



Oregon Department of Environmental Quality

# Geotechnical Evaluation Work Plan – Sediment Removal Haul Roads

Former St. Helens Fiberboard Facility  
Lowland/In-Water Operable Unit IRAM Investigation

ECSI No. 91

April 15, 2024

Prepared by:



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**SIGNATURE PAGE FOR**

**REPORT ON  
GEOTECHNICAL EVALUATION WORK PLAN – SEDIMENT REMOVAL HAUL ROADS  
FORMER ST. HELENS FIBERBOARD FACILITY  
LOWLAND/IN-WATER OPERABLE UNIT IRAM INVESTIGATION  
ST. HELENS, OREGON**

**PREPARED FOR**  
OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY  
SALEM, OREGON

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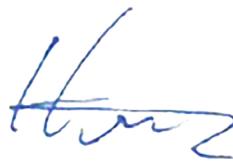
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## Abbreviations and Acronyms

ASTM	ASTM International
bww	below wood waste
CBR	California Bearing Ratio
DCP	Dynamic Cone Penetrometer
DEQ	Oregon Department of Environmental Quality
DGI	data gaps investigation
DQO	data quality objective
ECSI	Environmental Cleanup Site Information
G.E.	geotechnical engineer
GSI	GSI Water Solutions, Inc.
Haley & Aldrich	Haley & Aldrich, Inc.
HASP	health and safety plan
IDW	investigation derived waste
IRAM	interim remedial action measure
OU	operable unit
PDF	portable document format
P.E.	professional engineer
Project Area	IRAM Area
R.G.	Registered Geologist
RI	remedial investigation
RPB	remedy protection berm
Site	former St. Helens Fiberboard Facility in St. Helens, Oregon
Work Plan	Geotechnical Engineering Evaluation of Sediments Work Plan

## SECTION 1: Introduction

This Geotechnical Evaluation Work Plan (Work Plan) was prepared by GSI Water Solutions, Inc. (GSI), and Haley & Aldrich, Inc. (Haley & Aldrich), on behalf of the Oregon Department of Environmental Quality (DEQ) to develop geotechnical recommendations for haul road design to support remediation of the Operable Unit 2 (OU2) interim remedial action measure (IRAM) Area (Project Area) of the former St. Helens Fiberboard Facility (Site) in St. Helens, Oregon. This Work Plan describes the means and methods for performing a geotechnical evaluation to obtain data for the design and construction of haul roads to facilitate the excavation and removal of impacted materials in the Project Area as specified in the Conceptual IRAM Plan (GSI et al., 2023).

### 1.1 Evaluation Approach

The geotechnical evaluation approach will include the following:

1. Shallow subsurface characterization of soils via hand exploration methods, as follows:
  - a. Dynamic cone penetrometer (DCP) testing will be performed to enhance understanding of shallow subsurface profiles and develop sediment/soil consistency data.
  - b. Hand auger borings will be performed to allow for logging of shallow subsurface profiles and obtain soil samples for laboratory testing.
    - i. “Grab” samples of representative soils will be collected from the auger cuttings from each borehole for soil characterization and index laboratory testing.
    - ii. Where fine-grained soils are encountered, thin-walled Shelby tube sampling will be performed by manual methods to attempt to obtain undisturbed samples for consolidation testing.
    - iii. Bulk samples of cuttings at select locations will be collected for California bearing ratio (CBR) testing.
2. Geotechnical laboratory testing of collected grab samples for moisture content, Atterberg limits, grain-size distribution, consolidation properties, CBR, and moisture-density relationship.
3. Geotechnical engineering analysis to support the proposed design including:
  - a. Estimation of static settlements resulting from placement of haul road embankments.
  - b. Evaluation of bearing resistance of subgrade materials subject to haul road embankments and construction traffic loading.
  - c. Analysis of stability of haul road embankments using two-dimensional limit equilibrium methods to assess general static stability.
  - d. Design of haul road embankment section alternatives, including identification of recommended geosynthetic reinforcement, fill material specification, and minimum embankment thickness.
4. Preparation of a geotechnical engineering report, which will include discussions of existing data and past explorations, current field exploration program methods and procedures, subsurface conditions at the Site with a focus on conditions in the Project Area, laboratory testing results, settlement estimates, bearing capacity analysis, stability assessment, and recommendations for design and construction of the proposed haul roads and associated improvements in the Project Area.

These proposed geotechnical exploration activities will be planned for Spring 2024 during a period when water levels allow access to proposed sample locations by foot. Field work is expected to be accomplished during a single event.

## 1.2 Organization

This Work Plan is organized as follows:

- **Section 2:** Background
- **Section 3:** Data Quality Objectives
- **Section 4:** Exploration Approach
- **Section 5:** Analysis and Reporting
- **Section 6:** References

## SECTION 2: Background

The following sections discuss the Project and the data needs that have guided the development of this Work Plan.

### 2.1 Project Understanding

The Site is designated as Environmental Cleanup Site Information (ECSI) Site No. 91 by the DEQ. The Site is bordered to the northwest by Railroad Avenue and to the northeast, southwest, and southeast by Scappoose Bay. Historical operations at the Site have resulted in the release of hazardous substances. OU1 has been remediated and current remedial activities are focused on the Project Area in OU2. To date, environmental investigations have been performed to characterize the nature and extent of contamination within OU2 as part of the remedial investigation (RI) and data gaps investigation (DGI) (GSI and Haley & Aldrich, 2023).

The Project Area for the IRAM has been established in OU2 and divided into IRAM subareas with unique remedial approaches and considerations (GSI et al., 2023). The Project Area covers approximately 10.5 acres (Figure 1). Shallow subsurface data (less than 10 feet below ground surface) within the Project Area was collected using vibracores and hand-augered borings during previous exploration events. General stratigraphy at the previous DGI exploration locations is documented in core logs (GSI and Haley & Aldrich, 2023) and previous DGI exploration locations are shown on Figure 2. Based on this subsurface data, the Project Area is a low-lying, semi-wetlands environment with a subgrade typically composed of soft, saturated, fine-grained soils overlain by up to several feet of wood waste and organic-rich material.

Planned remediation of the Project Area consists of excavation and offsite disposal of impacted soil/sediment, typically located within 5 feet of the ground surface. The existing ground surface is weak and unsuitable for direct support of the construction equipment needed to excavate impacted material as planned (e.g., track-mounted long-reach excavators, dump trucks). As such, haul roads are proposed to provide construction equipment access to the Project Area. The haul roads will be constructed by first excavating impacted soil/sediment along the road alignments, then backfilling the road alignments with a structural haul road embankment suitable for supporting the required construction equipment and activities. This Work Plan describes a process of geotechnical explorations and analyses to support design and construction of these haul roads.

Once remedial activities in the Project Area are complete, the haul roads may be fully or partially demolished to allow free flow of water from Scappoose Bay into the Project Area. Upon completion of the IRAM, the abandoned haul roads may be converted to restoration features through the placement of backfill and plantings that increase habitat complexity and function. The southernmost section of haul road may remain intact for use in future remedial activities in portions of OU2 adjacent to the Project Area. It will also serve as a remedy protection berm (RPB) intended to limit the transport of sediments from unremediated portions of the OU2 to the Project Area. This function will be achieved by constructing the RPB at an elevation approximately 2 feet or greater above the unremediated portions of OU2 adjacent to it.

The haul roads are considered temporary construction-related features; therefore, seismicity and seismic hazards will not be accounted for in their design. Additionally, long-term stability and settlement of the haul roads is not a consideration in their design. However, due to the nature of the haul road construction they will likely be able to be repaired in the future through the placement of additional base materials if necessary.

## 2.2 Data Needs

Previous exploration activities within the Project Area have produced shallow subsurface data providing basic soil classifications and environmental test data. This data (gathered during Phases I through III of the RI and the DGI) was collected from depths generally on the order of 5 feet or shallower below the ground surface (GSI and Haley & Aldrich, 2023).

The construction of the planned haul roads within the Project Area is expected to occur on top of native soils that are relatively weak and compressible, which could result in consolidation settlement, embankment instability during haul road construction or usage, insufficient subgrade bearing capacity under embankment and construction equipment loading, and haul road disturbance (e.g., pumping and rutting) during construction. Data needs to evaluate these conditions include collection of geotechnical subsurface data, as well as disturbed and undisturbed samples for geotechnical laboratory testing, to facilitate design of haul roads over the soft native soils.

## SECTION 3: Data Quality Objectives

The primary Data Quality Objectives (DQOs) for this Work Plan are to gather key subsurface data from sediment/soil samples collected at various locations in the Project Area and to conduct geotechnical analyses in support of the haul road design process. The following sections list proposed data gathering activities corresponding to their associated geotechnical design purposes.

### 3.1 Bearing Capacity of Sediment/Soil Subgrade

- **DCP** – Interpretations of sediment/soil stiffness and undrained shear strength.
- **Hand Explorations** – Collection of shallow disturbed and undisturbed samples for laboratory testing, determination of sediment/soil consistency profile.
- **Laboratory Testing** – Index testing to determine sediment/soil classifications and properties (e.g., Atterberg limits, grain size distribution).

### 3.2 Road Section Design

- **DCP** – Interpretations of sediment/soil stiffness and undrained shear strength.
- **Hand Explorations** – Collection of shallow disturbed and undisturbed samples for laboratory testing, determination of sediment/soil consistency profile.
- **Laboratory Testing** – Index testing to determine sediment/soil classifications and properties (e.g., Atterberg limits, grain size distribution). CBR testing for road section calculations.

### 3.3 Static Slope Stability Analysis

- **DCP** – Interpretations of undrained shear strength.
- **Hand Explorations** – Lithologic profile, collection of shallow disturbed and undisturbed samples for laboratory testing.
- **Laboratory Testing** – Index testing to determine sediment/soil classifications and properties (e.g., Atterberg limits, grain size distribution).

### 3.4 Static Settlement Analysis

- **Borings** – Lithologic profile, collection of undisturbed samples for consolidation testing.
- **Hand Explorations** – Lithologic profile, collection of shallow disturbed and undisturbed samples for laboratory testing.
- **Laboratory Testing** – One-dimensional consolidation testing to determine consolidation properties, including over-consolidation ratio, and virgin and recompression ratios.

## SECTION 4: Exploration Approach

The following geotechnical exploration approach discussion addresses the DQOs described in Section 3.

### 4.1 Geotechnical Exploration Staff and Subcontractors

Logging of DCP, hand auger borings, and collection of physical samples will be performed by Haley & Aldrich and GSI. A Geotechnical Engineer (G.E.) registered in the State of Oregon will manage the field exploration program. During geotechnical exploration, a Haley & Aldrich Professional Engineer (P.E.) or Registered Geologist (R.G.) will be on site to assist with explorations, collect geotechnical samples, record detailed boring logs, and ensure DQOs are met.

### 4.2 Health and Safety Requirements

All field staff present on site will follow procedures and safety requirements outlined in the Site-Specific Health and Safety Plan (HASP) for the DGI (GSI, 2021b) as well as any safety requirements requested by the Site owner. Field and laboratory staff will have the potential to come into contact with site contaminants and will therefore be trained in Hazardous Waste Operations and Emergency Response, in accordance with Title 29 of the Code of Federal Regulations, Standard 1910.120, as well as all additional training requirements specified in the HASP. When performing sampling activities within 10 feet of open water, field staff shall each wear a U.S. Coast Guard-approved Type III or V personal flotation device. Onsite staff shall also be trained to comply with the Site Management Plan (GSI, 2021) in matters of investigation-derived waste (IDW) management, soil and sediment handling, and decontamination procedures.

### 4.3 Exploration and Testing Methods

The following sections discuss the exploration and testing methods that will be used to address the DQOs.

#### 4.3.1 Hand Explorations

Hand explorations, including shallow disturbed sample collection, DCP testing, and manual Shelby tube testing, will be performed by field personnel at exploration locations placed along or near the proposed haul road alignments. Prior to breaking ground, we will conduct a geotechnical reconnaissance of the Site, pre-mark exploration locations, and notify the “One-Call” service for public utility locates. Geotechnical explorations are proposed at twelve locations near the conceptual haul roads as shown in Figure 2 and their coordinates are listed in Table 1. Table 1 also presents the unique sample location IDs for the different geotechnical exploration points, along with the proposed sample coordinates, approximate ground surface elevations, type of exploration, and estimated total depth of exploration below wood waste (bww). Specific sample IDs will be adjusted in the field to reflect the actual achieved exploration depths and sample intervals.

The actual location of each exploration may vary slightly from described based on conditions encountered in the field (e.g., planned location conflicts with riprap, willow trees, submerged conditions). Exploration points will be offset no further than 25 feet from the described planned locations.

The approach for each planned exploration method is described below.

- Shallow samples will be collected using hand sampling techniques at 12 locations. A 3- to 6-inch diameter hand auger will be used to bore to the sampling depth below the near-surface wood waste, which will typically range between 1 and 3 feet below the ground surface.

- When the native soil contact is encountered through visual examination of spoils, a thin-walled Shelby tube will be pushed into the ground under manual force (e.g., hand pressure and/or advancement with a 15-pound Sowers DCP drive hammer). The tube will be extracted via use of a small manual-powered jack or pry bar. Timbers will be placed across the ground surface to provide adequate jacking resistance and will be removed once sampling is complete. Recovered Shelby tubes will be examined, molten wax will be placed at the ends, and the ends will be capped and taped to reduce potential for disturbance and moisture loss while in transit to the laboratory. The Shelby tube samples will be transported and stored in an upright position matching their in-situ orientation at all times prior to sample extrusion at the laboratory. We note that recovery of samples with the Shelby tube will be dependent on the soft sediment/soils adhering in the tube upon removal and not all tubes are expected to obtain full (24-inch) recovery.
- Whether or not the Shelby tube sample is recovered, the hand auger will be used to advance the exploration to a depth of at least 5 feet bww. Disturbed grab samples will be collected from the hand auger into sealed plastic bags, with each sample being double bagged.
- In three locations to be determined by the overseeing G.E. during field exploration, several adjacent hand auger borings will be completed in order to obtain sufficient bulk sample volume for CBR and Modified Proctor testing.
- All samples will be logged in the field by the field geologist or engineer per ASTM International (ASTM) D2488 (Standard Practice for Description and Identification of Soils [Visual-Manual Procedures]; 2017a), labeled, and sealed to be transported to the soil laboratory for testing and eventual disposal consistent with the Site Management Plan (GSI, 2021).
- A U.S. Army Corps of Engineers Dual Mass DCP will be advanced adjacent to each exploration location to help characterize soil stiffness and obtain an estimate of the *in situ* CBR of the native soils within 1 to 2 feet bww. The DCP consists of a steel extension shaft assembly with a 60-degree hardened steel cone tip attached to one end which is driven into the subgrade by means of a sliding dual mass (10.1- or 17.6-pound) hammer. The DCP is simply lifted out of the ground under manual force upon completion of testing. Testing will be conducted in accordance with ASTM D6951/D6951M-18 (2018).

Soil samples will be collected and transported to Haley & Aldrich’s geotechnical laboratory in Portland, Oregon or Seattle, Washington while following the methods and chain of custody procedures laid out in the SMP (GSI, 2021). Samples will be reviewed for classification/identification per ASTM D2488 (2017a) and then transported to Haley & Aldrich’s geotechnical laboratory in Seattle, Washington or a qualified subcontracted laboratory for testing as identified in Section 4.7.

## 4.4 Exploration Schedule

Geotechnical exploration work will commence approximately in May 2024 (dependent on Scappoose Bay water levels and sampling location access). The twelve DCP tests, hand auger borings, and Shelby tube drives are expected to take up to one week. However, specific timing will need to be coordinated and is contingent upon the ability to access proposed locations. Performing this work in Spring 2024 is critical to the overall project schedule including design and permitting.

## 4.5 Field Documentation

The following sections discuss the field documentation protocols that will be used during the implementation of this Work Plan.

### 4.5.1 Field Notes

Field notes will be used to document exploration and sampling activities, general observations, deviations to the work plan, and relevant file names or nomenclature for electronic files. At minimum, notes will include the following:

- Date and time, including duration of work at each exploration location
- Subcontractor(s) names and company
- Description of location of exploration
- Description of ground condition/amount of vegetation and water inundation
- Weather (temperature, atmospheric pressure, cloud cover)
- Decisions altering the implementation of this Work Plan

Field notes will be made on either bound Rite in the Rain® paper or on a field electronic tablet and contain numbered pages. Entries will be made in waterproof ink or electronically, dated, and accompanied by time stamps. Hard copy field notes will be completed, scanned, and archived at the end of each day.

### 4.5.2 Exploration Logs

Exploration logs for hand-augered borings will be prepared in the field by a Haley & Aldrich Oregon-registered P.E. or R.G. and overseen by an Oregon-registered G.E. At minimum, exploration logs will include the following:

- Date and time for significant events, including the start and end of each exploration
- Names of field crew members
- Project name and number
- Latitude and longitude of exploration as determined by global positioning system unit with submeter accuracy.
- Soil sample descriptions with relation to depth, in conformance with ASTM D2488 (Standard Practice for Description and Identification of Soils [Visual-Manual Procedures]; 2017a)
- Thickness and characteristics of wood wastes, described below:
  - **Sawdust.** Dense, fine, blocky/laminated wood material that may oxidize upon exposure to air from orange or red to brown. Sawdust may be mixed with cut wood chips or native lithology. This is a waste product sourced from fiberboard production and discharged through historical outfalls. Sawdust may also originate from the historical sawdust pile adjacent to the historical dock structure.
  - **Pulp.** Mushy wood material that often oxidizes to dark gray when exposed to air. A simple jar test can be used in the field: suspected pulp is added to water in a jar, shaken, and allowed to settle. If considerable fluffy material stays suspended in solution, it is identified as pulp. Pulp is likely a byproduct of fiberboard production and was discharged through historical outfalls.
  - **Fiber.** Stringy woody material with longer fibers than pulp found disseminated throughout native materials or deposits of other wood wastes. This was likely a waste product sourced from fiberboard production and discharged through historical outfalls.
  - **Chips.** Clean, transverse-cut pieces of wood ranging from 0.25 inch to approximately 2 inches long. Chips are often discolored (red or light brown) and either discretely bedded or suspended in other wastes or sediment. Chips were likely sourced from the former chip pile.
- Groundwater level measurements
- Backfill and exploration completion details

### 4.5.3 Sample Identification

During geotechnical sample collection, a unique identification code will be assigned to each sample as part of the data record and consistent with sample labeling procedures outlined in the Quality Assurance Project Plan (GSI, 2022a), with the exception that the letter “U” will be used to designate undisturbed Shelby tube samples. Specifically, the identification code will consist of up to five components, separated by dashes to indicate the unique sampling station code (as shown on Figure 2), the sample type (G for geotechnical), the depth interval, and the date presented as YYYYMMDD. Examples of the unique sample identifiers are as follows:

- HA-E03-G-1-5-20240524: A shallow sediment/soil, geotechnical grab sample collected at station HA-E03 at a depth from 1 to 5 feet below the ground surface on 24 May 2024.
- HA-H01-U-2-4-20240601: A shallow sediment/soil, geotechnical undisturbed (Shelby tube) sample collected at station HA-H01 at a depth from 2 to 4 feet below the ground surface on 1 June 2024.

### 4.5.4 Photographs

Photographs will be taken to document field activities and to document sample collection. A white board background will be used to annotate field photos of hand auger samples at a minimum, and other field efforts, as appropriate. At minimum, photo documentation will cover the following:

- Field conditions at the time of each exploration event throughout the Project Area
- General procedures and equipment used
- Sample identification number
- Hand auger samples for each sample interval at each sample location.

Photographs will be downloaded and kept with the electronic project files for future reference.

## 4.6 Data Management

Field notes will be scanned into a portable document format (PDF) and stored on the project server. Exploration logs will be scanned and entered into a digital format using gINT or OpenGround software and also saved as PDF files. Photographs will include date and time as a timestamp, or be recorded on a photograph log, and will be uploaded to the project server on a daily basis. Geotechnical laboratory reports will be provided by the laboratory as a PDF file.

## 4.7 Laboratory Testing

Haley & Aldrich will perform geotechnical laboratory testing on sediment/soil samples collected during the exploration to evaluate relevant soil properties for the design of the proposed haul roads. All laboratory testing will be performed at Haley & Aldrich laboratories in Seattle, Washington, or Portland, Oregon.

- Select disturbed (grab and bulk) samples collected from the hand explorations will be subjected to laboratory testing for determination of index properties and CBR.
- Select undisturbed samples collected from the Shelby tubes may be subjected to laboratory testing for determination of consolidation properties.

The planned geotechnical laboratory test schedule is presented in Table 2, attached. All laboratory testing is to be performed in conformance with referenced ASTM standards.

## 4.8 Sampled Soil/Sediment Disposal

The following sections discuss the disposal of excavated spoils and laboratory samples.

### 4.8.1 Disposal of Excavation Spoils

Past IDW sampling results for soil/sediments and liquids have been categorized as non-hazardous. Because of this, the containment and disposal of leftover sampled soil/sediments are not required for this event but may be undertaken if indicated.

During sampling, excess sediment will be returned to its point of origin. Limited amounts of unanticipated gross contamination and anticipated anthropogenic waste debris may be encountered during sampling activities. Waste debris discovered during sampling will be left in place. If oily or other obviously contaminated media are generated during sampling, the materials will be retained, to the extent practicable, in labeled 55-gallon drums, characterized for disposal, and disposed of at an appropriate facility.

All disposable materials used in sample collection and processing, such as paper towels, aluminum foil, masks, and gloves, will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be placed in a normal refuse container for disposal at a solid waste landfill.

### 4.8.2 Disposal of Laboratory Samples

Once geotechnical laboratory testing is complete, the remnant samples will be collected and returned to the site for disposal as IDW. The sample waste will be collected in 55-gallon drums and sealed with lids. Drums will be temporarily stored at a designated upland location (OU1) on the Site. If visually impacted sediment, debris, or liquid wastes have been containerized in drums, the drums will be inventoried and labeled to include the project name, container number, description of contents, generation date, and contact information. Wastes will be tested in conformance with procedures outlined in the SMP (GSI, 2021) to confirm that they meet the requirements to be managed as non-hazardous waste.

After the testing data are available, arrangements will be made with a subcontractor for timely and proper handling and disposal of the IDW at an appropriately permitted solid waste disposal facility according to DEQ solid waste rules. A waste profile will be prepared, and formal acceptance will be obtained at the selected DEQ-approved landfills prior to disposal of solid IDW. The current landowner will be provided with the information provided to the disposal facility and documentation of the acceptance of the waste prior to disposal. Bills of lading will be maintained documenting the tare and gross weight, date, and truck number for each load.

## SECTION 5: Evaluation and Reporting

The following sections discuss the analysis and reporting of the data collected as part of this Work Plan.

### 5.1 Engineering Evaluation and Design

Geotechnical engineering evaluation will be performed, including determining bearing capacity of near-surface sediment/soils with respect to construction of proposed haul roads and construction traffic loading, embankment stability (static loading conditions), and short-term and long-term settlements resulting from changes in overburden stresses. Geotechnical issues related to constructability (e.g., wet soil earthwork practices) will also be evaluated. Haul road design shall assume impacted soils/sediments are excavated from road footprints as part of road construction. This shall include over-excavation to the sides of the roads to allow for full removal of impacted materials. The planned analyses will be performed using the following methods and/or software:

- Bearing capacity calculations per the Oregon Department of Transportation Geotechnical Design Manual (ODOT, 2023)
- Embankment stability evaluation by limit equilibrium methods using Slide2 software by RocScience
- Short-term and long-term settlement analysis using Settle3 software by RocScience
- Haul road section design per U.S. Army Corps of Engineers, “Geotextile Reinforcement of Low-Bearing-Capacity Soils, Comparison of Two Design Methods Applicable to Thawing Soils,” Special Report 99-7, dated June 1999

### 5.2 Reporting

A draft Geotechnical Evaluation Report will be prepared presenting field activities, geotechnical analyses, findings, conclusions, and recommendations. The report will specifically include:

- Description of field activities including soil, sediment, and groundwater conditions within the Project Area;
- Sampling approach;
- Copies of field and laboratory documentation;
- Estimated settlement and bearing capacity of subgrade soils supporting haul road materials and construction loading;
- Stability of haul road embankments;
- Recommendations for haul road design and construction, including required road cross sections detailing fill requirements (type, thickness, placement, compaction) and geotextiles to be used (manufacturer, specification, installation requirements, etc.). Subgrade preparation should be detailed. Design should assume impacted soils/sediments will be excavated from haul road footprint and immediately adjacent area as required to protect haul roads during excavation of impacted material;
- Discussion of assumed surface water and groundwater levels during the construction period and impacts of water inundation on haul roads between construction seasons;
- Groundwater issues to be considered or addressed ; and
- Construction considerations, as appropriate

Upon completion of initial geotechnical evaluation and design, a draft version of the Geotechnical Evaluation Report will be submitted to DEQ. Upon receipt of comments from DEQ, Haley & Aldrich will discuss comments with DEQ, appropriately revise the report, and issue a final geotechnical report that is signed and stamped by a G.E. licensed in the State of Oregon.

## SECTION 6: References

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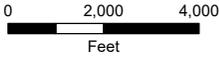
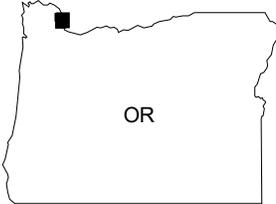
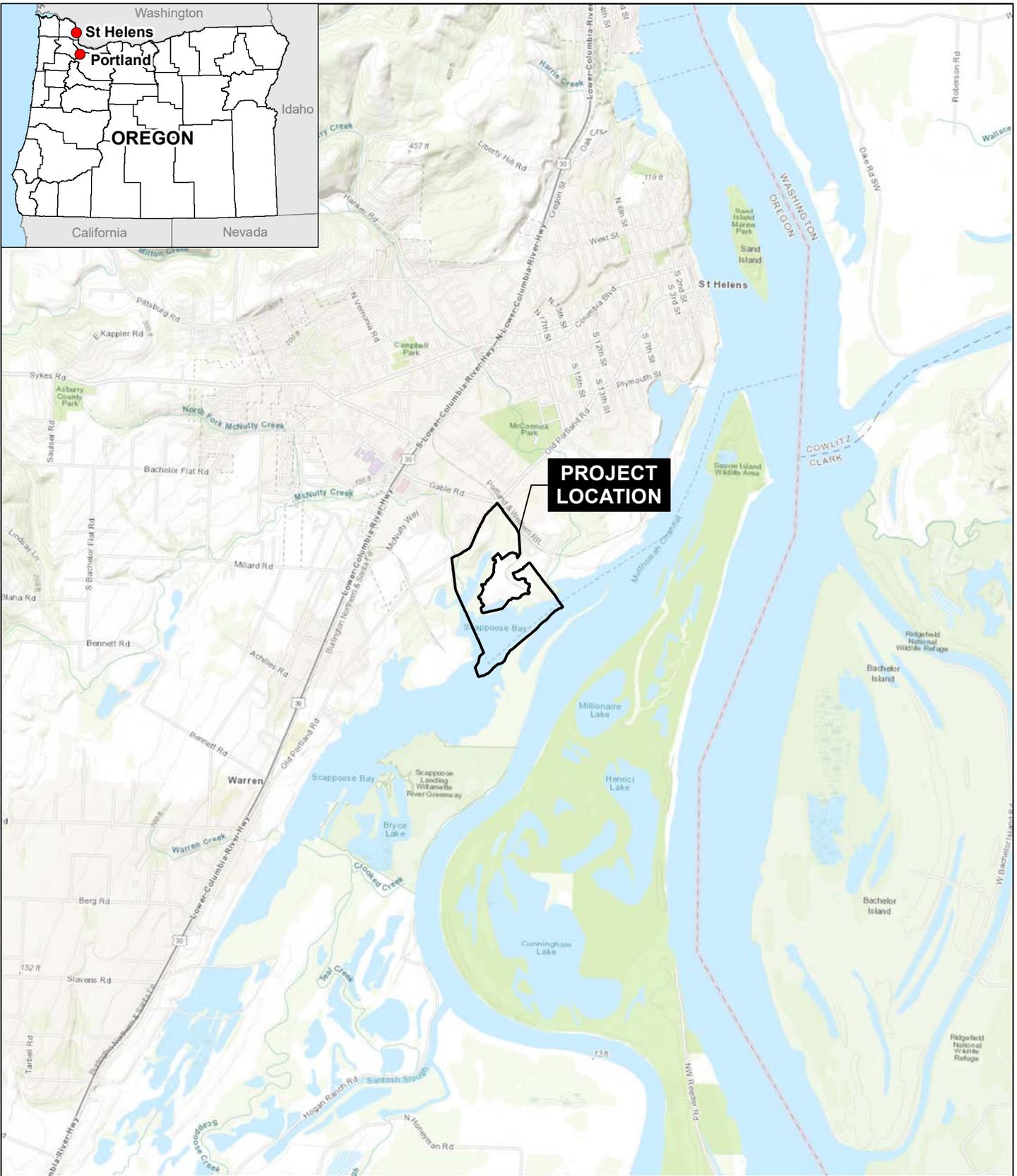
**Table 1. Proposed Geotechnical Exploration Locations and Samples**

Sample ID	Latitude	Longitude	Estimated Depth Range of Sample (feet, bww <sup>1</sup> )	Sample Type
HA-A02-U-0-2-MMYY	45.83849	-122.816406	0.5 to 3	Undisturbed (Shelby)
HA-A02-G-2-3-MMYY			3 to 4	Disturbed
HA-A02-G-3-4-MMYY			4 to 5	Disturbed
HA-A03-U-0-2-MMYY	45.838338	-122.816113	0.5 to 3	Undisturbed (Shelby)
HA-A03-G-2-3-MMYY			3 to 4	Disturbed
HA-A03-G-3-4-MMYY			4 to 5	Disturbed
HA-A05-U-0-2-MMYY	45.837940	-122.815569	0.5 to 3	Undisturbed (Shelby)
HA-A05-G-2-3-MMYY			3 to 4	Disturbed
HA-A05-G-3-4-MMYY			4 to 5	Disturbed
HA-C01-U-0-2-MMYY	45.838381	-122.817465	0.5 to 3	Undisturbed (Shelby)
HA-C01-G-2-3-MMYY			3 to 4	Disturbed
HA-C01-G-3-4-MMYY			4 to 5	Disturbed
HA-C03-U-0-2-MMYY	45.837955	-122.816873	0.5 to 3	Undisturbed (Shelby)
HA-C03-G-2-3-MMYY			3 to 4	Disturbed
HA-C03-G-3-4-MMYY			4 to 5	Disturbed
HA-C05-U-0-2-MMYY	45.837632	-122.816277	0.5 to 3	Undisturbed (Shelby)
HA-C05-G-2-3-MMYY			3 to 4	Disturbed
HA-C05-G-3-4-MMYY			4 to 5	Disturbed
HA-E01-U-0-2-MMYY	45.837966	-122.818474	0.5 to 3	Undisturbed (Shelby)
HA-E01-G-2-3-MMYY			3 to 4	Disturbed
HA-E01-G-3-4-MMYY			4 to 5	Disturbed
HA-E03-U-0-2-MMYY	45.837598	-122.817681	0.5 to 3	Undisturbed (Shelby)
HA-E03-G-2-3-MMYY			3 to 4	Disturbed
HA-E03-G-3-4-MMYY			4 to 5	Disturbed
HA-E06-U-0-2-MMYY	45.837139	-122.816713	0.5 to 3	Undisturbed (Shelby)
HA-E06-G-2-3-MMYY			3 to 4	Disturbed
HA-E06-G-3-4-MMYY			4 to 5	Disturbed
HA-G01-U-0-2-MMYY	45.837586	-122.819130	0.5 to 3	Undisturbed (Shelby)
HA-G01-G-2-3-MMYY			3 to 4	Disturbed
HA-G01-G-3-4-MMYY			4 to 5	Disturbed
HA-G03-U-0-2-MMYY	45.837145	-122.818707	0.5 to 3	Undisturbed (Shelby)
HA-G03-G-2-3-MMYY			3 to 4	Disturbed
HA-G03-G-3-4-MMYY			4 to 5	Disturbed
HA-G05-U-0-2-MMYY	45.836696	-122.817897	0.5 to 3	Undisturbed (Shelby)
HA-G05-G-2-3-MMYY			3 to 4	Disturbed
HA-G05-G-3-4-MMYY			4 to 5	Disturbed

**Notes:**

- 1) bww = below wood waste
- 2) Sample depths in this table assume the bottom of wood waste is at a depth of 0.

<b>Table 2. Proposed Laboratory Test Schedule</b>			
<b>Test Name</b>	<b>ASTM Test No.</b>	<b>Sample Type(s)</b>	<b>Estimated Number of Tests</b>
Moisture content or dry density	D2216 (ASTM, 2019b)	Disturbed Undisturbed	24
Grain-size distribution	D6913 (ASTM, 2017b)	Disturbed Undisturbed	6
Fines content	D1140 (ASTM, 2017c)	Disturbed Undisturbed	6
Atterberg limits	D4318 (ASTM, 2017d)	Disturbed Undisturbed	4
1D consolidation	D2435 (ASTM, 2020c)	Undisturbed	3
CBR	D1883 (ASTM, 2021)	Disturbed	3
Modified Proctor	D1557 (ASTM, 2021a)	Disturbed	3
<b>Note:</b> <i>Sample types and collection intervals are discussed in Section 4.3</i>			



MAP SOURCE: ESRI  
 SITE COORDINATES: 45°50'16"N, 122°49'23"W

**HALEY  
 ALDRICH**

ARMSTRONG ST. HELENS FIBERBOARD FACILITY  
 IRAM SUBAREA 6 HAUL ROADS INVESTIGATION  
 ST. HELENS, OREGON

**LOCATION MAP**

APPROXIMATE SCALE: 1 IN = 4,000 FT  
 APRIL 2024

**FIGURE 1**

GIS FILE PATH: \\haleyaldrich.com\share\pdx\_data\Notebooks\150002018\_DEC\_Armstrong\_Data\_Gaps\_Investigation\GIS\Maps\2024\_03\208900\_01\_0002\_PROPOSED\_GEOTECH\_EXP\_LOC.mxd — USER: mtoner — LAST SAVED: 3/25/2024 4:35:12 PM

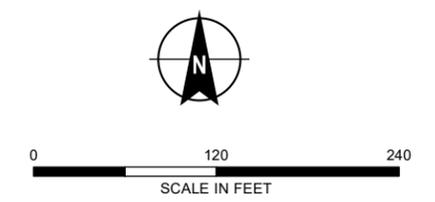


**LEGEND**

- PROPOSED HAND AUGER AND DCP SAMPLE
- PREVIOUS DATA GAP INVESTIGATION VIBRACORE SAMPLE
- ROAD PERPENDICULAR TO RIVER FLOW
- ROAD PARALLEL TO RIVER FLOW
- REMEDY PROTECTION BERM (RPB)
- PROPOSED SAMPLING GRID
- IRAM SUBAREA 1
- PROJECT BOUNDARY

**NOTES**

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. DEFINITIONS  
DCP = DYNAMIC CONE PENETROMETER  
IRAM = INTERIM REMIDIAL ACTION MEASURE
3. GRIDLINES GENERALLY FOLLOW PROPOSED HAUL ROAD CONFIGURATIONS.
4. AERIAL IMAGERY SOURCE: NEARMAP, 14 AUGUST 2023



**HALEY ALDRICH** ARMSTRONG ST. HELENS FIBERBOARD FACILITY  
IRAM SUBAREA 6 HAUL ROADS INVESTIGATION  
ST. HELENS, OREGON

**PROPOSED GEOTECHNICAL EXPLORATION LOCATIONS**

APRIL 2024

FIGURE 2