Work Plan

Northport Waterfront Remedial Investigation
Northport, Washington

for
Washington State Department of Ecology

March 7, 2019

GeoEngineers
Earth Science + Technology

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File No. 0504-160-00

March 7, 2019

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1.0 INTRODUCTION

This Work Plan presents the scope of work and approach to conduct a soil and sediment assessment at the Northport Waterfront site (herein designated the site) located in Stevens County near Northport, Washington (see Figure 1). The site consists of river bank and nearshore sediment along the south bank of the Columbia River approximately 7 miles south of the United States-Canadian border. The site borders, in part, the city park used for fishing, RV camping, boating and passive recreation activities. A small breakwater divides the site approximately in half, forming a boat basin and launch area in the upstream portion of the site. Broad, foot-accessible river beach flats form seasonally in the area downstream of the breakwater during periods of low water levels. Rising from the shoreline, steep vegetated slopes join the adjacent uplands consisting of upland city park facilities, a Burlington-Northern/Santa Fe (BNSF) railway right-of-way and a former smelter facility that has been previously remediated in 2004. Key features are depicted in Figure 2.

This Work Plan has been prepared by GeoEngineers for the State of Washington Department of Ecology (Ecology) under Ecology Master Contract No. C1900044, work assignment number GEI007. The purpose of this assessment is to characterize sediment contaminant nature and extent in the Northport waterfront area. This area of the river has been impacted by historical ore smelting operations, primarily originating from the adjacent upland as well as upstream locations within the Upper Columbia River basin. Data generated from this assessment will support planning potential remedial actions within the defined project area to address ecological and human health risks associated with historical contamination.

The scope of this Work Plan includes collecting surface and subsurface grab samples in seasonally exposed areas of sediment and bank soil influenced by the river (below the Ordinary High-Water Mark [OHWM] for this reach of the river). The assessment will include:

- Soil and sediment sampling;
- Field screening using X-ray fluorescence (XRF);
- Grain size; and
- Chemical analysis of selected samples for Target Analyte List (TAL) metals. TAL metals include: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

The body of this Work Plan is the Sampling and Analysis Plan (SAP). The Quality Assurance Project Plan (QAPP) and the Health and Safety Plan (HASP) are presented as Appendices A and B of this Work Plan, respectively. Included in this Work Plan are general guidelines with the following sections:

- Site Description and Background – Section 2.0
- Previous Investigations – Section 3.0
- Scope and Tasks – Section 4.0
- Assessment Procedures – Section 5.0
- Data Validation and Usability – Section 6.0
- Schedule – Section 7.0

2.0 SITE DESCRIPTION AND BACKGROUND

The site is located within the Northport city limits within the Upper Columbia River basin above Grand Coulee dam. The area of investigation is adjacent to a current city park and the former Le Roi copper and lead smelter on the south bank and nearshore areas of the river between Smelter Rock and the Highway 25 bridge. This area is also downstream of other smelters, including the large smelter across the United States-Canadian border in Trail, British Columbia.

The City park consists of an upper and lower area. The upper park is about 20 to 30 feet above the river and includes parking, picnic tables and shelters and several trailer hook-ups. The lower park includes an access road, boat launch and dock. The upper and lower portions of the park are separated by a steep vegetated bank; another vegetated bank separates the lower park from the river. Portions of the waterfront, including the breakwater, are permanently exposed and accessible. Water levels at the Northport waterfront are influenced by Columbia River flow conditions and indirectly by Lake Roosevelt, which is controlled by the Grand Coulee Dam. Portions of the site are exposed seasonally when river flows are low to moderate and as the water level in Lake Roosevelt is lowered to prepare for spring runoff water flows or other pool management purposes

The former Le Roi Smelter operated from about 1896 to 1921. The smelter refined copper, lead, and silver ores from northeast Washington mines and copper and gold tellurium ores from British Columbia. The smelter reportedly processed about 450 to 500 tons of ore per day until 1909 when operations initially ceased. Smelter waste operations included releasing slurried slag to the Columbia River at the site. After a period of inactivity, the smelter reopened in 1914 to process primarily lead ore, operating intermittently until 1921 when operations finally ceased. Most smelter buildings (furnace, roaster, crusher, and ore buildings) were demolished prior to 1953, although some foundations and one stack remained.

The upland smelter area underwent an emergency response action overseen by the US Environmental Protection Agency (US EPA) in 2004. Response actions included demolition of existing structures, excavation of shallow contaminated soil, on-site consolidation and subsequent capping with a barrier layer and 1 foot of gravel. BNSF performed additional excavation of contaminated soil southeast of their right-of-way within the city park area that was incorporated into the on-site disposal area. However, no cleanup actions to date have addressed the nearshore sediments and the bank, which has been impacted by smelter wastes and debris, including slags that historically were disposed of along the shoreline or within the river. Slag materials (as both clinker and fine granulated particles) are evident on the beach that forms during low water stages of the river. The quantity of slag exposed varies seasonally due to the dynamics of river flows in the area and over time.

3.0 PREVIOUS SITE INVESTIGATIONS

Our review of available records indicated there have been limited investigation of sediment quality in this reach of the river; most investigations focused on the upland area or the top of the bank in the park area.

- In 2001, Ecology & Environment (E&E) collected nine sediment samples from slag areas along the Columbia River and analyzed them for TAL metals. Total arsenic, cadmium, copper, lead, mercury and zinc were detected at “elevated/significant” concentrations (E&E 2002).

- Integral Consulting Inc. collected additional samples in 2009 and 2010 from the Northport beach and analyzed the samples for TAL metals. Elevated metals concentrations were detected (Integral Consulting Inc. 2014).

Other samples have also been collected at or near the Northport waterfront as part of broader assessments of the Upper Columbia River. Ecology summarized the available data for selected metals from previous assessments (Table 1).

Although previous site assessment activities have been conducted, additional data collection is warranted because of the limited data set that is available to support future cleanup planning.

4.0 SCOPE AND TASKS

Based on previous investigations, review of environmental documents, and discussions with Ecology additional assessment is required to better define the extent of sediment contamination at the site. Our general approach will consist of excavating shallow (0 to 4 feet) test pits in accessible areas to collect subsurface soil/sediment samples, collecting surface and near-surface samples using hand tools, and screening soil/sediment using an XRF. The goal of these activities is to define the nature and extent of contamination in soil and sediment to develop remedial alternatives for the site.

4.1. Task 1 - Prepare Work Plan

This Work Plan describes the sampling activities that will be implemented during low lake levels to maximize the characterization of contamination in nearshore areas where people and ecological receptors may be exposed to historical smelter wastes. Activities include:

- Review available data and information pertaining to the project site.
- Develop this draft Work Plan for Ecology review, which outlines approach to collecting useful data from the seasonally exposed riverbank and beaches to support remedial design. Permanently exposed sections of the riverbank will also be characterized.
- Describe the field and analytical approach for data collection. For this project, we will use a combination of analytical laboratory analyses and field-screening using an XRF to establish the extent of contamination. XRF data will be compared to laboratory analytical data to determine the degree of correlation between field and lab results and the reliability of the XRF data. The field approach is described in detail in Section 5; a field schedule is provided in Section 7.
- Develop a SAP, QAPP (included as Appendix A), and site-specific HASP (Appendix B), which addresses controlled risks of this investigation.

4.2. Task 2 – On-site Investigation and Report

The site investigation will be complete as described in Section 5; a draft report will be prepared for Ecology review to help establish the basis for any future remedial actions.

5.0 ASSESSMENT PROCEDURES

This section contains standard procedures for field data collection anticipated during the investigation. Field activities are summarized below:

- Marking the proposed sample locations (Figure 2) in advance of sampling. If the proposed sample locations are not accessible, or onsite visual inspection reveals potentially important areas that the proposed sample locations will not address, alternate locations will be identified and marked. GPS coordinates will be recorded at each location.
- Contacting the Washington Utility Notification Center to perform the required utility locate.
- Observing and documenting the collection of samples from about 25 locations (either from test pits or hand-collected as surface grabs) presented in the Scope of Work provided by Ecology. Sampling locations and depths will be adjusted, as needed, based on the field conditions (XRF screening results, accessibility, soil/sediment conditions, and water level) encountered. During excavation activities, we will prepare geologic logs of the subsurface materials observed.
- Collecting soil samples at the mudline or ground surface and at 6-inch depth intervals where test pits are excavated. Sample intervals will be homogenized and portions of each sample will be placed into laboratory-prepared sample containers, which will be logged and placed in a chilled cooler for subsequent transport to the analytical laboratory. Another portion of each sample will be screened on-site using a hand-held XRF unit.
- Excavating additional test pits, as necessary, to delineate the lateral extent of contamination based on XRF screening data. Collect soil samples at 6-inch depth intervals (two per exploration) and place a portion of each homogenized sample into laboratory-prepared sample containers and another portion for on-site XRF screening.
- Backfilling each test pit and shallow excavation immediately after sample collection using excavated materials and compact the soil to match surrounding grade.
- Conducting XRF screening on up to 300 surface soil/sediment samples throughout the project area, including on each test pit sample, using EPA Method 6200 procedures. This includes drying each sample until the soil moisture is less than 20 percent (by weight) of the sample, measuring the particle size, screening the sample for metals using the XRF and recording the data.
- Submitting up to 60 soil samples from at least 25 locations to an Ecology-certified lab using chain-of-custody protocols for chemical analysis of TAL total metals on a standard turnaround time. Samples will be selected for analysis in consultation with Ecology based on XRF results and field observations indicating the presence of slag. All other samples will be archived by the lab for potential future analyses.
- Properly disposing investigation-derived waste materials (gloves, bags, etc.)

Additional details regarding field activities (sample collection, screening, decontamination, handling of investigation-derived wastes (IDW) and sampling handling) are provided in the following sections. Information regarding sample location control, field measurement and observation documentation, data management and documentation and sample identification is also provided.

5.1. Collecting Soil Samples

Proposed sample locations are shown on Figure 2. Assessment procedures for each exploration type are described below.

5.1.1. Test Pits

Test pits will be excavated to approximately 4 feet below ground surface (bgs) using a small backhoe or mini-excavator. Test pits will be excavated by an environmental contractor with Hazardous Waste Operations and Emergency Response (HAZWOPER) training and supervised by a trained GeoEngineers field representative. Each test pit will be excavated at 6-inch intervals and samples will be collected from the undisturbed sidewalls or base of the excavation. Each 6-inch interval will be composited into a sample for field screening with an XRF unit and potential chemical analysis.

Upon completion of the exploration, material removed from the excavation will be placed into the test pit at the approximate depth from which it was removed. The soil will be placed in approximately 1-foot lifts into the test pit excavation and compacted with the excavator bucket. No surface treatment is anticipated upon completion of backfilling the explorations. Soil/sediment encountered will be classified in general accordance with ASTM International (ASTM) D 2488, the Standard Practice for Classification of Soils, Visual-Manual Procedure.

Soil samples will be field-screened for the presence of metals contamination using the procedures described in Section 5.2 to identify soil samples for chemical analysis. Based on field indicators and after consultation with Ecology, the soil/sediment samples will be submitted for laboratory analysis. Soil/sediment samples not initially submitted to the laboratory will be archived for potential follow up analysis depending on initial results.

Where test pits are used to collect subsurface sediment or soil, samples will be collected from the side wall of each excavations using a decontaminated sampling device (e.g., trowel, spoon, etc.) or from the excavator bucket and transferred to a clean stainless-steel bowl for homogenization Samples obtained from the excavator bucket will be taken from soil that is not in contact with the excavator bucket. A portion of the homogenized sample will be transferred into a laboratory-prepared container, labeled with a waterproof pen, and placed on “blue ice” or double-bagged wet ice in a cooler for submittal to the lab. Samples will be documented on a chain-of-custody form including sample name, sample collection date and time, sample type, sample depth and requested analyses and analytical methods. A second portion of each homogenized sample will be subject to on-site XRF screening.

5.1.2. Hand Samples

Shallow soil/sediment samples for XRF screening or potential chemical analysis will be collected using hand augers, shovels, or sediment samplers (such as the AMS, Inc. SBS System). These tools will be used to collect samples from locations where access for mechanized equipment is limited or will potentially undermine existing site features. Hand samples are anticipated to be collected primarily from the breakwater, the exposed riverbank upstream of the boat ramp and in the cove where sediments are soft. Similar to the test pits, hand samples will be collected in 6-inch intervals to the maximum depth practicable with hand tools and will be composited into samples for field screening and potential chemical analysis.

Sampling equipment will be decontaminated, as needed, between each sampling attempt as described in Section 5.4. Sample coolers will be delivered to the analytical laboratory under standard chain-of-custody procedures described in the QAPP. Samples will be handled and analyzed in accordance with the project QAPP (Appendix A).

5.2. Field Screening Methods

A GeoEngineers field representative will perform field screening tests on soil and sediment samples and record observations on the field exploration log and in the field notebook. Field screening results will be used to aid in the selection of soil samples for chemical analysis. The sample from each exploration showing the highest likelihood of contamination based on field screening will be selected for laboratory analysis. The remaining samples will be archived by the laboratory and held pending the initial results of the samples submitted for analysis.

Screening methods will include (1) visual examination for indications of clinker -slag material; and (2) XRF screening. Field screening using XRF will be performed according to the manufacturer's instructions and EPA Method 6200, which includes:

- Choosing a convenient work surface. The surface should be free of material containing elements that may be detected by the analyzer.
- Homogenizing the sample by removing debris (non-native materials and wood) and gravel from the sample by sifting it through a No. 4 sieve. Large clinkers will be pulverized to homogenize the particle size of the sample as recommended in EPA Method 6200.
- Reducing the moisture content to less than 20 percent as specified in EPA Method 6200. A drying oven will be set up on site and used to remove moisture from samples that appear visibly wet. Samples collected for XRF analysis will be split before drying and will be dried in non-metallic containers to avoid interference with the XRF readings. XRF screening will occur after the samples appear visibly dry. Based on conversations with an XRF manufacturer, accurate readings with the XRF are expected if the sample is not visibly wet or muddy. XRF screening will occur after the samples visibly appear dry. Portions of the XRF screened split samples (both the dried and wet portions) will be retained for potential moisture content measurement following ASTM Method D 2216 at GeoEngineers' soils lab in Spokane, Washington to confirm that the moisture content in the "visibly" dry samples screened is less than 20 percent. The ASTM method will not be used in the field as the full method requires low heat (110 degrees F) over 12 to 16 hours.
- After drying and homogenizing, samples will be placed into a plastic bag and flattening the bag of soil to form a continuous uniform layer of at least 1 centimeter (0.4 inch) thick. The bag will be placed on the work surface (not held). The nose of the XRF should be against the bag. Printed labels or other marks on the bag will be avoided (these opaque areas often contain detectable elements, most notable titanium, and should will avoided when possible).
- Positioning the instrument against the surface of the bagged sample and initiating a reading by squeezing the shutter release and firmly pressing the instrument flat against the sample. The trigger and the proximity sensor must both be engaged before the shutter will open and the measurement initiated.
- Recording the metals results on a prepared field form. Soil type, moisture content, temperature and estimated grain size, also will be recorded.

Field screening results are site specific. The results vary with temperature, soil type, type of contaminant, and soil moisture content.

5.3. Grain Size Distribution Analysis

Bulk samples will be collected from representative soil and sediment encountered at the site for grain size distribution analysis using ASTM Method C 136. A bulk sample will be obtained from each soil or sediment type encountered during the sampling program. Bulk samples will consist of approximately one gallon-sized resealable plastic bag labeled with the associated sample location.

Samples will be returned to GeoEngineers' soil laboratory in Spokane, Washington for grain size analysis. The laboratory technicians will be informed that the samples are likely contaminated with TAL metals and appropriate precautions will be enacted to prevent technician exposure and release of contaminated materials.

5.4. Decontamination Procedures

The objective of the decontamination procedures described herein is to minimize the potential for cross-contamination between sample locations.

A designated decontamination area will be established for decontamination of reusable sampling equipment. Equipment will be cleaned by physical removal of large particles and then rinsing with a detergent solution and then potable water. Rinse water from sampling equipment will be collected and placed into a 55-gallon drum.

Sampling equipment will be decontaminated in accordance with the following procedures before each sampling attempt or measurement.

1. Brush equipment with a nylon brush to remove large particulate matter.
2. Wash with non-phosphate detergent solution (Liquinox® and potable tap water).
3. Rinse with distilled water.
4. Rinse with dilute nitric acid.
5. Rinse with distilled water.

5.5. Handling of IDW

Disposable items, such as gloves, protective overalls, paper towels, etc., will be placed in plastic bags after use, returned to Spokane and deposited in trash receptacles for collection and disposal. Accumulated waste will be transported off site on the same schedule as the sample deliveries to the laboratory (anticipated to be every other day). Rinsate will be collected, drummed, sampled, and profiled for disposal at an appropriate facility, as needed.

5.6. Sample Location Control

Horizontal sample control will be maintained throughout the project. Horizontal control to locate test pits and hand samples in the field will be established using a global positioning system (GPS) software accurate to approximately ±3 feet.

5.7. Sampling and Analytical Methods

Field sampling methods, including quality control and maintenance of field instrumentation, will generally adhere to the requirements of the QAPP. Analytical method requirements also will adhere to the QAPP. The analytical lab provided the reporting limits and they were compared to MTCA Method A cleanup levels to ensure that data generated will be sufficient for assessment purposes. Any exceptions that occur in the laboratory results will be noted as part of data validation.

5.8. Sample Handling and Custody Requirements

Samples will be handled in accordance with the QAPP. A complete discussion of the sample identification and custody procedures is provided in the QAPP (Appendix A).

5.9. Field Measurements and Observation Documentation

Field measurements and observations will be recorded in a project field notebook. Daily logs will be dated, and pages will be consecutively numbered. Entries will be recorded directly and legibly in the daily log and signed and dated by the person conducting the work. If changes are made, the changes will not obscure the previous entry, and the changes will be signed and dated. At a minimum, the following data will be recorded in the logbook:

- Purpose of activity;
- Location of activity;
- Description of sampling reference point(s);
- Date and time of activity;
- Sample number identification;
- Sample top and bottom depth (bgs);
- Sample number and volume;
- Sample transporting procedures;
- Field measurements and screening observations;
- Calibration records for field instruments;
- Visitors to site;
- Relevant comments regarding field activities; and
- Signatures of responsible personnel.

Sufficient information will be recorded in the logbook so that field activities can be reconstructed without reliance on personnel memory.

5.10. Data Management and Documentation

Data logs and laboratory data packages will be in the project file system in GeoEngineers' Spokane, Washington office. Data reports will be available in both hard copy and electronic formats. Laboratory data reports will include internal laboratory quality control checks and sample results. Data logs and packages that are anticipated to be generated during the investigation include laboratory data report packages, test pit logs, field sampling data sheets and chain-of-custody forms.

Analytical data will be supplied to GeoEngineers in both electronic data deliverable (EDD) format and Portable Document Format (PDF). The hard copy will serve as the official record of laboratory results. The EDDs will contain only data reported in the hard copy reports (e.g., only reportable results).

Upon receipt of the analytical data, the EDD will be uploaded to a project database and reduced into summary tables for each group of analytes and media. Upon completion of the summary tables, the accuracy of the data reduction will be verified using the hard copy of the data received from the laboratory. Any exceptions will be noted and corrections will be made. The EDD data will be submitted to Ecology's Environmental Information Management (EIM) system.

5.11. Sample Identification

Sample identification is important to provide concise data management and to quickly determine sample location and date when comparing multiple samples.

Soil and sediment samples will be identified sequentially as HS (hand sample) for samples collected with hand tools and TP for test pits. Soil samples for the site shall adhere to the following general format:

Location ID(Depth)

For example, a soil sample collected at test pit location TP-1 at a depth interval of 2½ to 3 feet shall be labeled as TP-1(2.5-3).

6.0 DATA VALIDATION AND USABILITY

Upon receipt of the sample data from the laboratory, the data will be validated and evaluated for usability in accordance with the QAPP.

7.0 SCHEDULE

The proposed sampling effort will occur when the Columbia River water level is at or near its low point, likely in late winter/early spring 2019. We anticipate sample collection will take approximately one week, working approximately 8-hour days. The sampling program is tentatively scheduled for the week of March 11, 2019 based on prior year records of low water levels. A more detailed schedule will be developed once this Work Plan is approved and the occurrence of low-water conditions are known.

8.0 REFERENCES

Ecology & Environment. 2002. Preliminary Assessments and Site Inspections Report – Upper Columbia River Mines and Mills, Stevens County, Washington. Prepared for the United States Environmental Protection Agency, Seattle, Washington, TDD No. 01-02-0028. October 2002.

Integral Consulting, Inc. 2014. Upper Columbia River – Draft Final Beach Sediment Study Field Sampling and Data Summary Report. Prepared for Teck American Incorporated. March 2014.

U.S. Environmental Protection Agency (EPA). 1998. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846). Revision 5.

U.S. EPA. 2007. Method 6200, Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment. Revision 0. February 2007.

TABLES

Table 1

Northport City Park Nearshore Surface Sediment Metal Concentration Ranges Reported by Previous Studies[1]

Northport Waterfront Remedial Investigation

Northport, Washington

Source	Description	Sample Types	Depth	Range Results for	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Mercury	Zinc
Teck 2014	Minimum	discrete	0-6 in	5 (5 coring stations)	4.7	2.5	19	207	205	9.6	0.072	1,890
Teck 2014	Maximum	discrete	0-6 in	5 (5 coring stations)	8.3	4.2	23.9	325	259	18.4	0.222	3,050
Teck 2014	Minimum	three 12 pt composites	0-6 in	3	9.5	2.2	36.5	690	278	12.3	0.074	5,675
Teck 2014	Maximum	three 12 pt composites	0-6 in	3	14.9	3	51.2	1,150	741	13.9	0.32	8,420
E&E 2002, PA/SI	Minimum	discrete	0-6 in	9	7.5	0.7	20	257	230	8.4	0.06 U	2,800
E&E 2002, PA/SI	Maximum	discrete	0-6 in	9	41.4	4.9	139	2,960	845	17.6	0.29	16,900
EPA 2003, ESI	Single Result	discrete	0-4 in	1	25.5	0.06	142	2,900	316	17	0.05 U	20,100
CERC 06 USGS 2017	Bioassay	discrete	0-6 in	1	22.1	1.17	119	2,120	607	16.8	0.0322	17,600
Overall Min-Max Range (mg/kg)					4.7 to 41.4	0.06 to 4.9	19 to 142	207 - 2,960	205 to 845	8.4 to 18.4	0.03 to 0.32	1,890 to 20,100

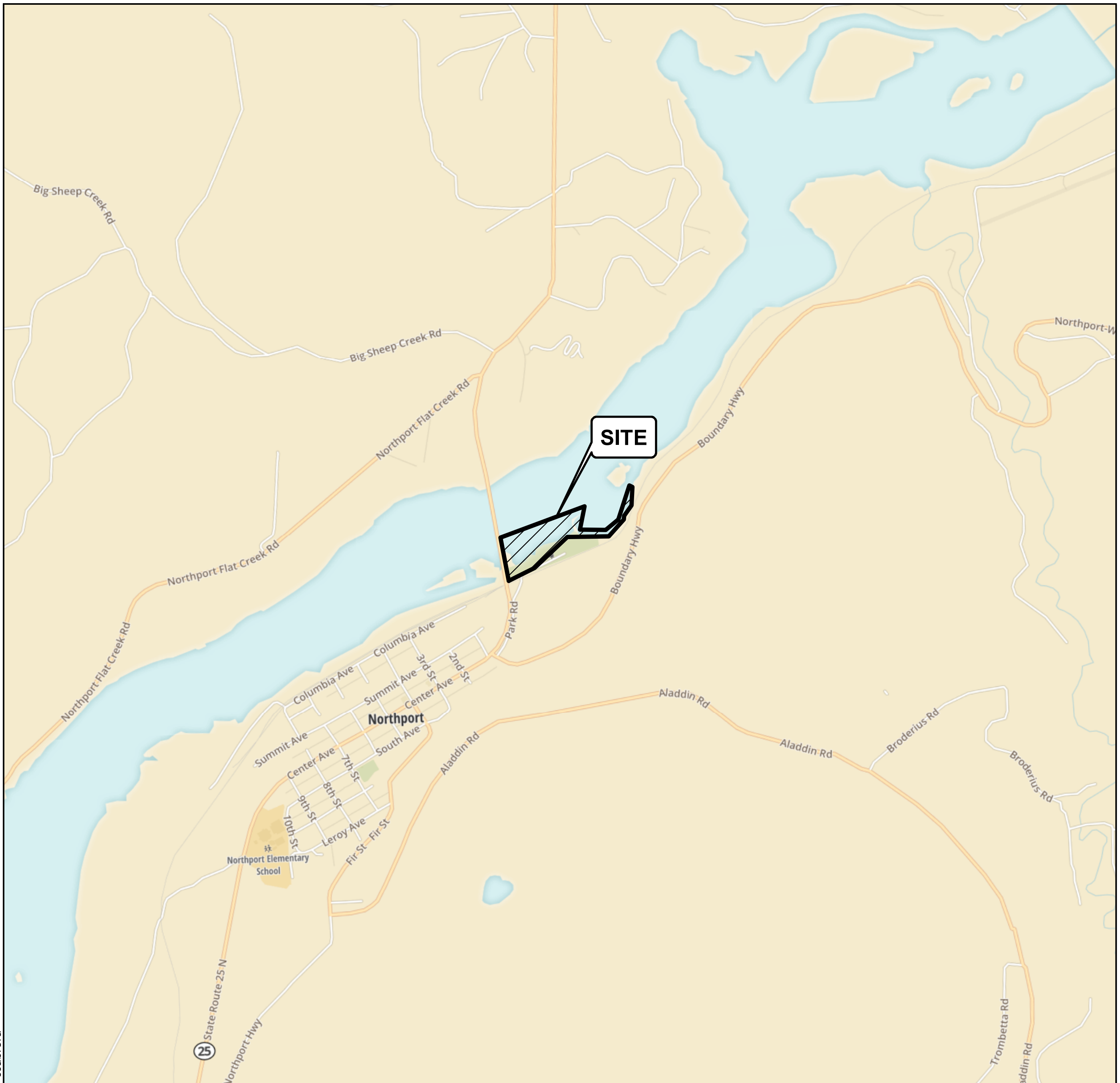
Notes:

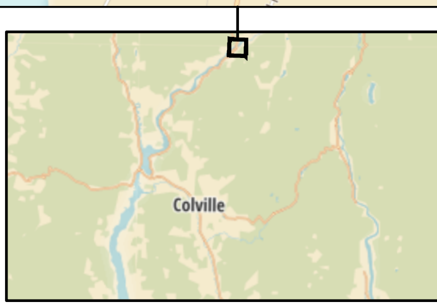
[1]Data tabulated and provided by the Washington State Department of Ecology on February 21, 2019.

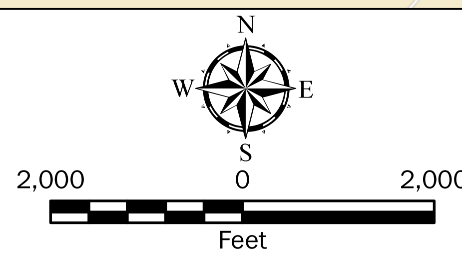
in = inches

mg/kg = milligrams per kilogram (all metals concentrations reported in mg/kg).

FIGURES







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

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

Vicinity Map

Northport Waterfront Remedial Investigation
Northport, Washington

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Figure 1

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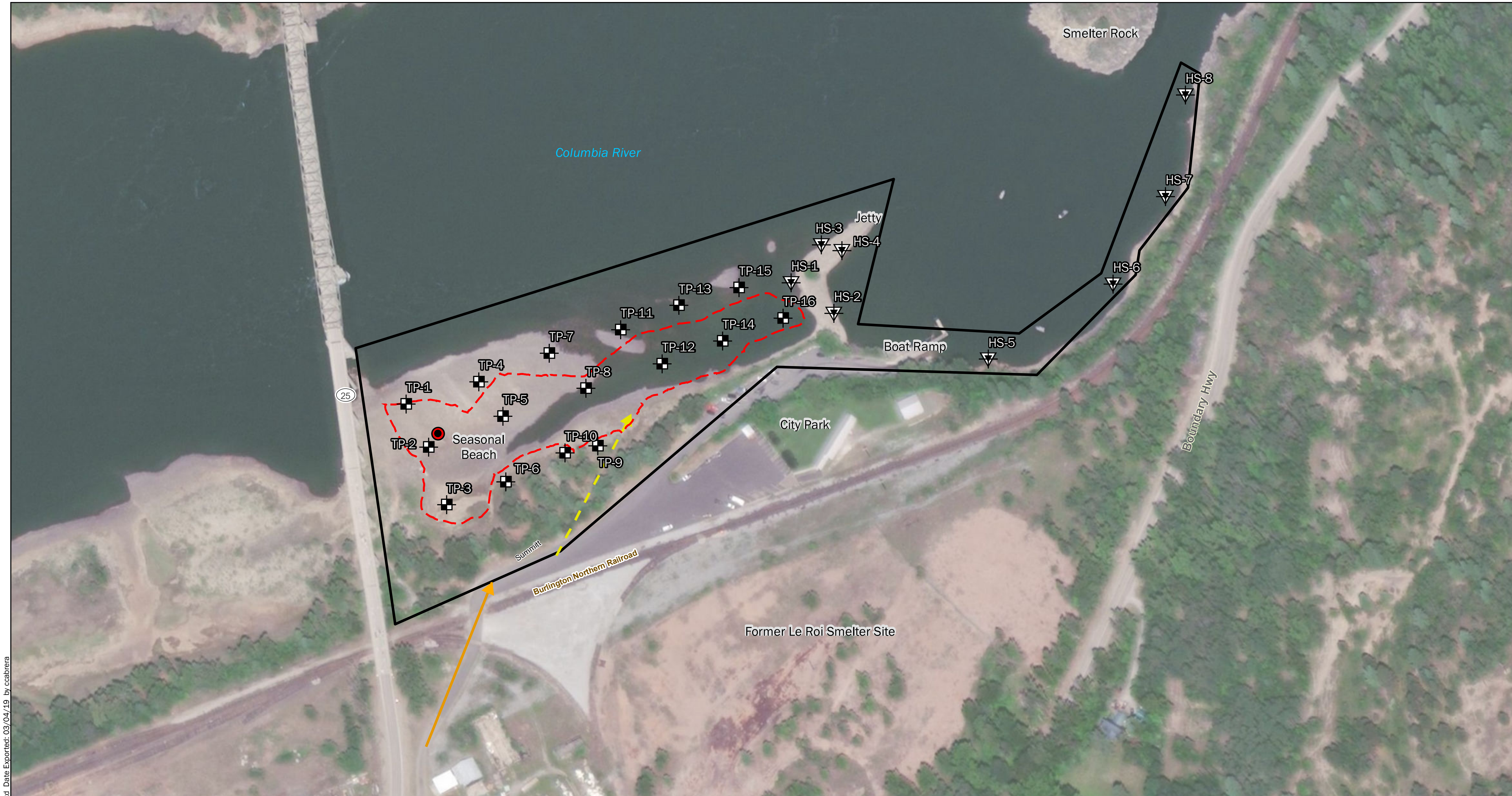

Notes:
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Data Source: ESRI.
Cemented slag locations from Washington Department of Ecology, 2018.

Projection: NAD 1983 UTM Zone 11N

Legend

HS-1 Proposed Hand Sample Number and Approximate Location
TP-1 Proposed Test Pit Number and Approximate Location
Project Boundary
Cemented Slag (Ecology Observation, 2018)
Slag Approximate Area (Ecology Observation, 2018)
Mini Excavator & Pedestrian Access
Vehicle Traffic Access

N W E S

200 0 200
Feet

Site Plan and Proposed Sampling Locations

Northport Waterfront Remedial Investigation
Northport, Washington

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Figure 2

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APPENDICES

APPENDIX A
Quality Assurance Project Plan

APPENDIX A
QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) was developed for investigation activities at the Northport Waterfront Site, Northport, Washington and serves as the primary guide for the integration of quality assurance (QA) and quality control (QC) functions into assessment activities. The QAPP presents the objectives, procedures, organization, functional activities and specific QA and QC activities designed to achieve data quality goals established for the project. This QAPP has been developed based on guidelines specified in Chapter 173-340-820 of the WAC and the EPA Requirements for Quality Assurance Project Plans (EPA 2004b).

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

Project Organization and Responsibility

Descriptions of the responsibilities, lines of authority and communication for the key positions to QA/QC are provided below. This organization facilitates the efficient production of project work, allows for an independent quality review, and permits resolution of QA issues before submittal.

Project Leadership and Management

The Project Manager's (PM) duties consist of providing concise technical work statements for project tasks, selecting project team members, determining subcontractor participation, establishing budgets and schedules, adhering to budgets and schedules, providing technical oversight, and providing overall production and review of project deliverables. Scott Lathen, a licensed professional engineer, is the PM for activities at the site. The Principal-in-Charge, Bruce Williams, is responsible for fulfilling contractual and administrative control of the project.

Field Coordinator

Josh Lee is the assigned Field Coordinator for this project and will be responsible for the daily management of activities in the field. Specific responsibilities include the following:

- Provide technical direction to the field staff;
- Develop schedules and allocates resources for field tasks;
- Coordinate data collection activities to be consistent with information requirements;
- Supervise the compilation of field data and laboratory analytical results;
- Assure that data are correctly and completely reported;
- Implement and oversee field sampling in accordance with project plans;
- Supervise field personnel;
- Coordinate work with on-site subcontractors;

- Schedule sample shipment with the analytical laboratory;
- Monitor that appropriate sampling, testing and measurement procedures are followed;
- Coordinate the transfer of field data, sample tracking forms, and logbooks to the PM for data reduction and validation; and
- Participate in QA corrective actions as required.

QA Leader

The GeoEngineers project QA Leader works under the direction of Scott Lathen and Bruce Williams, who are responsible for the project's overall QA. The Project QA Leader, Denell Warren, is responsible for coordinating QA/QC activities as they relate to the acquisition of field data. The QA Leader has the following responsibilities:

- Serves as the official contact for laboratory data QA concerns;
- Responds to laboratory data, QA needs, resolves issues, and answers requests for guidance and assistance;
- Reviews the implementation of the QAPP and the adequacy of the data generated from a quality perspective;
- Maintains the authority to implement corrective actions as necessary;
- Reviews and approves the laboratory QA Plan;
- Evaluates the laboratory's final QA report for any condition that adversely impacts data generation;
- Ensures that appropriate sampling, testing, and analysis procedures are followed and that correct QC checks are implemented; and
- Monitors subcontractor compliance with data quality requirements.

Laboratory Management

TestAmerica in Spokane, Washington will provide the analytical services for all samples collected for this project. The lab is required to obtain approval from the QA Leader before the initiation of sample analysis to assure that the laboratory QA Plan complies with the project QA objectives. The laboratory's QA Coordinator, Randee Arrington, administers the Laboratory QA Plan and is responsible for QC. Specific responsibilities of this position include:

- Ensure implementation of the QA Plan;
- Serve as the laboratory point of contact;
- Activate corrective action for out-of-control events;
- Issue the final QA/QC report;
- Administer QA sample analysis;
- Comply with the specifications established in the project plans as related to laboratory services; and
- Participate in QA audits and compliance inspections.

Data Quality Objectives

The QA objective for technical data is to collect environmental monitoring data of known, acceptable and documentable quality. The QA objectives established for the project are:

- Implement the procedures outlined herein for field sampling, sample custody, equipment operation and calibration, laboratory analysis, and data reporting that will facilitate consistency and thoroughness of data generated.
- Achieve the acceptable level of confidence and quality required so that data generated are scientifically valid and of known and documented quality. This will be performed by establishing criteria for precision, accuracy, representativeness, completeness and comparability and by testing data against these criteria.

The sampling design, field procedures, laboratory procedures, and QC procedures are set up to provide high-quality data for use in this project. Specific data quality factors that may affect data usability include quantitative factors (precision, bias, accuracy, completeness and reporting limits) and qualitative factors (representativeness and comparability). The measurement quality objectives (MQO) associated with these data quality factors are summarized in Tables A-1 and A-2 for soil and sediment, respectively.

Analytes and Matrices of Concern

Samples of bank soil and nearshore sediment will be collected during the assessment. Contaminants of potential concern are metals. Table A-1 summarizes the analyses to be performed at the site for soil and sediment.

Detection Limits

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Individual instruments often can detect but not accurately quantify compounds at concentrations lower than the MDL, referred to as the instrument detection limit (IDL). Although results reported near the MDL or IDL provide insight to site conditions, QA dictates that analytical methods achieve a consistently reliable level of detection known as the practical quantitation limit (PQL). Analytical results quantified at concentrations less than the PQL will be reported as not detected and the PQL will be provided. The PQL for site contaminants of potential concern (COPCs) were obtained from TestAmerica and are presented in Table A-1 for soil and sediment.

Achieving a stated detection limit for a given analyte is helpful in providing statistically useful data. Intended data uses, such as comparison to numerical criteria or risk-based values, typically dictate specific project target reporting limits (TRLs) necessary to fulfill stated objectives. TRLs for this project were established as the lowest value between the Model Toxics Control Act (MTCA) Method A or B Cleanup Levels or Sediment Quality Objectives (Table A-1). The analytical methods and processes selected will provide PQLs less than the TRLs under ideal conditions. However, the reporting limits in Table A-1 are considered targets because several factors may influence final detection limits. First, moisture and other physical conditions of sampled matrix affect detection limits. Second, analytical procedures may require sample dilutions or other practices to accurately quantify a given analyte at concentrations above the range of the instrument. The effect is that other analytes could be reported as undetected but at a value much higher than a specified TRL. Data users must be aware that high non-detect values, although correctly reported, can bias statistical summaries and careful interpretation is required to correctly characterize site conditions.

Precision

Precision is the measure of mutual agreement among replicate or duplicate measurements of an analyte from the same sample and applies to field duplicate or split samples, replicate analyses and duplicate spiked environmental samples (matrix spike duplicates). The closer the measured values are to each other, the more precise the measurement process. Precision error may affect data usefulness. Good precision is indicative of relative consistency and comparability between different samples. Precision will be expressed as the relative percent difference (RPD) for spike sample comparisons of laboratory duplicates. This value is calculated by:

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

Where

D_1	=	Concentration of analyte in sample.
D_2	=	Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked environmental samples (matrix spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Precision can also be expressed as the percent difference (%D) between replicate analyses. Persons performing the evaluation must review one or more pertinent documents (EPA 1999 and EPA 2004a) that address criteria exceedances and courses of action. Relative percent difference goals for this effort are 40 percent in soil or sediment for all analyses, unless the duplicate sample values are within 5 times the reporting limit.

Accuracy

Accuracy is a measure of bias in the analytic process. The closer the measurement value is to the true value, the greater the accuracy. This measure is defined as the difference between the reported value versus the actual value that is often measured with the addition of a known compound to a sample. The amount of known compound reported in the sample, or percent recovery, assists in determining the performance of the analytical system in correctly quantifying the compounds of interest. Since most environmental data collected represent one point spatially and temporally rather than an average of values, accuracy plays a greater role than precision in assessing the results. In general, if the percent recovery is low, non-detect results may indicate that compounds of interest are not present when in fact these compounds are present. Detected compounds may be biased low or reported at a value less than actual environmental conditions. The reverse is true when recoveries are high. Non-detect values are considered accurate while detected results may be higher than the true value.

Accuracy will be expressed as the percent recovery of a surrogate compound (also known as "system monitoring compound"), a matrix spike (MS) result, or from a standard reference material where:

$$Recovery\,(\%) = \frac{Sample\ Result}{Spike\ Amount}\; X\ 100$$

Persons performing the evaluation must review one or more pertinent documents (EPA 1999 and EPA 2004a) that address criteria exceedances and courses of action. Accuracy criteria for surrogate spikes, matrix spikes (MS), and laboratory control spikes (LCS) are found in Table A-1 of this QAPP.

Representativeness, Completeness and Comparability

Representativeness expresses the degree to which data accurately and precisely represent the actual site conditions. The determination of the representativeness of the data will be performed by completing the following:

- Comparing actual sampling procedures to those delineated within the Work Plan and this QAPP.
- Comparing analytical results of field duplicates to determine the variations in the analytical results.
- Invalidating non-representative data or identifying data to be classified as questionable or qualitative. Only representative data will be used in subsequent data reduction, validation and reporting activities.

Completeness establishes whether a sufficient amount of valid measurements were obtained to meet project objectives. The number of samples and results expected establishes the comparative basis for completeness. Completeness goals are 90 percent useable data for samples/analyses planned. If the completeness goal is not achieved an evaluation will be made to determine if the data are adequate to meet study objectives.

Comparability expresses the confidence with which one set of data can be compared to another. Although numeric goals do not exist for comparability, a statement on comparability will be prepared to determine overall usefulness of data sets, following the determination of both precision and accuracy.

Holding Times

Holding times are defined as the time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. Some analytical methods specify a holding time for analysis only. For many methods, holding times may be extended by sample preservation techniques in the field. If a sample exceeds a holding time, then the results may be biased low due to volatilization or degradation of a sample. Results for that analysis will be qualified as estimated to indicate that the reported results may be lower than actual site conditions. Holding times are presented in Table A-2.

Sample Collection, Handling and Custody

Sampling procedures are outlined in Section 5.0 of the Work Plan.

Sampling Equipment Decontamination

Sampling equipment decontamination procedures are described in Section 5.4 of the Work Plan.

Sample Containers and Labeling

The Field Coordinator will establish field protocol to manage field sample collection, handling and documentation. Samples obtained during this study will be placed in appropriate laboratory-prepared containers. Sample containers and preservatives are listed in Table A-2.

Sample containers will be labeled with the following information at the time of collection:

- Project name and number;
- Sample name, which will include a reference to depth if appropriate; and
- Date and time of collection.

The sample collection activities will be noted in the field logbooks. The Field Coordinator will monitor consistency between the Work Plan, sample containers/labels, field logbooks and the chain-of-custody.

Sample Storage

Samples will be placed in a cooler with "blue ice" or double-bagged "wet ice" immediately after they are collected. The objective of the cold storage will be to attain a sample temperature of 4 degrees Celsius. Holding times will be observed during sample storage. Holding times for the project analyses are summarized in Table A-2 for soil and sediment.

Sample Shipment

The samples will be transported and shipped to the analytical laboratory in the coolers. Samples will be transported to the laboratory either daily or every other day. The Field Coordinator will monitor that the shipping container (cooler) has been properly secured using clear plastic tape and custody seals.

The potential for sample breakage will be minimized by including packaging materials and placing sample bottles in the cooler in a manner intended to minimize damage. Sample bottles will be appropriately wrapped with bubble wrap or other protective material before being place in coolers.

Chain-of-custody Records

Field personnel are responsible for the security of samples from the time the samples are taken until the samples have been received by the shipper or laboratory. A chain-of-custody form or forms will be completed at the end of each field day for samples being shipped to the laboratory. Information to be included on the chain-of-custody form includes:

- Project name and number.
- Sample identification number.
- Date and time of sampling.
- Sample matrix (soil, water, etc.) and number of containers from each sampling point, including preservatives used.
- Depth below ground surface of subsurface soil or sediment sample.
- Analyses to be performed.
- Names of sampling personnel and transfer of custody acknowledgment spaces.
- Shipping information including shipping container number.

The original chain-of-custody record will be signed by a member of the field team and bear a unique tracking number. Field personnel shall retain carbon copies and place the original and remaining copies in a plastic bag, placed within the cooler or taped to the inside lid of the cooler before sealing the container for shipment. This record will accompany the samples during transit by carrier to the laboratory.

Laboratory Custody Procedures

The laboratory will follow their standard operating procedures (SOPs) to document sample handling from time of receipt (sample log-in) to reporting. Documentation will include at a minimum, the analysts name or initial, time and date.

Field Documentation

Field documentation provides valuable information about potential problems or special circumstances surrounding sample collection. Field personnel will maintain daily field logs while on-site. The field logs will be prepared on field report forms or in a bound logbook. Entries in the field logs and associated sample documentation forms will be made in waterproof ink, and corrections will consist of line-out deletions that are initialed and dated. Individual logbooks will become part of the project files at the conclusion of the site characterization field explorations.

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 sample collection.
- Designation of sample as composite or discrete.
- Type of sample (soil or sediment).
- Type of sampling equipment used.
- Field instrument readings.
- Field observations and details that are pertinent to the integrity/condition of the samples (e.g., weather conditions, performance of the sampling equipment, sample depth control, sample disturbance, etc.).
- Preliminary sample descriptions (e.g., lithologies, noticeable odors, colors, field-screening results).
- Sample preservation.
- Shipping arrangements (overnight air bill number).
- Name of recipient laboratory.

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

- Team members and their responsibilities.
- Time of arrival/entry on site and time of site departure.
- Personnel present at the site.
- Summary of pertinent meetings or discussions with regulatory agency or contractor personnel.
- Deviations from sampling plans, site safety plans and QAPP procedures.

- Changes in personnel and responsibilities with reasons for the changes.
- Levels of safety protection.
- Calibration readings for any equipment used and equipment model and serial number.

The handling, use and maintenance of field log books are the Field Coordinator's responsibilities.

Calibration Procedures

Field Instrumentation

Equipment and instrumentation calibration assure accurate and reliable field measurements. Field and laboratory equipment used on the project will be calibrated and adjusted in general accordance with the manufacturer's recommendations. Methods and intervals of calibration and maintenance will be based on the type of equipment, stability characteristics, required accuracy, intended use and environmental conditions. The basic calibration frequencies are described below.

The X-ray fluorescence (XRF) used for field measurements of metals does not have a field calibration procedure. However, readings obtained from the XRF will be correlated to laboratory analytical results obtained from the same sample location.

Laboratory Instrumentation

For analytical chemistry, calibration procedures will be performed in general accordance with the methods cited and laboratory standard operating procedures. Calibration documentation will be retained at the laboratory and readily available for a period of six months.

Data Reporting and Laboratory Deliverables

Laboratories will report data in formatted hardcopy and digital form. Analytical laboratory measurements will be recorded in standard formats that display, at a minimum, the field sample identification, the laboratory identification, reporting units, qualifiers, analytical method, analyte tested, analytical result, extraction and analysis dates, and detection limit (PQL only). Each sample delivery group will be accompanied by sample receipt forms and a case narrative identifying data quality issues. Laboratory electronic data deliverable (EDD) will be established by GeoEngineers with the contract laboratory. Final results will be sent to the PM.

The laboratory will assure that the full heights of all peaks appear on the chromatograms and that the same horizontal time scale is used to allow for comparisons to other chromatograms.

Internal Quality Control

Table A-3 summarizes the types and frequency of QC samples to be collected during the site characterization, including both field QC and laboratory QC samples.

Field Quality Control

Field QC samples serve as a control and check mechanism to monitor the consistency of sampling methods and the influence of off-site factors on environmental samples. Field duplicates will be collected as measures of precision. Under ideal conditions, field duplicates are created when a volume of the sample matrix is thoroughly mixed, placed in separate containers, and identified as different samples. Analysis of these duplicates test both the precision and consistency of laboratory analytical procedures and methods, and the consistency of the sampling techniques used by field personnel.

One duplicate sediment or soil sample will be collected per every 10 samples shipped to the laboratory (anticipated to be every other day).

Laboratory Quality Control

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

- Method blanks;
- Internal standards;
- Calibrations;
- MS/matrix spike duplicates (MSD);
- LCS/laboratory control spike duplicates (LCSD);
- Laboratory replicates or duplicates; and
- Surrogate spikes.

The frequency that these samples are collected and analyzed is described in Table A-3. Laboratory QC results will be evaluated through a formal data validation process.

Laboratory Blanks

Laboratory procedures employ the use of several types of blanks but the most commonly used blank for QA/QC assessments are method blanks. Method blanks are laboratory QC samples that consist of either a soil-like material having undergone a contaminant destruction process or high-performance liquid chromatography (HPLC) water. Method blanks are extracted and analyzed with each batch of environmental samples undergoing analysis. If a substance is found in the method blank then one (or more) of the following occurred:

- Measurement apparatus or containers were not properly cleaned and contained contaminants.
- Reagents used in the process were contaminated with a substance(s) of interest.
- Contaminated analytical equipment was not properly cleaned.

It is difficult to determine which of the above scenarios took place if blank contamination occurs. However, it is assumed that the conditions that affected the blanks also likely affected the project samples. Given method blank results, validation rules assist in determining which substances in samples are considered "real," and which ones are attributable to the analytical process. Furthermore, the guidelines state, ". . . there may be instances where little or no contamination was present in the associated blank, but qualification of the sample is deemed necessary. Contamination introduced through dilution water is one example."

Calibrations

Several types of calibrations are used, depending on the method, to determine whether the methodology is 'in control' by verifying the linearity of the calibration curve and to assure that the sample results reflect accurate and precise measurements. The main calibrations used are initial calibrations, daily calibrations, and continuing calibration verification.

MS/MSD

MS/MSD samples are used to assess influences or interferences caused by the physical or chemical properties of the sample itself. For example, extreme pH affects the results of semi-volatile organic compounds (SVOCs). Or, the presence of a given compound may interfere with accurate quantitation of another analyte. MS/MSD data is reviewed in combination with other QC monitoring data to determine matrix effects. In some cases, matrix affects cannot be determined due to dilution and/or high levels of related substances in the sample. A MS is evaluated by spiking a known amount of one or more of the target analytes ideally at a concentration of 5 to 10 times higher than the sample result. A percent recovery is calculated by subtracting the sample result from the spike result, dividing by the spiked amount, and multiplying by 100.

The samples for the MS and MSD analyses should be collected from a sampling location that is believed to exhibit low-level contamination. A sample from an area of low-level contamination is needed because the objective of MS/MSD analyses is to determine the presence of matrix interferences, which can best be achieved with low levels of contaminants. Additional sample volume will be collected for these analyses. This MS/MSD sample will be a composite to achieve a level of representativeness and reproducibility in the data.

LCS/LCSD

Also known as blanks spikes, LCSs are similar to matrix spikes in that a known amount of one or more of the target analytes are spiked into a prepared media and a percent recovery of the spiked substances are calculated. The primary difference between a MS and LCS is that the LCS media is considered “clean” or contaminant free. For example, HPLC water is typically used for LCS water analyses. The purpose of an LCS is to help assess the overall accuracy and precision of the analytical process including sample preparation, instrument performance, and analyst performance. LCS data must be reviewed in context with other controls to determine if out-of-control events occur.

Laboratory Replicates/Duplicates

Laboratories often utilize MS/MSDs, LCS/LCSDs, and/or replicates to assess precision. Replicates are a second analysis of a field collected environmental sample. Replicates can be split at varying stages of the sample preparation and analysis process, but most commonly occur as a second analysis on the extracted media.

Surrogate Spikes

The purposes of using a surrogate are to verify the accuracy of the instrument being used and extraction procedures. Surrogates are substances similar to, but not one of, the target analytes. A known concentration of surrogate is added to the sample and passed through the instrument, noting the surrogate recovery. Each surrogate used has an acceptable range of percent recovery. If a surrogate recovery is low, sample results may be biased low and depending on the recovery value, a possibility of false negatives may exist. Conversely, when recoveries are above the specified range of acceptance a possibility of false positives exist, although non-detected results are considered accurate.

Data Reduction and Assessment Procedures

Data Reduction

Data reduction involves the conversion or transcription of field and analytical data to a useable format. The laboratory personnel will reduce the analytical data for review by the QA Leader and PM.

Field Measurement Evaluation

Field data will be reviewed at the end of each day by following the QC checks outlined below and procedures in the Work Plan. Field data documentation will be checked against the applicable criteria as follows:

- Sample collection information;
- Field instrumentation and calibration;
- Sample collection protocol;
- Sample containers, preservation and volume;
- Field QC samples collected at the frequency specified;
- Sample documentation and chain-of-custody protocols; and
- Sample shipment.

Cooler receipt forms and sample condition forms provided by the laboratory will be reviewed for out-of-control incidents. The final report will contain what effects, if any, an incident has on data quality. Sample collection information will be reviewed for correctness before inclusion in a final report.

Field QC Evaluation

A field QC evaluation will be conducted by reviewing field logbooks and daily reports, discussing field activities with staff and reviewing field QC samples (trip blanks and field duplicates). Trip blanks will be evaluated using the same criteria as method blanks.

Laboratory Data QC Evaluation

The laboratory data assessment will consist of a formal review of the following QC parameters:

- Holding times
- Method blanks
- MS/MSD
- LCS/LCSD
- Surrogate spikes
- Replicates

In addition to these QC mechanisms, other documentation such as cooler receipt forms and case narratives will be reviewed to fully evaluate laboratory QA/QC.

References

U.S. Environmental Protection Agency. 1999. "Contract Laboratory Program National Functional Guidelines for Organic Data Review." 540/R-99/008.

U.S. Environmental Protection Agency. 2004a. "Contract Laboratory Program National Functional Guidelines for Inorganic Data Review." 540/R-04/004.

U.S. Environmental Protection Agency). 2004b. "EPA Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies." EPA 04-03-030.

Table A-1

Soil/Sediment Measurement Quality Objectives and Target Reporting Limits

Northport Waterfront Remedial Investigation

Northport, Washington

				LCS			MS/MSD			DUP			
Analyte	**Method**	**MDL (mg/kg)**	**PQL (mg/kg)**	**Lower**	**Upper**	**RPD**	**Lower**	**Upper**	**RPD**	**RPD**	**SMS Sediment Quality Objectives (mg/kg)**	**MCTA Level A/B Cleanup Levels (mg/kg)**	**Target Reporting Limit (mg/kg)[1]**
Metals (mg/kg)													
Aluminum	6010C	33.1	50.0	80	120	20	75	125	20	20	NE	80,000	80,000
Antimony	6010C	0.904	2.50	80	120	20	75	125	20	20	NE	32	32.0
Arsenic	6010C	0.496	1.25	80	120	20	75	125	20	20	14	20	14.00
Barium	6010C	0.335	1.25	80	120	20	75	125	20	20	NE	16,000	16,000
Beryllium	6010C	0.202	1.25	80	120	20	75	125	20	20	NE	160	160.00
Cadmium	6010C	0.059	1.00	80	120	20	75	125	20	20	2.1	2.0	2.0
Calcium	6010C	30.0	100	80	120	20	75	125	20	20	NE	NE	NE
Chromium	6010C	0.177	1.25	80	120	20	75	125	20	20	72	19	19.00
Cobalt	6010C	0.097	1.25	80	120	20	75	125	20	20	NE	NE	NE
Copper	6010C	1.54	4.00	80	120	20	75	125	20	20	400	3,200	400
Iron	6010C	43.2	100	80	120	20	75	125	20	20	NE	NE	NE
Lead	6010C	1.47	3.00	80	120	20	75	125	20	20	360	250	250
Magnesium	6010C	17.9	50.0	80	120	20	75	125	20	20	NE	NE	NE
Manganese	6010C	1.04	15.0	80	120	20	75	125	20	20	NE	11,200	11,200
Mercury	7471B	0.00357	0.050	80	120	20	80	120	20	20	0.66	2.00	0.66
Nickel	6010C	0.154	1.25	80	120	20	75	125	20	20	26	NE	26
Potassium	6010C	12.5	25.0	80	120	20	75	125	20	20	NE	NE	NE
Selenium	6010C	3.01	5.00	80	120	20	75	125	20	20	11	400	11
Silver	6010C	0.134	1.25	80	120	20	75	125	20	20	0.57	400	0.57
Sodium	6010C	10.4	25.0	80	200	20	75	125	20	20	NE	NE	NE
Thallium	6010C	0.346	2.50	80	120	20	75	125	20	20	NE	0.48	0.48
Vanadium	6010C	0.220	1.25	80	120	20	75	125	20	20	NE	400	400
Zinc	6010C	0.794	5.00	80	120	20	75	125	20	20	3,200	24,000	3,200

Notes:

[1] Target reporting limit is the Sediment Quality Objective or MTCA Cleanup Level, whichever is lower.

DUP = laboratory duplicate sample

EPA = Environmental Protection Agency

LCS = laboratory control sample

MDL = method detection limit

mg/kg = milligrams per kilogram

MS/MSD = matrix spike/matrix spike duplicate

NE = not established

PQL = practical quantitation limit; provided by TestAmerica

MDL = method detection limit

MCTA = Model Toxics Control Act

RPD = relative percent difference

SMS = Sediment Management Standards

Table A-2

Soil/Sediment Test Methods, Sample Containers, Preservation and Holding Time[1]

Northport Waterfront Remedial Investigation

Northport, Washington

Analysis	Matrix	Method	Minimum Sample Size	Sample Containers	Sample Preservation	Holding Times
TAL Metals	Soil/Sediment	6010C with strong acid digestion	50g	4oz polyethylene or borosilicate glass jar	Freezing	180 days at 4°C; 2 years at -18°C
Mercury	Soil/Sediment	7471B	10 g	4oz polyethylene or borosilicate glass jar	Freezing	28 days at -18°C

Notes:

[1] Holding times are based on elapsed time from date of collection.

C = Celsius

g = gram

Table A-3

Quality Control Samples Type and Frequency

Northport Waterfront Remedial Investigation

Northport, Washington

Parameter	Field Quality Control Sample		Laboratory Quality Control Sample			
	Field Duplicate	Trip Blanks	Method Blanks	LCS	MS / MSD	DUP
TAL Metals	1/10 samples	NA	1/analytical batch[1]			
Mercury	1/10 samples	NA	1/analytical batch[1]			

Notes:

[1]No more than 20 field samples can be contained in one analytical batch.

DUP = laboratory duplicate sample

LCS = laboratory control sample

MS/MSD = matrix spike/matrix spike duplicate

NA = not applicable

APPENDIX B
Health and Safety Plan

APPENDIX B
SITE HEALTH AND SAFETY PLAN
NORTHPORT WATERFRONT REMEDIAL INVESTIGATION
FILE NO. 0504-160-00

This Health and Safety Plan (HASP) is to be used in conjunction with the GeoEngineers, Inc. (GeoEngineers) Safety Programs. Together, the written safety programs and this HASP constitute the site safety plan for this site. This plan is to be used by GeoEngineers personnel on this site and must be available on site. If the work entails potential exposures to other substances or unusual situations, additional safety and health information will be included, and the plan will need to be approved by the GeoEngineers Health and Safety Program Manager. All plans are to be used in conjunction with current standards and policies outlined in the GeoEngineers Health and Safety Programs.

Liability Clause: If requested by subcontractors, this site HASP may be provided for informational purposes only. In this case, Form 1 shall be signed by the subcontractor. Please be advised that this site-specific HASP is intended for use by GeoEngineers employees only. Nothing herein shall be construed as granting rights to GeoEngineers' subcontractors or any other contractors working on this site to use or legally rely on this HASP. GeoEngineers specifically disclaims any responsibility for the health and safety of any person not employed by the company.

GENERAL PROJECT INFORMATION

Project Name:	Northport Waterfront Remedial Investigation
Project Number:	0504-160-00
Type of Project:	Site Assessment
Start/Completion:	March/April 2019
Subcontractors:	Spokane Environmental Solutions (SES), TestAmerica Laboratories, Inc.

Chain of Command	Title	Name	Telephone Numbers
1	**Project Manager**	Scott Lathen	509.251.5239
2	**Site Safety Officer (SSO)**	Josh Lee	406.239.7810
3	**Health and Safety Program Manager**	Mary Lou Sullivan	253.722.2425
4	**Field Personnel**	Josh Lee Justin Orr Matt Peterson	406.239.7810 406.890.1310 425.293.9560
5	**Client Assigned Site Supervisor**	Scott Lathen	509.251.5239
6	**Subcontractor(s)**	TestAmerica SES	509.924.9200 509.279.5559
7	**Current Owner**	City of Northport	-

Functional Responsibility

Health and Safety Program Manager (HSM), Mary Lou Sullivan

GeoEngineers' HSM is responsible for implementing and promoting employee participation in the program. The HSM issues directives, advisories and information regarding health and safety to the technical staff. Additionally, the HSM has the authority to audit on-site compliance with HASPs, suspend work or modify work practices for safety reasons, and dismiss from the site any GeoEngineers or subcontractor employees whose conduct on the site endangers the health and safety of themselves or others.

Project Manager (PM), Scott Lathen, PE

A PM is assigned to manage the activities of various projects and is responsible to the principal-in-charge of the project. The PM is responsible for assessing the hazards present at a job site and incorporating the appropriate safety measures for field staff protection into the field briefing and/or Site Safety Plan. He or she is also responsible for assuring that appropriate HASPs complying with this manual are developed. The PM will provide a summary of chemical analysis to personnel completing the HASP. PMs will also see that their project budgets consider health and safety costs. The PM will keep the HSM informed of the project's health- and safety-related matters as necessary. The PM will designate the project Site Safety Officer (SSO) and help the SSO implement the specifications of the HASP. The PM is responsible for communicating information in site safety plans and checklists to appropriate field personnel. Additionally, the PM and SSO will hold a site safety briefing before any field activities begin. The PM is responsible for transmitting health and safety information to the SSO when appropriate.

Site Safety Officer/HAZWOPER, Josh Lee

The SSO will have the on-site responsibility and authority to modify and stop work or remove personnel from the site if working conditions change that may affect on-site and off-site health and safety. The SSO will be the main contact for any on-site emergency situation. The SSO is First Aid- and CPR-qualified and has current Hazardous Waste Operations and Emergency Response (HAZWOPER) training. The SSO is responsible for implementing and enforcing the project safety program and safe work practices during site activities. The SSO will conduct daily safety meetings, conduct site safety inspections as required, coordinate emergency medical care, and ensure personnel are wearing the appropriate personal protective equipment (PPE). The SSO will have advanced fieldwork experience and will be familiar with health and safety requirements specific to the project. The SSO has the authority to suspend site activities if unsafe conditions are reported or observed.

Duties of the SSO include the following:

- Implementing the HASP in the field and monitoring compliance with its guidelines by staff.
- Being sure that all GeoEngineers field personnel have met the training and medical examination requirements. Advising other contractor employees of these requirements.
- Maintaining adequate and functioning safety supplies and equipment at the site.
- Setting up work zones, markers, signs and security systems, if necessary.
- Communicating health and safety requirements and site hazards to field personnel, subcontractors and contractor employees, and site visitors.
- Directing personnel to wear PPE and guiding compliance with all health and safety practices in the field.

- Consulting with the PM regarding new or unanticipated site conditions, including emergency response activities. If monitoring detects concentrations of potentially hazardous substances at or above the established exposure limits, notify/consult with the PM. Consult with the PM and the HSM regarding new or unanticipated site conditions, including emergency response activities. If field monitoring indicates concentrations of potentially hazardous substances at or above the established exposure limits, the HSM must be notified and corrective action taken.
- Documenting all site accidents, illnesses and unsafe activities or conditions, and reporting them to the PM and the HSM.
- Directing decontamination operations of equipment and personnel.

Field Employees

All employees working on site that have the potential to come in contact with hazardous substances or physical hazards are responsible for participating in the health and safety program and complying with the site-specific health and safety plans. These employees are required to:

- Participate and be familiar with the health and safety program as described in this manual.
- Notify the SSO that when there is need to stop work to address an unsafe situation.
- Comply with the HASP and acknowledge understanding of the plan.
- Report to the SSO, PM or HSM any unsafe conditions and all facts pertaining to incidents or accidents that could result in physical injury or exposure to hazardous materials.
- Participate in health and safety training, including initial 40-hour Occupational Safety and Health Administration (OSHA) course, annual 8-hour HAZWOPER refresher, and First Aid/cardiopulmonary resuscitation (CPR) training.
- Participate in the medical surveillance program if applicable.
- Schedule and take a respirator fit test annually.
- Any field employee working on site may stop work if the employee believes the work is unsafe.

Contractors Under GeoEngineers Supervision

Contractors working on the site under GeoEngineers supervision or direct control that have the potential of coming in contact with hazardous substances or physical hazards will have their own health and safety program that is in line with the site-specific health and safety plan.

List of Field Personnel and Training

Name of Employee on Site	Level of HAZWOPER Training (24-/40-hr)	Date of 8-Hr Refresher Training	First Aid/ CPR	Date of Respirator Fit Test
Josh Lee	40-hr (Supervisor)	5/30/2018	1/31/2018	
Matt Peterson	40-hr	9/24/2018	11/12/2018	
Justin Orr	40-hr	1/11/19	12/19/18	

Site Description and History

The site is on the bank of the Columbia River near Northport, Washington. The Le Roi Smelter was located upland from the site. Smelter structures were demolished and the upland portion of the smelter was remediated in 2006. Waste, including slag, was discharged into the river during the historical operations of the smelter.

Currently, the City of Northport operates a boat launch at the site. Large portions of the site are usually underwater and only exposed when the river levels are lowered to prepare for spring runoff. The purpose of the current assessment is to investigate the nature and extent of metals contaminated sediment from smelter deposits.

WORK PLAN

Tasks associated with this assessment are described in the Work Plan. General activities will include:

- Test pit excavations to collect sediment samples.
- Hand collection of surface sediment samples.
- Field screening using an XRF including sample preparation to reduce the moisture content to an acceptable level for valid XRF results.
- Logging the sample and screening locations with a GPS.

List of Field Activities

Check the activities to be completed during the project:

☒ Job hazard analyses (JHA) Form 3
☒ Site reconnaissance
☐ Exploratory borings
☐ Construction monitoring
☐ Surveying
☒ Test pit exploration
☒ Soil sample collection
☐ Groundwater sampling
☐ Groundwater depth and free-product measurement
☐ Vapor measurements
☐ Product sample collection
☐ Soil stockpile testing
☐ Remedial excavation
☐ Recovery of free product
☐ Monitoring well installation
☐ Monitoring well development
☐ UST removal monitoring
☐ Other:

EMERGENCY INFORMATION

Hospital Name and Address:	**Providence Mount Carmel Hospital** 982 East Columbia Avenue Colville, Washington

Phone Numbers (Hospital ER): **Phone**: 509.685.5100

Distance: 43 miles

Route to Hospital:

Head South on WA-25

Turn Left onto US-395/WA-20

Turn Left on East Columbia Avenue

Map to Hospital:

Ambulance:	9-1-1
Poison Control:	1-800-222-1222
Police:	9-1-1
Fire:	9-1-1
Location of Nearest Telephone:	Cell phones are carried by field personnel.
Nearest Fire Extinguisher:	Located in the GeoEngineers vehicle on site.
Nearest First-Aid Kit:	Located in the GeoEngineers vehicle on site.

Standard Emergency Procedures

Get help

- Send another worker to phone 9-1-1 (if necessary)
- As soon as feasible, notify GeoEngineers' Project Manager

Reduce risk to injured person

- Turn off equipment
- Move person from injury location (if in life-threatening situation only)
- Keep person warm
- Perform CPR (if necessary)

Transport injured person to medical treatment facility (if necessary)

- By ambulance (if necessary) or GeoEngineers vehicle
- Stay with person at medical facility
- Keep GeoEngineers Project Manager apprised of situation and notify Human Resources Manager of situation

HAZARD ANALYSIS

A hazard analysis has been completed as part of preparation of this HASP. The hazard analysis was performed considering the known and potential hazards at the site and surrounding areas, as wells as the planned work activities. The results of the hazard analysis are presented in this section. The hazard assessment will be evaluated each day before beginning work. Updates will be made as necessary and documented in the JHA Form 3 or daily field log.

The following are known applicable hazards.

Physical Hazards

☐ Drill rigs and concrete coring, including working inside a warehouse

☒ Backhoe

☒ Trackhoe

☐ Crane

☐ Front-end loader

☒ Excavations/trenching (1:1 slopes for Type B soil) (1:1.5 slopes for Type C soil)

☐ Shored/braced excavation if greater than 4 feet of depth

☐ Overhead hazards/power lines

☒ Slipping/tripping/puncture hazards (debris on site, steep slopes or pits)

☒ Unusual traffic hazard – Street traffic. Railroad right-of-way

☒ Heat/cold, wind (and wind chill), humidity

☒ Utilities/utility locate

☒ Noise

☒ Other: Columbia River, icy conditions.

- High-visibility vests will be worn by on-site personnel to ensure they can be seen by vehicle and equipment operators.
- Field personnel will always be aware of the location and motion of heavy equipment in the area of work to ensure a safe distance between personnel and the equipment. Personnel will be visible to the operator at all times and will remain out of the swing and/or direction of the equipment apparatus. Personnel will approach operating heavy equipment only when they are certain the operator has indicated that it is safe to do so through hand signal or other acceptable means.
- Field personnel will always be aware of the presence and motion of trains and/or equipment while working within, or crossing, the BNSF right-of-way and tracks. The buddy system (pairs) will be used

when working within 25 feet of the centerline of the tracks. One member of the pair will watch for approaching trains.

- Field personnel will maintain awareness of river conditions while working adjacent to the river. Personal floatation devices will be worn by field personnel while working along the riverbank. The buddy system will be used when sampling near the river. One member of the pair will maintain a safe distance from the shore line and be available to respond in the event of an emergency situation.
- Field personnel will visually assess areas prior to mobilizing equipment to include assessing the potential of soft ground, unstable riverbank slopes and water depths. Snow and ice conditions will also be assessed prior to mobilizing equipment or personnel.
- Heavy equipment and/or vehicles used on this site will not work within 20 feet of overhead utility lines without first ensuring that the lines are not energized. This distance may be reduced to 10 feet, depending on the client and the use of a safety watch. Note: If it is later determined that overhead lines are a hazard on this job site, a copy the overhead lines safety section from the HASP Supplemental document will be attached.
- Personnel entry into unshored or unsloped excavations deeper than 4 feet is not allowed. Any trenching and shoring requirements will follow guidelines established in Washington Administrative Code (WAC) 296-155, the Washington State Construction Standards or OSHA 1926.651 Excavation Requirements. If a worker is required to enter an excavation deeper than 4 feet, a trench box or other acceptable shoring will be employed or the side walls of the excavation will be sloped according to the soil type and guidelines as outlined in Department of Occupational Safety and Health (DOSH) and OSHA regulations.
- Personnel will avoid tripping hazards, steep slopes, pits and other hazardous encumbrances. If it becomes necessary to work within 6 feet of the edge of a pit, slope or other potentially hazardous area, appropriate fall-protection measures will be implemented by the Site Safety Officer in accordance with OSHA/DOSH regulations and the GeoEngineers Health and Safety Program.
- Cold stress control measures will be implemented according to the GeoEngineers Health and Safety Program to prevent frost nip (superficial freezing of the skin), frost bite (deep tissue freezing), or hypothermia (lowering of the core body temperature). Heated break areas and warm beverages will be available during periods of cold weather.
- Heat stress control measures required for this site will be implemented according to GeoEngineers Health and Safety Program with water provided on site.

Biological Hazards and Procedures

☒ Poison Ivy or other vegetation

☒ Insects or snakes

☐ Hypodermic needles or other infectious hazards

☒ Wildlife

☐ Other:

Ergonomic Hazard Mitigation Measures and Procedures

Avoiding Lifting Injuries

Back injuries often result from lifting objects that are too heavy or from using the wrong lifting technique. Keep your back healthy and pain-free by following common sense safety precautions.

- Minimize reaching by keeping frequently used items within arm's reach, moving your whole body as close as possible to the object.
- Avoid overextending by standing up when retrieving objects on shelves.
- Keep your back in shape with regular stretching exercises.
- Get help from a coworker or use a hand truck if the load is too heavy or bulky to lift alone.

Proper Lifting Techniques

- Face the load; don't twist your body. Stand in a wide stance with your feet close to the object.
- Bend at the knees, keeping your back straight. Wrap your arms around the object.
- Let your legs do the lifting.
- Hold the object close to your body as you stand up straight. To set the load down, bend at the knees, not from the waist.

1.1 Engineering Controls

☒ Trench shoring (1:1 slope for Type B Soils) (1:1.5 slope for Type C Soils)

☒ Location work spaces upwind/wind direction monitoring

☐ Other soil covers (as needed)

☐ Other (specify):

Chemical Hazards

CHEMICAL HAZARDS (POTENTIALLY PRESENT AT SITE)

Compound/ Description	Exposure Limits/IDLH	Exposure Routes[a]	Toxic Characteristics
Aluminum	OSHA PEL: TWA 15 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Cough, redness in eyes
Antimony compounds	OSHA PEL: TWA 0.5 mg/m^3 IDLH: 50 mg/m^3	Ingestion, inhalation, skin absorption, skin and eye contact	Cough, pain and redness in eyes, abdominal pain, vomiting, diarrhea
Arsenic	OSHA PEL= TWA 0.01 mg/m^3 NIOSH = 0.002 mg/m^3 IDLH = 5 mg/m^3 TLV-TWA = 0.01 mg/m^3	Inhalation, skin absorption, ingestion, skin and/or eye contact	Ulcerated nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, potential carcinogen

Compound/ Description	Exposure Limits/IDLH	Exposure Routes[a]	Toxic Characteristics
Barium compounds	OSHA PEL= TWA 0.5 mg/m^3 IDLH = 50 mg/m^3	Inhalation, skin absorption, ingestion, skin and/or eye contact	Cough, sore throat, redness of skin and eyes
Beryllium compounds	OSHA PEL: TWA 0.002 mg/m^3 IDLH: 4 mg/m^3	Inhalation, skin absorption, ingestion, skin and/or eye contact	Cough, labored breathing, shortness of breath, sore throat
Cadmium as dust	OSHA PEL: TWA 0.005 mg/m^3 IDLH: 9 mg/m^3 TLV–TWA: 0.002 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]
Calcium compounds	OSHA PEL: TWA 15 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Sore throat, cough, shortness of breath, redness in skin and eyes, burning sensation, abdominal pain and vomiting
Chromium	OSHA = TWA 1 mg/m^3 NIOSH = TWA 0.5 mg/m^3 IDLH 250 mg/m^3 TLV-TWA = 0.5 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Chromium III is an essential nutrient, Chromium VI can cause irritation to nose, skin ulcers, linked to cancer
Cobalt (metal dust)	OSHA PEL= TWA 0.1 mg/m^3 NIOSH REL = TWA 0.05 mg/m^3 IDLH = 20 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Cough, shortness of breath, sore throat, wheezing, redness in eyes, abdominal pain and vomiting
Copper (dusts and mists)	OSHA PEL = TWA 1 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Lassitude (weakness, exhaustion), insomnia, facial pallor, anorexia, weight loss, malnutrition, constipation, abdominal pain, colic, anemia, gingival lead line, tremor, wrist and ankle paralysis, encephalopathy, kidney disease, irritated eyes, hypotension
Iron Oxide (dust and fumes)	OSHA PEL = TWA 10 mg/m^3 NIOSH REL = TWA 5 mg/m^3 IDLH = 2,500 mg/m^3	Inhalation, ingestion, skin and/or eye contact	Cough, sore throat, weakness of breath, redness in skin and eyes, burning sensation, nausea, vomiting, diarrhea

Compound/ Description	Exposure Limits/IDLH	Exposure Routes[a]	Toxic Characteristics
Lead (and inorganic compounds as lead) A heavy, ductile, soft, gray solid.	OSHA PEL: 0.5 mg/m³ (TWA) (skin) IDLH: 100 mg/m³	Inhalation, ingestion, skin and/or eye contact	Lassitude (weakness, exhaustion), insomnia, facial pallor, anorexia, weight loss, malnutrition, constipation, abdominal pain, colic, anemia, gingival lead line, tremor, wrist and ankle paralysis, encephalopathy, kidney disease, irritated eyes, hypotension
Magnesium compounds	OSHA PEL: TWA 15 mg/m³ NIOSH REL: TWA 10 mg/m³	Inhalation, ingestion, skin and/or eye contact	Cough, sore throat, shortness of breath, redness in skin and eyes
Manganese compounds	OSHA PEL: 5 mg/m³ NIOSH REL: TWA 1 mg/m³ IDLH: 500 mg/m³	Inhalation, ingestion, skin and/or eye contact	Cough, abdominal pain, nausea
Mercury (and inorganic compounds as mercury)	IDLH: 10 mg/m³ TLV-TWA = 0.025 mg/m³ Ceiling: 0.1 mg/m³	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritated eyes and skin, coughing, chest pain, difficulty breathing, bronchitis, pneumonitis, tremor, insomnia, irritability, indecision, headache, lassitude (weakness, exhaustion), stomatitis, salivation, gastrointestinal disturbance, anorexia, weight loss, proteinuria
Nickel, as Ni	OSHA = TWA 1 mg/m³	Inhalation, ingestion, skin and/or eye contact	Lassitude (weakness, exhaustion), insomnia, facial pallor, anorexia, weight loss, malnutrition, constipation, abdominal pain, colic, anemia, gingival lead line, tremor, wrist and ankle paralysis, encephalopathy, kidney disease, irritated eyes, hypotension
Selenium compounds	OSHA PEL: TWA 0.2 mg/m³ IDLH: 1 mg/m³	Inhalation, skin absorption, ingestion, skin and/or eye contact	Sore throat, cough, nasal discharge, loss of smell, diarrhea, headache and redness in skin and eyes
Thallium (soluble compounds, as Ti)	OSHA PEL: TWA 0.1 mg/m³ IDLH: 15 mg/m³	Inhalation, skin absorption, ingestion, skin and/or eye contact	Abdominal pain, nausea, vomiting, headache, weakness, muscle pain, blurred vision, restlessness, convulsions and increased heart rate
Zinc	OSHA PEL: 15 mg/m³ (Dust) IDLH: 500 mg/m³	Inhalation, skin absorption, ingestion, skin and/or eye contact	Cough, sore throat, redness in skin and eyes, nausea, vomiting

Notes:

a = Inhalation is not anticipated to be an exposure pathway at the Northport sediment site.

If a State has established a PEL more restrictive than the OSHA limits, then the applicable State limit becomes the legal limit.

IDLH = immediately dangerous to life or health

LEL = lower explosive limit

PEL = permissible exposure limit

mg/m³ = milligrams per cubic meter

REL = recommended exposure limit
ACGIH = American Conference of Governmental Industrial Hygienists
TWA = time-weighted average (over 8 hrs)
TLV = threshold limit value (over 10 hrs)

Summary of Selected Chemical Hazards

Metals are the primary COCs at the site. Ingestion and direct contact are the primary exposure pathways for the suspected on-site chemicals

Arsenic

Arsenic is a naturally occurring element. Elevated levels of inorganic arsenic may be present in soil, either from natural mineral deposits or contamination from historical smelter activities, which may lead to dermal or ingestion exposure. Organic and inorganic arsenic compounds are known to cause cancer of the lung, urinary bladder and skin. Also, a positive association has been observed between exposure to arsenic and inorganic arsenic compounds and cancer of the kidney, liver and prostate.

Cadmium

Cadmium is a naturally occurring element. Elevated levels of cadmium may be present in soil from historical smelter activities, which may lead to dermal or ingestion exposure. Long-term exposure to cadmium through air, water, soil and foods can lead to cancer and organ system toxicity such as skeletal, urinary, reproductive, cardiovascular, central and peripheral nervous, and respiratory systems.

Lead

Lead is absorbed and stored in the bones, blood and tissue of the body. It doesn't bioaccumulate and is excreted by the body. Health effects from short-term lead exposure include abdominal pain, constipation, tiredness, memory loss or weakness. Long-term exposure to lead causes symptoms like those described for short term exposure.

Mercury

Elemental mercury is a heavy, shiny, silver-white, odorless liquid. It is nonflammable, but releases toxic vapor, especially when heated. Inhalation of mercury vapor is the primary route of exposure to elemental mercury. Elemental mercury is very slowly absorbed through the skin in high concentrations but causes irritation of both skin and eyes and might produce contact dermatitis. Respiratory symptoms associated with the inhalation of mercury vapor include corrosive bronchitis with fever chills and dyspnea, which can progress to pulmonary edema or fibrosis. Abdominal cramps, diarrhea, renal dysfunction, visual disturbances, and central nervous system damage leading to neuropsychiatric disturbances and intention tremors may also occur.

Additional Hazards

Additional hazards that are specific to your site should be identified on the JHA Form 3.

Daily field logs will include evaluation of:

- *Physical Hazards* (excavations and shoring, equipment, traffic including trains, tripping, cold stress and others)

- *Biological Hazards* (snakes, spiders, bees/wasps, animals, discarded needles, poison ivy, pollen, and others present)
- *Ergonomic Hazards* (lifting heavy loads, tight work spaces, etc.)
- *Chemical Hazards* (odors, spills, free product, airborne particulates and others present)

SITE CONTROL PLAN

Work zones will be within 50 feet of the excavation equipment (backhoe/track hoe). Employees will work upwind of the machinery if possible. To the extent practicable, use the buddy system. Do not approach heavy equipment unless you are sure the operator sees you and has indicated it is safe to approach. All personnel from GeoEngineers and subcontractor(s) will be made aware of safety features during each morning's safety tailgate meeting (location of fire extinguishers, cell phone numbers, etc.). For medical assistance, see above.

Traffic or Vehicle Access Control Plans

Portions of the site might be trafficked by locals accessing the boat ramp facilities. Excavation and sample locations near the boat ramp will be coned off to indicate the work areas. Sampling near the railroad right-of-way (ROW) will be suspended when oncoming train traffic is observed until the train is no longer visible.

Site Work Zones

An exclusion zone, contamination reduction zone, and support zone will be established around working areas. Personnel leaving the facility or on break will exit the exclusion zone through the contamination reduction zone. The contamination reduction zone, at a minimum, will consist of garbage bags into which used PPE will be disposed. Personnel will wash hands before eating or leaving the facility.

Hot zone/exclusion zone: *Within 10 feet of active excavations or sample locations.*

Method of Delineation/Excluding Non-Site Personnel

☐ Fence

☐ Survey tape

☒ Traffic cones

☐ Other:

Buddy System

Personnel on site will use the buddy system (pairs), particularly whenever communication is restricted. A buddy system can be arranged with subcontractor/contractor personnel.

Site Communication Plan

Positive communications (within sight and hearing distance or via radio) will be maintained between pairs on site, with the pair remaining in proximity to assist each other in case of emergencies. The team will prearrange hand signals or other emergency signals for communication when voice communication becomes impaired (including cases of lack of radios or radio breakdown) and an agreed upon location for an emergency assembly area.

In instances where communication cannot be maintained, you will consider suspending work until it can be restored. If this is not an option, the following are some examples for communication:

- Hand gripping throat: Out of air, can't breathe.
- Gripping partner's wrist or placing both hands around waist: Leave area immediately, no debate.
- Hands on top of head: Need assistance.
- Thumbs up: Okay, I'm all right; or, I understand.
- Thumbs down: No, negative.

Emergency Action

In the event of an emergency, employees with convene in a designated area Identified on the JHA Form 3. Employees will communicate with others working on site and the PM to determine the Emergency Action Plan for each site. All personnel from GeoEngineers and subcontractor(s) will be made aware of the Emergency Action for the site at each morning's safety tailgate meeting (equipment shutoff switch, location of fire extinguishers, cell phone numbers, etc.). For medical assistance, see above.

Decontamination Procedures

Decontamination, at a minimum, will include removing and disposing of PPE when exiting the exclusion zone; and washing your hands. Decontamination may also consist of removing outer protective gloves and washing soiled boots and gloves using bucket and brush provided on site in the contamination reduction zone. If needed, inner gloves will then be removed, hands and face will be washed in either a portable wash station or a bathroom facility at the site. Employees will perform decontamination procedures and wash before eating, drinking or leaving the site.

Waste Disposal or Storage

Used PPE is to be placed in a plastic bag for disposal.

Excavated Soil and Development Water:

☒ On site, pending analysis and further action for soil boring cuttings

☐ Secured (list method):

☒ Other (describe destination, responsible parties): Placed back into the excavation and tamped flat with excavation equipment.

PERSONAL PROTECTIVE EQUIPMENT

After the initial and/or daily hazard assessment has been completed the appropriate PPE will be selected to ensure worker safety. Task-specific levels of PPE will be reviewed with field personnel during the pre-work briefing conducted before the start of site operations. Task-specific levels of PPE will be reviewed with field personnel during the pre-work briefing conducted before the start of site operations.

Site activities include handling and sampling solid subsurface material (material may potentially be saturated with contaminated materials). Site hazards include potential exposure to hazardous materials, and physical hazards such as trips/falls, heavy equipment, and contaminant exposure.

- Level D PPE, unless a higher level of protection is required, will be worn at all times on the site. Potentially exposed personnel will wash gloves, hands, face and other pertinent items to prevent hand-to-mouth contact. This will be done prior to hand-to-mouth activities including eating, smoking, etc. Personal floatation devices will be worn when working in the river or along the river bank.
- Adequate personnel and equipment decontamination will be used to decrease potential ingestion and inhalation.

Check Applicable Personal Protection Gear to be Used:

☒ Hardhat (if overhead hazards, or client requests)

☒ Steel-toed boots (if crushing hazards are a potential or if client requests)

☒ Safety glasses (if dust, particles, or other hazards are present or client requests)

☒ Reflective vest (if working near traffic or equipment)

☒ Hearing protection (if it is difficult to carry on a conversation 3 feet away)

☒ Insulated, water-proof boots (for cold conditions)

☒ Personal floatation device (if working along river bank)

Gloves (Specify):

☒ Nitrile

☐ Latex

☐ Liners

☒ Leather (for use during with hand sampling equipment, if needed)

☐ Other (specify)

Protective Clothing:

☐ Tyvek (if dry conditions are encountered, Tyvek is sufficient) (modified Level D or Level C)

☐ Saranex (personnel will use Saranex if liquids are handled or splash may be an issue) (modified Level D or Level C)

☒ Cotton (Level D)

☒ Rain gear (as needed) (Level D)

☒ Layered warm clothing (as needed) (Level D)

Inhalation Hazard Protection:

☒ Level D (no respirator)

☐ Level C (respirators with organic vapor/HEPA P100 filters)

☐ Level B (self-contained breathing apparatus— STOP, Consult the HSM)

Personal Protective Clothing Inspections

PPE clothing ensembles designated for use during site activities will be selected to provide protection against known or anticipated hazards. However, no protective garment, glove or boot is entirely chemical-resistant, nor does any PPE provide protection against all types of hazards. To obtain optimum performance from PPE, site personnel will be trained in the proper use and inspection of PPE. This training will include the following:

- Inspect PPE before and during use for imperfect seams, non-uniform coatings, tears, poorly functioning closures or other defects. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Inspect PPE during use for visible signs of chemical permeation such as swelling, discoloration, stiffness, brittleness, cracks, tears or other signs of punctures. If the integrity of the PPE is compromised in any manner, proceed to the contamination reduction zone and replace the PPE.
- Disposable PPE will not be reused after breaks unless it has been properly decontaminated.

ADDITIONAL ELEMENTS

Cold Stress Prevention

Working in cold environments presents many hazards to site personnel and can result in frost nip (superficial freezing of the skin), frost bite (deep tissue freezing), or hypothermia (lowering of the core body temperature).

The combination of wind and cold temperatures increases the degree of cold stress experienced by site personnel. Site personnel will be trained on the signs and symptoms of cold-related illnesses, how the human body adapts to cold environments, and how to prevent the onset of cold-related illnesses. Heated break areas with wind protection and warm beverages will be provided during periods of cold weather. Chemical hand-warmers will also be available to field personnel.

Heat Stress Prevention

Keep workers hydrated in a hot outdoor environment requires more water be provided than at other times of the year. When employee exposure is at or above an applicable temperature listed in the Heat Stress table below, Project Managers will ensure that:

- A sufficient quantity of drinking water is always readily accessible to employees
- All employees have the opportunity to drink at least one quart of drinking water per hour

HEAT STRESS

Type of Clothing	Outdoor Temperature Action Levels
Nonbreathing clothes including vapor barrier clothing or PPE such as chemical resistant suits	52°
Double-layer woven clothes including coveralls, jackets and sweatshirts	77°
All other clothing	89°

Emergency Response

Indicate what site-specific procedures you will implement.

- Personnel on site will use the “buddy system” (pairs).

- Visual contact will be maintained between "pairs" on site, with the team remaining in proximity to assist each other in case of emergencies.
- If any member of the field crew experiences any adverse exposure symptoms while on site, the entire field crew will immediately halt work and act according to the instructions provided by the SSO.
- The discovery of any condition that would suggest the existence of a situation more hazardous than anticipated will result in the evacuation of the field team, contact of the PM, and reevaluation of the hazard and the level of protection required.
- If an accident occurs, the SSO and the injured person are to complete, within 24 hours, an Accident Report (Form 4) for submittal to the PM, the HSPM and HR. The PM will ensure that follow-up action is taken to correct the situation that caused the accident or exposure.

MISCELLANEOUS

Personnel Medical Surveillance

GeoEngineers employees are not in a medical surveillance program because they do not fall into the category of "Employees Covered" in OSHA 1910.120(f)(2), which states that a medical surveillance program is required for the following employees:

1. All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year.
2. All employees who wear a respirator for 30 days or more a year or as required by state and federal regulations.
3. All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation.
4. Members of HAZMAT teams.

Spill Containment Plans

Field personnel will perform daily vehicle inspections and address leaks (fuel, oil, hydraulics) before commencing work at the site. The contractor will be responsible for maintaining an appropriate spill response plan and cleanup material for the contractor's equipment. Leaks or spills will be addressed immediately using field personnel and equipment on site. The site topography is sloped toward the Columbia River. Field personnel will implement spill response actions with available equipment to help stop the flow of released products to reduce the impacts to soil, groundwater and surface water.

Sampling, Managing and Handling Drums and Containers

Drums and containers used during the cleanup will meet the appropriate Department of Transportation (DOT), OSHA and U.S. Environmental Protection Agency (EPA) regulations for the waste that they contain. Site operations will be organized to minimize the amount of drum or container movement. When practicable, drums and containers will be inspected, and their integrity will be ensured before they are moved. Unlabeled drums and containers will be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled. Before drums or containers are moved, all employees involved in the transfer operation will be warned of the potential hazards associated with the contents.

Drums or containers and suitable quantities of proper absorbent will be kept available and used where spills, leaks or rupturing may occur. Where major spills may occur, a spill containment program will be implemented to contain and isolate the entire volume of the hazardous substance being transferred. Fire extinguishing equipment will be on hand and ready for use to control incipient fires.

Entry Procedures for Tanks or Vaults (Confined Spaces)

GeoEngineers employees will not enter confined spaces to perform work unless they have been properly trained and with hands-on experience in the use of retrieval equipment. If a project requires confined space entry, please include a copy of the confined space permit and include the training documentation in this HASP.

Trenches greater than 4 feet in depth with the potential for buildup of a hazardous atmosphere are considered confined spaces.

Sanitation

Sanitary facilities are available adjacent to the site at the City Park.

Lighting

Work is anticipated to be performed during daylight hours. Work may extend slightly into the evening provided adequate lighting is used (e.g., portable flood lights).

DOCUMENTATION TO BE COMPLETED FOR HAZWOPER PROJECTS

- Daily Field Log
- FORM 1—Health and Safety Pre-Entry Briefing and Acknowledgment of Site Health and Safety Plan for use by employees, subcontractors and visitors
- FORM 2—Safety Meeting Record
- FORM 3—JHA Form
- FORM 4—Accident/Exposure Report Form

NOTE: The Field Log is to contain the following information:

- Updates on hazard assessments, field decisions, conversations with subcontractors, client or other parties, etc.;
- Actions taken;
- Action level for upgrading PPE and rationale; and
- Meteorological conditions (temperature, wind direction, wind speed, humidity, rain, snow, etc.).

APPROVALS

1. Plan Prepared

Justin W. Rice, LG	February 21, 2019
Signature	Date

2. Plan Approval

Scott H. Lathen, PE	Click here to enter text.
PM Signature	Date

3. Health & Safety Officer

Mary Lou Sullivan	Click here to enter text.
HSPM Signature	Date

FORM 1
HEALTH AND SAFETY PRE-ENTRY BRIEFING AND ACKNOWLEDGEMENT OF THE SITE HEALTH AND SAFETY PLAN FOR GEOENGINEERS' EMPLOYEES, SUBCONTRACTORS AND VISITORS

NORTHPORT, WASHINGTON – NORTHPORT WATERFRONT REMEDIAL INVESTIGATION
FILE NO. 0504-160-00

Inform employees, contractors and subcontractors or their representatives about:

- The nature, level and degree of exposure to hazardous substances they're likely to encounter;
- All site-related emergency response procedures; and
- Any identified potential fire, explosion, health, safety or other hazards.

Conduct briefings for employees, contractors and subcontractors, or their representatives as follows:

- A pre-entry briefing before any site activity is started.
- Additional briefings, as needed, to make sure that the site-specific HASP is followed.
- Make sure all employees working on the site are informed of any risks identified and trained on how to protect themselves and other workers against the site hazards and risks.
- Update all information to reflect current sight activities and hazards.
- All personnel participating in this project must receive initial health and safety orientation. Thereafter, brief tailgate safety meetings will be held as deemed necessary by the Site Safety Officer.
- The orientation and the tailgate safety meetings will include a discussion of emergency response, site communications and site hazards.

(All of GeoEngineers' site workers will complete this form, which will remain attached to the HASP and be filed with other project documentation). Please be advised that this site-specific HASP is intended for use by GeoEngineers employees only. Nothing herein will be construed as granting rights to GeoEngineers' subcontractors or any other contractors working on this site to use or legally rely on this HASP. GeoEngineers specifically disclaims any responsibility for the health and safety of any person not employed by the company.

I hereby verify that a copy of the current HASP has been provided by GeoEngineers, Inc., for my review and personal use. I have read the document completely and acknowledge an understanding of the safety procedures and protocol for my responsibilities on site. I agree to comply with all required, specified safety regulations and procedures.

Print Name	Signature	Date

FORM 2
SAFETY MEETING RECORD

NORTHPORT, WASHINGTON –NORTHPORT WATERFRONT REMEDIAL INVESTIGATION
FILE NO. 0504-160-00

Safety meetings will include a discussion of emergency response, site communications and site hazards.

- Use in conjunction with the HASP and Job Hazard Analyses (JHA) Form 3 to help identify hazards.

Date: ____________________________ **Site Safety Officer (SSO):**__________________________________

Topics: ____

Attendees:
Print Name **Signature:**

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FORM 3
JOB HAZARD ANALYSES (JHA) FORM
EXAMPLE

NORTHPORT, WASHINGTON –NORTHPORT WATERFRONT REMEDIAL INVESTIGATION
FILE NO. 0504-160-00

This form can be used for analyses of daily hazards where there are multiple tasks and ongoing projects and for record keeping purposes. Make copies as needed.

Project: Northport Waterfront RI **File No:** 0504-160-00	**Date:**	**Site Location:** Northport, WA

Development Team:	**Position/Title:**	**Reviewed by:**	**Position/Title:**

Minimum Required Protective Equipment: (see critical actions for task-specific requirements)

PPE	**Equipment**	**Tools**	**Actions**
☒ Hard Hat	☐ Safety Beacons	☒ Cell/Satellite Phone	☒ Stay Visible
☒ High Visibility Vest	☒ Safety Cones	☐ Digital Camera	☒ Equipment Inspection
☒ Safety Shoes/Waders	☒ First Aid Kit	☒ GPS	☒ Work in Pairs
☒ Gloves	☒ Fire Extinguisher	☐	☒ Safety Control/Traffic Plan
☒ Safety Glasses	☐ Eye Wash/ Drinking Water	☐	☐

Job Steps	**Potential Hazards**	**Critical Actions to Mitigate Hazards**
Pre-Job Activities	Example: Unfamiliar locations, congestion, unpaved roads, Mechanical Failure, Flat Tires Vehicle Fire, Exhaust Leaks, Vehicle Collision, Internal Projectiles	■ Inspect the vehicle before departure: ▪ Check for tire cuts, fluid leaks, flat tires, body damage, windshield cracks, and other damage. ▪ Check lights, wipers, fluid levels, and seat belts. ■ Study the area maps, photos and use GPS and compass skills. ■ Identify the safest spot to park field vehicles.
Familiarize crew with the task and location of site	Crew does not notify site owner / manager. Unaware of the job site hazards and steps to prevent injury. Appropriate personnel protective equipment not worn. Other Hazards	■ Example: Conduct a tailgate safety meeting discussing the jobs, the hazards and actions that will be taken to prevent injury. ■ Discuss “Stop Work Authority” as it applies to each site member. ■ Discuss appropriate PPE including high visibility clothing such as reflective vest. ■ Notify attendant and/or site owner/manager of work activities and location. ■ Discuss appropriate PPE including high visibility clothing such as reflective vest. ■ Set up exclusion zone surrounding work area.

Driving to work site location (Highway Driving)	Unfamiliar road, Mechanical Failure, Flat Tires, Vehicle Fire, Vehicle Collision. Other Hazards	■ Inspect the vehicle before departure: ▪ Check for tire cuts, fluid leaks, flat tires, body damage, windshield cracks, and other damage. ▪ Check lights, wipers, fluid levels, and seat belts. ■ Study the area maps, photos and use GPS and compass skills. ■ Use only vehicles appropriate for the work needs and the driving conditions expected. ■ Ensure the vehicle has a complete and current first aid kit and fire extinguisher. ■ Place heavy objects behind a secure safety cage if they must be carried in a passenger compartment. ■ Use parking brake, and don't leave vehicle unattended while it is running. ■ Ensure vehicle has fuel to get to and from your destinations. ■ Inform your Project Manager of your destination and estimated time of return. ■ Carry extra food, water, and clothing. ■ Drive defensively.
Driving on Unimproved Roads **(Off-Highway Driving)**	Encountering Other Vehicles on Narrow Unfamiliar Road, Narrow, Rough Roads, Animal / Object Collision, Running / Skidding Off Road, Icy / Muddy Roads Flying Debris (Rocks, etc.), Poor Visibility Backing, Run-Away Vehicle, Roadway Obstacles Project Manager unaware of location.	■ Stay on the main roadway. Pull over on firm ground and avoid soft shoulders, if a stop is necessary. ■ Drive on maintained trails when possible. ■ Drive with care in tall brush and grass. Watch for wildlife, fallen trees, rocks, and other obstacles. ■ Slow down, especially on corners. Maintain a safe speed at all times. ■ Follow from a safe distance. ■ Know when and how to use 4WD. ■ Use only vehicles appropriate to the road conditions. Learn these conditions before you go. ■ Pull over to allow larger vehicles (ie: trucks and trailers) to pass from either direction. ■ Don't travel the road at all if there is high potential for vehicle damage. ■ Park so that backing up will not be necessary. ■ Use a spotter or get out to check behind vehicle.

		■ Use ground guide to walk the path on questionable roadways. ■ When removing debris from the roadway, use care, lift properly, and use proper equipment and PPE. ■ When descending a long grade, use lower gears to control speed rather than brakes. ■ Keep vehicle well ventilated by opening a window at least 6 inches, when idling or heating for a period. ■ Keep all windows clear of snow, ice, mud, and anything else obstructing the driver's view. ■ Keep vehicle windows clean, inside and out, and washer fluid full. Replace damaged or worn wipers.
Traveling on Foot	Falls, Foot Injuries, and Stress and Impact Injuries Forest Fires Lightning Personal Safety	■ Identify and use safe travel routes. Do not exceed physical abilities or equipment design. ■ Use pack equipment properly. Carry weight on hips, not back. ■ Warm up and stretch the appropriate muscle groups before and after hitting the trail. ■ Test and use secure footing. Move cautiously and deliberately. Never run. ■ In heavy undergrowth, particularly off-trail, slow down and watch carefully. ■ Carry tools on the downhill side. ■ Wear safety-toed boots with good, non-skid soles that are tall enough to support ankles. ■ Know basic first aid. Completion of a basic first aid course is required. ■ Use footwear appropriate to the terrain and load being carried. ■ Know how to fall. Roll, protect the head and neck, and do not extend arms to break the fall. ■ Wear fire retardant clothing ■ Refer to GeoEngineers Personal Safety Program - Never you're your personal safety. Leave the area and contact your Project Manager. ■ Travel on maintained trails when possible.
	Biological Hazards	■ Discuss applicable hazard mitigation measures - Insects, Snakes, Wildlife, Vegetation

Stream/River Bank Evaluation	Slips, Trips, Falls	■ Travel on maintained trails when possible. ■ Take extra precautions when encountering steep, loose, wet trail conditions. ■ Always carry tools on your downhill side. ■ Use a rope for stability if needed. Tie-off to trees and have throw rope with on-shore buddy. ■ Take slow deliberate steps as conditions dictate. ■ Use a flashlight or headlamp after dark. ■ Travel after dark only in an emergency. ■ Wear appropriate footwear for conditions. ■ Wear a personal floatation device (PFD).
Stream/River Crossing	Slips, Trips, Falls	■ Evaluate current, rocks and brush before entering stream/river. ■ Do not attempt to cross deep, fast water, particularly during spring snowmelt or a flood. ■ Use waders/boots and wear a personal floatation device (PFD). ■ Use a long stick or trekking pole to probe for deep spots and aid in balance. ■ Cross at a 45-degree angle traveling upstream. ■ Do not cross barefoot. Wear boots. ■ Use care in placing feet.
Physical Hazards	Heat/Cold Stress	■ Take breaks as needed. ■ Consume adequate food and beverages. ■ If possible, adjust work schedule to avoid heat/cold stresses.
Slope Evaluation	Slips, Trips and Falls	■ Travel on maintained trails when possible. ■ Take extra precautions when encountering steep, loose, wet trail conditions. ■ Always carry tools on your downhill side. ■ Use a rope for stability if needed / tie off to trees / have throw rope with on-shore buddy. ■ Take slow deliberate steps as conditions dictate. ■ Use a flashlight after dark. ■ Travel after dark only in an emergency. ■ Wear appropriate footwear for conditions.
Communication	Additional Hazards, i.e., No communication in case of emergency	■ Verify cell phone is working. ■ Maintain communication with Project Manager throughout job task. ■ Verify location and contact numbers for emergency medical assistance or 911.
	Additional Hazards, i.e., Emergency	■ **Dial 911** ■ Hospital Route (Attached Fall Protection Plan)
Required Control Measures: (check the box when complete)		
☐ Perform a pre-work vehicle inspection (First Aid kit, fire extinguisher).		
☐ Drive defensively looking out for the other guy.		

☐ Conduct a pre-work safety meeting.
☐ Use a Safety Watch to monitor equipment Minimum Approach Distance (MAD) and to keep personnel clear if needed.
☐ Wear Personal Protective Equipment (PPE).
☐ Ensure training is current (First Aid, defensive driving, etc.).
☐ Conduct Task Safety Assessments throughout the job.
Additional Comments:

DAILY HAZARD ASSESSMENT RECORD OF SAFETY MEETINGS

Signature	Date	Signature	Date

FORM 4
ACCIDENT/EXPOSURE REPORT FORM
NORTHPORT, WA – NORTHPORT WATERFRONT SITE
FILE NO. 0504-160-00

To (Supervisor): ______________________ From (Employee): ______________________

Telephone (with area code): ______________________

Name of injured or ill employee: ______________________

Date of accident: Time of accident: Exact location of accident:

Narrative description of: **accident/exposure** (circle one):

Medical attention given on site:

Nature of illness or injury and part of body involved: Lost Time? Yes ☐ No ☐

Probably Disability (check one):

Fatal	Lost work day with days away from work	Lost work day with days of restricted activity	No lost work day	First Aid only
☐	☐	☐	☐	☐

Corrective action taken by reporting unit and corrective action that remains to be taken (by whom and when):

Employee Signature: Date:

Name of Supervisor:

GeoEngineers