5.0	105	80-120
Cadmium	mg/L (ppm)	0.5	103	80-120
Chromium	mg/L (ppm)	2.0	98	80-120
Lead	mg/L (ppm)	1.0	93	80-120
Mercury	mg/L (ppm)	1.0	81	80-120
Selenium	mg/L (ppm)	0.5	94	80-120
Silver	mg/L (ppm)	0.5	96	80-120

Date of Report: 11/28/18
Date Received: 11/13/18
Project: Snopac 150054, F&BI 811213

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR POLYCHLORINATED BIPHENYLS AS AROCLOR 1016/1260 BY EPA METHOD 8082A

Laboratory Code: 811082-07 1/6 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result (Wet Wt)	Percent Recovery MS	Control Limits
Aroclor 1016	mg/kg (ppm)	0.5	<0.02	62	38-122
Aroclor 1260	mg/kg (ppm)	0.5	<0.02	42	39-131

Laboratory Code: Laboratory Control Sample 1/6

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Aroclor 1016	mg/kg (ppm)	0.5	94	99	55-130	5
Aroclor 1260	mg/kg (ppm)	0.5	80	85	58-133	6

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The compound is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

811213

SAMPLE CHAIN OF COUSTODY

ME 11-13-18

BI4

Page # 1 of 2

SAMPLERS (signature) Chad Hearn

Report To Adam Griffin & cc: Chad Hearn

Company Aspect Consulting

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Phone 206-780-7746 Email agriffin@aspectconsulting.com chearn@aspectconsulting.com

PROJECT NAME	PO #
Snopac	150054

REMARKS	INVOICE TO
Hold 1 jar until analytical provided, two samples will be submitted to Rainier Environmental based on TCLP results.	Aspect

TURNAROUND TIME
- ☑ Standard Turnaround
- ☐ RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- ☐ Dispose after 30 days
- ☐ Archive Samples
- ☑ Other Hold for Rainier

ANALYSES REQUESTED

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	Total As, Cu, Pb, Ni, Zn / PAHs 8270D SIM	TCLP RCRA-8 Metals	Total PCBs	Total Metals *	HOLD Acute Fish Toxicity (Rainier)	Notes (* low MTCA 5 per CH STD TAT)
VSP-14-4.1	01 AB	11/12/18	0900	Soil	2							⊕	X	X	X	X	~~* Hold all samples~~ for total metals.
VSP-9-3.2	02	11/12/18	0925	Soil	2								X		X	X	(arsenic, copper, lead, nickel & zinc)
VSP-5-2.6	03	11/12/18	0950	Soil	2								X	[crossed out]	X	X	⊕ per CH
VSP-3-3.6	04	11/12/18	1010	Soil	2								X		X	X	11/15/18 ME
VSP-7-8.2	05	11/12/18	1050	Soil	2								X		X	X	
VSP-15-4.8	06	11/12/18	1125	Soil	2								X		X	X	
VSP-11-5.6	07	11/12/18	1155	Soil	2								X		X	X	
VSP-12-3.3	08	11/12/18	1225	Soil	2								X		X	X	
VSP-1-2.2	09	11/12/18	1240	Soil	2								X		X	X	
DUP-1	10	11/12/18	—	Soil	2							↓	X		X	X	

	SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	[signature]	Chad Hearn	Aspect	11/13/18	1240
Received by:	[signature]	Nhan Phan	FEBI	11/13/18	1240
Relinquished by:					
Received by:					

Samples received at 3 °C

Friedman & Bruya, Inc.

3012 16th Avenue West

Seattle, WA 98119-2029

Ph. (206) 285-8282

81213

SAMPLE CHAIN OF CUSTODY

ME 11-13-18 BIY

Page # 2 of 2

Report To Adam Griffin & cc: Chad Hearn

Company Aspect Consulting

Address 710 Second Ave, Suite 550

City, State, ZIP Seattle, WA 98104

Phone 206-780-7746 Email agriffin@aspectconsulting.com; chearn@aspectconsulting.com

SAMPLERS (*signature*) Chad Hearn

PROJECT NAME: Snopac

PO #: 150054

REMARKS: Hold 1 jar, pending TCLP results. Two samples will eventually be submitted to Rainier lab.

INVOICE TO: Aspect

TURNAROUND TIME
- [x] Standard Turnaround
- [ ] RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- [ ] Dispose after 30 days
- [ ] Archive Samples
- [x] Other Hold for Rainier

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	ANALYSES REQUESTED: TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	Total As, Phenanthrene, PAHs 8270D-SIM	TCLP RCRA-8 Metals	Total PCBs	Total Metals*	Hold Acute Fish Toxicity (Rainier)	Notes
VSP-4-4.5	11AB	11/12/18	1305	soil	2							⊕	X		X	X	
VSP-8-5.6	12	11/12/18	1345	soil	2								X	X	X	X	
VSP-2-5.1	13	11/12/18	1415	soil	2								X	X	X	X	
VSP-10-4.6	14	11/13/18	0745	soil	2								X		X	X	
VSP-6-6.2	15	11/13/18	0800	soil	2								X	X	X	X	
VSP-13-2.2	16	11/13/18	0820	soil	2							↓	X		X	X	

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: Chad Hearn	Chad Hearn	Aspect	11/13/18	1240
Received by: Nhan Phan	Nhan Phan	FBI	11/13/18	1240
Relinquished by:				
Received by:		Samples received at 3 °C		

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

ATTACHMENT 5 DANGEROUS WASTE FISH BIOASSAY REPORT, SAMPLE ID: VSP-12-3.3

Rainier ENVIRONMENTAL

Dangerous Waste Characterization

Sample ID: VSP-12-3.3

Report date: December 13, 2018

Submitted to:

Freidman and Bruya, Inc.
3012 16th Ave W
Seattle, WA 98119

Rainier Environmental
5013 Pacific Hwy East
Suite 20
Tacoma, WA 98424

1.0 INTRODUCTION

A dangerous waste characterization using the test organism *Oncorhynchus mykiss* (rainbow trout) was conducted on one sample submitted by Friedman and Bruya, Inc. to Rainier Environmental. Testing was conducted following the Washington State Department of Ecology Publication 80-12.

2.0 METHODS

The sample, identified as VSP-12-3.3 was received in the laboratory on December 3, 2018. Upon arrival at the laboratory the sample was inspected and contents verified against information provided on the chain-of-custody form. The sample was stored at 4°C in the dark until use. The test procedure is outlined in Table 1.

Table 1. Summary of Dangerous Waste Characterization Test Conditions

Parameter	Standard Fish Toxicity Test
Test number	1812-009
Sample ID	VSP-12-3.3
Test initiation date; time	12/7/2018; 1030h
Test termination date; time	12/11/2018; 0910h
Endpoint	Mortality at 96-hours
Test chamber	7.5 L plastic tank
Test temperature	12 ± 1°C
Dilution water	Moderately hard synthetic water
Test solution volume	6 L
Test concentrations (mg/L)	100, 10, 0
Number of organisms/ chamber	10
Number of replicates	3
Test organism	*Oncorhynchus mykiss* (rainbow trout)
Feeding	No feeding during test
Photoperiod	16 hours light/ 8 hours dark
Extraction	Rotary agitation (30 +/- 2 rpm) for 18 hours
Reference Toxicant	Copper sulfate
Deviations	None

The test organisms used in the test are outlined in Table 2. The samples were tested using fish received on November 26, 2018.

Table 2. Test organisms (*Oncorhynchus mykiss*)

Test organism age	59 days post swim-up (hatch date 9/14/2018)
Mean weight	0.42 g
Mean length	42 mm
Ratio of longest to shortest	1.2
Loading	0.71 g/L
Test organism source	Trout Lodge; Sumner, WA

3.0 RESULTS

A summary of results for the dangerous waste characterization conducted on sample VSP-12-3.3 is contained in Table 3. There was no mortality during the test. Based on these results, the sample does not designate as either a dangerous or extremely hazardous waste. Copies of the laboratory bench sheets, statistical summaries of reference toxicant tests, and chain-of-custody form are provided in Appendices A through C.

Table 3. Summary of Results

Sample ID	Concentration (mg/L)	Survival (# fish, N=30)	Percent Mortality	Dangerous Waste Designation
Control	0	30	0	NA
VSP-12-3.3	10	30	0	None
	100	30	0	

4.0 QUALITY ASSURANCE

The most recently completed reference toxicant test was initiated December 5, 2018. The LC_{50} of 132 g/L copper fell within the acceptable range of mean ± two standard deviations of historical test results indicating that the test organisms were of an appropriate degree of sensitivity. The coefficient of variation (CV) for the last 21 tests was 25.0 percent, which is considered excellent by the Biomonitoring Science Advisory Board.

5.0 REFERENCES

WDOE. 2008. Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria. Washington State Department of Ecology. Water Quality Program. Publication number: WQ-R-95-80, Revised December 2008.

WDOE. 2009. Biological Testing Methods 80-12 for the Designation of Dangerous Waste. Washington State Department of Ecology. Hazardous Waste and Toxics Reduction Program. Publication number: 80-12, Revised June 2009.

Appendix A
Oncorhynchus mykiss Dangerous Waste Toxicity Test
Raw Bench Sheets

Dangerous Waste Toxicity Test

Client: Friedman and Bruya, Inc.
Sample ID: VSP-12-3.3
Test #: 1812-009
Log In #: T18-304

Start Date & Time: 12/7/18 1030
End Date & Time: 12/11/18 0910
Test Organism: *Oncorhynchus mykiss*
Test Protocol: **Washington State Department of Ecology Publ. 80-12**

Rep	Conc.	Cont #	Number of Live Organisms					Dissolved Oxygen (mg/L)					pH (units)					Conductivity (umhos/cm)					Temperature (°C)					Percent Survival
			0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	0	24	48	72	96	
1	CON	14	10	10	10	10	10	8.8	8.5	8.1	7.3	6.6	7.68	7.57	7.42	7.30	7.27	273				266	11.5	12.1	11.7	11.8	12.6	
2		4	10	10	10	10	10	8.6	8.2	8.0	7.4	6.8	7.70	7.55	7.41	7.28	7.24	270				269						
3		9	10	10	10	10	10	8.9	8.4	8.1	7.0	6.7	7.65	7.54	7.45	7.31	7.29	271				265						
1	10 PPM	24	10	10	10	10	10	8.4	8.1	7.8	7.4	6.4	7.84	7.67	7.44	7.27	7.32	265				276	12.0	12.0	12.1	11.7	12.2	
2		27	10	10	10	10	10	8.7	8.4	8.2	7.1	6.5	7.80	7.65	7.47	7.24	7.34	264				275						
3		18	10	10	10	10	10	8.8	8.4	8.1	7.5	6.3	7.87	7.61	7.42	7.30	7.30	261				277						
1	100 PPM	26	10	10	10	10	10	8.9	8.5	8.1	7.6	6.5	7.81	7.64	7.44	7.38	7.34	265				279	12.0	11.8	11.8	11.7	12.2	
2		5	10	10	10	10	10	8.7	8.2	8.4	7.8	6.3	7.84	7.64	7.41	7.31	7.36	264				278						
3		11	10	10	10	10	10	9.0	8.6	8.0	7.3	6.2	7.82	7.62	7.40	7.39	7.33	263				275						
1																												
2																												
3																												
1																												
2																												
3																												
1																												
2																												
3																												
1																												
2																												
3																												
Technician Initials			APT	ET	ET	APT	APT	APT	ET	ET	APT	APT																

Sample	Alk. (init.)	Hard. (init.)	Alk. (fin.)	Hard. (fin.)	Chlorine
	(mg/L as CaCO3)				(mg/L Cl2)
Control	64	84	64	84	<0.03
100PPM	64	84	64	84	

Animal Source: Troutlodge
Date Received: 11/16/18

Test Volume: 6.0 L
Date of Hatch: 9/14/18
Date of Swim up: 10/8/18

Weights (g): .47 .44 .40 .41 .38 .42 .44 .45 .42 .41 μ = .42
Lengths(mm): 45 46 41 40 37 41 42 43 43 43 μ = 42
Length max/min: 45/37 1.2
Loading: 0.71g/L

Rainier Environmental
Washington Laboratory
5013 Pacific HWY E Suite 20
Tacoma, WA 98424

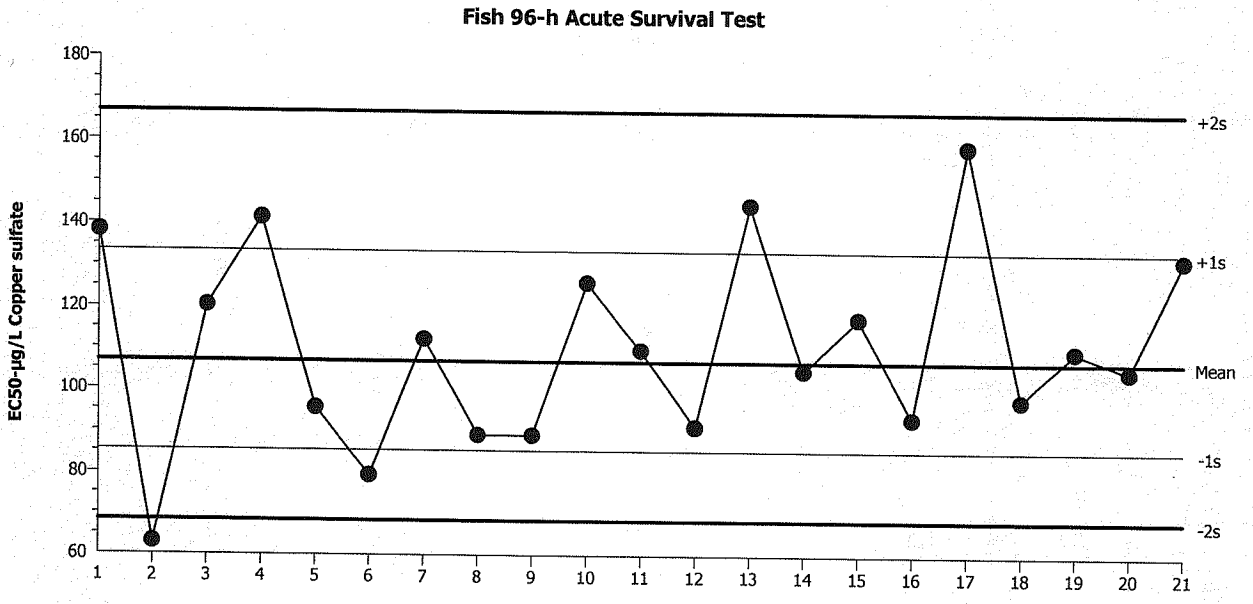
Dilution Water Source: MHSW 088
QA Check ET

Appendix B
Reference Toxicant Test
Control Chart and Statistical Summary

CETIS QC Plot

Fish 96-h Acute Survival Test — **Rainier Environmental Laboratory**

Test Type:	Survival (96h)	**Organism:**	Oncorhynchus mykiss (Rainbow Tro	**Material:**	Copper sulfate
Protocol:	Not Applicable	**Endpoint:**	96h Survival Rate	**Source:**	Reference Toxicant-REF



Mean:	106.8	**Count:**	20	**-1s Warning Limit:**	85.44	**-2s Action Limit:**	68.35
Sigma:	NA	**CV:**	25.00%	**+1s Warning Limit:**	133.5	**+2s Action Limit:**	166.9

Quality Control Data

Point	Year	Month	Day	QC Data	Delta	Sigma	Warning	Action	Test ID	Analysis ID
1	2017	Mar	2	138.2	31.39	1.154	(+)		06-3918-0228	07-9779-4134
2		Apr	4	63	-43.81	-2.365	(-)	(-)	03-6593-7512	17-2989-4259
3		May	3	120.3	13.5	0.5332			11-5596-3648	06-1016-9279
4		Jun	2	141.4	34.62	1.258	(+)		12-4358-3517	15-4391-5735
5		Jul	5	95.48	-11.32	-0.502			15-6974-4640	17-7171-1787
6		Aug	9	79.37	-27.43	-1.33	(-)		14-0940-5366	14-5578-7811
7		Sep	6	112.2	5.442	0.2226			20-3302-1945	19-8536-6321
8		Oct	10	89.09	-17.71	-0.8125			16-6680-8798	20-0898-2992
9		Nov	14	89.09	-17.71	-0.8125			03-8806-4974	08-0487-5780
10		Dec	17	126	19.19	0.7402			21-2907-2796	14-7957-6406
11	2018	Jan	16	109.7	2.878	0.1191			07-7088-1157	16-4889-5798
12		Feb	15	91.17	-15.63	-0.709			06-6357-5370	00-6522-6981
13		Mar	17	144.7	37.92	1.361	(+)		00-4331-1834	10-4388-1035
14		Apr	21	104.7	-2.075	-0.0879			00-5606-6972	09-2556-2363
15		May	23	117.6	10.75	0.4297			20-2785-4749	16-3316-3415
16		Jun	20	93.3	-13.5	-0.6055			05-6858-8909	21-3433-5668
17		Jul	25	158.7	51.94	1.775	(+)		03-7661-5860	05-4916-3169
18		Aug	30	97.72	-9.088	-0.3985			01-6631-0399	00-2872-0274
19		Oct	5	109.7	2.878	0.1191			09-8718-1650	14-5303-2875
20		Nov	6	104.7	-2.075	-0.0879			20-5282-8357	01-3690-0719
21		Dec	5	132	25.15	0.9473			01-4499-1094	07-5652-1457

CETIS Summary Report

Test Code: RA120718OM | 01-4499-1094

Fish 96-h Acute Survival Test — **Rainier Environmental Laboratory**

Batch ID:	15-8681-7607	**Test Type:**	Survival (96h)	**Analyst:**	Eric Tollefson
Start Date:	05 Dec-18 15:15	**Protocol:**	Not Applicable	**Diluent:**	Mod-Hard Synthetic Water
Ending Date:	09 Dec-18 15:00	**Species:**	Oncorhynchus mykiss	**Brine:**	
Duration:	96h	**Source:**	Trout Lodge Fish Farm	**Age:**	57d
Sample ID:	01-9994-0076	**Code:**	RA120718OM	**Client:**	Internal Lab
Sample Date:	07 Dec-18	**Material:**	Copper sulfate	**Project:**	
Receive Date:	07 Dec-18	**Source:**	Reference Toxicant		
Sample Age:	NA	**Station:**	In House		

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
11-7957-8248	96h Survival Rate	50	100	70.71	20.5%		Dunnett Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level	µg/L	95% LCL	95% UCL	TU	Method
07-5652-1457	96h Survival Rate	LC50	132	111	156.9		Spearman-Kärber

96h Survival Rate Summary

C-µg/L	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Dilution Water	3	1	1	1	1	1	0	0	0.0%	0.0%
25		3	1	1	1	1	1	0	0	0.0%	0.0%
50		3	0.9333	0.8902	0.9765	0.8	1	0.06667	0.1155	12.37%	6.67%
100		3	0.7	0.6253	0.7747	0.5	0.9	0.1155	0.2	28.57%	30.0%
200		3	0.2667	0.2096	0.3237	0.1	0.4	0.08819	0.1528	57.28%	73.33%
400		3	0	0	0	0	0	0	0		100.0%

96h Survival Rate Detail

C-µg/L	Control Type	Rep 1	Rep 2	Rep 3
0	Dilution Water	1	1	1
25		1	1	1
50		1	0.8	1
100		0.9	0.7	0.5
200		0.4	0.1	0.3
400		0	0	0

96h Survival Rate Binomials

C-µg/L	Control Type	Rep 1	Rep 2	Rep 3
0	Dilution Water	10/10	10/10	10/10
25		10/10	10/10	10/10
50		10/10	8/10	10/10
100		9/10	7/10	5/10
200		4/10	1/10	3/10
400		0/10	0/10	0/10

Appendix C
Chain-of-Custody Form

SUBCONTRACT SAMPLE CHAIN OF CUSTODY

Send Report To Michael Erdahl

Company Friedman and Bruya, Inc.

Address 3012 16th Ave W

City, State, ZIP Seattle, WA 98119

Phone # (206) 285-8282 Fax # (206) 283-5044

SUBCONTRACTER Rainier

PROJECT NAME/NO. 811213

PO # A-636

REMARKS

Please Email Results

TURNAROUND TIME

☒ Standard (2 Weeks)

☐ RUSH

Rush charges authorized by:

SAMPLE DISPOSAL

☐ Dispose after 30 days

☐ Return samples

☐ Will call with instructions

Sample ID	Lab ID	Date Sampled	Time Sampled	Matrix	# of jars	ANALYSES REQUESTED: Total Organic Carbon	COD	BOD	Chloride	Sulfate	Sulfide	Fish BioAssay			Notes
VSP-12-3.3		11/12/18	1225	SO.1	1							X			Login: 718-304

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

	SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:		Michael Erdahl	Friedman & Bruya	12/3/18	0900AM
Received by:		Annie Tran	Rainier Environmental	12/3/18	1406
Relinquished by:					
Received by:					

811213

SAMPLE CHAIN OF COUSTODY

ME 11-13-18

BI4

Report To Adam Griffin + cc: Chad Hearn

Company Aspect Consulting

Address 710 Second Ave, Suite 550

City, State, ZIP Seattle, WA 98104

Phone 206-780-7746 Email agriffin@aspectconsulting.com chearn@aspectconsulting.com

SAMPLERS (signature) Chad Hearn

PROJECT NAME Snopac

PO # 150054

REMARKS Hold 1 jar until analytical provided, two samples will be submitted to Rainier Environmental based on TCLP results.

INVOICE TO Aspect

Page # 1 of 2

TURNAROUND TIME
☑ Standard Turnaround
☐ RUSH
Rush charges authorized by:

SAMPLE DISPOSAL
☐ Dispose after 30 days
☐ Archive Samples
☑ Other Hold for Rainier

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	Fish Bioassay (~~TPH-Gasoline~~)	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	Total As, Cu, Pb, Ni, Zn (~~PAHs 8270D SIM~~)	TCLP RCRA-8 Metals	Total PCBs	~~HOLD~~ Total Metals *	HOLD Acute Fish Toxicity (Rainier)	Notes (* New MTCA 5 per CH, STD TAT)
VSP-14-4.1	01 AB	11/12/18	0900	Soil	2							⊕	X	X	X	X	~~* Hold all samples for total metals,~~ (arsenic, copper, lead, nickel + zinc)
VSP-9-3.2	02	11/12/18	0925	Soil	2							↓	X		X	X	
VSP-5-2.6	03	11/12/18	0950	Soil	2							↓	X	⊕	X	X	⊕ per CH
VSP-3-3.6	04	11/12/18	1010	Soil	2							↓	X		X	X	11/15/18 ME
VSP-7-8.2	05	11/12/18	1050	Soil	2							↓	X		X	X	◆ - per CH
VSP-15-4.8	06	11/12/18	1125	Soil	2							↓	X		X	X	11/30/18 ME
VSP-11-5.6	07	11/12/18	1155	Soil	2							↓	X		X	X	
VSP-12-3.3	08	11/12/18	1225	Soil	2			◆				↓	X		X	X	
VSP-1-2.2	09	11/12/18	1240	Soil	2							↓	X		X	X	
DUP-1	10	11/12/18	—	Soil	2							↓	X		X	X	

	SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	[signature]	Chad Hearn	Aspect	11/13/18	1240
Received by:	[signature]	Nhan Phan	FEBI	11/13/18	1240
Relinquished by:					
Received by:			Samples received at 3 °C		

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

811213

SAMPLE CHAIN OF CUSTODY

ME 11-13-18 BIY

Page # 2 of 2

Report To Adam Griffin & cc: Chal Hearn

Company Aspect Consulting

Address 710 Second Ave, Suite 550

City, State, ZIP Seattle, WA 98104

Phone 206-780-7746 Email agriffin@aspectconsulting.com chearn@aspectconsulting.com

SAMPLERS (signature): Chad Hearn

PROJECT NAME: Snopac

PO # 150054

REMARKS: Hold 1 jar, pending TCLP results. Two samples will eventually be submitted to Rainier lab.

INVOICE TO: Aspect

TURNAROUND TIME
- [x] Standard Turnaround
- [ ] RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- [ ] Dispose after 30 days
- [ ] Archive Samples
- [x] Other Hold for Rainier

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	Total As & Pb via PAHs 8270D-SIM	TCLP RCRA-8 Metals	Total PCBs	TCLP Total Metals*	Hold Acute Fish Toxicity (Rainier)	Notes
VSP-4-4.5	11AB	11/12/18	1305	soil	2							◆	X		X	X	
VSP-8-5.6	12	11/12/18	1345	soil	2								X	X	X	X	
VSP-2-5.1	13	11/12/18	1415	soil	2								X	X	X	X	
VSP-10-4.6	14	11/13/18	0945	soil	2								X		X	X	
VSP-6-6.2	15	11/13/18	0800	soil	2								X	X	X	X	
VSP-13-2.2	16	11/13/18	0820	soil	2							↓	X		X	X	

ANALYSES REQUESTED

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: Chad Hearn	Chal Hearn	Aspect	11/13/18	1240
Received by: Nhan Phan	Nhan Phan	FBT	11/13/18	1240
Relinquished by:				
Received by:		Samples received at 3 °C		

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

ATTACHMENT 6 WASTE CHARACTERIZATION SAMPLING AND ANALYSIS PLAN (DH ENVIRONMENTAL, 2018)

Snopac Property Upland Source Control
Waste Characterization Sampling Analysis Plan

SnoPac Property
5055 East Marginal Way South
Seattle, Washington

Prepared For:

Aspect Consulting LLC
350 Madison Avenue N.
Bainbridge Island, Washington 98110

Prepared By:

DH Environmental, Inc.
1011 SW Klickitat Way
Suite 107
Seattle, Washington 98134

November 8, 2018

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List of Appendices

Section 1: INTRODUCTION

DH Environmental, Inc. (DH Environmental) has prepared this Sampling and Analysis Plan (SAP) on behalf of Aspect Consulting, LLC (Aspect), for the Snopac Property Uplands Source Control waste characterization sampling. The Snopac property is located at 5055 East Marginal Way South in Seattle, Washington (Site; Figure 1).

The purpose of this sampling event is to defensibly characterize upland soils with respect to state and federal regulations governing waste characterization, and to determine where and how the soil can be disposed of. This SAP has been prepared to describe the specific sampling and analysis protocols to be followed during soil sampling activities associated with waste characterization efforts. These protocols are pursuant to the requirements of Washington Administrative Code (WAC) 173-340-820, the technical requirements of EPA publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, and the Washington State Department of Ecology (Ecology) Publication #97-407, revised December 2014, *Chemical Testing Methods for Designating Dangerous Waste*.

The SAP describes the sample collection program, including the design and implementation of the proposed sampling; sample collection, handling, and analysis procedures; and quality assurance and quality control (QA/QC) requirements. The QA/QC protocols described here are necessary to achieve the site-specific objectives for sample collection and analysis. Records must be maintained documenting all sampling activities performed and data generated during implementation of this waste characterization SAP.

This SAP was developed and intended to be used for waste characterization sampling only. Other site-specific project documents may also govern work conducted at the Site (e.g., health and safety plan, RI/FS work plans, etc.).

1.1 PROJECT ORGANIZATION

This section identifies key individuals and their responsibilities for all waste characterization sampling aspects of the project.

Key personnel involved in the SAP activities and their roles and responsibilities are summarized below:

- Aspect Consulting Project Manager: Adam Griffin, 206-780-7746
- DH Environmental Project Manager: Scott St. John, 206-327-0026
- IO Environmental, Site Supervisor:
- Freidman and Bruya, Project Manager:

Freidman and Bruya, of Seattle Washington, is a Washington State accredited environmental laboratory.

1.2 ENVIRONMENTAL CONSULTANT

The environmental consultant conducting the waste characterization sampling activities will complete the following tasks:

- Communicate data quality objectives to the analytical laboratory analyzing samples collected from the Site.
- Assemble project teams, implement sample collection activities, and coordinate sample analyses.
- Ensure that the proper number, type, and quantity of sample containers, including preservation requirements, are available for field activities.
- Follow standard sampling protocols as defined in this SAP and other relevant site-specific project documents.
- Record and document all field data as specified in this SAP.
- Following applicable Standard Operating Procedures (SOPs), ensure that all samples are collected, preserved, labeled, packaged, and shipped to the contract analytical laboratory in an appropriate manner.
- Review analytical laboratory results and Quality Control (QC) data.
- Prepare analytical laboratory data summary reports and Quality Assurance (QA) reports.
- Where applicable, report deficiencies in sample collection, preservation, handling, test methods, or documentation.
- Initiate and support technical audits and corrective action that may arise from deficiencies in sample collection, preservation, handling, test methods, or documentation.

1.3 ANALYTICAL LABORATORY

The analytical laboratory analyzing and reporting results for samples collected from the Site will:

- Understand and follow sampling objectives outlined in this SAP.
- Perform requested analyses using appropriate test methods specified in this SAP.
- Prepare analytical laboratory reports for the environmental consultant, including all relevant data and QC reports.
- Communicate analytical problems, issues, or concerns to the environmental consultant in a timely manner.
- Initiate corrective action when deficiencies in sample collection, preservation, handling, test methods, or documentation are identified internally by the contract analytical laboratory, or by the environmental consultant.

Section 2: PROJECT DESCRIPTION AND BACKGROUND

2.1 BACKGROUND

The Site is currently undergoing a remedial investigation / feasibility study (RI/FS). As part of the feasibility study, soils in the uplands portion of the Site are being characterized for waste disposal purposes as part of an evaluation of a soil removal alternative.

2.2 PROJECT DESCRIPTION

The soil removal alternative under evaluation for the uplands portion of the Site consists of removing approximately 2,240 cubic yards (yd^3) of soil from the area outlined in Figure 1. This area is approximately 10-feet deep along the western boundary, adjacent to a sheet pile wall, and the base of the proposed excavation slopes upwards to approximately 5-feet deep along the eastern boundary.

As part of the soil removal planning process, it is necessary to characterize potential contaminants in the soil for waste characterization purposes, in order to determine the disposal method of the soil. Preliminary screening, based on previously collected soil samples, indicates the contaminants of concern at the Site (from a waste disposal perspective) are metals.

Section 3: SAMPLING DESIGN

This sampling event has been designed as a random sampling plan in accordance with EPA Publication SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA SW846). Previous investigations at the site indicate concentrations of total lead in soil range up to 524 milligrams per kilogram (mg/kg). Therefore, the focus of this sampling design is to determine if the soil will designate as characteristic waste for lead and be subject to Federal Land Disposal Restrictions.

The number of samples and location of sample points prescribed for this sampling plan was calculated using Visual Sampling Plan (VSP), a statistical sampling software package developed by the Pacific Northwest National Laboratory. A non-parametric random sampling plan was chosen for this site because spatial distribution of potential contamination is unknown, and due to the heterogeneous nature of fill soils. A non-parametric formula was chosen because previously collected soil sampling data for total lead indicates the data are sufficient to conclude with 95% confidence that the data are not normally distributed (Shapiro-Wilk Test Statistic = 0.50043; Shaprio-Wilk 5% Critical Value = 0.923).

Null Hypothesis. For this sampling design, we have chosen to assume the site is unacceptable (i.e., it will designate as RCRA Hazardous Waste) until proven otherwise. The working hypothesis (or 'null' hypothesis) is that the median(mean) concentration of leachable lead (e.g., lead concentrations in leachate after performing a Toxicity Characteristic Leaching Procedure [TCLP] test, Environmental Protection Agency [EPA] Method 1311) at the site is equal to or greater than the threshold of 5 milligrams per liter (mg/L). The alternative hypothesis is that the median(mean) TCLP lead concentration is less than 5 mg/L. That is, if we fail to reject the null hypothesis, we will not be 95% confident that the true median TCLP lead concentration is less than 5 mg/L, and thus we will conclude that the soil is RCRA Hazardous Waste for Characteristic of Lead Toxicity.

Similarly, the same null hypothesis will also be evaluated for the concentration of leachable RCRA 8 metals (Resource Conservation and Recovery Act list of eight metals [Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver]), compared with their respective regulatory levels (Maximum Concentration of Contaminants for the Toxicity Characteristic, 40 CFR 261.24(b)). A Summary of the maximum concentrations is included in Table 1.

Table 1 - Maximum Concentration of Contaminants for the Toxicity Characteristic

Contaminant	Regulatory Level (mg/L)
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0

Simple Random Sampling. In random sampling, VSP places samples within a sample area in a random arrangement using a random number generator. This includes both X and Y coordinates (lateral spacing), as well as the Z coordinate (depth).

Number of Samples. Using a nonparametric test and the input parameters summarized in Table 2, VSP calculated a minimum of 12 samples required to reject the null hypotheses with 95 percent confidence and ensure that soil would not be mistakenly designated as non-hazardous if it is hazardous. The total number of samples was increased by 20%, as recommended by MARSSIM (EPA,2000), to account for missing or unusable data and uncertainty in the calculated value of *n*. Therefore, a total of 15 samples was chosen for the sample plan to ensure convergence of statistical confidence. In addition, one field duplicate will also be collected from a location to be determined in the field.

Sample Locations. The X and Y coordinates for each of the randomly located samples are shown on Figure 2. The coordinate system is Washington State Plane North, the datum is the North American Datum of 1983 (NAD83). Each sample location will be located and marked in the field using a map grade GPS unit capable of sub-meter accuracy.

Table 2 below shows the VSP Parameter Inputs.

Table 2: Visual Sample Plan Inputs

Parameter	Value	Basis
Primary Objective of the Sampling Design	Compare a site mean or median to a fixed threshold	Reject the null hypothesis.
Type of Sampling Design	Non-parametric	Previously collected data indicate the data are not normally distributed.
Sample Placement	Simple Random Sampling	Random sampling is a probability-based sample design that provides an unbiased distribution over the entire soil sampling area. Probability-based design also allows for statistical inferences to be made about the sample population, based on the data obtained from a limited number of samples.
Standard deviation (S)	123.13	Estimated based on the Standard Deviation of total lead concentrations in 30 soil samples collected at the Site in 2017.
Delta (Δ)	243.5	This is the width of the gray region. It is a user-defined value relative to a unit action level. This value was calculated based on the Delta of total lead concentrations from 30 soil samples collected at the Site in 2017.
Alpha (α)	5%	This is the acceptable error of deciding a dirty site is clean when the true mean is equal to the Action Level. It is a maximum error rate since dirty sites with a true mean above the Action Level will be easier to detect. A value of 5% was chosen as a practical balance between health risks and sampling cost.

Beta (β)	5%	This is the acceptable error of deciding a clean site is dirty when the true mean is at the lower bound of the gray region.
MARSSIM sampling overage	20%	MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of n.

A copy of the sample design summary from VSP is included in Attachment A.

3.1 ADDITIONAL ANALYSIS

15 samples are prescribed for the sample design as described above in Section 3. In addition, one duplicate sample will also be collected for a total of 16 samples to be analyzed for TCLP RCRA 8 Metals. In addition to a statistical evaluation of TCLP metals data, additional compounds also need to be analyzed to make a complete waste determination for the Site.

Four of the 15 soil samples will also be analyzed for polychlorinated biphenyls (PCBs) because preliminary screening at the Site has shown low level detections of PCBs in soil from a limited number of samples. The four samples selected for PCB analysis will be determined based on their proximity to previously collected samples with the highest concentrations of PCBs (B-4, through B-6, and MW-11). Those include:

- VSP-5 or VSP-14
- VSP-6
- VSP-2
- VSP-8

In addition, two samples also need to be run for a fish bioassay test per *Biological Testing Method 80-12 for the Designation of Dangerous Waste* (Ecology, 2009). The two samples selected for a fish bioassay test will be determined after receipt of the TCLP Metals data. A fish bioassay test will be performed on the two samples with the highest concentrations of TCLP metals. If the samples are all non-detect for TCLP metals, then the fish bioassay tests will be performed on samples closest in proximity to previously collected samples from boring B-12 and MW-11, which had relatively high concentrations of reported metals. Those include:

- VSP-10
- VSP-14 or VSP-5

Previously collected soil data collected across the Site for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) is sufficient for waste characterization screening purposes, and therefore, no additional samples need to be collected for these compounds as part of this sampling effort.

Volatile Organic Analysis: Total VOCs are typically analyzed to screen for the presence of TCLP volatiles, F-Listed solvents, and total halogenated organic compounds for WA State Persistent Criteria. Based on initial screening results, VOCs have not been identified as chemicals of concern.

Semivolatile Organic Analysis: Total SVOCs are typical analyzed to screen for the presence of TCLP semivolatiles, F-Listed solvents, and total carcinogenic polycyclic aromatic hydrocarbons for WA State Persistent Criteria. Based on initial screening results, SVOCs have not been identified as chemicals of concern.

Section 4: FIELD SAMPLING AND ANALYTICAL PROCEDURES

All field operations will be supervised by experienced personnel with appropriate training to conduct sampling activities and work at hazardous waste sites.

4.1 SOIL SAMPLING PROCEDURES SUMMARY:

1. Target soil sampling locations will be located in the field using a map-grade GPS unit capable of sub-meter accuracy.
2. Sample depths will be achieved using a mini-excavator.
3. Once target locations are located and the test pit has been excavated to the desired sample depth, a soil sample will be retrieved using the excavator.
4. Soil samples will be collected from the excavator bucket, being careful to collect soil which is not in contact with the excavator bucket
5. Each sample will require a minimum of (2) 4 oz jars. One of the jars will be retained for potential follow-up analysis for fish bioassay testing, pending receipt of the TCLP metals data.
6. Samples must be reasonably reduced in the field so as to fill the sample jars with minimal void space, and to remove rocks or other debris larger than approximately 0.5-inches.
7. Each sample should contain approximately the same volume to the extent possible.
8. Sample naming conventions shall be determined by Aspect, but need to include at a minimum the sample location identified on Figure 2 (VSP-1, VSP-2, etc.) and the depth the sample was collected from.
9. All sampling equipment must be dedicated or properly decontaminated with Alconox (or equivalent) prior to use in sample collection.
10. All samples shall be immediately labeled and placed on ice following collection. Samples will be delivered to the selected analytical laboratory following standard chain of custody procedures.
11. A field log must be kept that denotes field conditions, time of arrival, soil logs, and any deviation from the sampling plan.

4.2 ANALYTICAL PROCEDURES

All samples will be analyzed for TCLP RCRA 8 metals. The following methods, preservations and holding times apply.

Table 1: Containers, Preservatives, and Holding Times for Media Samples

Analysis	Matrix	EPA Analytical Method	Sample Container Size/Type	Preservation	Holding Time
TCLP Metals	Soil	• EPA 1311 (extraction) • EPA 6010/6020 (all except Hg) • EPA 7470 (Hg)	4-oz. clear wide mouth glass jar	None. Store on ice ≤ 6˚C	6 months
PCBs	Soil	• EPA 8082	4-oz. clear wide mouth glass jar	None. Store on ice ≤ 6˚C	6 months
Fish Bioassay	Soil	• Method 80-12	4-oz. clear wide mouth glass jar	None. Store on ice ≤ 6˚C	45 days

4.3 EQUIPMENT DECONTAMINATION PROCEDURES

All non-dedicated sampling equipment (augers, trowels, etc.) will be thoroughly decontaminated using a solution of anionic soap (e.g., Liquonox®) and deionized water followed by a "clean" rinse using deionized water. Because samples will be collected using dedicated sampling equipment and placed directly into laboratory supplied sampling containers, equipment decontamination is not expected to be necessary. All liquids generated during decontamination procedures will be containerized in Department of Transportation approved 55-gallon drums. The characterization and disposition of Investigative Derived Wastes (IDW) is discussed in Section 7.

4.4 FIELD LOGBOOKS

Field logbooks and/or pre-printed logs will be used to document where, when, how, and from whom any vital project information was obtained. Log entries will be complete and accurate enough to allow reconstruction of field activities. All entries will be legible, written in blue or black ink, and signed by the individual making the entries. Only factual and objective language should be used.

At a minimum, the following information will be recorded during the collection of each sample:

- Sample location and description
- Site or Sampling area sketch showing sample location and measured distances
- Sampler's name(s)
- Date and Time of each sample collection
- Designation of sample as composite or grab
- Type of sample (e.g., soil, sediment, or water)
- Type of sampling equipment used to collect each sample
- Field instrument readings and calibrations
- Field observations and details related to analysis or integrity of samples (e.g., weather conditions, noticeable odors, colors, etc.)
- Preliminary sample descriptions (e.g., for soils: clay loam, very wet; for water: clear water with strong ammonia-like odor)
- Sample preservations
- Sample identification numbers and any explanatory codes, and chain-of-custody form numbers
- Shipping arrangements (overnight air bill number)

- Name of recipient laboratories

In addition to the sampling information listed above, the following specific information will also be recorded in the field logbook for each day of sampling:

- Team members and their responsibilities
- Time of arrival/entry on site and time of site departure
- Other personnel on site
- Summary of any site meetings or discussions with contractors, agency personnel, site personnel, etc.
- Deviations from sampling plans, site safety plans, and QAPP procedures
- Changes in personnel and responsibilities with reasons for the changes
- Levels of safety protection

4.5 PHOTOGRAPHS

Photographs will be taken at the sampling locations and at other areas of interest on site or sampling area. Photographs will serve to verify information entered in the field logbook. For each photograph taken, the following information will be written in the field logbook or recorded in a separate field photography log:

- Time, date, location, direction, and weather conditions
- Description of the subject photographed
- Name of person taking the photograph and name of person witnessing the photograph

4.6 LABELING

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. The samples will have preassigned, identifiable, and unique numbers. At a minimum, the sample labels will contain the following information:

- Station location
- Date of collection
- Analytical parameter(s)
- Method of preservation, if applicable

Every sample, including samples collected from a single location but going to separate laboratories, will be assigned a unique sample number.

4.7 CHAIN OF CUSTODY FORMS AND PROCEDURES

Chain-of-custody forms are used to document sample collection and shipment to laboratories for analysis. All sample shipments for analyses will be accompanied by a chain-of-custody form.

The chain-of-custody form will identify the contents of each shipment and maintain the custodial integrity of the samples. Generally, a sample is considered to be in someone's custody if it is either in someone's physical possession, in someone's view, locked up, or kept in a secured area that is restricted to authorized personnel. Until the samples are shipped or delivered to a WA State accredited environmental laboratory, the custody of the samples will be the responsibility of DH Environmental or

Aspect Consulting. The sampling team leader or designee will sign the chain-of-custody form in the "relinquished by" box and note date, time, and air bill number.

The sample numbers for all rinsate samples, reference samples, laboratory QC samples, and duplicates will be documented on the chain-of-custody form as found in Figure 4. The original form is left with the laboratory analyzing the samples.

The shipping containers in which the samples are stored (e.g., usually an ice chest), will be sealed with self-adhesive custody seals any time the samples are not in someone's possession or view before shipping. All custody seals will be signed and dated.

4.8 PACKAGING

The packaging procedures that will be followed:

- When ice is used, it will be packed in double plastic bags.
- The bottom of the cooler will be lined with bubble wrap to prevent breakage.
- All sample bottles will be placed in plastic zip-lock bags or equivalent.

4.9 INVESTIGATION DERIVED WASTE

Investigative-Derived Waste (IDW) generated during this investigation could include, but is not limited to, soil cuttings produced while installing borings; soils generated for logging field screening and sampling purposes; disposable personal protective equipment (PPE) and sampling utensils; and decontamination fluid from cleaning PPE, sampling equipment, and drilling equipment. Groundwater may be encountered and therefore, is considered as potential IDW material. DH Environmental will be responsible for waste management at the site, which includes drumming and securing the IDW, and labeling, staging, waste designation and profiling for disposal within all required timeframes (i.e. 180 or 90 days).

All IDW will be placed in DOT approved 55-gallon drums and labeled with the drum number, contents, date of accumulation, property owner, and contact information for the property owner or representative.

Section 5: REFERENCES

United States Environmental Protection Agency. (1991). Risk Assessment Guidance for Superfund, Part A. Office of Solid Waste.

United States Environmental Protection Agency. (1993, September). Data Quality Objectives for Superfund, Interim Final Guidance (540/G-93/017).

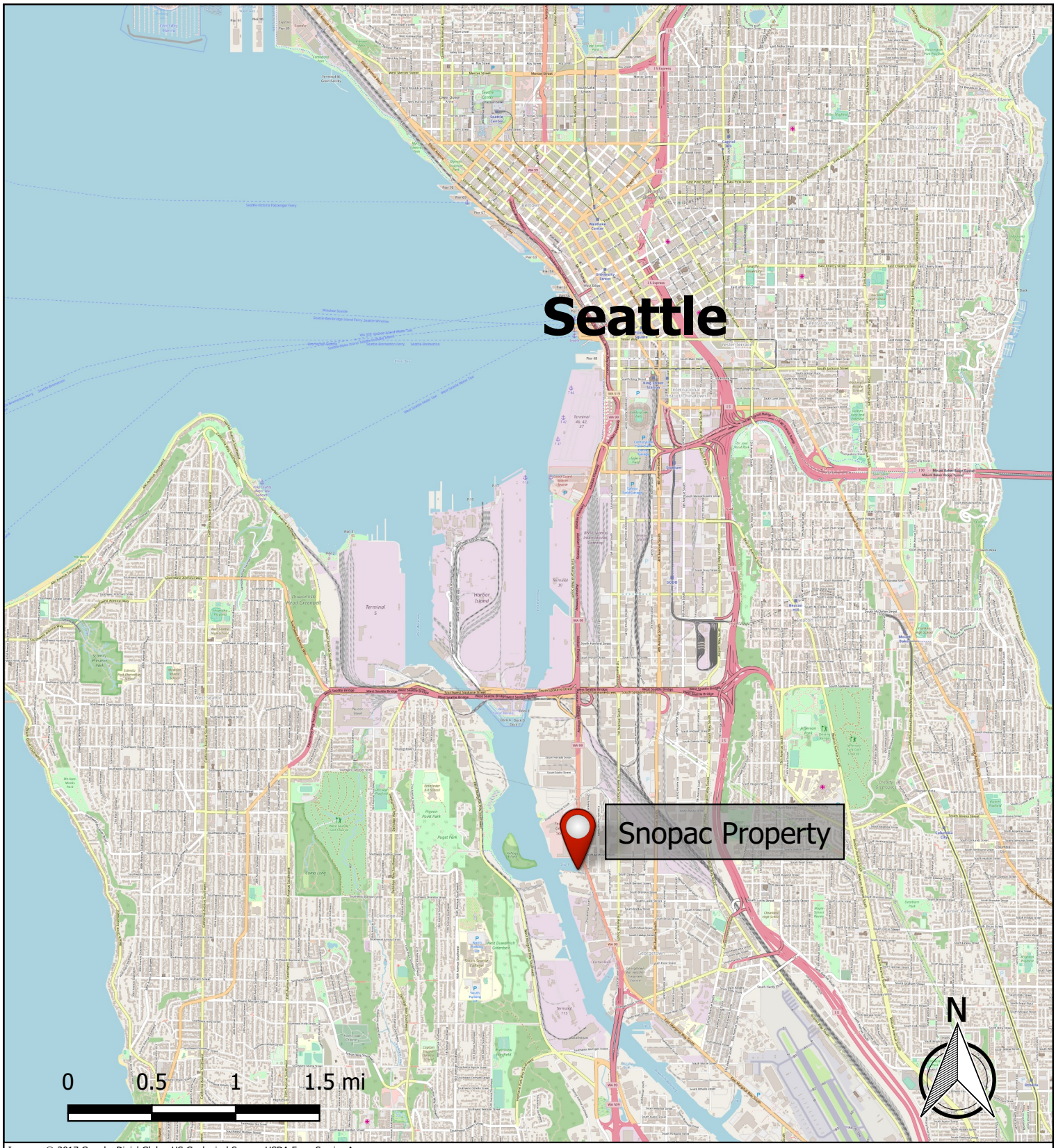
United States Environmental Protection Agency. (1991, May). Management of Investigation-Derived Wastes During Site Inspections (9345.3-02).

United States Environmental Protection Agency. (1992, April). Guidance to Management of Investigation-Derived Wastes (9345.3-03FS).

United States Environmental Protection Agency. (1998, January). Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. Chapter 9. Publication 846, Office of Solid Waste and Emergency Response.

United States Environmental Protection Agency. (August 2000). Guidance for the Data Quality Objectives (EPA/600/R-96/055,).

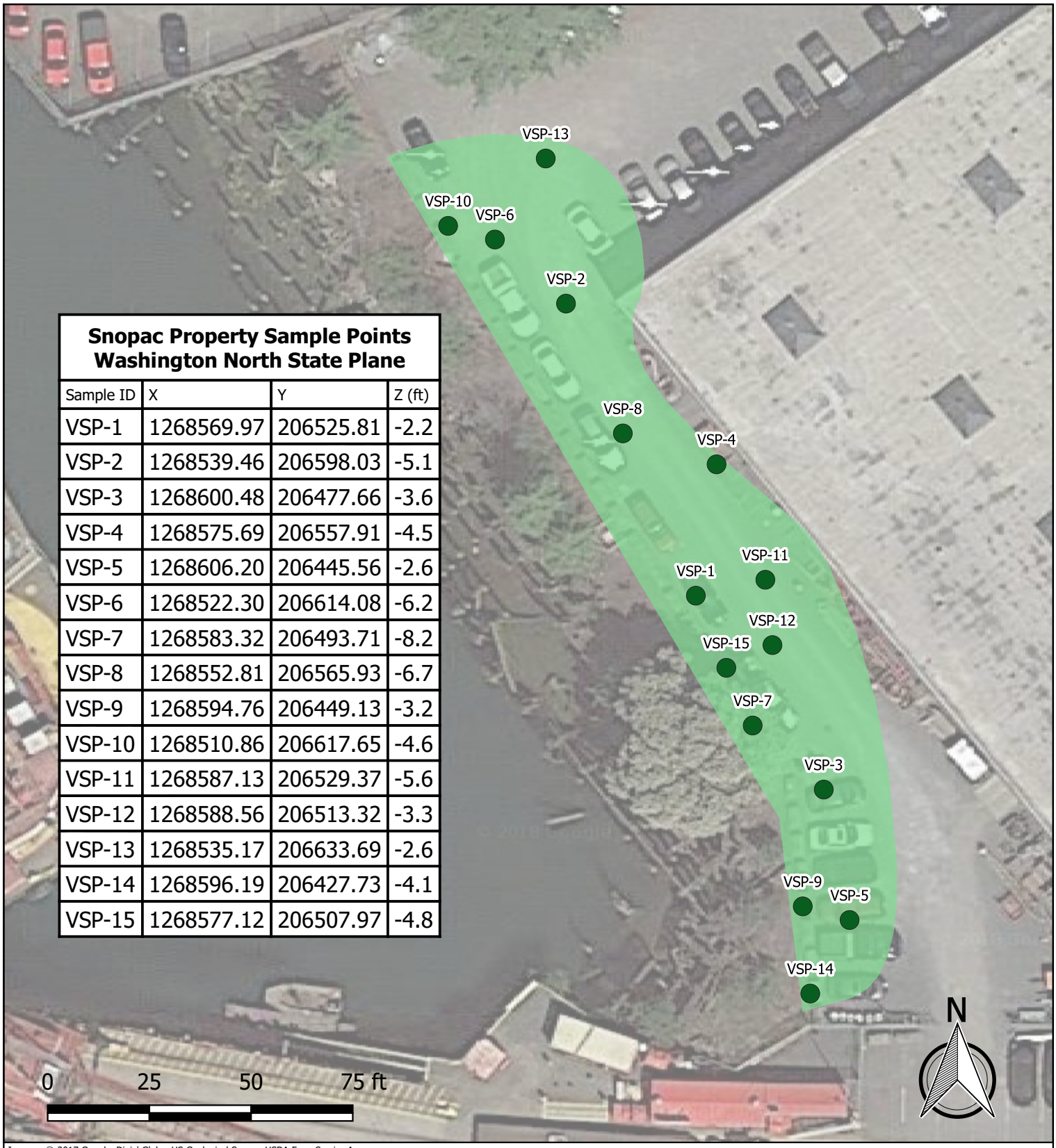
EPA, 2000. Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) Revision 1, report number EPA-402-R-97-016, Rev. 1.



Note: All Locations are Approximate.

DH Environmental Inc

Snopac Property Sampling Locations		
Snopac Property *5198 E Marginal Way S* *Seattlle, WA*	11-07-2018 BY: Sellers Weatherall	*FIGURE NO.* 1



Snopac Property Sample Points Washington North State Plane			
Sample ID	X	Y	Z (ft)
VSP-1	1268569.97	206525.81	-2.2
VSP-2	1268539.46	206598.03	-5.1
VSP-3	1268600.48	206477.66	-3.6
VSP-4	1268575.69	206557.91	-4.5
VSP-5	1268606.20	206445.56	-2.6
VSP-6	1268522.30	206614.08	-6.2
VSP-7	1268583.32	206493.71	-8.2
VSP-8	1268552.81	206565.93	-6.7
VSP-9	1268594.76	206449.13	-3.2
VSP-10	1268510.86	206617.65	-4.6
VSP-11	1268587.13	206529.37	-5.6
VSP-12	1268588.56	206513.32	-3.3
VSP-13	1268535.17	206633.69	-2.6
VSP-14	1268596.19	206427.73	-4.1
VSP-15	1268577.12	206507.97	-4.8

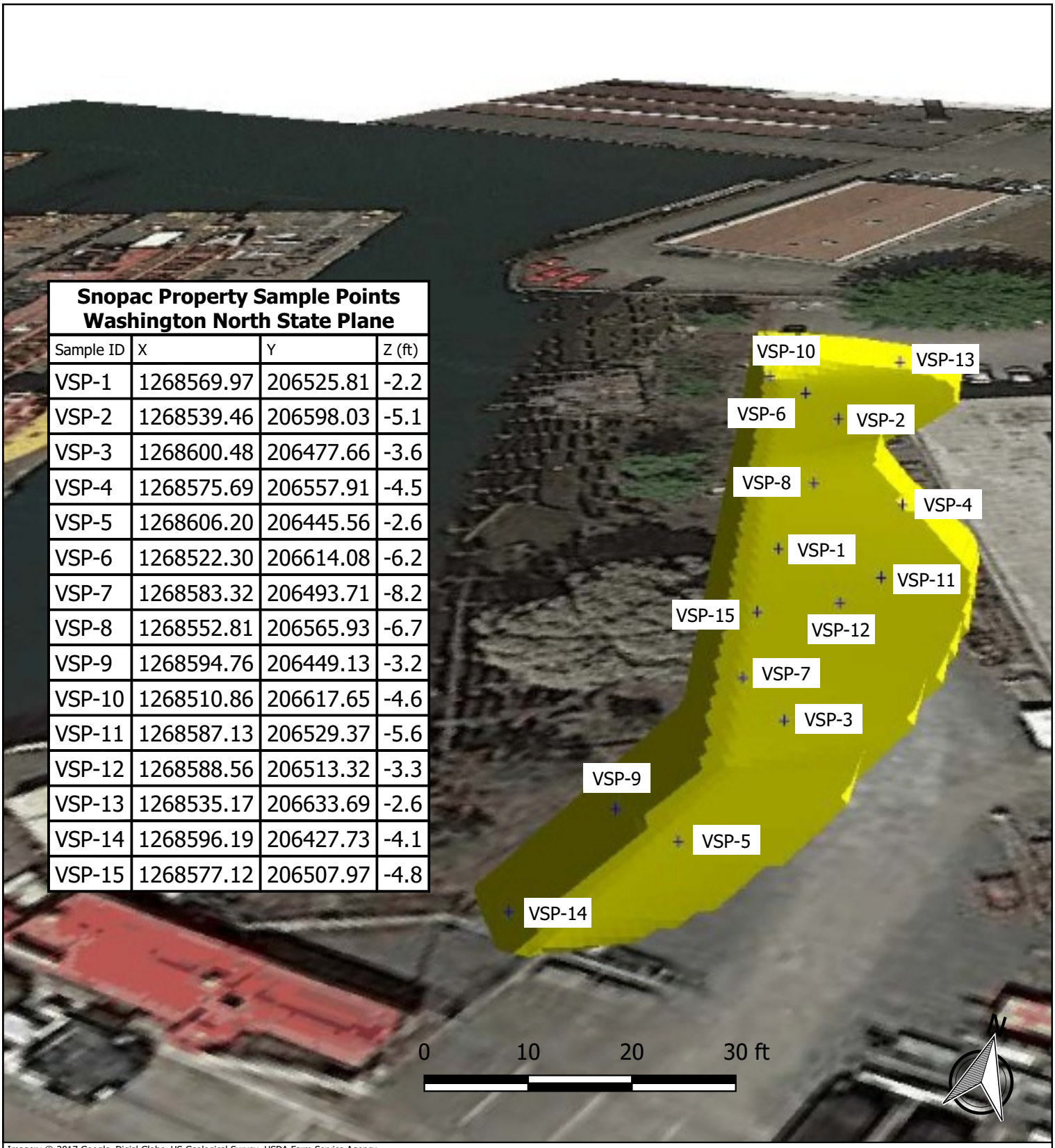
Note: All Locations are Approximate.
Coordinate System: NAD 1983 Washington North State Plane 4601 ft

Legend

- Sample Locations
- Excavation Area

DH Environmental Inc

Snopac Property Sampling Locations		
Snopac Property *5198 E Marginal Way S* *Seattlle, WA*	11-07-2018 BY: Sellers Weatherall	*FIGURE NO.* 2



Snopac Property Sample Points Washington North State Plane

Sample ID	X	Y	Z (ft)
VSP-1	1268569.97	206525.81	-2.2
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VSP-3	1268600.48	206477.66	-3.6
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VSP-5	1268606.20	206445.56	-2.6
VSP-6	1268522.30	206614.08	-6.2
VSP-7	1268583.32	206493.71	-8.2
VSP-8	1268552.81	206565.93	-6.7
VSP-9	1268594.76	206449.13	-3.2
VSP-10	1268510.86	206617.65	-4.6
VSP-11	1268587.13	206529.37	-5.6
VSP-12	1268588.56	206513.32	-3.3
VSP-13	1268535.17	206633.69	-2.6
VSP-14	1268596.19	206427.73	-4.1
VSP-15	1268577.12	206507.97	-4.8

Note: All Locations are Approximate.
Coordinate System: NAD 1983 Washington North State Plane 4601 ft

Legend

+ Sample Locations

Excavation Area

DH Environmental Inc

Snopac Property 3D Sampling Locations		
Snopac Property *5198 E Marginal Way S* *Seattlle, WA*	11-07-2018 BY: Sellers Weatherall	*FIGURE NO.* 3

Appendix A
Snopac Property Uplands Characterization, VSP Sample Design Summary

Random sampling locations for comparing a median with a fixed threshold (nonparametric - MARSSIM)

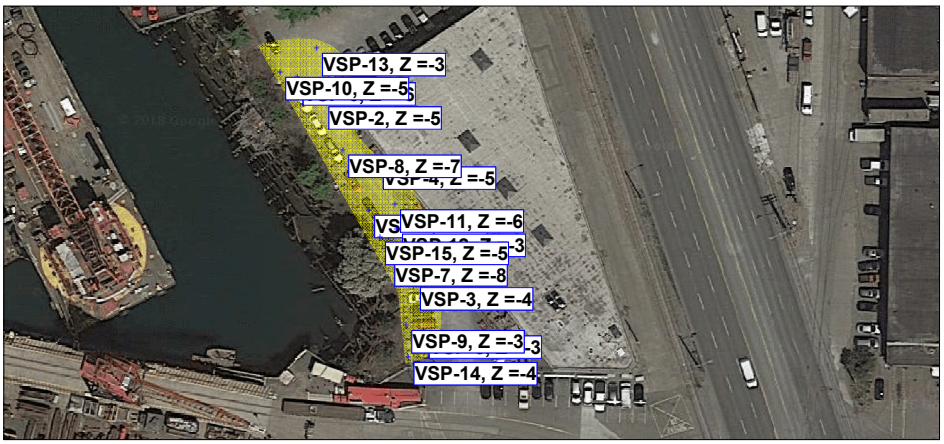
Summary

This report summarizes the sampling design used, associated statistical assumptions, as well as general guidelines for conducting post-sampling data analysis. Sampling plan components presented here include how many sampling locations to choose and where within the sampling area to collect those samples. The type of medium to sample (i.e., soil, groundwater, etc.) and how to analyze the samples (in-situ, fixed laboratory, etc.) are addressed in other sections of the sampling plan.

The following table summarizes the sampling design developed. A figure that shows sampling locations in the field and a table that lists sampling location coordinates are also provided below.

SUMMARY OF SAMPLING DESIGN	
Primary Objective of Design	Compare a site mean or median to a fixed threshold
Type of Sampling Design	Nonparametric
Sample Placement (Location) in the Field	Simple random sampling
Working (Null) Hypothesis	The median(mean) value at the site exceeds the threshold
Formula for calculating number of sampling locations	Sign Test - MARSSIM version
Calculated number of samples	12
Number of samples adjusted for EMC	12
Number of samples with MARSSIM Overage	15
Number of samples on map [a]	15
Number of selected sample areas [b]	1
Specified sampling area [c]	8103.01 ft^2

[a] This number may differ from the calculated number because of 1) grid edge effects, 2) adding judgment samples, or 3) selecting or unselecting sample areas.
[b] The number of selected sample areas is the number of colored areas on the map of the site. These sample areas contain the locations where samples are collected.
[c] The sampling area is the total surface area of the selected colored sample areas on the map of the site.



Area: ProposedExcavationExtent						
X Coord	**Y Coord**	**Label**	**Value**	**Type**	**Historical**	**Sample Area**

1268569.9718	206525.8071	VSP-1, Z =-2		Random		
1268539.4602	206598.0294	VSP-2, Z =-5		Random		
1268600.4834	206477.6589	VSP-3, Z =-4		Random		
1268575.6927	206557.9059	VSP-4, Z =-5		Random		
1268606.2043	206445.5600	VSP-5, Z =-3		Random		
1268522.2974	206614.0789	VSP-6, Z =-6		Random		
1268583.3206	206493.7083	VSP-7, Z =-8		Random		
1268552.8090	206565.9306	VSP-8, Z =-7		Random		
1268594.7624	206449.1266	VSP-9, Z =-3		Random		
1268510.8555	206617.6454	VSP-10, Z =-5		Random		
1268587.1345	206529.3736	VSP-11, Z =-6		Random		
1268588.5648	206513.3242	VSP-12, Z =-3		Random		
1268535.1695	206633.6948	VSP-13, Z =-3		Random		
1268596.1927	206427.7274	VSP-14, Z =-4		Random		
1268577.1229	206507.9744	VSP-15, Z =-5		Random		

Primary Sampling Objective
The primary purpose of sampling at this site is to compare a site median or mean value with a fixed threshold. The working hypothesis (or 'null' hypothesis) is that the median(mean) value at the site is equal to or exceeds the threshold. The alternative hypothesis is that the median(mean) value is less than the threshold. VSP calculates the number of samples required to reject the null hypothesis in favor of the alternative one, given a selected sampling approach and inputs to the associated equation.

Selected Sampling Approach
A nonparametric random sampling approach was used to determine the number of samples and to specify sampling locations. A nonparametric formula was chosen because the conceptual model and historical information (e.g., historical data from this site or a very similar site) indicate that typical parametric assumptions may not be true.

Both parametric and non-parametric equations rely on assumptions about the population. Typically, however, non-parametric equations require fewer assumptions and allow for more uncertainty about the statistical distribution of values at the site. The trade-off is that if the parametric assumptions are valid, the required number of samples is usually less than if a non-parametric equation was used.

VSP offers many options to determine the locations at which measurements are made or samples are collected and subsequently measured. For this design, simple random point sampling was chosen. Locating the sample points randomly provides data that are separated by varying distances, providing good information about the spatial structure of the potential contamination. Knowledge of the spatial structure is useful for geostatistical analysis. However, it may not ensure that all portions of the site are equally represented.

Nuclides
The following table summarizes the analyzed nuclides.

Nuclides Analyzed by Study		
Nuclide	**$DCGL_W$**	**$DCGL_{EMC}$**
TCLP lead	250	
Analyte 2		

Number of Total Samples: Calculation Equation and Inputs
The equation used to calculate the number of samples is based on a Sign test (see PNNL 13450 for discussion). For this site, the null hypothesis is rejected in favor of the alternative one if the median(mean) is sufficiently smaller than the threshold. The number of samples to collect is calculated so that if the inputs to the equation are true, the calculated number of samples will cause the null hypothesis to be rejected.

The formula used to calculate the number of samples is:

$$n = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(SignP - 0.5)^2}$$

where

$$SignP = \Phi\left(\frac{\Delta}{s_{total}}\right)$$

$\Phi(z)$ is the cumulative standard normal distribution on $(-\infty,z)$ (see PNNL-13450 for details),
n is the number of samples,
S_{total} is the estimated standard deviation of the measured values including analytical error,
Δ is the width of the gray region,
α is the acceptable probability of incorrectly concluding the site median(mean) is less than the threshold,
β is the acceptable probability of incorrectly concluding the site median(mean) exceeds the threshold,
$Z_{1-\alpha}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\alpha}$ is $1-\alpha$,
$Z_{1-\beta}$ is the value of the standard normal distribution such that the proportion of the distribution less than $Z_{1-\beta}$ is $1-\beta$.

Note: MARSSIM suggests that the number of samples should be increased by at least 20% to account for missing or unusable data and uncertainty in the calculated value of n. VSP allows a user-supplied percent overage as discussed in MARSSIM (EPA 2000, p. 5-33).

For each nuclide in the **Nuclides Analyzed by Study** table, the values of these inputs that result in the calculated number of sampling locations are:

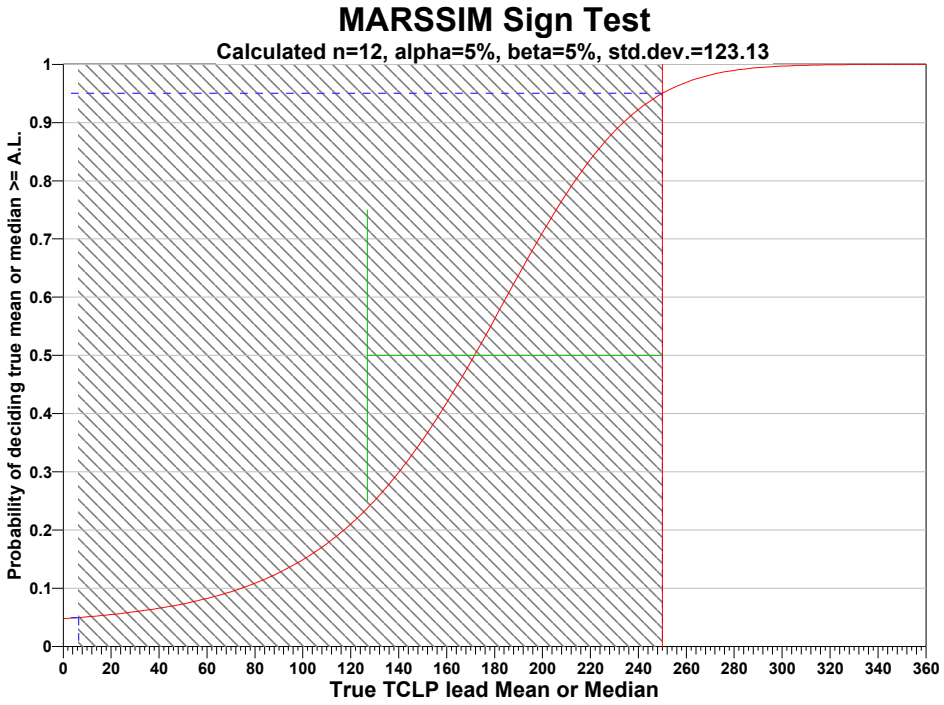
Nuclide	n[a]	n[b]	n[c]	Parameter					
				S	Δ	α	β	$Z_{1-\alpha}$ [d]	$Z_{1-\beta}$ [e]
TCLP lead	12	12	15	123.13	243.5	0.05	0.05	1.64485	1.64485
Analyte 2	0	0	0						

[a] The number of samples calculated by the formula.
[b] The number of samples increased by EMC calculations.
[c] The final number of samples increased by the MARSSIM Overage of 20%.
[d] This value is automatically calculated by VSP based upon the user defined value of α.
[e] This value is automatically calculated by VSP based upon the user defined value of β.

Performance
The following figure is a performance goal diagram, described in EPA's QA/G-4 guidance (EPA, 2000). It shows the probability of concluding the sample area is dirty on the vertical axis versus a range of possible true median(mean) values for the site on the horizontal axis. This graph contains all of the inputs to the number of samples equation and pictorially represents the calculation.

The red vertical line is shown at the threshold (action limit) on the horizontal axis. The width of the gray

shaded area is equal to Δ; the upper horizontal dashed blue line is positioned at 1-α on the vertical axis; the lower horizontal dashed blue line is positioned at β on the vertical axis. The vertical green line is positioned at one standard deviation below the threshold. The shape of the red curve corresponds to the estimates of variability. The calculated number of samples results in the curve that passes through the lower bound of Δ at β and the upper bound of Δ at 1-α. If any of the inputs change, the number of samples that result in the correct curve changes.



Statistical Assumptions

The assumptions associated with the formulas for computing the number of samples are:

1. the computed sign test statistic is normally distributed,
2. the variance estimate, S^2, is reasonable and representative of the population being sampled,
3. the population values are not spatially or temporally correlated, and
4. the sampling locations will be selected randomly.

The first three assumptions will be assessed in a post data collection analysis. The last assumption is valid because the sample locations were selected using a random process.

Sensitivity Analysis

The sensitivity of the calculation of number of samples was explored by varying the standard deviation, delta, beta (%), probability of mistakenly concluding that μ > action level and alpha (%), probability of mistakenly concluding that μ < action level. The following table shows the results of this analysis.

Number of Samples							
		α=5		α=10		α=15	
		s=246.26	s=123.13	s=246.26	s=123.13	s=246.26	s=123.13
Δ=121.75	β=5	92	29	72	23	62	20
	β=10	72	23	56	18	46	15
	β=15	62	20	46	15	36	12
Δ=243.5	β=5	29	15	23	12	20	10
	β=10	23	12	18	10	15	8
	β=15	20	10	15	8	12	6
Δ=365.25	β=5	18	14	15	11	12	10

β=10	15	11	11	9	10	8
β=15	12	10	10	8	8	6

s = Standard Deviation
Δ = Delta
β = Beta (%), Probability of mistakenly concluding that μ > action level
α = Alpha (%), Probability of mistakenly concluding that μ < action level

Note: Values in table are not adjusted for EMC.

APPENDIX D

Proposed Analytes for Soil Excavation Performance Monitoring during Interim Action

DRAFT MEMORANDUM

Project No. 150054-005-02

June 4, 2019

To: Sandra Matthews, LHG, Washington State Department of Ecology Northwest Regional Office

cc: Doug Steding, PhD, Northwest Resource Law; Aaron Rugg, Manson Construction

From:

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Re: **Appendix D: Proposed Analytes for Soil Excavation Performance Monitoring during Interim Action**
Snopac Property Site, 5055 and 5053 East Marginal Way South, Seattle, Washington

Aspect Consulting, LLC (Aspect) has prepared this memorandum proposing the analytes for soil excavation performance monitoring during the interim action planned for a portion of the Snopac Property Site (Site) uplands located at 5055 and 5053 East Marginal Way South in Seattle, Washington. The Site abuts Slip 1 of the Lower Duwamish Waterway (LDW). The interim action will be completed under Agreed Order No. DE 16300 between 5055 Properties LLC and Washington State Department of Ecology (Ecology).

As described in the Agency Review Draft Interim Action Work Plan (Draft IAWP; Aspect, 2019), the interim action involves excavation and off-Site disposal of an estimated 3,500 tons of contaminated fill materials containing spent sandblast grit (SBG) occurring landward (east) of a planned sheet pile shoring wall located immediately inland of the Site's mean higher high water (MHHW) line. This memorandum proposes constituents for analysis for the performance monitoring program (excavation verification soil sampling and analysis) that is described in the Draft IAWP. Note that this analysis is not intended to define contaminants of concern or indicator hazardous substances for the Site as a whole; those will be defined in the subsequent remedial investigation/feasibility study (RI/FS) for the Site.

The following sections discuss the remedial investigation data and the basis for the proposed analytes for soil performance monitoring during the interim action.

Proposed Analytes for Interim Action

Methods

The soil and groundwater screening levels applied for this analysis are the most stringent preliminary cleanup levels (PCULs) established in the 2019 LDW Preliminary Cleanup Level Workbook and Supplemental Information (Ecology, 2019). The soil screening levels for the Site constituents of potential concern are based on either leaching to groundwater (for surface water or sediment protection) or for selected contaminants (e.g., chromium and tributyl tin [TBT]) soil erosion into LDW sediment as the most stringent exposure pathway and apply irrespective of future land use; the screening levels are also protective of direct contact for unrestricted land use. Some of the LDW PCULs are less than analytical reporting limits achieved for the Site sampling and analysis to date. However, for purposes of this analysis, screening levels have not been adjusted for laboratory practical quantitation limits (PQL), as per Model Toxics Control Act (MTCA; Washington Administrative Code [WAC] 173-340-700(6)(d)).

As described in the Draft IAWP (Aspect, 2019), a sheet pile shoring wall will be installed just inland from the MHHW line along the entire Site shoreline prior to start of excavation for the interim action. All of the SBG-containing fill inland of the shoring wall will be removed in the interim action, and the excavation will be backfilled with imported aggregate to a grade elevation below the top of the shoring wall pending Site redevelopment.

The MTCA fixed-parameter three-phase partitioning model (WAC 173-340-747(4)) for calculating the leaching-based soil screening levels is simplistic and intentionally highly conservative in terms of predicting contaminant leaching to groundwater. The empirical upland groundwater data are a more reliable determination of whether contaminant leaching from soil is occurring at concentrations of concern, and thus whether the existing soil concentrations are protective of groundwater in accordance with MTCA (WAC 173-340-747(9))—i.e., measurements outweigh modeling.

Under MTCA, contaminant concentrations in soil can be demonstrated empirically to be protective of groundwater via leaching if there are reliable groundwater data demonstrating no exceedances of groundwater cleanup levels (WAC 173-340-747(9)). The MTCA requirements for making that empirical demonstration are that a sufficient length of time has elapsed for contaminant migration to have occurred, and that the current site characteristics are representative of future site conditions (WAC 173-340-747(9)(b)). High concentrations of arsenic and other metals had migrated from the SBG-containing fill into upland groundwater and then the intertidal Seep 76 as of 2004, which is 13 to 14 years prior to collection of the Site groundwater monitoring data; this demonstrates that sufficient time has elapsed to observe contaminant migration from the SBG-containing fill. The current Site conditions represented by the groundwater data represent worst-case conditions relative to future Site conditions, which include full removal of the SBG-containing fill (from the uplands and in-water portions of the Site) and construction of a sheet pile shoring wall that will generally lengthen upland groundwater flow paths prior to discharge to the LDW. We therefore conclude that the MTCA requirements are met to allow using the existing groundwater data to empirically evaluate whether contaminant concentrations in soil are protective of groundwater quality at the Site.

For our analysis, we focused on the groundwater and seeps data collected by Aspect between 2015 and 2018. The groundwater quality data were collected from properly installed and developed

monitoring wells, which provide data as representative as possible of Site groundwater quality. Note that Farallon collected "reconnaissance" grab groundwater samples from temporary soil borings as part of their 2011 Phase 2 environmental site assessment at the Site (Farallon, 2011). Groundwater samples collected from open soil borings are typically turbid, which can bias detected contaminant concentrations high, particularly for metals and hydrophobic organic compounds. If no exceedances are detected in such samples, there is a high level of confidence that contaminant concentrations in the groundwater are below cleanup levels at that location. Conversely, if there are exceedances detected, more reliable groundwater data (i.e., from permanent monitoring wells) should be collected—as implied by Farallon's use of the term "reconnaissance" for their grab groundwater samples. The reconnaissance groundwater data for petroleum hydrocarbons are discussed as appropriate in this memorandum.

Table D-1 provides a statistical summary of Site upland soil and groundwater/intertidal seeps data collected to date in support of the forthcoming remedial investigation/feasibility study (RI/FS) for the Site. Table D-1 lists the following parameters for each constituent[1] by media:

- Number of samples
- Number of detections
- Detection frequency (number of detects / number of samples)
- Maximum detected concentration
- Frequency of exceedance (number of exceedances / number of samples)
- Maximum magnitude of exceedance (maximum detected concentration / screening level)

These parameters and other information presented below form the basis for the proposed performance monitoring analyte list.

The soil and groundwater quality data for constituents detected at the Site, and the media-specific screening levels, used for the Table D-1 summary are presented in Tables D-2 through D-4. Tables D-2 and D-3, respectively, present data for vadose-zone soil and saturated-zone soil. Table D-4 presents the intertidal seep data collected in July 2015 and the groundwater data collected in January-February 2017 and January 2018. Table D-5 presents Farallon's (2011) reconnaissance groundwater data, which are discussed qualitatively but are not included in the statistical summary because they are deemed less representative of Site groundwater quality than the 2017–2018 groundwater data, as stated above. For the groundwater and seep samples, the total metals data, not dissolved metals data, are used in this analysis for conservatism. Figure 1 depicts locations of the Site explorations for reference.

Constituents Proposed as Analytes for Excavation Performance Monitoring

The following analytes are proposed for the interim action performance monitoring (excavation soil sampling and analysis) and are yellow-highlighted in Table D-1:

[1] Volatile organic compounds and semivolatile organic compounds excluding PAHs not detected in Site soil and groundwater media are not included in the data tables to save space.

- Metals (arsenic, copper, lead, mercury, and zinc)
- Polychlorinated biphenyls (PCBs)
- Polycyclic aromatic hydrocarbons (PAHs)
- Total Petroleum Hydrocarbons (TPH) in the area of MW-2

Each of these constituents are present in the SBG-containing fill at concentrations exceeding soil screening levels and are present in Site groundwater and/or intertidal seeps at concentrations exceeding groundwater screening levels. The following sections discuss the rationale for the specific constituents proposed as analytes in the interim action performance monitoring program.

Metals: Arsenic, Copper, Lead, Mercury, and Zinc

Arsenic, copper, lead, and zinc had detected concentrations in soil exceeding the screening level in greater than 10 percent of the soil samples and had a maximum magnitude of exceedance of at least 10 times. Each of these metals also exceeded the groundwater screening level in one of more groundwater or seep samples, with arsenic and copper exceeding their screening level in greater than 60 percent of those samples (Table D-1). Concentrations of these metals also exceeded screening levels during the 2004 intertidal seep sampling at the Site (Seep 76; Lower Duwamish Waterway Group [LDWG], 2004).

In addition, detected concentrations of mercury exceeded its leaching-based soil screening level[2] in only 17 percent of soil samples, with a maximum concentration of 1.4 milligram per kilogram (mg/kg). Mercury has not been detected in any Site groundwater sample, but the analytical reporting limit for the samples was an order of magnitude greater than the stringent 0.025 micrograms per Liter (ug/L) screening level. However, mercury exceeded the screening level in a Site intertidal seep sampled in 2004 (LDWG, 2004) and in 2015 (Table D-1). Mercury is proposed as an analyte for the soil performance monitoring program.

PCBs

Detected concentrations of total PCBs in Site soil are relatively low (less than 0.9 mg/kg), but PCBs were detected at a concentration exceeding the groundwater screening level in a 2015 intertidal seep sample (Table D-4). Based on those data, and because PCBs are a primary constituent of concern for the LDW including Slip 1 sediments, PCBs are proposed as an analyte for performance monitoring.

PAHs

PAHs represent a broad group of hydrocarbon compounds with widely varying mobility and toxicity. Several PAHs are present in Site soil at concentrations exceeding soil screening levels, and fluoranthene, pyrene, naphthalene, and total cPAHs (TEQ)[3] exceed groundwater samples in one or more samples of Site groundwater. While cPAHs have far less mobility in dissolved phase than does naphthalene, total cPAHs (TEQ) most frequently exceed because of its extremely stringent 0.000016 ug/L groundwater screening level (two orders of magnitude below the 0.03 ug/L reporting limit achieved for the Site sampling; Table D-4). Based on those data, and because PAHs

[2] The soil screening levels for mercury default to the defined natural background concentration (see Tables D-2 and D-3).
[3] Total toxic equivalent concentration of benzo(a)pyrene calculated in accordance with WAC 173-340-708(8)(e).

are a primary constituent of concern for the LDW including Slip 1 sediments, PAHs as a group are proposed as an analyte for performance monitoring. This does not imply that all individual PAH compounds pose a migration risk at the Site.

Petroleum Hydrocarbons Other than PAHs

The discussion of petroleum hydrocarbons apart from PAHs is divided into total petroleum hydrocarbons (TPH) as gasoline-range organics (GRO) with associated benzene, ethylbenzene, toluene and xylenes (BTEX), and then the heavier-range TPH as diesel-range organics (DRO) and oil-range organics (ORO). It is important to recognize that there are no promulgated surface water or marine sediment standards for petroleum mixtures.[4]

GRO including BTEX

BTEX compounds are primary mobile and toxic constituents comprising a GRO mixture, with screening levels much more stringent than that of the complete GRO mixture (e.g., 1.6 ug/L benzene vs 800 ug/L GRO).

In their 2011 environmental site assessment (Farallon, 2011), Farallon detected GRO, benzene, ethylbenzene, and total xylenes at concentrations exceeding leaching-based soil screening levels in soil from a depth interval of approximately 5 feet at borings FB-2, FB-2A, and FB-2B completed adjacent to a former 2,500-gallon diesel underground storage tank (UST) at the northwest corner of the property (Figure 1). No soil exceedances for these compounds were detected in deeper samples from those borings, or in adjacent borings F-B2D, FB-2E, or FB-2F. The presence of DRO and ORO in these samples at concentrations comparable to or greater than the GRO concentration, in combination with low BTEX concentrations and the presence of detectable high molecular weight PAHs (e.g. cPAHs), indicate that the petroleum product released in this area was a fuel oil, not gasoline. During Aspect's 2017–2018 investigation, BTEX compounds were not detected in any of the 15 Site soil samples, including at boring B-12 located adjacent to boring FB-2B.

GRO was not detected in Farallon's reconnaissance groundwater sample collected from the FB-2 boring with the highest detected soil GRO concentration, or in any of the five other reconnaissance groundwater samples collected, with an analytical reporting limit well below the groundwater screening level (Table D-5). The lack of GRO detection in a turbid groundwater sample collected from the FB-2 boring, where the highest soil GRO concentration was detected on Site, indicates that the soil GRO is not leaching at concentrations of concern. This is consistent with results from Aspect's 2017-2018 investigation, in which no exceedances of the highly mobile BTEX compounds were detected in 24 samples of groundwater, including from well MW-4 located generally downgradient of the FB-2/FB-2A area (Figure 1; Table D-4).

The lack of any GRO or BTEX exceedances in Site groundwater indicates that GRO and BTEX concentrations in Site soil are protective of groundwater. As stated above, the data indicate that the detected GRO and BTEX are a light-molecular-weight fraction of a fuel oil that is also measured using the DRO/ORO analyses.

[4] The groundwater screening levels for TPH from Ecology (2018) are based on potable use, which is not an applicable exposure pathway for the Site.

DRO/ORO

PAHs are primary toxic components of heavier-range petroleum mixtures (DRO/ORO) and they are proposed performance monitoring analytes, as stated above.

For evaluation of diesel-range and oil-range TPH data (from NWTPH-Dx analytical method), Ecology policy requires summing the DRO and ORO results to represent a single petroleum product, unless it is clear that more than one product is present (Ecology, 2004). For purposes of this analysis, we term the summed value "DRO+ORO," which is used for comparison against screening levels.

The detected DRO+ORO concentrations in Farallon's (2011) 18 soil samples were all less than a 2,000 mg/kg screening level based on accumulation of free-phase petroleum product. During Aspect's 2017-2018 investigation, one of 34 soil samples exceeded the screening level—8,700 mg/kg in the 10-foot sample from the MW-2 boring located at the location of a historical 8000-gallon diesel UST. No free-phase petroleum product has been observed during any of the drilling or in any of the completed monitoring wells on Site, including at the MW-2 location.

The summed DRO+ORO concentrations detected in seven of Farallon's eight reconnaissance groundwater samples exceeded the 500 ug/L screening level, and the eighth sample (460 ug/L at FB-6) almost exceeded (Table D-5). Comparing the DRO+ORO reconnaissance groundwater results to DRO/ORO soil data from the same borings indicates essentially no correlation. For example, at boring FB-8, there is no detectable DRO+ORO in soil, but the summed DRO+ORO groundwater concentration is 1,510 ug/L, versus boring FB-2 with 630 mg/kg DRO+ORO in soil and 700 ug/L DRO/ORO in groundwater. The fact that DRO+ORO concentrations in turbid grab groundwater samples appear unrelated to detected concentrations in Site soil, coupled with a lack of naphthalene and carcinogenic PAH (cPAH) detections in the reconnaissance groundwater samples (Table D-5), suggests that the DRO+ORO detections in the reconnaissance groundwater samples likely represent non-polar degradation compounds and/or naturally occurring organic compounds rather than petroleum hydrocarbons.

When more reliable groundwater data were collected from Site monitoring wells in 2017-2018, no DRO+ORO exceedances were detected in 24 groundwater samples (Table D-4). This includes the two groundwater samples collected from well MW-2 which is screened at a depth interval (5 to 15 feet) directly across the soil interval containing the maximum-detected 8,700 mg/kg DRO+ORO. Notably, groundwater collected from MW-2 had detected naphthalene and cPAH exceedances (up to 10 ug/L and 0.17 ug/L, respectively) even though there were no detected DRO+ORO exceedances.

The weight of evidence indicates that DRO- and ORO-range hydrocarbons beyond PAHs in Site soils are not a leaching concern. PAHs are the appropriate analytes to address potential transport of DRO- and ORO-range hydrocarbons at the Site and are proposed as performance monitoring analytes as stated above.

TPH based on Direct Contact

The aforementioned MW-2 location (up to 8,700 mg/kg DRO+ORO where an 8,000-gallon diesel UST was historically present) is the one location on Site, out of 40 locations, where a soil TPH

concentration greater than a generic 1,500 mg/kg soil cleanup level based on direct contact[5] was detected. No soil TPH concentrations measured in the vicinity of the historical 2,500-gallon UST[6] exceed 1,500 mg/kg (Tables D-2 and D-3).

To address direct contact risks associated with the petroleum mixture, excavation verification soil samples collected adjacent to the MW-2 location will be analyzed for gasoline-, diesel-, and oil-range TPH.

Constituents Not Proposed as Analytes for Excavation Performance Monitoring

The following sections discuss the rationale for the constituents not proposed as analytes in the excavation performance monitoring program.

Other Metals

The rationale for not proposing metals other than arsenic, copper, lead, mercury, and zinc as analytes for soil excavation performance monitoring is as follows:

- **Barium.** Each of the 30 samples of Site saturated soil had detected barium concentrations exceeding the 8.3 mg/kg screening level (maximum detection 76.9 mg/kg); none of the barium concentrations in the three vadose soil samples exceeded the 160 mg/kg soil screening level (Tables D-2 and D-3). However, the vadose and saturated soil screening levels for barium established in Ecology (2018) are roughly 5 times to 100 times, respectively, below a 90th percentile[7] naturally occurring barium concentration of 760 mg/kg determined for Washington State soils by USGS (1995), which was a study conducted in cooperation with Ecology. In establishing soil PCULs, Ecology (2018) applied natural background soil metals data from Ecology (1994), which did not include barium analyses, but did not consider the USGS (1995) dataset. The soil barium soil screening levels are based on leaching to groundwater and, most importantly, there are no groundwater detections of barium greater than one-half the groundwater screening level in 25 Site groundwater samples (Table D-1). We conclude that concentrations of barium in Site soil are protective of Site groundwater.

- **Cadmium.** The leaching-based screening levels for cadmium in vadose and saturated soils default to a natural background concentration (1 mg/kg). Cadmium was only detected in 4 of 46 Site soil samples (combined vadose and saturated) with a maximum detection of 1.9 mg/kg—9 percent of the samples exceed the screening level and no detection is greater than 2 times the screening level. Most importantly, there were no cadmium detections in 26 groundwater samples with an analytical reporting limit (1 ug/L) below the 1.2 ug/L groundwater screening level (Table D-4). Consistent with that, cadmium concentrations detected in Seep 76 during the 2004 sampling were also less than the screening level (LDWG, 2004). We conclude that concentrations of cadmium in Site soil are protective of Site groundwater.

[5] Generic soil screening level based on child direct contact and applicable to model remedy cleanups for petroleum-contaminated soil where gasoline-range TPH is present. The screening level is compared against the summed concentration of gasoline-, diesel-, and oil-range petroleum fractions (Ecology, 2017).
[6] FB-2, FB-2A, FB-2B, FB-2D, FB-2E, FB-2F, FB-9, FB-9A, B-5, B-9, B-19, MW-4, and MW-7 locations.
[7] MTCA establishes a natural background concentration as the 90th percentile or four times the 50th percentile, whichever is lower, for a lognormally distributed natural background data set (WAC 173-340-709(3)).

- **Chromium.** The 46 samples of Site soil all had chromium concentrations less than the 260 mg/kg screening level, so there is no on-Site source of chromium identified. The only groundwater exceedance out of 31 Site samples was an anomalously high total chromium concentration (129 ug/L) detected in the January 2018 groundwater sample from monitoring well MW-3; although, the corresponding dissolved chromium concentration in the sample was only 4.62 ug/L. No other metals concentrations in that groundwater sample appear anomalous. The total and dissolved chromium concentrations in the January 2017 sample from well MW-3 were 1.89 ug/L and less than 1 ug/L, respectively (Table D-4).[8] The cause for the anomalous groundwater detection is not known but it appears inconsistent with the very low chromium concentrations in soil positioned within the MW-3 well screen interval spanning a depth interval of 2.5 to 12.5 feet (12.1 mg/kg and 7.98 mg/kg chromium in soil samples collected at depths of 5.5 to 6.0 feet and 10 to 12 feet, respectively). Consistent with the low-level chromium concentrations in Site groundwater, no total or dissolved chromium was detected in Seep 76 during the 2004 sampling (LDWG, 2004). We conclude that concentrations of chromium in Site soil are protective of Site groundwater.

- **Nickel.** The leaching-based screening levels for nickel in vadose and saturated soils default to a defined natural background concentration (48 mg/kg). Nickel concentrations detected in Site soil marginally exceeded the natural background level in only two of 44 samples (4 percent frequency of exceedance), with a maximum magnitude of exceedance of only 1.1, indicating there is not a nickel source in Site soils. Low-level nickel exceedances were detected sporadically in Site groundwater samples (Table D-4). However, only well MW-5 had an average concentration from the 2017 and 2018 samples greater than 2 times the screening level, which is due to the anomalously high 100 ug/L detection in the January 2018 sample. In addition, concentrations of total and dissolved nickel detected in Seep 76 during the 2004 sampling were less than the screening level (LDWG, 2004), indicating Site groundwater is not a source of elevated nickel to the LDW.

- **Selenium.** Selenium was not detected in any of 29 Site soil samples, and there were no selenium detections in 22 groundwater samples with analytical reporting limits below the 71 ug/L groundwater screening level in 21 of 22 samples[9] (Table D-4). We conclude that concentrations of selenium in Site soil are protective of Site groundwater.

- **Silver.** The leaching-based screening levels for vadose and saturated soils are 0.32 mg/kg and 0.016 mg/kg, respectively, which are below the 1 mg/kg reporting limit achieved during the Site soil sampling. Most importantly, there were no silver detections, much less exceedances, in 25 groundwater samples with an analytical reporting limit (1 ug/L) below the 1.9 ug/L groundwater screening level (Table D-4). We conclude that concentrations of silver in Site soil are protective of Site groundwater.

[8] While this analysis applies total metals water data to be conservative, the dissolved chromium data are included in Table 4 to assist with assessment of the anomalous 129 ug/L detection.
[9] The January 2018 sample from MW-2 had a reporting limit at 110 ug/L; the February 2017 groundwater sample from that well had a selenium detection of 40 ug/L (Table 4).

Non-PAH SVOCs: Carbazole and Pentachlorophenol

Carbazole was detected in one of 13 Site soil samples analyzed, but it was not detected in any of 24 Site groundwater samples. There are no PCULs defined, thus no Site screening levels, for carbazole in either media (Table D-1).

Pentachlorophenol was detected in four of 13 Site samples at concentrations (up to 7.6 mg/kg) greater than the exceptionally stringent 0.000032 and 0.0000018 mg/kg screening levels for vadose and saturated soils, respectively, based on predicted leaching to protect groundwater discharge to surface water; the soil screening levels are four to five orders of magnitude below the 0.5 mg/kg reporting limit generally achieved for the Site soil samples (Tables D-2 and D-3). Pentachlorophenol was not detected in any of the 24 Site groundwater samples, but the 0.002 ug/L screening level[10] is three orders of magnitude less than the 2 ug/L reporting limit achieved for the Site groundwater samples (Table D-4). Concentrations of pentachlorophenol in Site groundwater are less than the 7.9 ug/L ambient water quality criterion based on protecting aquatic life.

Prior to start of the interim action, groundwater monitoring for pentachlorophenol will be performed with lower analytical reporting limits. This sampling will be described in the Additional Characterization Sampling and Analysis (SAP) required by the Site Agreed Order and to be approved by Ecology.

Tributyl Tin (TBT)

TBT is present in marine paint wastes within the SBG-containing fill to be removed in the interim action. Reported concentrations of TBT in the SBG-containing fill ranged from non-detect to 5.6 mg/kg, with 6 of 8 samples exceeding the soil screening level. TBT's very stringent soil screening level of 0.0021 mg/kg is based on erosion of soil to sediment, a pathway that will be terminated once the sheet pile shoring wall and excavation are complete.

Ecology (2018) does not provide a soil screening level based on leaching to groundwater because no partitioning coefficient was available. A cursory review of publicly available documents did not find quantitative estimates for soil-to-water partitioning coefficients for TBT. However, there is qualitative information indicating that TBT has a strong affinity to sorb to organic matter. For example, the Extension Toxicology Network (1993) TBT profile states "Because of the low water solubility (inability to dissolve in water) of TBT and other properties, it will bind strongly to suspended material such as minute organic material or inorganic sediments…It has not been found in groundwater."

We do not propose TBT as an analyte for performance monitoring as it is associated with the SBG-containing fill for which the limits will be defined by metals concentrations; it does not appear to have substantial leachability; and, equally importantly, multiple analytical laboratories indicate that rush analytical turnaround (e.g. 24-hour; as is needed to effectively guide excavation), is not technically feasible. Given concerns regarding excavation stability discussed in the draft IAWP, waiting a week or longer to obtain excavation verification soil data for TBT by itself, when there is a broad list of chemicals being analyzed to guide excavation, would not be practicable in our opinion.

[10] The 0.002 ug/L groundwater PCUL is a human-health-based surface water standard promulgated by EPA in 2016.

References

Aspect Consulting, LLC (Aspect), 2019, Draft Interim Action Work Plan, Snopac Property, Seattle, Washington, March 28, 2019 Ecology Review Draft.

Extension Toxicology Network, 1993, Pesticide Information Profile: Tributyl Tin, http://pmep.cce.cornell.edu/profiles/extoxnet/pyrethrins-ziram/tributyltin-ext.html, September 1993.

Farallon Consulting (Farallon), 2011, Subsurface Investigation Results, Snopac Property, 5055 East Marginal Way South, Seattle, Washington, October 21, 2011.

Lower Duwamish Waterway Group, 2004, Data Report: Survey and Sampling of Lower Duwamish Waterway Seeps, Final, November 18, 2004.

U.S. Environmental Protection Agency (EPA), 2014, Record of Decision, Lower Duwamish Waterway Superfund Site, November 2014.

U.S. Geological Survey (USGS), 1995, Background Concentrations of Metals from Selected Regions in the State of Washington, Water Resources Investigations Report 95-4018, Prepared in Cooperation with State of Washington Department of Ecology, Tacoma, Washington, 1995.

Washington State Department of Ecology (Ecology), 1994, Natural Background Soil Metals Concentrations in Washington State, Ecology Publication No. 84-115, October 1994.

Washington State Department of Ecology (Ecology), 2004, Determining Compliance with Method A Cleanup Levels for Diesel and Have Oil, Ecology Implementation Memorandum No. 4, June 17, 2004.

Washington State Department of Ecology (Ecology), 2009, Lower Duwamish Waterway RM 0.9 to 1.0 East (Slip 1) Source Control Action Plan, May 2009.

Washington State Department of Ecology (Ecology), 2017, Model Remedies for Sites with Petroleum Contaminated Soils, Ecology publication no. 15-09-043, December 2017.Washington State Department of Ecology (Ecology), 2019, Lower Duwamish Waterway Preliminary Cleanup Level Workbook including Supplemental Information, April 5, 2019.

Limitations

Work for this project was performed for the 5055 Properties, LLC (Client), and this memorandum was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

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Attachments: Table D-1 – Data Summary Identifying Analytes Proposed for Interim Action
Table D-2 – Vadose Zone Soil Data with Comparison to Screening Levels
Table D-3 – Saturated Zone Soil Data with Comparison to Screening Levels
Table D-4 – Groundwater and Seeps Data with Comparison to Screening Levels
Table D-5 – Reconnaissance Groundwater Data from Farallon (2011)
Figure 1 – Exploration Locations

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TABLES

Table D-1. Data Summary Identifying Analytes Proposed for Interim Action Performance Monitoring

Project No. 150054, Snopac Property, Seattle, WA

The proposed soil analytes for performance monitoring of the uplands interim action are highlighted (refer to text).

	Combined Vadose + Saturated Zone Soils[a]						Groundwater + Seeps					
Constituent	**No. Samples**	**No. Detects**	**Detection Frequency**	**Max Detection**	**Frequency of Exceedance**	**Max Magnitude of Exceedance**	**No. Samples**	**No. Detects**	**Detection Frequency**	**Max Detection**	**Frequency of Exceedance**	**Max Magnitude of Exceedance**
Metals												
Arsenic	61	55	90%	3880	48%	532	31	29	94%	75.5	65%	15
Barium	33	33	100%	76.2	91%	9	25	25	100%	96.4	0%	NE
Cadmium	46	4	9%	1.9	7%	1.9	26	0	0%		0%	NE
Chromium	46	46	100%	32.6	0%	NE	31	27	87%	129	6%	5
Copper	61	61	100%	2540	41%	71	30	19	63%	226	63%	73
Lead	61	55	90%	2780	12%	11	31	9	29%	8.47	3%	1.05
Mercury	46	8	17%	1.4	7%	20.0	31	1	3%	0.28	3%	11
Nickel	48	44	92%	52.1	4%	1.1	25	25	100%	100	36%	12
Selenium	29	0	0%	0	0%	NE	22	11	50%	58	0%	NE
Silver	46	0	0%	0	0%	NE	25	0	0%		0%	NE
Zinc	61	61	100%	9700	38%	97	31	24	77%	393	3%	5
Organotin Compounds												
Tributyltin Ion	8	6	75%	5.6	75%	2,667	0					
Polycyclic Aromatic Hydrocarbons (PAHs)												
1-Methylnaphthalene	23	3	13%	16	0%	NE	30	1	3%	0.033		No SL
2-Methylnaphthalene	23	4	17%	22	9%	33	30	1	3%	0.026		No SL
Acenaphthene	35	8	23%	89	11%	3179	30	6	20%	3.3	0%	NE
Acenaphthylene	35	4	11%	2.1	3%	2	30	0	0%			No SL
Anthracene	35	9	26%	120	17%	2353	30	2	7%	0.052	0%	NE
Benz(a)anthracene	38	16	42%	73		No SL	30	4	13%	0.14		No SL
Benzo(a)pyrene	38	16	42%	40		No SL	30	3	10%	0.14		No SL
Benzo(b)fluoranthene	38	19	50%	65		No SL	30	6	20%	0.2		No SL
Benzo(g,h,i)perylene	35	14	40%	12	14%	18	30	3	10%	0.13		No SL
Benzo(k)fluoranthene	38	13	34%	19		No SL	30	3	10%	0.06		No SL
Chrysene	38	17	45%	110		No SL	30	4	13%	0.15		No SL
Dibenzo(a,h)anthracene	38	7	18%	4.1		No SL	30	0	0%			No SL
Dibenzofuran	13	1	8%	28	8%	52	30	0	0%			No SL
Fluoranthene	35	16	46%	290	29%	3222	30	10	33%	2	3%	1.1
Fluorene	35	8	23%	63	11%	2172	30	4	13%	0.044	0%	NE
Indeno(1,2,3-cd)pyrene	38	15	39%	13		No SL	30	3	10%	0.1		No SL
Naphthalene	44	9	20%	70	20%	33238	30	6	20%	10	3%	7
Phenanthrene	35	13	37%	270	11%	180	30	9	30%	0.056		No SL
Pyrene	35	19	54%	250	29%	1786	30	10	33%	2.2	3%	1.1
Total Benzofluoranthenes	18	14	78%	84		No SL	30	6	20%	0.35		No SL
Total HPAHs	15	12	80%	876	33%	73	30	11	37%	3.9035		No SL
Total LPAHs	15	12	80%	568	7%	109	30	12	40%	10.654		No SL
Total cPAHs TEQ[c]	38	18	47%	59	47%	3656875	30	6	20%	1.023	20%	63938
Detected Other Semi-Volatile Organic Compounds (SVOCs)												
Carbazole	13	1	8%	15		No SL	24	0	0%			No SL
Pentachlorophenol	13	4	31%	7.6	31%	1111111	24	0	0%		0%	NE
Polychlorinated Biphenyls (PCBs)												
Total PCBs (Sum of Aroclors)[c]	36	15	42%	0.86	42%	145455	30	1	3%	0.054	3%	7714
Total Petroleum Hydrocarbons (TPH)												
Gasoline Range Organics	20	3	15%	420	15%	14	0					
Diesel Range Organics	56	12	21%	2100	2%	1.1	24	7	29%	110	0%	NE
Motor Oil Range Organics	56	18	32%	6600	2%	3.3	24	1	4%	290	0%	NE
Diesel + Oil Range Organics	56	18	32%	8700	4%	4.4	24	7	29%	400	0%	NE
G+D+O Range Organics*	58	17	29%	8700	3%	5.8	N/A					
Volatile Organic Compounds (VOCs)												
Benzene	40	3	23%		23%	8392.9	24	1	4%	0.42	0%	NE
Toluene	40	3	23%		23%	36.4	24	0	0%	0	0%	NE
Ethylbenzene	40	3	23%		23%	733.3	24	0	0%	0	0%	NE
Total Xylenes	40	3	23%		0%	NE	24	0	0%	0	0%	NE

Notes

(a) The respective screening levels for unsaturated and saturated soils are applied in the exceedance statistics (see Tables 2 and 3 for details by soil type).

(b) Screening levels for each media are the most stringent preliminary cleanup levels (PCULs) established for the Lower Duwamish Waterway Site (Ecology, 2019); refer to text and Tables 2 through 4.

(c) The screening level for total cPAHs (TEQ) and Total PCBs are applied in lieu of screening levels for individual cPAHs and PCB Aroclors. Any exceedance for an individual compound will create an exceedance for the total value (summation).

(d) 1500 mg/kg TPH is generic soil cleanup level based on direct contact where gasoline-range TPH is present, and is summation of all fractions, thus refered to as G+D+O Range Organics (Ecology, 2017).

(e) No SL = No screening level is available from EPA (2018).

(f) NE = No exceedance of screening level.

Table D-2. Vadose Zone Soil Data with Comparison to Screening Levels

Project No. 150054, Snopac Property, Seattle, WA

Constituent	Unit	Most Stringent Screening Level	No. Samples	No. Detects	Detection Frequency	Max Detect	Frequency of Exceedance	Max Magnitude of Exceedance	Sample Location: / Depth (feet): / Date:	FB-2B 4.7 10/6/11	FB-2F 2.2 10/6/11	FB-6 1.1 8/26/11	B-4 0 1/24/17	B-6 0.8 - 1.1 1/24/17	B-9 0 - 1.5 1/24/17	MW-3 1 - 2 1/23/17	MW-6 5.2 - 5.4 1/26/17	MW-8 5 - 6 1/25/17	SSA-20 1 11/13/18	SSA-20 3 11/13/18	SSA-21 1 11/13/18	SSA-21 3 11/13/18	SSA-22 1 11/13/18	SSA-22 3 11/13/18	VSP-01 2.2 11/12/18	VSP-03 3.6 11/12/18	VSP-04 4.5 11/12/18	VSP-05 2.6 11/12/18	VSP-09 3.2 11/12/18	VSP-10 4.6 11/13/18	VSP-12 3.3 11/12/18	VSP-13 2.2 11/13/18	VSP-14 4.1 11/12/18	VSP-15 4.8 11/12/18
Metals																																		
Arsenic	mg/kg	7.3	14	14	100%	3880	79%	532				**7.5**			**309**	**73**		**1.54**							**816**	**2.54**	**337**	**15.4**	**57**	**135**	**3880**	**1340**	**95.4**	**3.3**
Barium	mg/kg	160	3	3	100%	52.4	0%								**52.4**	**25.2**		**11.4**																
Cadmium	mg/kg	1	4	1	25%	1.9	25%	1.9				**1.9**			1 UJ	1 U		1 U																
Chromium	mg/kg	260	4	4	100%	30.2	0%					**25**			**29**	**30.2**		**5.66**																
Copper	mg/kg	36	14	14	100%	2540	86%	71				**97**			**216**	**91.9**		**5.97**							**603**	**85.3**	**214**	**51.1**	**72.2**	**87.7**	**2540**	**803**	**107**	**21.7**
Lead	mg/kg	250	14	13	93%	2780	36%	11				**99**			**333**	**64.3**		1 U							**605**	**5.08**	**268**	**99.9**	**154**	**124**	**2780**	**1130**	**157**	**22.9**
Mercury	mg/kg	0.07	4	1	25%	0.15	25%	2.1				**0.15**			1 U	1 U		1 U																
Nickel	mg/kg	48	13	9	69%	27.2	0%								**27.2**	**23.4**		**3.1**							50 U	**13**	25 U	**17.6**	**16.3**	**21**	125 U	50 U	**19.7**	**5.44**
Selenium	mg/kg	7.4	3	0	0%		0%								1 U	1 U		1 U																
Silver	mg/kg	0.32	4	0	0%		0%					1.3 U			1 UJ	1 U		1 U																
Zinc	mg/kg	100	14	14	100%	9700	79%	97				**320**			**842**	**189**		**11.4**							**2250**	**38.2**	**923**	**151**	**284**	**401**	**9700**	**3630**	**393**	**21.7**
Organotin Compounds																																		
Tributyltin Ion	mg/kg	0.0021	4	4	100%	5.6	100%	2667					**3.9**	**2.2**	**0.59**		**5.6**																	
Polycyclic Aromatic Hydrocarbons (PAH)																																		
1-Methylnaphthalene	mg/kg	29	5	0	0%		0%						0.5 U	0.5 U		0.5 U	2.5 U	0.05 U																
2-Methylnaphthalene	mg/kg	0.67	5	0	0%		0%						0.5 U	0.5 U		0.5 U	2.5 U	0.05 U																
Acenaphthene	mg/kg	0.5	5	3	60%	0.39	0%						**0.16**	**0.11**		**0.39**	0.5 U	0.01 U																
Acenaphthylene	mg/kg	1.3	5	1	20%	0.15	0%						0.1 U	0.1 U		**0.15**	0.5 U	0.01 U																
Anthracene	mg/kg	0.96	5	3	60%	1.2	20%	1.3					**0.53**	**0.21**		**1.2**	0.5 U	0.01 U																
Benz(a)anthracene	mg/kg	0.0011	6	5	83%	3	apply total cPAH (TEQ)						**2**	**0.87**	**0.43**	**3**	**2.4**	0.01 U																
Benzo(a)pyrene	mg/kg	0.00031	6	5	83%	4.2	apply total cPAH (TEQ)						**2.3**	**0.93**	**0.5**	**4.2**	**2.8**	0.01 U																
Benzo(b)fluoranthene	mg/kg	0.0039	6	5	83%	7.3	apply total cPAH (TEQ)						**3**	**1.2**	**0.74**	**7.3**	**3.4**	0.01 U																
Benzo(g,h,i)perylene	mg/kg	0.67	5	4	80%	2.2	60%	3.3					**1.2**	**0.51**		**2.2**	**1.6**	0.01 U																
Benzo(k)fluoranthene	mg/kg	0.039	6	5	83%	2.5	apply total cPAH (TEQ)						**1.2**	**0.42**	**0.21**	**2.5**	**1.4**	0.01 U																
Chrysene	mg/kg	0.13	6	5	83%	12	apply total cPAH (TEQ)						**2.3**	**1.2**	**0.53**	**12**	**2.9**	0.01 U																
Dibenzo(a,h)anthracene	mg/kg	0.00057	6	3	50%	0.59	apply total cPAH (TEQ)						**0.35**	**0.15**	0.2 U	**0.59**	0.5 U	0.01 U																
Dibenzofuran	mg/kg	0.54	5	0	0%		0%						0.5 U	0.5 U		0.5 U	2.5 U	0.05 U																
Fluoranthene	mg/kg	1.7	5	4	80%	4.5	60%	2.6					**4.2**	**1.7**		**4.5**	**4.2**	0.01 U																
Fluorene	mg/kg	0.54	5	2	40%	0.35	0%						**0.17**	0.1 U		**0.35**	0.5 U	0.01 U																
Indeno(1,2,3-cd)pyrene	mg/kg	0.011	6	5	83%	2	apply total cPAH (TEQ)						**1.4**	**0.57**	**0.3**	**2**	**2**	0.01 U																
Naphthalene	mg/kg	0.039	5	0	0%		0%						0.1 U	0.1 U		0.1 U	0.5 U	0.01 U																
Phenanthrene	mg/kg	1.5	5	4	80%	2.2	40%	1.5					**2.2**	**1.1**		**1.5**	**1.7**	0.01 U																
Pyrene	mg/kg	2.6	5	4	80%	6.2	60%	2.4					**3.8**	**2**		**6.2**	**4.5**	0.01 U																
Total cPAHs TEQ	mg/kg	0.00031	6	5	83%	5.86	83%	18900					**3.12**	**1.26**	**0.68**	**5.86**	**3.77**	0.00755 U																
Other Semi-Volatile Organic Compounds (SVOC)																																		
Carbazole	mg/kg		5	0	0%		0%						5 U	5 U		5 U	25 U	0.5 U																
Pentachlorophenol	mg/kg	0.000032	5	3	60%	7.6	60%	237500					**2.1**	**2.6**		5 U	**7.6**	0.5 U																
Polychlorinated Biphenyls (PCBs)																																		
Aroclor 1254	mg/kg		12	11	92%	0.85	apply Total PCBs						**0.43**	**0.31**	**0.2**		**0.24**	0.2 U	**0.084**	**0.043**	**0.42**	**0.85**	**0.19**	**0.061**									**0.37**	
Aroclor 1260	mg/kg		12	4	33%	0.15	apply Total PCBs						0.2 U	**0.15**	0.2 U		0.1 U	0.2 U	**0.036**	0.02 U	0.02 U	0.02 U	**0.11**	**0.078**									0.02 U	
Total PCBs (Sum of Aroclors)	mg/kg	0.000043	12	11	92%	0.86	92%	20000					**0.43**	**0.46**	**0.2**		**0.24**	0.2 U	**0.12**	**0.05**	**0.43**	**0.86**	**0.30**	**0.14**									**0.38**	
Total Petroleum Hydrocarbons (TPH)																																		
Gasoline Range Organics	mg/kg	30	2	1	50%	184	50%	6.1		**184**	11.7 U																							
Diesel Range Organics	mg/kg	2000	3	2	67%	69	0%								**68**	**69**		50 U																
Motor Oil Range Organics	mg/kg	2000	3	2	67%	760	0%								**760**	**410**		250 U																
Diesel + Oil Range Organics	*mg/kg*	*2000*	*3*	*2*	*67%*	*828*	*0%*								***828***	***479***		*250 U*																
*G+D+O Range Organics**	*mg/kg*	*1500*	*5*	*3*	*60%*	*828*	*0%*			***184***	*11.7 U*				***828***	***479***		*250 U*																
Volatile Organic Compounds (VOC)																																		
Benzene	mg/kg	0.0088	6	1	17%	0.77	17%	87		**0.768**	0.0585 U		0.03 U	0.03 U		0.03 U	0.03 U																	
Toluene	mg/kg	0.92	6	1	17%	1.32	17%	1.4		**1.32**	0.146 U		0.05 U	0.05 U		0.05 U	0.05 U																	
Ethylbenzene	mg/kg	0.26	6	1	17%	3.57	17%	14		**3.57**	0.146 U		0.05 U	0.05 U		0.05 U	0.05 U																	
Total Xylenes	mg/kg	16000	6	1	17%	9.36	0%			**9.36**	0.292 U		0.1 U	0.1 U		0.1 U	0.1 U																	

Notes

Most stringent screening levels are the most stringent preliminary cleanup levels (PCULs) for vadose soil (nonpotable groundwater) established by the December 2019 Lower Duwamish Waterway (LDW) Preliminary Cleanup Level Workbook (Ecology, 2019).

*: 1500 mg/kg TPH is generic soil cleanup level based on direct contact where gasoline-range TPH is present, and is summation of all fractions, thus refered to as G+D+O Range Organics (Ecology, 2017).

Bold indicates a result detected above the laboratory reporting limit.

Highlighted values exceed the screening level.

U = analyte not detected above the laboratory reporting limit shown.

Blank cells indicate that the sample was not analyzed for that analyte.

Table D-3. Saturated Zone Soil Data with Comparison to Screening Levels

Project No. 150054, Snopac Property, Seattle, WA

Constituent	Unit	Most Stringent Screening Level	No. Samples	No. Detects	Detection Frequency	Max Detect	Frequency of Exceedance	Max Magnitude of Exceedance	Sample Location: / Depth (feet): / Date:	FB-1 9.5 8/25/11	FB-1A 9.8 10/5/11	FB-2 5.2 8/25/11	FB-2 16 8/25/11	FB-2A 5.3 10/6/11	FB-2A 10 10/6/11	FB-2A 16 10/6/11	FB-2D 5.2 10/6/11	FB-2E 5.2 10/6/11
Metals																		
Arsenic	mg/kg	7.3	47	41	87%	582	38%	80		3.3 U		**6**	**8.9**					
Barium	mg/kg	8.3	30	30	100%	76.2	100%	9										
Cadmium	mg/kg	1	42	3	7%	1.69	5%	1.7		0.56 U		0.47 U	0.93 U					
Chromium	mg/kg	260	42	42	100%	32.6	0%			**7.3**		**9.3**	**13**					
Copper	mg/kg	36	47	47	100%	457	28%	13		**8**		**270**	**29**					
Lead	mg/kg	250	47	42	89%	524	4%	2.1		1.7 U		**50**	**3.7**					
Mercury	mg/kg	0.07	42	7	17%	1.4	5%	20.0		0.02 U		0.095 U	**0.03**					
Nickel	mg/kg	48	35	35	100%	52.1	6%	1.1										
Selenium	mg/kg	0.38	26	0	0%		0%											
Silver	mg/kg	0.016	42	0	0%		0%			1.1 U		0.93 U	1.9 U					
Zinc	mg/kg	85	47	47	100%	1680	26%	20		**23**		**120**	**38**					
Organotin Compounds																		
Tributyltin Ion	mg/kg	0.0021	4	2	50%	3.7	50%	1762										
Polycyclic Aromatic Hydrocarbons (PAHs)																		
1-Methylnaphthalene	mg/kg	29	18	3	17%	16	0%			0.0063 U		**0.94**	0.0098 U					
2-Methylnaphthalene	mg/kg	0.67	18	4	22%	22	11%	33		0.0063 U		**1.1**	0.0098 U					
Acenaphthene	mg/kg	0.028	30	5	17%	89	13%	3179		0.0063 U	0.0234 U	**0.027**	0.0098 U	0.0324 U	0.0209 U	0.0193 U		
Acenaphthylene	mg/kg	1.3	30	3	10%	2.1	3%	1.6		0.0063 U	0.0234 U	**0.021**	0.0098 U	0.0607	0.0209 U	0.0193 U		
Anthracene	mg/kg	0.051	30	6	20%	120	17%	2353		0.0063 U	0.0234 U	**0.10**	0.0098 U	**0.199**	0.0209 U	0.0193 U		
Benz(a)anthracene	mg/kg	0.0011	32	11	34%	73	apply Total cPAH (TEQ)			0.0063 U	0.0234 U	**0.14**	0.0098 U	**0.782**	0.0209 U	0.0193 U		
Benzo(a)pyrene	mg/kg	0.00031	32	11	34%	40	apply Total cPAH (TEQ)			0.0063 U	0.0234 U	**0.12**	0.0098 U	**0.586**	0.0209 U	0.0193 U		
Benzo(b)fluoranthene	mg/kg	0.0039	32	14	44%	65	apply Total cPAH (TEQ)			0.0063 U	0.0234 U	**0.30**	0.0098 U	**0.51**	**0.0337**	0.0193 U		
Benzo(g,h,i)perylene	mg/kg	0.67	30	10	33%	12	7%	18		0.0063 U	0.0234 U	**0.10**	0.0098 U	**0.648**	0.0209 U	0.0193 U		
Benzo(k)fluoranthene	mg/kg	0.039	32	8	25%	19	apply Total cPAH (TEQ)			0.0063 U	0.0234 U	**0.034**	0.0098 U	**0.386**	0.0209 U	0.0193 U		
Chrysene	mg/kg	0.13	32	12	38%	110	apply Total cPAH (TEQ)			0.0063 U	0.0234 U	**1.3**	0.0098 U	**0.73**	0.0209 U	0.0193 U		
Dibenzo(a,h)anthracene	mg/kg	0.00057	32	4	13%	4.1	apply Total cPAH (TEQ)			0.0063 U	0.0234 U	**0.026**	0.0098 U	**0.144**	0.0209 U	0.0193 U		
Dibenzofuran	mg/kg	0.54	8	1	13%	28	13%	52										
Fluoranthene	mg/kg	0.09	30	12	40%	290	23%	3222		0.0063 U	0.0234 U	**0.31**	0.0098 U	1.02 U	**0.035**	0.0193 U		
Fluorene	mg/kg	0.029	30	6	20%	63	13%	2172		0.0063 U	0.0234 U	**0.031**	0.0098 U	0.0647 U	0.0209 U	0.0193 U		
Indeno(1,2,3-cd)pyrene	mg/kg	0.011	32	10	31%	13	apply Total cPAH (TEQ)			0.0063 U	0.0234 U	**0.064**	0.0098 U	**0.383**	0.0209 U	0.0193 U		
Naphthalene	mg/kg	0.0021	39	9	23%	69.8	23%	33238		0.0063 U	0.0234 U	**0.85**	0.0098 U	**3.8**	0.0209 U	0.0193 U		
Phenanthrene	mg/kg	1.5	30	9	30%	270	7%	180		0.0063 U	0.0234 U	**0.48**	0.0098 U	0.847	0.0209 U	0.0193 U		
Pyrene	mg/kg	0.14	30	15	50%	250	23%	1786		0.0063 U	0.0234 U	**0.29**	0.0098 U	**1.14**	**0.06**	0.0193 U		
Total cPAHs TEQ	mg/kg	0.000016	32	13	41%	58.51	41%	3656875		0.0047 U	0.0353 U	**0.189**	0.0148 U	**0.814**	0.0632 U	0.0291 U		
Other Semi-Volatile Organic Compounds (SVOC)																		
Carbazole	mg/kg		8	1	13%	15												
Pentachlorophenol	mg/kg	0.0000018	8	1	13%	2	13%	1111111										
Polychlorinated Biphenyls (PCBs)																		
Aroclor 1254	mg/kg		24	4	17%	0.21	apply Total PCBs			0.012 U	0.0577 U	0.011 U	0.019 U	0.0399 U		0.048 U		
Aroclor 1260	mg/kg		24	3	13%	0.12	apply Total PCBs			0.012 U	0.0577 U	0.011 U	0.019 U	0.0399 U		0.048 U		
Total PCBs (Sum of Aroclors)	mg/kg	0.0000022	24	4	17%	0.32	17%	145455		0.012 U	0.0577 U	0.011 U	0.019 U	0.0399 U		0.048 U		
Total Petroleum Hydrocarbons (TPH)																		
Gasoline Range Organics	mg/kg	30	18	2	11%	420	11%	14		10 U	19.2 U	**420**	20 U	**143**	14.5 U	12.4 U	8.97 U	9.79 U
Diesel Range Organics	mg/kg	2000	53	10	19%	2100	2%	1.1		31 U	21.7 U	**200**	48 U	**320**	19.4 U	17.9 U		
Motor Oil Range Organics	mg/kg	2000	53	16	30%	6600	2%	3.3		63 U	**46.5**	**430**	96 U	**569**	38.8 U	35.7 U		
Diesel + Oil Range Organics	*mg/kg*	*2000*	*53*	*16*	*30%*	*8700*	*4%*	*4.4*		*63 U*	***57***	***630***	*96 U*	***889***	*38.8 U*	*35.7 U*		
G+D+O Range Organics	*mg/kg*	*1500*	*53*	*14*	*26%*	*8700*	*4%*	*5.8*		*73 U*	***67***	***1050***	*116 U*	***1032***	*53 U*	*48 U*	*8.97 U*	*9.79 U*
Volatile Organic Compounds (VOCs)																		
Benzene	mg/kg	0.00056	34	2	6%	4.7	6%	8393		0.051 U	0.0959 U	**4.7**	10 U	**1.56**	0.0725 U	0.0619 U	0.0448 U	0.0489 U
Toluene	mg/kg	0.055	34	2	6%	2	6%	36.4		0.13 U	0.24 U	**2**	26 U	**0.918**	0.181 U	0.31 U	0.112 U	0.122 U
Ethylbenzene	mg/kg	0.015	34	2	6%	11	6%	733		0.13 U	0.24 U	**11**	26 U	**5.01**	0.181 U	0.31 U	0.112 U	0.122 U
Total Xylenes	mg/kg	16000	34	2	6%	8.65	0%			0.25 U	0.479 U	**16**	0.51 U	**8.65**	0.362 U	0.929 U	0.224 U	0.245 U

Notes

Most stringent screening levels are the most stringent preliminary cleanup levels (PCULs) for vadose soil (nonpotable groundwater) established by the December 2019 Lower Duwamish Waterway (LDW) Preliminary Cleanup Level Workbook (Ecology, 2019).

*: 1500 mg/kg TPH is generic soil cleanup level based on direct contact where gasoline-range TPH is present, and is summation of all fractions, thus refered to as G+D+O Range Organics (Ecology, 2017).

Bold indicates a result detected above the laboratory reporting limit.

Highlighted values exceed the screening level.

U = analyte not detected above the laboratory reporting limit shown.

Blank cells indicate that the sample was not analyzed for that analyte.

Table D-3. Saturated Zone Soil Data with Comparison to Screening Levels

Project No. 150054, Snopac Property, Seattle, WA

Constituent	Unit	Most Stringent Screening Level	FB-3 14.9 8/25/11	FB-3A 7.6 10/6/11	FB-3A 14.5 10/6/11	FB-4 8.7 8/25/11	FB-4A 9.7 10/5/11	FB-5 6.2 8/25/11	FB-5 10.2 8/25/11	FB-5 18 8/25/11	FB-5A 8.4 10/5/11	FB-5A 18 10/5/11	FB-5B 18 10/5/11	FB-5C 10.2 10/5/11	FB-5C 14.8 10/5/11	FB-6 11.6 8/26/11	FB-6A 11.5 10/5/11	FB-7 11.8 8/26/11	FB-7A 11.8 10/5/11	FB-8 11.6 8/26/11	FB-8A 11.7 10/5/11	FB-9 12 8/26/11
Metals																						
Arsenic	mg/kg	7.3	**8.8**			3.5 U		**6.5**	**9.8**	**6.4**						**5.1**		**9.8**		**7.4**		**9**
Barium	mg/kg	8.3																				
Cadmium	mg/kg	1	0.82 U			0.59 U		**1.1**	**0.61**	0.68 U						0.66 U		0.71 U		0.84 U		0.7 U
Chromium	mg/kg	260	**15**			**7.7**		**21**	**20**	**13**						**15**		**19**		**18**		**17**
Copper	mg/kg	36	**32**			**11**		**180**	**75**	**21**						**21**		**26**		**30**		**43**
Lead	mg/kg	250	**3.8**			1.8 U		**73**	**19**	**4**						**50**		**3.7**		**13**		**7.7**
Mercury	mg/kg	0.07	**0.038**			0.018 U		**1.4**	**0.099**	**0.039**						**0.038**		0.046 U		0.094 U		0.06
Nickel	mg/kg	48																				
Selenium	mg/kg	0.38																				
Silver	mg/kg	0.016	1.6 U			1.2 U		1.3 U	0.99 U	1.4 U						1.3 U		1.4 U		1.7 U		1.4 U
Zinc	mg/kg	85	**37**			**21**		**200**	**120**	**39**						**30**		**39**		**45**		**62**
Organotin Compounds																						
Tributyltin Ion	mg/kg	0.0021																				
Polycyclic Aromatic Hydrocarbons (PAHs)																						
1-Methylnaphthalene	mg/kg	29	0.0089 U			0.006 U				0.008 U						0.0078 U		0.0075 U		0.0088 U		0.0078 U
2-Methylnaphthalene	mg/kg	0.67	0.0089 U			0.006 U				0.008 U						0.0078 U		0.0075 U		0.0088 U		0.0078 U
Acenaphthene	mg/kg	0.028	0.0089 U	0.0168 U	0.0228 U	0.006 U	**0.0458**			0.008 U		0.0164 U				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Acenaphthylene	mg/kg	1.3	0.0089 U	0.0168 U	0.0228 U	0.006 U	0.0188 U			0.008 U		0.0164 U				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Anthracene	mg/kg	0.051	0.0089 U	0.0168 U	0.0228 U	0.006 U	**0.105**			0.008 U		0.0164 U				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Benz(a)anthracene	mg/kg	0.0011	0.0089 U	**0.024**	0.0228 U	0.006 U	**0.0947**			0.008 U		0.0164 U				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Benzo(a)pyrene	mg/kg	0.00031	0.0089 U	**0.0196**	0.0228 U	0.006 U	**0.0473**			0.008 U		0.0164 U				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Benzo(b)fluoranthene	mg/kg	0.0039	0.0089 U	**0.0219**	0.0228 U	0.006 U	**0.0556**			0.008 U		**0.0194**				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	**0.0318**	0.0078 U
Benzo(g,h,i)perylene	mg/kg	0.67	0.0089 U	0.0174	0.0228 U	0.006 U	**0.0234**			0.008 U		0.0164 U				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Benzo(k)fluoranthene	mg/kg	0.039	0.0089 U	0.0168 U	0.0228 U	0.006 U	**0.0383**			0.008 U		0.0164 U				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Chrysene	mg/kg	0.13	0.0089 U	**0.0336**	0.0228 U	0.006 U	**0.124**			0.008 U		**0.0352**				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Dibenzo(a,h)anthracene	mg/kg	0.00057	0.0089 U	0.0168 U	0.0228 U	0.006 U	0.0188 U			0.008 U		0.0164 U				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Dibenzofuran	mg/kg	0.54																				
Fluoranthene	mg/kg	0.09	0.0089 U	**0.0641**	**0.0508**	0.006 U	**0.434**			0.008 U		**0.0271**				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Fluorene	mg/kg	0.029	0.0089 U	0.0168 U	0.0228 U	0.006 U	0.0188 U			0.008 U		0.0164 U				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	**0.014**
Indeno(1,2,3-cd)pyrene	mg/kg	0.011	0.0089 U	0.0168 U	0.0228 U	0.006 U	**0.021**			0.008 U		0.0164 U				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Naphthalene	mg/kg	0.0021	0.0089 U	0.0168 U	0.0228 U	0.006 U	**0.021**			**9.11**	0.739 U	0.0164 U	0.743 U	**54.9**	**69.8**	0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Phenanthrene	mg/kg	1.5	0.0089 U	0.0168 U	0.0228 U	0.006 U	**0.0499**			0.008 U		0.0164 U				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	0.0078 U
Pyrene	mg/kg	0.14	0.0089 U	**0.072**	**0.0478**	0.006 U	**0.411**			0.008 U		**0.0274**				0.0078 U	0.0231 U	0.0075 U	0.0223 U	0.0088 U	0.0293 U	**0.011**
Total cPAHs TEQ	mg/kg	0.000016	0.0134 U	**0.027**	0.0344 U	0.0091 U	**0.07000**			0.0121 U		**0.014**				0.0118 U	0.0349 U	0.0113 U	0.0337 U	0.0133 U	**0.024**	0.0118 U
Other Semi-Volatile Organic Compounds (SVOC)																						
Carbazole	mg/kg																					
Pentachlorophenol	mg/kg	0.0000018																				
Polychlorinated Biphenyls (PCBs)																						
Aroclor 1254	mg/kg		0.017 U		0.0557 U	0.012 U	0.0468 U			0.016 U		0.0401 U					0.0565 U					
Aroclor 1260	mg/kg		0.017 U		0.0557 U	0.012 U	0.0468 U			0.016 U		0.0401 U					0.0565 U					
Total PCBs (Sum of Aroclors)	mg/kg	0.0000022	0.017 U		0.0557 U	0.012 U	0.0468 U			0.016 U		0.0401 U					0.0565 U					
Total Petroleum Hydrocarbons (TPH)																						
Gasoline Range Organics	mg/kg	30	17 U	9.87 U	14.8 U													14 U	18.1 U	9.9 U	25.4 U	14 U
Diesel Range Organics	mg/kg	2000	44 U	**15.7**	21.1 U	30 U	17.4 U			39 U		**55.5**				39 U	21.5 U	39 U	20.8 U	43 U	27.3 U	40 U
Motor Oil Range Organics	mg/kg	2000	**98**	**38.4**	**68.1**	60 U	34.9 U			77 U		**156**				79 U	**112**	78 U	41.6 U	86 U	**116**	79 U
Diesel + Oil Range Organics	*mg/kg*	*2000*	***120***	***54***	***79***	*60 U*	*34.9 U*			*77 U*		***212***				*79 U*	***123***	*78 U*	*41.6 U*	*86 U*	***130***	*79 U*
G+D+O Range Organics	*mg/kg*	*1500*	***129***	***59***	***86***	*60 U*	*34.9 U*			*77 U*		***212***				*79 U*	***123***	*92 U*	*60 U*	*96 U*	***142***	*93 U*
Volatile Organic Compounds (VOCs)																						
Benzene	mg/kg	0.00056	0.083 U	0.0493 U	0.0741 U					0.0306 U	0.0739 U	0.0457 U	0.0743 U	0.102 U	0.117 U			0.068 U	0.0907 U	0.05 U	0.127 U	
Toluene	mg/kg	0.055	0.21 U	0.123 U	0.185 U					0.153 U	0.369 U	0.229 U	0.371 U	0.509 U	0.584 U			0.17 U	0.227 U	0.12 U	0.318 U	
Ethylbenzene	mg/kg	0.015	0.21 U	0.123 U	0.185 U					0.153 U	0.369 U	0.229 U	0.371 U	0.509 U	0.584 U			0.17 U	0.227 U	0.12 U	0.318 U	
Total Xylenes	mg/kg	16000	0.42 U	0.247 U	0.371 U					0.59 U	1.11 U	0.686 U	1.11 U	1.529 U	1.754 U			0.34 U	0.454 U	0.25 U	0.636 U	

Notes

Most stringent screening levels are the most stringent preliminary cleanup levels (PCULs) for vadose soil (nonpotable groundwater) established by the December 2019 Lower Duwamish Waterway (LDW) Preliminary Cleanup Level Workbook (Ecology, 2019).

*: 1500 mg/kg TPH is generic soil cleanup level based on direct contact where gasoline-range TPH is present, and is summation of all fractions, thus refered to as G+D+O Range Organics (Ecology, 2017).

Bold indicates a result detected above the laboratory reporting limit.

Highlighted values exceed the screening level.

U = analyte not detected above the laboratory reporting limit shown.

Blank cells indicate that the sample was not analyzed for that analyte.

Table D-3. Saturated Zone Soil Data with Comparison to Screening Levels

Project No. 150054, Snopac Property, Seattle, WA

Constituent	Unit	Most Stringent Screening Level	FB-9A 11.8 10/5/11	B-5 10 - 10.2 1/24/17	B-5 13 - 14 1/24/17	B-5 16 - 17 1/24/17	B-8 12 - 13 1/24/17	B-9 16 - 17 1/24/17	B-12 5 - 6 1/25/17	B-12 10 - 11 1/25/17	B-13 5.5 - 6.5 1/25/17	B-13 10 - 11 1/25/17	B-13 17.5 - 18.5 1/25/17	B-15 11 - 12 1/27/17	B-15 16 - 17 1/27/17	B-19 12 - 13 1/27/17	MW-1 10 - 10.5 1/23/17	MW-1 15 - 16 1/23/17	MW-2 5 - 6 1/23/17	MW-2 10 1/23/17	MW-2 10 - 11 1/23/17	MW-3 5.5 - 6 1/23/17
Metals																						
Arsenic	mg/kg	7.3			**6.39**	**3.4**	**5.34**	**6.33**	**21.8**	**12.4**	**1.38**						**61.6**	**7.77**	**95.7**	**63.7**	**42.2**	**22.9**
Barium	mg/kg	8.3			**17.4**	**16**	**14.9**	**12**	**67.5**	**76.2**	**19**						**18.1**	**12.2**	**29.1**	**72.7**	**63**	**17.5**
Cadmium	mg/kg	1			1 U	1 U	1 U	1 U	1 U	1 U	1 U						1 U	1 U	1 U	1 U	1 U	1 U
Chromium	mg/kg	260			**12.5**	**11**	**12.6**	**12.1**	**17.5**	**8.57**	**11.3**						**10.9**	**9.35**	**13.8**	**18.5**	**27.2**	**12.1**
Copper	mg/kg	36			**23.3**	**14.8**	**21**	**15.5**	**35.3**	**334**	**102**						**58.6**	**12**	**137**	**173**	**137**	**56.9**
Lead	mg/kg	250			**4.88**	**1.72**	**3.15**	**2.6**	**30.2**	**400**	**3.37**						**54.4**	**6.5**	**58.8**	**119**	**143**	**33.4**
Mercury	mg/kg	0.07			1 U	1 U	1 U	1 U	1 U	1 U	1 U						1 U	1 U	1 U	1 U	1 U	1 U
Nickel	mg/kg	48			**10.7**	**8.74**	**8.7**	**10.7**	**16.1**	**12.1**	**15**						**11.4**	**6.43**	**13.9**	**52.1**	**49.8**	**16.7**
Selenium	mg/kg	0.38			1 U	1 U	1 U	1 U	1 U	1 U	1 U						1 U	1 U	1 U	1 U	1 U	1 U
Silver	mg/kg	0.016			1 U	1 U	1 U	1 U	1 U	1 U	1 U						1 U	1 U	1 U	1 U	1 U	1 U
Zinc	mg/kg	85			**24**	**20.7**	**24.3**	**26.9**	**153**	**183**	**55.1**						**179**	**32.8**	**228**	**306**	**432**	**94.9**
Organotin Compounds																						
Tributyltin Ion	mg/kg	0.0021		**3.7**						0.0012 U	0.0012 U											
Polycyclic Aromatic Hydrocarbons (PAHs)																						
1-Methylnaphthalene	mg/kg	29		0.5 U								0.05 U	0.05 U							0.5 U		**16**
2-Methylnaphthalene	mg/kg	0.67		0.5 U								0.05 U	0.05 U							0.5 U		**22**
Acenaphthene	mg/kg	0.028	0.022 U	**0.15**								0.01 U	0.01 U							**0.11**		**89**
Acenaphthylene	mg/kg	1.3	0.022 U	0.1 U								0.01 U	0.01 U							0.1 U		**2.1**
Anthracene	mg/kg	0.051	0.022 U	**0.62**								0.01 U	0.01 U							0.1 U		**120**
Benz(a)anthracene	mg/kg	0.0011	0.022 U	**2.4**						**0.84**	0.01 U	0.01 U	0.01 U							**0.79**		**73**
Benzo(a)pyrene	mg/kg	0.00031	0.022 U	**3**						**0.59**	0.01 U	0.01 U	0.01 U							**0.55**		**40**
Benzo(b)fluoranthene	mg/kg	0.0039	0.022 U	**3.5**						**0.73**	0.01 U	0.01 U	0.01 U							**0.79**		**65**
Benzo(g,h,i)perylene	mg/kg	0.67	0.022 U	**1.6**								0.01 U	0.01 U							**0.41**		**12**
Benzo(k)fluoranthene	mg/kg	0.039	0.022 U	**1.5**						**0.22**	0.01 U	0.01 U	0.01 U							**0.22**		**19**
Chrysene	mg/kg	0.13	0.022 U	**2.9**						**0.73**	0.01 U	0.01 U	0.01 U							**0.38**		**110**
Dibenzo(a,h)anthracene	mg/kg	0.00057	0.022 U	**0.48**						0.1 U	0.01 U	0.01 U	0.01 U							0.1 U		**4.1**
Dibenzofuran	mg/kg	0.54		0.5 U								0.05 U	0.05 U							0.5 U		**28**
Fluoranthene	mg/kg	0.09	0.022 U	**4.4**								0.01 U	0.01 U							**3.6**		**290**
Fluorene	mg/kg	0.029	0.022 U	**0.13**								0.01 U	0.01 U							**0.14**		**63**
Indeno(1,2,3-cd)pyrene	mg/kg	0.011	0.022 U	**2**						**0.31**	0.01 U	0.01 U	0.01 U							**0.28**		**13**
Naphthalene	mg/kg	0.0021	0.022 U	0.1 U				0.05 U				0.01 U	0.01 U	0.05 U	0.05 U	0.05 U				**0.19**		**24**
Phenanthrene	mg/kg	1.5	0.022 U	**1.8**								0.01 U	0.01 U							**0.33**		**270**
Pyrene	mg/kg	0.14	**0.0227**	**4.1**								0.01 U	0.01 U							**3.8**		**250**
Total cPAHs TEQ	mg/kg	0.000016	0.0332 U	**4.02**						**0.812**	0.00755 U	0.00755 U	0.00755 U							**0.77**		**59**
Other Semi-Volatile Organic Compounds (SVOC)																						
Carbazole	mg/kg			5 U								0.5 U	0.5 U							5 U		**15**
Pentachlorophenol	mg/kg	0.0000018		**2**								0.5 U	0.5 U							5 U		5 U
Polychlorinated Biphenyls (PCBs)																						
Aroclor 1254	mg/kg		0.054 U	**0.21**						0.2 U	0.2 U									0.2 U		
Aroclor 1260	mg/kg		0.054 U	**0.11**						0.2 U	0.2 U									0.2 U		
Total PCBs (Sum of Aroclors)	mg/kg	0.0000022	0.054 U	**0.32**						0.2 U	0.2 U									0.2 U		
Total Petroleum Hydrocarbons (TPH)																						
Gasoline Range Organics	mg/kg	30	15.6 U																			
Diesel Range Organics	mg/kg	2000	**22.9**		50 U	50 U	50 U	50 U	**310**					50 U	50 U	50 U	50 U	50 U	50 U	**2100**	**500**	**750**
Motor Oil Range Organics	mg/kg	2000	**124**		250 U	250 U	250 U	250 U	**320**					250 U	250 U	250 U	**510**	250 U	250 U	**6600**	**2000**	**700**
Diesel + Oil Range Organics	*mg/kg*	*2000*	***147***		*250 U*	*250 U*	*250 U*	*250 U*	***630***					*250 U*	*250 U*	*250 U*	***535***	*250 U*	*250 U*	***8700***	***2500***	***1450***
G+D+O Range Organics	*mg/kg*	*1500*	***155***		*250 U*	*250 U*	*250 U*	*250 U*	***630***					*250 U*	*250 U*	*250 U*	***535***	*250 U*	*250 U*	***8700***	***2500***	***1450***
Volatile Organic Compounds (VOCs)																						
Benzene	mg/kg	0.00056	0.0782 U	0.03 U				0.03 U						0.03 U	0.03 U	0.03 U						0.03 U
Toluene	mg/kg	0.055	0.391 U	0.05 U				0.05 U						0.05 U	0.05 U	0.05 U						0.05 U
Ethylbenzene	mg/kg	0.015	0.391 U	0.05 U				0.05 U						0.05 U	0.05 U	0.05 U						0.05 U
Total Xylenes	mg/kg	16000	1.173 U	0.1 U				0.1 U						0.15 U	0.15 U	0.15 U						0.1 U

Notes

Most stringent screening levels are the most stringent preliminary cleanup levels (PCULs) for vadose soil (nonpotable groundwater) established by the December 2019 Lower Duwamish Waterway (LDW) Preliminary Cleanup Level Workbook (Ecology, 2019).

*: 1500 mg/kg TPH is generic soil cleanup level based on direct contact where gasoline-range TPH is present, and is summation of all fractions, thus refered to as G+D+O Range Organics (Ecology, 2017).

Bold indicates a result detected above the laboratory reporting limit.

Highlighted values exceed the screening level.

U = analyte not detected above the laboratory reporting limit shown.

Blank cells indicate that the sample was not analyzed for that analyte.

Table D-3. Saturated Zone Soil Data with Comparison to Screening Levels

Project No. 150054, Snopac Property, Seattle, WA

Constituent	Unit	Most Stringent Screening Level	MW-3 10 - 12 1/23/17	MW-4 7 - 8 1/23/17	MW-4 12.5 - 13.5 1/23/17	MW-5 10 - 10.5 1/25/17	MW-5 15.8 - 17 1/25/17	MW-6 7 - 8 1/26/17	MW-6 15 - 16 1/26/17	MW-7 10 - 11 1/26/17	MW-7 17 - 18 1/26/17	MW-8 15.5 - 16.5 1/25/17	MW-9 5 - 6 1/25/17	MW-9 15 - 16 1/25/17	MW-10 5 - 6 1/25/17	MW-10 15.5 - 16.5 1/25/17	MW-11 10 - 11 1/26/17	MW-12 11 - 12 1/26/17	MW-12 17.5 - 18.5 1/26/17	VSP-02 5.1 11/12/18	VSP-06 6.2 11/13/18	VSP-07 8.2 11/12/18	VSP-08 5.6 11/12/18	VSP-11 5.6 11/12/18
Metals																								
Arsenic	mg/kg	7.3	**3.91**	**3.09**	**4.52**	**2.59**	**1.54**	5 U	**21.9**	5 U	5 U	**5.01**	**3.4**	**2.95**	**12.9**	**3.29**	**582**	**8**	5 U	**15.5**	**17.5**	**1.95**	**207**	**17.3**
Barium	mg/kg	8.3	**52.3**	**19.1**	**11.1**	**16.9**	**8.73**	**8.83**	**14.1**	**9.46**	**8.31**	**24.7**	**22.6**	**15.8**	**50.2**	**11.7**	**41.1**	**14.8**	**9.44**					
Cadmium	mg/kg	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1.69	1 U	1 UJ	1 U	1 U					
Chromium	mg/kg	260	**7.98**	**7.32**	**9.22**	**8.83**	**10.3**	**6.01**	**7.72**	**7.19**	**10**	**12.2**	**7.98**	**14.5**	**10**	**10.1**	**32.6**	**10.7**	**7.34**					
Copper	mg/kg	36	**23.6**	**47.8**	**19.9**	**10.1**	**11.1**	**7.25**	**21.1**	**9.37**	**8.34**	**25.2**	**12.9**	**18.6**	**28**	**14.6**	**457**	**24**	**5.08**	**51.8**	**52.2**	**124**	**154**	**33.1**
Lead	mg/kg	250	**33.4**	**31.1**	**3.17**	**1.68**	**1.29**	1 U	**10.6**	**3.14**	1 U	**3.95**	**14.4**	**2.71**	**49.4**	**2.4**	**524**	**2.84**	1 U	**221**	**69.7**	**4.88**	**179**	**52.5**
Mercury	mg/kg	0.07	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U					
Nickel	mg/kg	48	**6.48**	**7.69**	**7.8**	**8.74**	**6.04**	**4.63**	**5.55**	**4.88**	**5.13**	**9.86**	**5.89**	**8.57**	**8.35**	**6.1**	**16.3**	**8.39**	**5.73**	**17.1**	**7.46**	**15.7**	**10.9**	**5.98**
Selenium	mg/kg	0.38	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U									
Silver	mg/kg	0.016	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	1 U	1 U					
Zinc	mg/kg	85	**27.5**	**61.3**	**18.7**	**18.4**	**19.5**	**18**	**51.7**	**21.4**	**15.7**	**26.3**	**39.6**	**26.8**	**393**	**20.7**	**1680**	**17.5**	**12.7**	**221**	**77.6**	**49.6**	**626**	**97.6**
Organotin Compounds																								
Tributyltin Ion	mg/kg	0.0021															**0.032**							
Polycyclic Aromatic Hydrocarbons (PAHs)																								
1-Methylnaphthalene	mg/kg	29											0.05 U		**0.07**		0.5 U							
2-Methylnaphthalene	mg/kg	0.67											**0.056**		**0.076**		0.5 U							
Acenaphthene	mg/kg	0.028											0.01 U		0.01 U		0.1 U							
Acenaphthylene	mg/kg	1.3											0.01 U		0.01 U		0.1 U							
Anthracene	mg/kg	0.051											0.01 U		**0.015**		0.1 U							
Benz(a)anthracene	mg/kg	0.0011											**0.013**		**0.042**		**0.18**							
Benzo(a)pyrene	mg/kg	0.00031											**0.013**		**0.053**		**0.25**							
Benzo(b)fluoranthene	mg/kg	0.0039											**0.025**		**0.087**		**0.35**							
Benzo(g,h,i)perylene	mg/kg	0.67											**0.021**		**0.039**		**0.2**							
Benzo(k)fluoranthene	mg/kg	0.039											0.01 U		**0.032**		0.1 U							
Chrysene	mg/kg	0.13											**0.02**		**0.069**		**0.29**							
Dibenzo(a,h)anthracene	mg/kg	0.00057											0.01 U		0.01 U		0.1 U							
Dibenzofuran	mg/kg	0.54											0.05 U		0.05 U		0.5 U							
Fluoranthene	mg/kg	0.09											**0.026**		**0.13**		**0.34**							
Fluorene	mg/kg	0.029											0.01 U		**0.014**		0.1 U							
Indeno(1,2,3-cd)pyrene	mg/kg	0.011											**0.016**		**0.039**		**0.18**							
Naphthalene	mg/kg	0.0021			0.05 U								**0.04**		**0.056**		0.1 U							
Phenanthrene	mg/kg	1.5											**0.033**		**0.13**		**0.17**							
Pyrene	mg/kg	0.14											**0.024**		**0.12**		**0.4**							
Total cPAHs TEQ	mg/kg	0.000016											**0.0196**		**0.07419**		**0.3339**							
Other Semi-Volatile Organic Compounds (SVOC)																								
Carbazole	mg/kg												0.5 U		0.5 U		5 U							
Pentachlorophenol	mg/kg	0.0000018											0.5 U		0.5 U		5 U							
Polychlorinated Biphenyls (PCBs)																								
Aroclor 1254	mg/kg												0.2 U		0.2 U		**0.16**			**0.044**	0.02 U		**0.24**	
Aroclor 1260	mg/kg												0.2 U		0.2 U		**0.12**			**0.064**	0.02 U		0.02 U	
Total PCBs (Sum of Aroclors)	mg/kg	0.0000022											0.2 U		0.2 U		**0.28**			**0.11**	0.02 U		**0.25**	
Total Petroleum Hydrocarbons (TPH)																								
Gasoline Range Organics	mg/kg	30																						
Diesel Range Organics	mg/kg	2000	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	**190**	50 U	50 U					
Motor Oil Range Organics	mg/kg	2000	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	**1300**	250 U	250 U					
Diesel + Oil Range Organics	*mg/kg*	*2000*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	***1490***	*250 U*	*250 U*					
G+D+O Range Organics	*mg/kg*	*1500*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	*250 U*	***1490***	*250 U*	*250 U*					
Volatile Organic Compounds (VOCs)																								
Benzene	mg/kg	0.00056			0.03 U							0.03 U	0.03 U	0.03 U	0.03 U									
Toluene	mg/kg	0.055			0.05 U							0.05 U	0.05 U	0.05 U	0.05 U									
Ethylbenzene	mg/kg	0.015			0.05 U							0.05 U	0.05 U	0.05 U	0.05 U									
Total Xylenes	mg/kg	16000			0.15 U							0.15 U	0.1 U	0.15 U	0.1 U									

Notes

Most stringent screening levels are the most stringent preliminary cleanup levels (PCULs) for vadose soil (nonpotable groundwater) established by the December 2019 Lower Duwamish Waterway (LDW) Preliminary Cleanup Level Workbook (Ecology, 2019).

*: 1500 mg/kg TPH is generic soil cleanup level based on direct contact where gasoline-range TPH is present, and is summation of all fractions, thus refered to as G+D+O Range Organics (Ecology, 2017).

Bold indicates a result detected above the laboratory reporting limit.

Highlighted values exceed the screening level.

U = analyte not detected above the laboratory reporting limit shown.

Blank cells indicate that the sample was not analyzed for that analyte.

Table D-4. Groundwater and Seeps Data with Comparison to Screening Levels

Project No. 150054, Snopac Property, Seattle, WA

Constituent	Unit	Most Stringent Screening Level	No. Samples	No. Detects	Detection Frequency	Max Detect	Frequency of Exceedance	Max Magnitude of Exceedance	Sample Location: / Date:	ASP-1 7/2/15	ASP-2 7/2/15	ASP-3 7/2/15	ASP-4 7/2/15	ASP-5 7/2/15	ASP-6 7/2/15	MW-1 2/7/17	MW-1 1/29/18	MW-2 2/7/17	MW-2 1/30/18	MW-3 2/6/17
Metals (Totals except as noted)																				
Arsenic	ug/L	5	31	29	94%	75.5	65%	15		**44.7**	**40.1**	**42.4**	**75.5**	**42.2**	**63.5**	**15.4**	**10.2**	**9.24**	**11.3**	**10.8**
Barium	ug/L	200	25	25	100%	96.4	0%									**54.2**	**16.3**	**17.7**	**11.1**	**10.3**
Cadmium	ug/L	1.2	26	0	0%		0%					1 U				1 U	1 U	1 U	1 U	1 U
Chromium, dissolved	ug/L	27	24	15	63%	20.5	0%									**5.32**	**1.9**	**2.16**	**1.42**	
Chromium	ug/L	27	31	27	87%	129	6%	4.8		**2.58**	**2.21**	**2.81**	**3.36**	**1.47**	**2.59**	**6.23**	**35**	**3.17**	**23.7**	**3.43**
Copper	ug/L	3.1	30	19	63%	226	63%	73		**86.5**	**97.5**	**35.2**	**226**	**103**	**31**	**5.49**	**14.8**	**5.44**	**11.3**	**7.92**
Lead	ug/L	8.1	31	9	29%	8.47	3%	1.05		10 U	10 U	**5.8**	**8.47**	1 U	1 U	1 U	**2.73**	1 U	1 U	**2.82**
Mercury	ug/L	0.025	31	1	3%	0.28	3%	11		0.1 U	0.1 U	0.1 U	**0.28**	0.1 U	0.1 U	1 U	1 U	1 U	1 U	1 U
Nickel	ug/L	8.2	25	25	100%	100	36%	12								**16.8**	**3.39**	**18.4**	**4.87**	**20.5**
Selenium	ug/L	71	22	11	50%	58.1	0%									**58.1**	65 U	**40**	110 U	**41.1**
Silver	ug/L	1.9	25	0	0%		0%									1 U	1 U	1 U	1 U	1 U
Zinc	ug/L	81	31	24	77%	393	3%	4.9		**21.4**	**16.2**	**35.9**	**393**	**8.46**	50 U	**12.8**	**15.9**	**43.7**	**18.1**	**13.9**
Polycyclic Aromatic Hydrocarbons (PAH)																				
1-Methylnaphthalene	ug/L		30	1	3%	0.033				0.025 U	0.025 U	0.025 U	0.025 U	**0.033**	0.025 U	0.2 U	0.2 U	0.2 U	0.2 U	
2-Methylnaphthalene	ug/L		30	1	3%	0.026				0.025 U	0.025 U	0.025 U	0.025 U	**0.026**	0.025 U	0.2 U	0.2 U	0.2 U	0.2 U	
Acenaphthene	ug/L	5.3	30	6	20%	3.3	0%			0.025 U	**0.33**	**3.3**	0.025 U	**0.11**	0.025 U	0.03 U	0.03 U	**0.044**	**0.054**	
Acenaphthylene	ug/L		30	0	0%					0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.03 U	0.03 U	0.03 U	0.03 U	
Anthracene	ug/L	2.1	30	2	7%	0.052	0%			0.025 U	0.025 U	**0.047**	0.025 U	0.025 U	0.025 U	0.03 U	0.03 U	0.03 U	0.03 U	
Benz(a)anthracene	ug/L		30	4	13%	0.14	apply total cPAH (TEQ)			0.025 U	0.025 U	**0.14**	0.025 U	0.025 U	0.025 U	0.03 U	0.03 U	0.03 U	**0.032**	
Benzo(a)pyrene	ug/L		30	3	10%	0.14	apply total cPAH (TEQ)			0.025 U	0.025 U	**0.089**	0.025 U	0.025 U	0.025 U	0.03 U	0.03 U	0.03 U	0.03 U	
Benzo(b)fluoranthene	ug/L		30	6	20%	0.2	apply total cPAH (TEQ)			0.025 U	0.025 U	**0.18**	0.025 U	0.025 U	**0.028**	0.03 U	0.03 U	0.03 U	**0.03**	
Benzo(g,h,i)perylene	ug/L		30	3	10%	0.13				0.025 U	0.025 U	**0.074**	0.025 U	0.025 U	0.025 U	0.03 U	0.03 U	0.03 U	0.03 U	
Benzo(k)fluoranthene	ug/L		30	3	10%	0.06	apply total cPAH (TEQ)			0.025 U	0.025 U	**0.051**	0.025 U	0.025 U	0.025 U	0.03 U	0.03 U	0.03 U	0.03 U	
Chrysene	ug/L		30	4	13%	0.15	apply total cPAH (TEQ)			0.025 U	0.025 U	**0.084**	0.025 U	0.025 U	0.025 U	0.03 U	0.03 U	0.03 U	0.03 U	
Dibenzo(a,h)anthracene	ug/L		30	0	0%		apply total cPAH (TEQ)			0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.025 U	0.03 U	0.03 U	0.03 U	0.03 U	
Dibenzofuran	ug/L		30	0	0%					0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.2 U	0.2 U	0.2 U	
Fluoranthene	ug/L	1.8	30	10	33%	2	3%	1.1		**0.03**	**0.035**	**2**	**0.028**	**0.19**	0.025 U	0.03 U	0.03 U	**0.24**	**0.37**	
Fluorene	ug/L	3.7	30	4	13%	0.044				0.025 U	0.025 U	**0.028**	0.025 U	**0.041**	**0.033**	0.03 U	0.03 U	**0.044**	0.03 U	
Indeno(1,2,3-cd)pyrene	ug/L		30	3	10%	0.1	apply total cPAH (TEQ)			0.025 U	0.025 U	**0.073**	0.025 U	0.025 U	0.025 U	0.03 U	0.03 U	0.03 U	0.03 U	
Naphthalene	ug/L	1.4	30	6	20%	10	3%	7.1		0.025 U	**0.033**	0.025 U	0.025 U	**0.47**	0.025 U	0.03 U	0.03 U	**0.73**	**10**	
Phenanthrene	ug/L		30	9	30%	0.056				**0.033**	**0.031**	**0.053**	**0.038**	**0.05**	**0.037**	0.03 U	0.03 U	0.03 U	0.03 U	
Pyrene	ug/L	2	30	10	33%	2.2	3%	1.1		**0.03**	**0.035**	**1.2**	0.025 U	**0.28**	**2.2**	0.03 U	0.03 U	**0.18**	**0.25**	
Total cPAHs TEQ	ug/L	0.000016	30	6	20%	1.02	20%	63938		0.018875 U	0.018875 U	**0.135**	0.018875 U	0.018875 U	**0.020**	0.02265 U	0.02265 U	0.02265 U	**0.167**	
Other Semi-Volatile Organic Compoungs (SVOC)																				
Carbazole	ug/L		24	0	0%											2 U	2 U	2 U	2 U	
Pentachlorophenol	ug/L	0.002	24	0	0%		0%									2 U	2 U	2 U	2 U	
Polychlorinated Biphenyls (PCB)																				
Aroclor 1254	ug/L		30	1	3%	0.054	apply Total PCBs			0.01 U	0.01 U	**0.054**	0.01 U	0.01 U	0.01 U	0.1 U	0.1 U	0.1 U	0.1 U	
Aroclor 1260	ug/L		30	0	0%		apply Total PCBs			0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.1 U	0.1 U	0.1 U	0.1 U	
Total PCBs (Sum of Aroclors)	ug/L	0.000007	30	1	3%	0.054	3%	7714		0.01 U	0.01 U	**0.054**	0.01 U	0.01 U	0.01 U	0.1 U	0.1 U	0.1 U	0.1 U	
Total Petroleum Hydrocarbons (TPH)																				
Diesel Range Organics	ug/L	500	24	7	29%	110	0%									50 U	50 U	**85**	50 U	
Motor Oil Range Organics	ug/L	500	24	1	4%	290	0%									250 U	250 U	250 U	250 U	
Diesel + Oil Range Organics	*ug/L*	*500*	*24*	*7*	*29%*	*400*	*0%*									*250 U*	*250 U*	***210***	*250 U*	
Volatile Organic Compounds (VOC)																				
Benzene	ug/L	1.6	24	1	4%	0.42	0%									0.35 U	0.35 U	0.35 U	0.35 U	
Toluene	ug/L	130	24	0	0%	0	0%									1 U	1 U	1 U	1 U	
Ethylbenzene	ug/L	31	24	0	0%	0	0%									1 U	1 U	1 U	1 U	
Total Xylenes	ug/L	330	24	0	0%	0	0%									2 U	3 U	2 U	3 U	

Notes

Most stringent screening levels are the most stringent preliminary cleanup levels (PCULs) for nonpotable groundwater established by the December 2018 Lower Duwamish Waterway (LDW) Preliminary Cleanup Level Workbook (Ecology, 2018). Screening levels defaulting to PQLs are displayed in red.

Bold indicates a result detected above the laboratory reporting limit.

Highlighted values exceed the screening level.

U = analyte not detected above the laboratory reporting limit shown.

Blank cells indicate that the sample was not analyzed for that analyte.

Table D-4. Groundwater and Seeps Data with Comparison to Screening Levels

Project No. 150054, Snopac Property, Seattle, WA

Constituent	Unit	Most Stringent Screening Level	MW-3 2/8/17	MW-3 1/30/18	MW-4 2/6/17	MW-4 1/28/18	MW-5 2/5/17	MW-5 1/28/18	MW-6 2/6/17	MW-6 1/29/18	MW-7 2/6/17	MW-7 1/30/18	MW-8 2/8/17	MW-8 1/29/18	MW-9 2/7/17	MW-9 1/30/18	MW-10 2/8/17	MW-10 1/30/18	MW-11 2/8/17	MW-11 1/29/18	MW-12 2/7/17	MW-12 1/28/18
Metals (Totals except as noted)																						
Arsenic	ug/L	5	**18.8**	**15.1**	**14.7**	**10.7**	**1.34**	**8.94**	**1.96**	**25.1**	**3.76**	**6.38**	**2.41**	**1.25**	1 U	**1.92**	**1.15**	1 U	**20**	**8.19**	**1.23**	**2.42**
Barium	ug/L	200	**12.4**	**9.9**	**96.4**	**18.5**	**11.1**	**89.8**	**7.17**	**33.2**	**68.1**	**24.7**	**14.9**	**15**	**12.5**	**52.7**	**5.82**	**3.37**	**25.5**	**7.63**	**7.29**	**6.74**
Cadmium	ug/L	1.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chromium, dissolved	ug/L	27	1 U	**4.62**	**1.31**	**20.5**	**1.6**	**12**	1 U	1 U	1 U	**1.57**	**1.12**	1 U	1 U	**1.03**	**1.96**	**1.73**	1 U	**1.23**	1 U	1 U
Chromium	ug/L	27	**1.89**	**129**	**2.28**	**1.52**	**1.42**	**21.3**	1 U	**1.01**	**1.31**	**2.38**	**1.23**	**1.08**	1 U	**1.09**	**4.71**	**2.16**	**2.61**	**9.86**	1 U	1 U
Copper	ug/L	3.1	**10.9**	**21.3**	**8.5**	**7.98**	5 U	5 U	**7.4**	**11.6**	5 U	**5.05**	5 U	5 U	5 U	5 U	5 U	5 U		**14.1**	5 U	5 U
Lead	ug/L	8.1	1 U	**3.23**	**2.69**	1 U	1 U	1 U	**1.08**	1 U	**1.12**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**6.61**	1 U	1 U	1 U
Mercury	ug/L	0.025	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Nickel	ug/L	8.2	**11.4**	**7.24**	**11.7**	**16.3**	**5.02**	**100**	**1.58**	**2.53**	**9.96**	**6.74**	**2.95**	**1.94**	**2.23**	**15.2**	**2.1**	**1.35**	**6.67**	**3.52**	**4.2**	**3.86**
Selenium	ug/L	71		65 U		10 U	**2.4**	55 U	1 U	**1.73**	**5.68**	15 U	**7.43**	**2.98**	1 U	**6.53**	**1.06**	1 U		25 U	**1.56**	1 U
Silver	ug/L	1.9	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Zinc	ug/L	81	**18**	**20.8**	**8.68**	**5.49**	**8.14**	**75**	**12.2**	**34.1**	**9.22**	5 U	5 U	5 U	**5.91**	**8.75**	5 U	**6.7**	**34.6**	**12.7**	5 U	5 U
Polycyclic Aromatic Hydrocarbons (PAH)																						
1-Methylnaphthalene	ug/L		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-Methylnaphthalene	ug/L		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Acenaphthene	ug/L	5.3	**0.59**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Acenaphthylene	ug/L		0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Anthracene	ug/L	2.1	**0.052**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Benz(a)anthracene	ug/L		0.03 U	**0.068**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.046**	0.03 U	0.03 U	0.03 U
Benzo(a)pyrene	ug/L		0.03 U	**0.14**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.072**	0.03 U	0.03 U	0.03 U
Benzo(b)fluoranthene	ug/L		**0.042**	**0.2**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.11**	0.03 U	0.03 U	0.03 U
Benzo(g,h,i)perylene	ug/L		0.03 U	**0.13**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.062**	0.03 U	0.03 U	0.03 U
Benzo(k)fluoranthene	ug/L		0.03 U	**0.06**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.035**	0.03 U	0.03 U	0.03 U
Chrysene	ug/L		**0.05**	**0.15**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.073**	0.03 U	0.03 U	0.03 U
Dibenzo(a,h)anthracene	ug/L		0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Dibenzofuran	ug/L		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Fluoranthene	ug/L	1.8	**0.27**	**0.08**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.082**	0.03 U	0.03 U	0.03 U
Fluorene	ug/L	3.7	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Indeno(1,2,3-cd)pyrene	ug/L		0.03 U	**0.1**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.053**	0.03 U	0.03 U	0.03 U
Naphthalene	ug/L	1.4	0.03 U	0.03 U	**0.081**	0.03 U	0.03 U	0.03 U	**0.031**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
Phenanthrene	ug/L		0.03 U	0.03 U	**0.056**	0.03 U	0.03 U	0.03 U	**0.033**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.044**	0.03 U	0.03 U	0.03 U
Pyrene	ug/L	2	**0.062**	**0.14**	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	**0.11**	0.03 U	0.03 U	0.03 U
Total cPAHs TEQ	ug/L	0.000016	**0.026**	**1.023**	0.02265 U	0.02265 U	0.02265 U	0.02265 U	0.02265 U	0.02265 U	0.02265 U	0.02265 U	0.02265 U	0.02265 U	0.02265 U	0.02265 U	0.02265 U	0.02265 U	**0.099**	0.02265 U	0.02265 U	0.02265 U
Other Semi-Volatile Organic Compoungs (SVOC)																						
Carbazole	ug/L		2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Pentachlorophenol	ug/L	0.002	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
Polychlorinated Biphenyls (PCB)																						
Aroclor 1254	ug/L		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Aroclor 1260	ug/L		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Total PCBs (Sum of Aroclors)	ug/L	0.000007	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Total Petroleum Hydrocarbons (TPH)																						
Diesel Range Organics	ug/L	500	70 U	50 U	**110**	50 U	60 U	50 U	50 U	50 U	60 U	**88**	**110**	**100**	50 U	50 U	50 U	50 U	**100**	60 U	50 U	**110**
Motor Oil Range Organics	ug/L	500	350 U	250 U	280 U	250 U	280 U	250 U	250 U	250 U	280 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U	300 U	250 U	**290**
Diesel + Oil Range Organics	*ug/L*	*500*	*350 U*	*250 U*	***235***	*250 U*	*280 U*	*250 U*	*250 U*	*250 U*	*280 U*	***213***	***235***	***225***	*250 U*	*250 U*	*250 U*	*250 U*	***225***	*300 U*	*250 U*	***400***
Volatile Organic Compounds (VOC)																						
Benzene	ug/L	1.6	0.35 U	0.35 U	**0.42**	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U	0.35 U
Toluene	ug/L	130	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	ug/L	31	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Total Xylenes	ug/L	330	2 U	3 U	2 U	3 U	2 U	3 U	2 U	3 U	2 U	3 U	2 U	3 U	2 U	3 U	2 U	3 U	2 U	3 U	2 U	3 U

Notes

Most stringent screening levels are the most stringent preliminary cleanup levels (PCULs) for nonpotable groundwater established by the December 2018 Lower Duwamish Waterway (LDW) Preliminary Cleanup Level Workbook (Ecology, 2018). Screening levels defaulting to PQLs are displayed in red.

Bold indicates a result detected above the laboratory reporting limit.

Highlighted values exceed the screening level.

U = analyte not detected above the laboratory reporting limit shown.

Blank cells indicate that the sample was not analyzed for that analyte.

Table D-5. Reconnaissance Groundwater Data from Farallon (2011)

Project No. 150054, Snopac Property, Seattle, WA

Location:		FB-1	FB-2	FB-3	FB-4	FB-5	FB-6	FB-7	FB-8	FB-9
Date:		8/25/11	8/25/11	8/25/11	8/25/11	8/25/11	8/26/11	8/26/11	8/26/11	8/26/11
Constituent	**Unit**									
Total Metals										
Arsenic	ug/L	**130**	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U
Cadmium	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chromium	ug/L	**82**	**61**	25 U	**45**	25 U	**33**	25 U	25 U	25 U
Copper	ug/L	**71**	**41**	20 U	**56**	**21**	**35**	20 U	20 U	20 U
Lead	ug/L	30 U	30 U	30 U	30 U	30 U	30 U	30 U	30 U	30 U
Mercury	ug/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Silver	ug/L	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Zinc	ug/L	**270**	**110**	40 U	**70**	40 U	40 U	40 U	40 U	40 U
PAHs										
Benz(a)anthracene	ug/L	0.1 U	0.1 U	0.1 U	0.096 U		0.1 U	0.1 U	0.098 U	0.098 U
Benzo(a)pyrene	ug/L	0.2 U	0.2 U	0.2 U	0.19 U		0.2 U	0.2 U	0.2 U	0.2 U
Benzo(b)fluoranthene	ug/L	0.1 U	0.1 U	0.1 U	0.096 U		0.1 U	0.1 U	0.098 U	0.098 U
Benzo(k)fluoranthene	ug/L	0.1 U	0.1 U	0.1 U	0.096 U		0.1 U	0.1 U	0.098 U	0.098 U
Chrysene	ug/L	0.1 U	0.1 U	0.1 U	0.096 U		0.1 U	0.1 U	0.098 U	0.098 U
Dibenzo(a,h)anthracene	ug/L	0.1 U	0.1 U	0.1 U	0.096 U		0.1 U	0.1 U	0.098 U	0.098 U
Indeno(1,2,3-cd)pyrene	ug/L	0.1 U	0.1 U	0.1 U	0.096 U		0.1 U	0.1 U	0.098 U	0.098 U
Naphthalene	ug/L	**0.11**	0.1 U	0.1 U	0.096 U		0.1 U	0.1 U	0.098 U	0.098 U
PCB Aroclors										
Aroclor 1016	ug/L	0.48 U	0.5 U	0.48 U	0.48 U					0.48 U
Aroclor 1221	ug/L	0.48 U	0.5 U	0.48 U	0.48 U					0.48 U
Aroclor 1232	ug/L	0.48 U	0.5 U	0.48 U	0.48 U					0.48 U
Aroclor 1242	ug/L	0.48 U	0.5 U	0.48 U	0.48 U					0.48 U
Aroclor 1248	ug/L	0.48 U	0.5 U	0.48 U	0.48 U					0.48 U
Aroclor 1254	ug/L	0.48 U	0.5 U	0.48 U	0.48 U					0.48 U
Aroclor 1260	ug/L	0.48 U	0.5 U	0.48 U	0.48 U					0.48 U
Total PCBs (Sum of Aroclors)	ug/L	0.48 U	0.5 U	0.48 U	0.48 U					0.48 U
Total Petroleum Hydrocarbons (TPH)										
Gasoline Range Organics	ug/L	50 U	50 U	50 U				50 U	50 U	50 U
Diesel Range Organics	ug/L	**270**	**270**	**560**	**280**		**180**	**190**	**600**	**210**
Motor Oil Range Organics	ug/L	**310**	**430**	**520**	**360**		**280**	**360**	**910**	**370**
Volatile Organic Compounds (VOC)										
Benzene	ug/L	0.5 U						0.5 U	0.5 U	
Toluene	ug/L	0.5 U						0.5 U	0.5 U	
Ethylbenzene	ug/L	**0.95**						0.5 U	0.5 U	
Total Xylenes	ug/L	1 U						1 U	1 U	

Notes

These data are from reconnaissance grab groundwater samples collected from an open soil boring, not a monitoring well.
Bold indicates a result detected above the laboratory reporting limit.
U = analyte not detected above the laboratory reporting limit shown.
Blank cells indicate that the sample was not analyzed for that analyte.
Results from *Subsurface Investigation Results, Snopac Property, 5055 East Marginal Way South, Seattle, Washington, by Farallon Consulting, October 21, 2011.*

FIGURES

N

A

A'

B

B'

Slip 1

EAST MARGINAL WAY S

FB-4
FB-4A
MW-8
MW-12
FB-1
FB-1A
B-8
FB-2E
SSA-10
FB-2B
B-7
B-12
VSP-13
FB-2
B-21
FB-2F
FB-2A
B-19
FB-2C
MW-7
SSA-8
VSP-10
VSP-6
MW-4R
MW-4
FB-2D
FB-9
FB-9A
ASP-6
B-6
VSP-2
SSA-9
B-9
B-5
B-14
SSA-7
VSP-8
B-4
VSP-4
B-15
SSA-6
MW-3
MW-3R
MW-6
ASP-5
B-3
FB-3A
VSP-11
VSP-1
FB-3
B-2
B-16
VSP-12
VSP-15
B-17
SSA-5
MW-2
MW-2R
B-18
VSP-7
MW-5
SSA-3
SSA-4
VSP-3
FB-5B
ASP-4
ASP-3
FB-5
ASP-2
FB-5A
B-13
FB-5C
B-20
MW-9
VSP-9
VSP-5
SSA-2
MW-1R
MW-1
ASP-1
MW-11
B-1
VSP-14
SSA-1
FB-6A
FB-6
MW-10
FB-7A
FB-7
FB-8A
FB-8

Explorations

- Boring - Aspect
- Boring - Farallon
- Geotech Boring - Aspect
- Monitoring Well - Aspect
- Seep Sample - Aspect
- Soil Sample - Aspect

- Cross Section Line
- Property Boundary
- Ordinary High Water Mark (ESA, 1/23/18)
- King County Tax Parcel

0 20 40
Feet

Note: The seaward face of the retaining wall structure on the west side of the Property generally conforms to the location of the Ordinary High Water Mark.

Exploration Locations

Snopac Property Upland Source Control RI/FS
Slip 1 Source Control Area – Lower Duwamish Superfund Site
5055 Properties, LLC
Seattle, Washington

Aspect Consulting	JAN-2019	BY: MLK / RAP	FIGURE NO. 1
	PROJECT NO. 150054	REVISED BY: TDR	

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