ENGINEERING DESIGN REPORT FOR UPLAND CLEANUP ACTION

Harris Avenue Shipyard Site

Prepared for: Port of Bellingham

Project No. 210195-A-08a • June 30, 2023 FINAL

earth + water

Aspect CONSULTING

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ERIC JAMES MARHOFER
STATE OF WASHINGTON
44162
REGISTERED PROFESSIONAL ENGINEER

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Steve Germiat, LHG, CGWP
Principal Hydrogeologist
sgermiat@aspectconsulting.com

Eric Marhofer, PE
Sr. Associate Environmental Engineer
emarhofer@aspectconsulting.com

Matthew Eddy, EIT
Project Engineer
meddy@aspectconsulting.com

Jane R. Gregg, PE
Project Geotechnical Engineer
jgregg@aspectconsulting.com

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Acronyms

AO	Agreed Order
Aspect	Aspect Consulting, LLC
BMC	Bellingham Municipal Code
CAP	Cleanup Action Plan
CSBC	crushed surfacing base course
CSGP	Construction Stormwater General Permit
CUL	Cleanup level
DAHP	Washington Department of Archeological and Historical Preservation
DNR	Washington Department of Natural Resources
Ecology	Washington Department of Ecology
mg/kg	milligrams/kilograms
MNA	monitored natural attenuation
MTCA	Model Toxics Control Act
PAH	polycyclic aromatic hydrocarbons
PRDI	Pre-Remedial Design Investigation
RAO	Remedial Action Objectives
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling Analysis Plan
SEPA	State Environmental Policy Act
SMP	Shoreline Master Plan
SWPPP	Stormwater Pollution Prevention Plan
UCL	upper confidence limit
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation

1 Introduction

Aspect Consulting, LLC (Aspect) developed this Engineering Design Report (EDR) for cleanup of the upland portion of the Harris Avenue Shipyard Site (Site) located in Bellingham, Washington (Figure 1). This EDR is deliverable C.1 in the Schedule of Deliverables (Exhibit C – Scope of Work and Schedule) for Agreed Order (AO) No. DE 19450. As discussed with the Washington State Department of Ecology (Ecology) and described in the Pre-Remedial Design Investigation (PRDI) Work Plan (Anchor, 2021), the Port of Bellingham (Port) has chosen to complete remedial design for the upland and in-water portions of the Site separately.

1.1 Purpose

This EDR presents the results of the upland PRDI and describes the upland components of the Site cleanup for Ecology's review. The EDR is intended to present a 30 percent level of design for the upland cleanup action. Design details will be further defined in the subsequent 90 percent and 100 percent plans and specifications in accordance with the AO Scope of Work and Schedule of Deliverables.

1.2 Background

Both the upland and in-water portions of the Site are regulated by the cleanup process under the Model Toxics Control Act (MTCA), Revised Code of Washington 70.105D, and Washington Administrative Code (WAC) Chapter 173-340, administered by Ecology. The in-water portion of the Site is also regulated under the Sediment Management Standards (SMS) and WAC 173-204.

In 1998, the Port began voluntarily investigating sediment quality at the Site. Based on this work, Ecology and the Port entered into an AO in 2003 to complete a Remedial Investigation/Feasibility Study (RI/FS) for Site sediments. In 2010, Ecology and the Port entered into a new AO (No. 7342 and associated First Amendment) to incorporate upland areas of the Site into a single RI/FS and Cleanup Action Plan (CAP; Ecology 2021). The final RI/FS was issued in 2019 (Floyd|Snider 2019a). In 2021, AO No. 7342 (as amended) was replaced by a new AO (No. DE 19450), which requires design of the cleanup action as described in the CAP (Exhibit B to the AO). Ecology made a determination that a cleanup performed in accordance with the CAP would comply with the requirements for selection of a remedy under WAC 173-340-360 (MTCA) and WAC 173-204 (SMS).

1.3 Site Description

The Site is located at 201 Harris Avenue in Bellingham, Washington (Figure 1). Portions of the upland and in-water areas have been used historically and recently for industrial purposes, primarily as a shipyard. A new tenant, Fairhaven Industrial Marine Repair Facility (FIMRF), began occupying the upland portion of the Site in early 2021 and has plans to use the Site for vessel moorage, repair, dry docking, and other industrial uses. The Site boundaries were determined by the extent of identified contamination through investigations of soil, groundwater, and sediment quality within the study area (Ecology, 2021).

The Site consists of approximately 5 acres of upland and 5 acres of in-water area, totaling 10 acres (Figure 1). The Site is bordered on the north and west by Bellingham Bay and on the south by the City of Bellingham's (City) Marine Park and the BNSF Railway rail lines. Industrial properties owned by the Port are present to the east and southeast of the Site. Properties to the east of the Site and their current uses include the former Arrowac Fisheries, Inc. warehouse on the uplands and a parking lot. Farther to the east is the Bellingham Cruise Terminal, operated by the Port as the southern terminus for the Alaska State Ferry.

1.4 Geologic Setting

A detailed description of Site geology can be found in the RI/FS (Floyd|Snider 2019a). The Geologic Map of the Bellingham 1:100,000 Quadrangle (Lapen, 2000) indicates the Site is underlain by the Padden Member of the Chuckanut Formation (ECcp). The ECcp unit is described as moderately to well sorted sandstone and conglomerate alternating with mudstone and minor coal. Although not indicated in geologic mapping, the ECcp may be overlain by glacial till as described in the RI/FS. Till is often described as a poorly sorted mixture of pebbles and cobbles in a matrix of silt, clay, and sand that was deposited by ice from the main advance of the last major continental glaciation.

The RI/FS states that roughly 20 percent of the Site overlies a flattened ridge consisting of glacial outwash and till that was hydraulically sluiced in the early 1900s to fill adjacent tidelands. The remaining upland area was developed in the 1930s by placing up to 15 feet of dredged sediments on the western and northern edges of the Site. The Geomorphic Map of the Bellingham (Kovanen, D.J., et al., 2020) shows that the Site is underlain by modified land (m), defined as a filled or graded area, which is consistent with the RI/FS interpretation.

In general, abundant subsurface obstructions and debris are often found within the fill material on nearshore industrial properties like the Site.

1.5 Upland Cleanup Action Plan Summary

Ecology's selected cleanup action for soil and groundwater is a comprehensive final remedy for the upland portion of the Site that complies with applicable remedy selection requirements under MTCA. Figure 1 shows the three upland cleanup areas (CAs) as defined in the CAP as follows:

- CA 1 encompasses shallow soils outside of CA 3 and existing building footprints containing elevated concentrations of metals. Concentrations of metals are present in shallow soils throughout the uplands portion of the Site at concentrations above cleanup levels (CULs) due to the long history of industrial site use.
- In the northwestern portion of the uplands, CA 2 is an area of deeper soil containing concentrations of copper and zinc representing a source of those metals to nearshore groundwater.

- In the northeastern portion of the uplands, CA 3 is where the 2018 interim action removed petroleum-contaminated soils (Floyd|Snider, 2019b) but has residual concentrations of polycyclic aromatic hydrocarbons (PAHs) exceeding groundwater CULs (specifically 1-methylnaphthalene).

The CAP-specified cleanup action for the three upland CAs includes:

- **Shallow Soil Source Removal and Capping in CA 1:** One of the following cleanup actions will be implemented in CA 1 to address metals contamination in shallow soil[1]:
  - Removal of the top 2 feet of contaminated soil to support gravel cap placement. Excavated soil would be disposed of off site at a permitted facility. A geotextile indicator fabric would be placed over the excavated areas to prevent mixing of clean surface gravel with contaminated subsurface material and to provide a visible indicator of that interface during any future subsurface work. Excavated areas would then be capped with a compacted gravel surface meeting Site operational requirements with installation of appropriate stormwater drainage controls for the new surface; or
  - Removal of the top 1 foot of contaminated soil to support pavement placement. Excavation depth would vary across the Site based on geotechnical conditions and existing grades. A separation geotextile would be placed over the excavation, which would then be backfilled with compacted base course material as necessary to support new asphalt pavement. Stormwater infrastructure would be installed in paved areas to manage stormwater runoff.
- **Deeper Soil Source Removal in CA 2:** This selected cleanup includes excavation of deeper copper- and zinc-contaminated soil contributing to localized copper and zinc exceedances in shoreline groundwater. The inferred lateral extents of excavation are described in Section 4.3 based on analysis of the results from the PRDI data collection effort and earlier soil sampling.
  - The CAP allows for *in situ* soil solidification/stabilization (ISS) as a contingency measure that may be conducted in CA 2, if it is determined during design that excavation of soil to CULs is not practicable due to geotechnical or other constraints. Based on the current understanding of the CA 2 subsurface conditions, the Port plans to proceed with soil cleanup via excavation.
- **Monitored Natural Attenuation of Groundwater in CA 2 and CA 3:** The selected cleanup includes monitored natural attenuation (MNA) of groundwater for metals in CA 2 and PAHs (namely 1-methylnaphthalene) in CA 3 until compliance with cleanup standards are achieved.
  - Bioremediation for treatment of hydrocarbons in CA 3 groundwater is a contingency measure identified in the CAP that will be considered if

[1] The two capping methods may be used in different parts of the upland area as appropriate for the planned operational use of the Site.

groundwater compliance monitoring indicates additional cleanup is required to accelerate MNA under the final remedy. Section 2.6.2 discusses that option.

- **Institutional Controls:** The implementation of institutional controls in the form of an Environmental Covenant will place several general and specific prohibitions, restrictions, and requirements on post-cleanup activities within the Site. Institutional controls would also include implementation of an Operations, Management, and Monitoring Plan that would specify cap inspection/maintenance, soil management, and health and safety requirements for future excavation work.

2 Upland Pre-Remedial Design Investigation Methods and Results

This section describes the scope of work and results of the PRDI in the upland portion of the Site. The results of the PRDI inform the design of the contaminated soil removal, capping, and groundwater monitored natural attenuation components of the upland cleanup action.

2.1 Scope of Work

In accordance with the PRDI Work Plan (Anchor and Aspect, 2021), the following work was performed to further assess and quantify Site and contaminant conditions within the upland cleanup areas as defined in the CAP:

1. A survey of surface conditions and utility locations in CA 1 and CA 2
2. An upland structural inspection
3. Additional environmental and geotechnical soil characterization in CA 2
4. Groundwater hydraulic testing and tidal study in CA 2
5. Groundwater quality sampling and analysis in CA 3

The scope and results of these PRDI activities are further described in the following sections.

2.2 Survey of Surface Conditions and Utility Locations

A licensed professional land surveyor, Wilson Engineering, LLC (Wilson) as subcontracted to Anchor QEA, completed a detailed survey of the existing topography and surface features across the upland area during April and May of 2022 to inform design requirements for the CA 1 and CA 2 excavations. Prior to that survey, a private utility locating service, Applied Professional Services (APS) conducted a subsurface utility locate in April 2022. The Site features, topography, and the utility locations marked by APS were captured by Wilson using unmanned aerial vehicle (UAV) photogrammetric methodologies. Wilson established UAV ground-control using a Trimble S7 Robotic 3 Total Station and Trimble R7 survey-grade GPS receivers.

We also reviewed the City IQ online map viewer (City of Bellingham, 2022) to evaluate the presence and locations of existing subsurface utility locations at the Site.

2.2.1 Topography and Surfacing

The ground surface across most of CA 1 and CA 2 primarily consists of gravel (crushed rock) with some concrete pads and paved asphalt areas that are generally flat. The paved marine rail area near the northern upland boundary slopes down to the water. Existing conditions and topography are shown on Figure 2.

2.2.2 Utilities

The following subsurface utilities were identified within the upland cleanup areas:

- **CA 1:** Storm drain, water, telephone, fiber optic, gas, power lines, and unidentified buried utilities.
- **CA 2:** Storm drain, water, power, fiber optic, and unidentified buried lines.

Figure 2 depicts locations of subsurface utilities identified by a professional locating service and survey, but there are no readily available as-built or other records documenting their size or depth.

Given the age of the facility and lack of accurate historical records, it is probable that subsurface utilities beyond those indicated on Figure 2 are present within the planned cleanup excavation extents. Decommissioning of inactive utilities and temporary removal and replacement of active utilities will be included as requirements in the construction plans and specifications for the upland cleanup action.

2.3 Structural Inspection

WSP USA (WSP) performed a structural inspection of the upland above-grade structures (e.g., marine railway winch house, paint and sandblast shops, water treatment infrastructure, and mechanical/electrical out buildings) (WSP, 2023). Warehouse buildings and associated office trailers were not considered in the assessment because they are not expected to be impacted by the remedial actions.

A report summarizing the findings from the structure inspection is provided in Appendix A. In general, the upland foundations and structures are in fair condition and excavation shoring is recommended if the water treatment structures were to remain in-place during excavation activities in CA 2. However, the water treatment structures, as well as the railway winch house, paint shop, sandblast shed, and other mechanical/electrical outbuildings are all to be removed prior to or during cleanup activities as shown on Figure 3. No deep excavation is planned adjacent to the remaining structures (e.g., Warehouse and Fabrication Shop). Therefore, the planned cleanup excavation activities are not expected to adversely impact the remaining structures.

2.4 Soil Characterization in CA 2

Ten soil borings (AB-01 through AB-10) were advanced to a depth of 15 feet below ground surface (bgs) to better delineate the lateral and vertical extents of copper-/zinc-contaminated soils requiring excavation in CA 2. In addition to the analytical data, geotechnical properties of the existing soil were documented to inform design of the CA 2 excavation, as well as the capping across CA 1. Some boring locations were shifted from the planned locations based on spatial constraints and obstructions encountered in the field at the time of drilling. The PRDI boring locations are shown on Figure 4.

2.4.1 Drilling and Soil Sampling Procedures

The soil borings were advanced by a licensed driller (Cascade) using sonic-core drilling methods on April 25 to 26, 2022. Disturbed soil samples were obtained from each boring in accordance with Standard Penetration Test (SPT) methods. Split spoon samples were collected from each boring at 2.5-foot intervals or as determined based on field conditions. Soil boring logs are provided in Appendix B for reference.

Four soil samples from each of the 10 borings were submitted to an Ecology-accredited analytical laboratory (Analytical Resources, Incorporated [ARI]) for analysis of copper and zinc. The soil sample depth intervals were selected based on field conditions (e.g., field screening indications of contamination and/or sample recovery volume). In the absence of contamination indicators (e.g., visual evidence of debris, sand blast grit, or other materials suspected of containing high metals concentration), sample depths for chemical analysis were as follows (and assuming adequate sample recovery):

- 2.5 to 4.0 feet bgs
- 5.0 to 6.5 feet bgs
- 7.5 to 9.0 feet bgs
- 12.5 to 14.0 feet bgs

Actual sample depths are shown on the boring logs in Appendix B and reflected in the sample identifications in Table 1. Laboratory Data Consultants (LDC), under subcontract to Anchor QEA, completed independent data quality review of the analytical data collected. No data were rejected during the review and the data was qualified as usable for their intended purpose. The PRDI data validation and analytical laboratory reports are provided in Appendix C for reference.

In accordance with the PRDI Work Plan, an archaeologist from AMS Affiliates Inc. of Stanwood, Washington, was present during the drilling of soil borings to monitor for cultural materials; none were observed.

2.4.2 Geologic Interpretation

In each of the ten borings, we observed gravel base extending from ground surface to 4 to 12 inches bgs. Directly below the gravel, we observed fill material consisting of sand, silty sand, or clayey sand with occasional gravel, silty gravel, and clayey gravel interbeds. In AB-04 and AB-05, we observed clay with gravel beginning at 12 feet bgs and extending to the depth of exploration (14 feet bgs). Silt was encountered in AB-10 from 4.5 to 9 feet bgs between sand and gravel layers. Varying amounts of shell fragments, wood debris, and miscellaneous debris (i.e., nails and rags) were encountered within the fill.

Based on the presence of shell fragments and the historical documentation, the fill material encountered in AB-01 through AB-10 likely consists of hydraulically dredged sediments that were placed in the 1930s along the northern and western portions of the Site. The fill exhibits moderate to high compressibility and low to moderate shear strength characteristics. It also exhibits moderate moisture sensitivity and moderate to high permeability.

We did not observe glacial outwash, till, or bedrock in our relatively shallow explorations AB-01 to AB-10. Groundwater was encountered between 9 and 12 feet bgs at the time of drilling in borings AB-1, AB-2, and AB-4 to AB-10. No water was encountered in AB-03.

2.4.3 Soil Chemical Analytical Results

Copper or zinc concentrations were detected in eight of the ten PRDI borings at concentrations exceeding respective soil CULs protective of groundwater (390 mg/kg copper and 960 mg/kg zinc). The depths of exceedances were not consistent across the eight borings. No exceedances were detected in the soil samples from borings AB-01 and AB-10. Analytical soil sampling results are presented in Table 1 and illustrated on Figure 4. Figure 4 color codes the soil quality data from the PRDI soil samples as (a) no exceedance of copper or zinc CULs (green), (b) an exceedance less than 2 times the CUL (orange), and (c) an exceedance greater than 2 times the CUL (red). Figure 4 also shows the older soil borings, color-coded equivalently, but without displaying all the individual samples results, for legibility.

As shown on Figure 4, concentrations of copper and zinc are present in soil throughout the uplands portion of the Site at concentrations exceeding CULs protective of groundwater. However, as discussed in Section 1.5, the empirical groundwater data from the Site indicate that only soils upgradient of well MW-2A and MW-12 are creating copper and zinc exceedances in groundwater.

2.5 Groundwater Hydraulic Testing and Tidal Study in CA 2

Because the CA 2 contaminated soils to be excavated may extend below the water table, the cleanup construction contractor may need to dewater the excavation area in CA 2. To assist the contractor in designing a dewatering approach, Aspect conducted hydraulic conductivity testing to estimate aquifer permeability in the vicinity of CA 2. In addition, continuous water level monitoring was performed to document groundwater elevations and the magnitude of tidal influence in the excavation area.

2.5.1 Hydraulic Conductivity Testing and Results

An Aspect engineer conducted field permeability (slug) testing on April 28 and May 3, 2022, to estimate horizontal hydraulic conductivity (K) of the shallow aquifer within CA 2. The slug tests were completed in MW-2A and MW-12, which are screened from approximately 5 to 15 feet bgs in the fill layer and located roughly between CA 2 and Bellingham Bay (Figure 2).

After reviewing the slug test data, the Bouwer & Rice (1976) method was used to estimate the K value of the material within the screened interval. Appendix D summarizes the testing methods, well parameters, and resulting K estimates, which were geometrically averaged for the well. The resulting K estimates from MW-02A and MW-12 are 2.4×10^{-4} centimeters/second (cm/sec) and 4.2×10^{-3} cm/sec, respectively. These estimates are consistent with the silty sand with low fines content described within the monitoring well screen intervals and with conditions observed in the field during testing.

2.5.2 Continuous Water Level Monitoring and Results

Aspect installed a digital pressure transducer with integral data loggers (Van Essen TD-Divers Model D1802) near the bottom of MW-2A and MW-12 and monitored groundwater depths from April 28 to May 3, 2022. A barometric digital pressure transducer (Van Essen Baro-Diver Model D1800) was installed near the ground surface in the well to measure the atmospheric pressure at the Site. Both pressure transducers were programmed to record pressure once every six minutes, consistent with the National

Oceanic and Atmospheric Administration (NOAA) frequency for collecting tidal stage measurements at gaging stations.

The groundwater levels at both wells show a definitive tidal influence with very little time lag from changes in tidal stage. The minimum and maximum depths to groundwater were roughly 8.5 and 11.2 feet bgs (between elevations 3.5 and 7.5 feet NAVD88) during the monitoring period. The groundwater levels at well MW-12S, located on the west side of CA 2, show a somewhat greater magnitude of tidal response (up to 3.0 feet) than does MW-2A located on the east side of CA 2 (up to 2.0 feet) (Figure D-1).

Groundwater levels will fluctuate seasonally with precipitation, as well as with tidal fluctuations in Bellingham Bay and changes in Site and near-Site surface conditions.

2.6 Groundwater Quality Sampling in CA 3

Two rounds of groundwater samples were collected from four existing wells in May and June 2022 from wells contiguous to CA 3 to document concentrations of PAHs and geochemical indicators. The results are used to assess natural attenuation of PAHs in groundwater and the potential need for a contingency measure to enhance hydrocarbon biodegradation in accordance with the CAP.

Groundwater samples from inland well MW-01 located near the former hydrocarbon source area, and nearshore wells MW-06 and MW-09 near the downgradient edge of CA 3 (Figure 5), were analyzed for PAHs (including 1-methylnaphthalene). The samples were also analyzed for geochemical indicators of hydrocarbon natural attenuation, including sulfate, nitrate, iron, manganese, and bicarbonate measured as alkalinity. To provide a basis for comparison to background geochemical conditions in groundwater, well MW-04 (located outside the CA 3 hydrocarbon plume based on historical sampling) was also sampled.

2.6.1 Groundwater Sampling Procedures

Groundwater samples were collected using low flow sampling procedures, including measurement of groundwater field parameters (pH, specific conductance, temperature, dissolved oxygen, and oxidation-reduction potential). The groundwater samples were submitted to ARI for chemical analyses. PRDI data validation and analytical laboratory reports are provided in Appendix C for reference.

2.6.2 Groundwater Chemical Analytical Results

Based on the results of the PRDI groundwater sampling in 2022, 1-methylnaphthalene groundwater impacts appear to be attenuating naturally following the 2018 interim action source removal. Figure 6 presents trend plots for 1-methylnaphthalene in monitoring wells MW-01, MW-06, and MW-09 for the years 2011 (pre-interim action) through 2022.

In addition, 1-methylnaphthalene was not detected above the CUL in monitoring wells MW-06 and MW-09 located along the shoreline downgradient of CA 3, which represents the groundwater conditional point of compliance in accordance with the CAP. The only CUL exceedance of 1-methylnaphthalene in groundwater was at inland well MW-01 (approximately 30 feet from the shoreline). The analytical results from PRDI groundwater sampling are summarized in Table 2 and shown on Figure 5.

An analysis of the geochemical results collected during the PRDI also provides clear evidence that natural hydrocarbon biodegradation is occurring and is a component of the natural attenuation occurring. As shown on Figure 7, nitrate and sulfate concentrations are depressed while ferrous iron and manganese are elevated as compared to background, which is indicative of biodegradation. While alkalinity was not elevated relative to background, the composition of the dredge fill material at the Site includes the presence of shell fragments, which makes differentiating between natural background and biological production difficult. For the three wells with historical hydrocarbon impacts (MW-1, MW-6, and MW-9), the alkalinity concentration is highest at inland well MW-1 where residual PAH concentrations are highest, which fits the pattern expected for ongoing hydrocarbon biodegradation.

Based on the multiple lines of evidence above, natural attenuation of PAHs is achieving protection from groundwater discharge to Bellingham Bay. Consequently, in accordance with the CAP, enhanced bioremediation of groundwater is not considered warranted for CA 3 at this time. Continued MNA of groundwater as part of the final uplands remedy is described further in Section 6. As a component of the MNA monitoring program to be established, bioremediation for treatment of hydrocarbons will be retained as a contingency measure that will be considered if long-term monitoring indicates additional cleanup is required to achieve protection of surface water.

3 Remedial Action Objectives and Cleanup Standards

Based on the cleanup standards presented in the CAP, the remedial action objectives (RAOs) for the upland areas at the Site are identified as follows:

1. **Protection of human health from direct contact with and ingestion of contaminated soil and groundwater through capping of contaminated soil and institutional controls.** Permanently remove the top 2 feet of metals contaminated soil in CA 1 and replace with a gravel cap to provide protection from direct contact with soil. Implement institutional controls to ensure continued protection from direct contact with soil and restrict groundwater use.
2. **Protection from soil contamination leaching to groundwater through excavation of contaminated soil.** Permanently remove metals-contaminated soils in CA 2 as described in Section 2.4 to achieve cleanup levels protective of soil contamination leaching to groundwater and enhance natural attenuation of groundwater impacts.
3. **Protection of surface water and sediment quality from groundwater contamination through monitored natural attenuation and institutional controls.** Implement monitored natural attenuation of metals- and PAH-contaminated groundwater in CA 2 and CA 3, respectively. Implement institutional controls to ensure continued protection of surface water and sediment quality from metals and PAH contamination.
4. **Protection from inhalation of vapors.** There are no buildings in the area that have diesel No. 2 contamination. There are aboveground trailers, but no buildings with on-grade or below-grade foundations within 30 feet of TPH contamination; therefore, there is no opportunity for vapor intrusion into buildings (Floyd|Snider 2019a). Prior to any future Site development involving occupied structures, soil vapor risk will be evaluated in consultation with Ecology using the most current and appropriate soil vapor guidance documents (Ecology, 2021).

The soil removal action and construction requirements for meeting these RAOs are described in Sections 4 and 5. An overview of the planned groundwater MNA program is included in Section 6. The requirements for the institutional controls (i.e., the environmental covenant) are outlined in Section 7.

3.1 Cleanup Standards

A cleanup standard consists of a cleanup level for a hazardous substance present at a site, combined with the location where the cleanup level must be met (point of compliance), and other regulatory requirements that apply to the cleanup action ("applicable state and federal laws"). The Site soil and groundwater cleanup levels and points of compliance are described below.

3.1.1 Soil

Table 3 lists the CAP's soil cleanup levels for the contaminants of concern for the site uplands, including which upland cleanup area (CA) the cleanup levels apply. The point of compliance for soil cleanup levels based on groundwater protection is all depths. The point of compliance for soil cleanup levels based on the (industrial) direct-contact exposure pathway is from the ground surface to 15 feet bgs.

3.1.2 Groundwater

Table 3 also lists the CAP's groundwater cleanup levels for the Site upland contaminants of concern. The cleanup levels are based on groundwater discharge to Bellingham Bay sediment and surface water. Because the highest beneficial use of Site groundwater at the Site is discharge to Bellingham Bay, the CAP set a groundwater conditional point of compliance at the point of groundwater discharge to sediment.[2]

[2] Groundwater discharges to sediment prior to discharging to the overlying surface water.

4 Soil Removal Action and Capping Design

This section describes the soil excavation and capping remedies to achieve RAOs 1 and 2 as described in Section 3.

4.1 Structure Demolition

Demolition will occur at the Site to allow access for the CA 1 and CA 2 remediation activities.

The selected contractor will be responsible for demolishing the water treatment building and associated treatment-related infrastructure (large tanks etc.), sandblast shed, paint shop, winch house, conex building, and paint building as part of the upland cleanup action as shown on Figure 3. Prior to demolition, the contractor will properly abate all regulated building materials (asbestos, lead-based paint, etc.) identified in the structures. The concrete pavement around the paint shop and sandblast shed, and the foundations for aboveground structures and water treatment infrastructure will also be demolished and removed during the upland cleanup.

The maintenance and fabrication shop, warehouse and associated office trailers, and structures associated with the used oil drum storage area, such as an oil-water separator, will be retained during the cleanup.

The upland concrete components of the marine railway system (sloped toward Bay) will not be removed or altered during the upland cleanup because there is no downslope shoreline structure against which to raise grade or prevent erosion if the concrete were removed; the existing concrete also serves as a suitable environmental cap. Changes to the marine railway system will be incorporated into the in-water cleanup design, which includes substantive improvements to the shoreline.

4.2 CA 1 Excavation and Capping

Cleanup for CA 1 includes a roughly 2-foot excavation of the entire upland area within the project limits outside of CA 3, the marine railway area, and below structures that will not be demolished. Areas below structures to be demolished will be excavated to 2 feet below existing surrounding grades, or as needed to remove the structure's foundation, whichever is deeper[3]. A separation geotextile will be installed on the excavation subgrade to prevent mixing of clean surface gravel with subsurface material and provide an indicator layer for any future subsurface work. All areas will be backfilled (capped) with 1 foot of gravel borrow and 1 foot of crushed surfacing base course (CSBC) suitable for heavy industrial use. The estimated extent of capping is shown on Figure 8 and includes CA 2[4].

The excavation depth may vary depending on the final grade of the surface needed to facilitate stormwater drainage. A 2-foot gravel cap is required as per the CAP. Therefore,

[3] However, any wood pilings supporting foundations will only be removed to a depth approximately 6 inches below the excavation subgrade.
[4] Per the CAP, CA 2 includes soil excavation deeper than that required for capping.

if the final grade is higher than the existing grade to facilitate drainage, then less excavation may be required to achieve the required 2-foot cap thickness. If the final grade is lower than the existing grade, then deeper excavation may be required. Final cut/fill elevations will be determined during the 90 percent engineering design.

If excavation extends 2 feet below existing grades, the CA 1 cleanup will include removal and off-site disposal of an estimated 9,760 bank cubic yards (approximately 16,600 tons) of soil containing elevated concentrations of metals exceeding CULs for industrial worker direct contact.

4.3 CA 2 Deeper Excavation for Metals Source Removal

Given the ubiquitous nature of copper and zinc exceedances in soil throughout the uplands (refer to Section 2.4.3), a MTCA three-part compliance analysis was performed to estimate the minimum extent of soil excavation required to meet soil CULs in CA 2 and thereby control the source of metals impacts contributing to the groundwater exceedances at shoreline monitoring wells MW-2A and MW-12. The extents of soil requiring removal determined by this methodology would be the minimum excavation conducted, with the actual extents determined by results of verification soil sampling conducted within the excavation. This analysis and the subsequent excavation extents for CA 2 are described in the following sections.

4.3.1 MTCA Three-Part Compliance Analysis

An “area of influence” for this analysis is defined as the area of soil impacts assumed to be contributing to the shoreline groundwater metals exceedances. Based on the distribution of copper and zinc data in soil and groundwater, an area of influence larger than the CA 2 excavation area established in the CAP was defined for this analysis. The area of influence was selected based on the locations of contaminated wells MW-2A and MW-12, the documented groundwater flow direction to the north-northwest, an assumed 120- to 150-foot upgradient distance of the contaminated wells. It includes the area extending approximately 40 feet east of MW-2A and west of MW-12 to account for variations in groundwater flow direction throughout the year (Figure 9).

The minimum excavation design was determined by applying the MTCA three-part compliance criteria as defined in WAC 173-340-740(7)(d) and (e), where compliance is defined as follows:

- The 95 percent upper confidence limit (UCL) on the mean concentration is less than the target cleanup level. For this evaluation, the 95 percent UCL values were calculated using the EPA’s ProUCL version 5.2 software[5];
- All residual soil concentrations are less than or equal to two times the target cleanup level; and
- The frequency of soil sample exceedance is less than 10 percent.

Using these criteria, the simulated compliance analysis begins by first removing the soil samples with copper or zinc concentrations exceeding two times the CUL from the soil data set within the area of influence. We assume these locations will be excavated as part

5 EPA’s statistical software package for analysis of environmental data sets (https://www.epa.gov/land-research/proucl-software)

of the cleanup. From there, the approach for defining the minimum extents of the excavation in CA 2 is focused on removal of CUL-exceeding soil samples adjacent to those initial areas to be excavated while meeting the compliance criterion of leaving less than 10 percent of CUL exceedances in place within the area of influence.

For purposes of this design analysis, the copper and zinc concentrations for soil samples to be excavated are replaced with the 95 percent UCL values in the initial data set (345 and 1,066 mg/kg for copper and zinc, respectively), which are assumed to be representative of post-excavation verification sample results at the excavation limits. Tables E-2 and E-3 in Appendix E include the ProUCL calculations for the baseline 95 UCL values (copper and zinc, respectively).

The modified data set for the area of influence, representing the minimum extents of the CA 2 excavation, is used to calculate the 95 UCL concentrations for copper and zinc in soil that remains in place after completion of the assumed excavation. Applying the baseline 95 UCL values for the residual in-place copper and zinc concentrations is considered a reasonably conservative approach because the statistical values include copper and zinc concentrations that exceed two times the target CUL—concentrations that will be removed during the cleanup.

The MTCA three-part compliance analysis specifics are summarized below and the supporting data and ProUCL calculations are presented in Appendix E (Tables E-1 through E-5).

- A total of 66 soil samples exist within the defined area of influence. The samples consist of those collected during Aspect's 2022 PRDI, detailed in Section 2.4, and historical data presented in the RI/FS (Floyd|Snider, 2019a).
- Copper and zinc were detected in each of the 66 samples, 17 of which have concentrations of copper and/or zinc that exceed respective CULs. Copper concentrations ranged from 13 to 2,140 mg/kg. Zinc concentrations ranged from 31 to 13,000 mg/kg. A 95 UCL value for both copper (345 mg/kg) and zinc (1,066 mg/kg) were calculated based on all in-place samples within the area of influence (pre-cleanup baseline conditions). The baseline data set used for these calculations is presented in Table E-1.
- Two samples exceeding two times the CUL will be removed during the shallow (upper 2 feet) CA 1 excavation: 3-A-0-0.3 (copper and zinc) and TP-10-1.2 (copper and zinc). Additional samples within the area of influence exceeding target CULs (but less than two times the CUL) will also be removed as part of the CA 1 excavation (3-B-0.2-0.7 (copper) and FS-03-1.5 (copper and zinc); sample locations shown on Figure 4).
- All remaining samples exceeding two times the CULs will be removed as part of the CA 2 deeper excavation design, shown on Figure 9, and as follows: AB-07-2.5-4.0 (copper), AB-07-7.5-8.0 (copper and zinc), FS-02-2.5 (copper and zinc), and MW-12-0-1 (copper and zinc).
- Additionally, the CA 2 excavation design will remove the following samples that exceed the respective CULs to reduce the frequency of exceedance to less than 10

percent for both copper and zinc: AB-02-2.5-4.0 (copper and zinc), AB-02-4.0-5.0 (copper and zinc), AB-07-2.5-4.0 (zinc), and MW-12-8-8.5 (copper and zinc).

The elements of the MTCA three-part analysis detailed above comply with two of the three metrics: (1) All samples within the area of influence exceeding two times the copper and zinc target cleanup levels will be removed as part of excavation CA 2 design (and CA 1, where applicable), and (2) Five sample locations exceeding the respective CULs will remain in place with the current excavation design. The five exceeding samples represent 7.6 percent of the 66 samples included within the area of influence, below the 10 percent compliance metric.

For the third metric (95 percent UCL concentrations), the results for the post-excavation in-place soil (modified data set including replacement values) are as follows:

- The 95 UCL value for copper based on the modified data set is 184 mg/kg, approximately 50 percent lower than the 390 mg/kg CUL. ProUCL identified the Student's-t UCL for a normal distribution to best fit the data set.
- The 95 percent UCL value for zinc based on the modified data set is 436 mg/kg, also approximately 50 percent lower than the 960 mg/kg CUL. ProUCL identified the Student's-t UCL for a normal distribution as best fitting to the zinc data.

The ProUCL 95 percent UCL calculations for the modified data sets are included in Tables E-4 and E-5 of Appendix E (copper and zinc, respectively).

The 95 percent UCL values based on the current excavation design and assumptions detailed above establish the final metric of compliance for the three-part analysis. The verification sample data and results of the three-part analysis will be reviewed and evaluated in consultation with Ecology as the excavation proceeds to obtain Ecology concurrence that the final excavation extent meets RAOs 2 and 3, defined in Section 3. Verification sampling and performance monitoring are detailed in Section 5.3.1.

Based on the MTCA three-part analysis, the minimum excavation in CA 2 is designed as two separate footprints as shown on Figure 9 as follows:

- The eastern excavation encompasses AB-09 and AB-02 and is adjacent and upgradient of MW-02A. This excavation will have a uniform depth of approximately 5.5 feet.
- The western excavation footprint encompasses AB-07, MW-12, AB-10 and FS-02. The southern portion of the excavation, encompassing AB-07 and MW-12, has a design depth of 9 feet. The northern portion, encompassing AB10 and FS-02, has a design depth of approximately 3.5 feet.

The fact that the highest baseline copper and zinc concentrations (requiring removal for MTCA compliance) exist immediately upgradient of wells MW-2A and MW-12 corroborates the CA 2 minimum excavation design.

Under this excavation design scenario, the following five samples within the area of influence with copper and/or zinc exceedances would not be removed: AB-03-7.5-8.5 (copper), AB-04-2.5-3.0 (copper and zinc), AB-05-6.5-7.5 (zinc), AB-06-2.5-4.0 (copper), and AB-08-2.5-4.0 (copper).

As stated above, the CA 2 excavation design represents the minimum extents of contaminated soils to be removed based on a simulated data set. During the cleanup action, verification soil samples will be collected on the excavation sidewalls and bottoms, and those data will be incorporated into a MTCA three-part compliance analysis to confirm actual extents of excavation. Verification sampling and compliance for the CA 2 excavation are detailed in Section 5.3.1. The verification sample data and results of the MTCA three-part compliance analysis will be reviewed and evaluated in consultation with Ecology as the excavation program proceeds to obtain Ecology concurrence that the CA 2 soil excavation has met CULs. This same excavation compliance approach was recently successfully applied, with Ecology concurrence, during the Port of Bellingham's Lignin Operable Unit soil removal in 2022 (Aspect, 2023).

4.3.2 CA 2 Excavation Extents and Quantities

CA 2 will consist of a western excavation that extends between 3.5 and 9 feet bgs (minimum) and an eastern excavation that extends at least 5.5 feet bgs (Figures 9 through 11). In this scenario, an estimated 980 bank cubic yards[6] (approximately 1,670 tons) of metals-impacted soils will be removed and disposed of off-site. These excavations will permanently reduce the source of metals below CULs protective of the soil leaching to groundwater pathway, thereby enhancing the natural attenuation of groundwater impacts and providing protection of Bellingham Bay surface water and sediment. The extent of CA 2 metals-impacted soils to be excavated are shown on Figure 9, and in cross section on Figures 10 and 11.

4.4 Stormwater System Replacement

As a necessary implication of the excavation and capping of CA 1, the stormwater surface drainage and conveyance system will require replacement. The preliminary stormwater drainage plan shown on Figure 12 includes the following components and approaches:

- New berm along the shoreline and top of slope at marine railway concrete area to ensure no sheet flow runoff to the Bay.
- New stormwater conveyance system better configured and sized to accommodate stormwater runoff from the regraded (capped) site. The stormwater conveyance system (catch basins and piping locations) will be determined during the 90 percent engineering design phase when the final grading plan is developed. The new stormwater conveyance system will connect to a stormwater treatment area along the western boundary of the upland area and from there to an existing outfall to Bellingham Bay located along the northern Site shoreline[7].
- New stormwater flow splitter manhole to direct the water quality flow rate to stormwater treatment devices and bypass greater flows directly to the outfall.

[6] Including assumed soil volume for sloping the 9-foot deep portion of the western excavation.

[7] This outfall may be replaced as part of the in-water cleanup action for the Site, anticipated to occur after the upland cleanup action. Any such permitting and construction would be accomplished as part of the Site's in-water cleanup and is not addressed in this document.

- New stormwater pre-treatment settling vault. Additional water quality treatment devices necessary to meet Ecology permitting will be the responsibility of the tenant and is not a component of the upland cleanup action.
- New tide check valve to prevent seawater from entering the stormwater conveyance system.

The final drainage and stormwater system design, including geotechnical design recommendations, will be determined during the 90 percent engineering design.

5 Upland Cleanup Construction Elements

Detailed design and construction recommendations for demolition and key earthwork activities anticipated for the Project are presented in the following sections. Material specifications reference the current Washington State Department of Transportation (WSDOT) Standard Specifications (WSDOT, 2022) unless otherwise noted.

5.1 Mobilization and Site Preparation

Prior to the start of cleanup construction, the Port's selected Contractor will prepare and submit for Port approval the following pre-construction submittals:

- **A Stormwater Pollution Prevention Plan (SWPPP)** describing erosion, sedimentation, and stormwater control Best Management Practices (BMPs) to be installed to manage and prevent stormwater runoff and fugitive dust emissions from leaving the construction site. The SWPPP and BMPs will be implemented by the Contractor and comply with City of Bellingham requirements throughout completion of the soil removal action.
- **Excavation and Water Management Plan** detailing the Contractor's planned means and methods for soil excavation, obstruction removal, materials handling and stockpiling on site, loading and off-site transportation of excavated materials, excavation backfill and compaction, as well as excavation dewatering, collection of runoff within the stockpile area, and treatment and discharge of water generated from excavation dewatering and from the stockpile area to comply with applicable permit requirements. The plan will also identify the permitted off-site facilities for disposal or recycling of materials generated during the soil removal action.
- **Construction Schedule** that identifies construction activities and milestones with estimated durations.

Cleanup mobilization and preparation activities include:

- Mobilize construction equipment, materials, and utilities (e.g., electrical generators).
- Mobilize, install, and test water management equipment as necessary (refer to Section 5.6).
- Construct a bermed and lined stockpile area(s) for contaminated soil pending transportation for off-site landfill disposal and a separate stockpile area for inert debris pending transportation for off-site recycling.
- Construct temporary erosion and sedimentation controls, including installation of a stabilized construction entrance, to ensure no materials track out and no construction stormwater leaves the Site throughout the cleanup earthwork, in accordance with the SWPPP.
- Decommission existing monitoring wells within CA 1 and CA 2 in accordance with the provisions of Chapter 173-160 WAC.

- Establish perimeter fencing for site security.

The construction entrance will be established at the existing entrance to the Site from Harris Avenue. Trucks used for the cleanup construction will be required to follow City-designated truck routes when driving to and from the construction entrance.

5.2 General Earthwork Considerations

Based on the explorations performed across the Site and our understanding of the Project, it is our opinion that the Contractor can complete earthwork and excavations with standard construction equipment. In general, unknown subsurface obstructions and debris are often found on shipyard Sites. It is likely that locations of all utilities (active or inactive) will not be known prior to excavation. The Contractor should be prepared to encounter unanticipated utilities, metal, concrete, or wood debris, boulders, and other miscellaneous materials during the CA 1 and CA 2 excavations.

5.2.1 Archaeological Resources

A subsurface archaeological site was identified within CA 3 during the 2017-2018 interim action cleanup (Floyd|Snider, 2019b). The archaeological site, 45WH1026, is a multicomponent shell midden, parts of which are disturbed. The full boundaries of the archaeological site are not known, and the documented extent is limited to the extents of excavation during the prior interim action cleanup. Prior to conducting the 2022 PRDI work in the uplands, a permit was obtained from the Department of Archeological and Historical Preservation (DAHP) that required on-site monitoring by a qualified archaeologist during all subsurface explorations. There was no evidence of shell midden or other cultural materials observed during the soil boring drilling within CA 2 during the PRDI.

However, the Port will obtain a revised or new DAHP permit for implementation of the upland cleanup actions. The upland cleanup excavation work will be completed with on-site archaeological monitoring in accordance with an Inadvertent Discovery Plan (IDP) to be developed during the DAHP permitting process. The IDP will define the stop-work and notification procedures to perform in the event of discovering potential archaeological materials while completing the excavation work.

5.2.2 Temporary Erosion and Sediment Controls

To prevent Site erosion during construction, appropriate temporary erosion and sedimentation control (TESC) measures will be used in accordance with local BMPs and the SWPPP. This will include a temporary construction exit, in accordance with City of Bellingham development guidelines, across which construction vehicles leaving the site must travel. If track-out of material is noted after a construction vehicle exits the Site, the Contractor will be required to immediately remove the tracked-out material and modify the construction exit to prevent further track-out. Other TESC measures may include appropriately placed silt fencing, straw wattles, rock check dams, and plastic covering of soil stockpiles. The Contractor will also apply BMPs (water truck, etc.) as needed to prevent fugitive dust emissions from leaving the Site during the cleanup earthwork.

5.2.3 Wet-Weather Conditions

The soils encountered at the Site contain variable amounts of fines (particles passing the U.S. Standard No. 200 sieve), making them moisture sensitive and subject to disturbance when wet. If earthwork is to be performed or backfill is to be placed under wet-weather conditions, when soil moisture content is above optimum and difficult to control, the following measures will apply:

- Earthwork should be performed in small areas to minimize exposure to rain.
- Excavation or removal of unsuitable soils shall be followed promptly by the placement and compaction of the specified structural fill.
- The size, type, and access of construction equipment used may have to be limited to prevent soil disturbance.
- The ground surface within the construction area shall be graded to promote runoff of surface water away from the slopes and to prevent water ponding.
- The ground surface within the construction area shall be properly covered and under no circumstances should be left uncompacted and/or exposed to moisture.
- Excavation and placement of backfill shall be observed by the Project Engineer to verify that all unsuitable materials are removed prior to placement, compaction requirements are met, and Site drainage is appropriate.
- Temporary erosion and sedimentation controls are implemented in accordance with the SWPPP.

5.2.4 Temporary Excavation Slopes

Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the Contractor. All temporary cuts in excess of 4 feet in height that are not shored or otherwise protected will be sloped in accordance with Part N of Chapter 296-155 WAC for worker safety. The existing fill is Type C Soil per the WAC and may be inclined no steeper than 1.5H:1V up to a maximum height of 20 feet.

The estimated maximum cut slope inclinations are provided for planning purposes only and are applicable to excavations without groundwater seepage or runoff and assume dry to moist conditions. Flatter slopes may be necessary in areas where groundwater seepage exists, or where construction equipment surcharges are placed in close proximity with the crest of the excavation.

With time and the presence of seepage and/or precipitation, the stability of temporary unsupported cut slopes can be significantly reduced. Therefore, all temporary slopes will be protected from erosion by installing a surface water diversion ditch or berm at the top of the slope. In addition, the Contractor will monitor the stability of the temporary cut slopes and adjust the construction schedule and slope inclination accordingly. Vibrations created by traffic and construction equipment may cause caving and raveling of the temporary slopes. In such an event, lateral support for the temporary slopes will be provided by the Contractor to prevent loss of ground support.

5.2.5 Temporary Excavation Support

The Contractor may use temporary shoring to facilitate excavation greater than 4 feet bgs, particularly within deeper trenches, if required, to install portions of the new storm drain piping system in conjunction with the environmental cap. General recommendations for the Contractor's design and implementation of trench shoring systems are presented below.

- Shoring should be designed and constructed to support lateral soil loads, and any surcharge loads from construction equipment, construction materials, excavated soils, and vehicular traffic.
- Precautions should be taken during removal of the shoring or sheeting materials to minimize disturbance of the pipe, underlying bedding materials, adjacent structures/utilities, and surrounding soils.
- Trench boxes, if used, should be adequately reinforced to withstand the lateral forces to which they will be subjected.
- Trench boxes should be of sufficient dimension, both vertically and laterally, to support the excavation without excessive deformation of the natural soils adjoining the open excavation. However, by their very nature, trench boxes normally are incapable of positive support of the trench walls and some deformation and possible spalling of the excavated slopes should be anticipated if trench boxes are employed. The Contractor should be responsible for repair of any deformation or damages that occur to adjoining facilities where trench box methods have been used.
- The open trench excavation should be backfilled immediately after the trench box has been moved.
- Trenches must be shored when heavy construction equipment and excavated soils are allowed within a lateral distance, measured from the edge of the excavation, equal to half the depth of the excavation.

5.3 Soil Excavation, Segregation, and Stockpiling

The planned contaminated soil excavation will extend to depths of 2 feet below grade in CA 1 (Figure 8), with deeper excavation planned to a maximum depth of 9 feet in CA 2 (Figures 9 through 11). The following sections discuss soil excavation, verification sampling, segregation, and stockpiling requirements.

5.3.1 Verification Sampling

Because the metals-impacted soils in CA 1 are being removed to facilitate capping, and not to achieve specific CULs for metals, verification sampling will not be conducted for the CA 1 excavation.

For the excavation of metals-impacted soils in CA 2, verification soil samples will be collected from the excavation sidewalls and floor to confirm that soil quality at the extents of the excavation comply with CULs for the protection of groundwater. Details regarding the excavation verification soil sampling and analysis will be presented in a Sampling and Analysis Plan (SAP) for the CA 2 soil removal. The SAP will be prepared as part of the 90 percent engineering design and reviewed and approved by Ecology prior to construction.

Where the concentration of metals in an excavation sidewall sample exceeds the CUL, the length of sidewall represented by the sample will be overexcavated a minimum of 1 foot laterally, if feasible, and a new sidewall verification sample will be collected. Likewise, where the concentration in an excavation bottom sample exceeds the cleanup level, the excavation will be deepened in the area represented by the sample by a minimum of 0.5 feet, if feasible, followed by collection of a new bottom verification sample.

As the excavation progresses, and existing soil samples representing contaminated soils are removed and replaced by new verification sample data, the residual in-place soil quality will be evaluated applying the MTCA three-part compliance criteria to confirm compliance with CULs[8] (WAC 173-340-740(7)(d) and (e)), where compliance is defined as follows:

- The 95 percent upper confidence limit (95 percent UCL) on the mean concentration is less than the target cleanup level;
- All residual soil concentrations are less than or equal to two times the target cleanup level; and
- The frequency of soil sample exceedance is less than 10 percent.

The verification sample data and results of the MTCA three-part compliance analysis will be reviewed and evaluated in consultation with Ecology as the excavation program proceeds in order to obtain Ecology concurrence that the soil excavation has met the applicable CULs while the Contractor remains working on other elements of the cleanup work.

5.3.2 Segregation of Excavated Soil

The estimated 10,740 bank cubic yards (approximately 18,270 tons) of excavated metals-contaminated soils from CA 1 and CA 2 may be disposed of at either a Subtitle D landfill or as Class 2 soils at Cadman's Everett or Iron Mountain's Granite Falls inert landfills, subject to obtaining approval from the individual disposal facilities. The choice soil disposal facility will be decided by the Contractor selected by the Port to conduct the cleanup construction.

5.3.3 Stockpile Management

If temporary stockpiling of excavated materials is needed during the cleanup activities, they will be placed within a designated stockpile area that will not hinder completion of the cleanup activities. The stockpile location may change through the course of construction if needed. Materials will be transported within the cleanup work area in a way to limit spillage of materials between the excavation location and the stockpile location.

Within the designated stockpile area, stockpiles of contaminated soil with debris will be segregated from stockpiles of inert debris such that intermixing does not occur. Each

[8] Dataset for the CA 2 Area of Influence that includes the existing data for soils not excavated plus the new excavation verification data.

stockpile will be underlain by plastic sheeting with a minimum 10-mil thickness, with adjacent sheeting sections continuously overlapped by a minimum of 3 feet. The ground surface on which the sheeting will be placed will be free of objects that could damage the sheeting. In addition, a layer of geotextile or plywood will be required on top of the sheeting to protect it. The stockpile area perimeter will be bermed to prevent stormwater run-on into, or runoff out of, the stockpile area.

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

Water accumulating in the stockpile area will be pumped to the on-site water management system described in Section 5.6.

5.4 Structural Obstruction Removal

Existing and historical structures (pavements, concrete foundation elements, etc.) are located on top of and adjacent to contaminated soils being removed. An estimated quantity of structural materials requiring removal will be provided in the 90 percent design. The structural elements include but are not limited to asphalt and concrete surfacing, building foundations and floor slabs, concrete tank pads and ancillary structures, wooden pilings supporting concrete foundations, and pipes of various sizes and materials.

The structural materials will be removed and resized as needed so that they can be handled and transported for off-site recycling or disposal. If visual and olfactory screening indicates the removed debris is contaminated (e.g., chemical staining or odors), it will be managed and disposed of at a Subtitle D landfill. Any wood pilings encountered within a soil excavation area will be broken off or cut at the base of the excavation, and the removed wood will be disposed of at a Subtitle D landfill. Any abandoned utilities will be cut and capped at the edge of the excavation; that portion of the utility extending within the excavation will be removed. All recyclable structural materials (asphalt, concrete, metal) removed during the cleanup will be transported to permitted facilities for recycling.

Prior to cleanup activities, a regulated building materials survey will be completed for the buildings to be removed as described in Section 4.1. Abatement of regulated building materials will be done prior to demolition of those structures.

5.5 Existing Utility Management

Numerous subsurface utilities were tentatively identified during the survey described in Section 2.2. It is anticipated that portions of these utilities will be encountered during the excavation activities in CA 1 and CA 2. Utilities no longer in use, as determined by the Port and tenant, will be cut and capped in place. Active utilities will require protection during excavation and may require temporary disconnection and/or relocation. The Contractor will determine the specific methods for utility protection, disconnection/

reconnection, and/or relocation, and will be responsible for coordinating with the local utility department, tenant, and Port accordingly.

The components of the stormwater drainage system, including catch basins and conveyance pipe, located above the required excavation depths will be removed and replaced as part of the cleanup as described in Section 4.4. Stormwater piping extending deeper than the planned excavation depths will be cut and capped in place, unless further removal is deemed practical by the Engineer in consultation with the Port.

5.6 Excavation Dewatering and Water Management

The majority of the planned soil excavations are above the water table observed during late-April 2022 (wet-season) conditions; therefore, the need for excavation dewatering is anticipated to be minimal. Dewatering of deeper excavations will be conducted as necessary to maintain unsaturated excavation conditions to facilitate soil excavation/handling/loading for transport, verification soil sampling in the excavation, and excavation backfilling and compaction. Means and methods for dewatering will be determined by the Contractor, and likely would include temporary sumps within the open excavation.

Groundwater extracted during excavation dewatering, and any water accumulating within the contaminated soil stockpile area, will be conveyed to the Contractor's temporary on-site water treatment system where it will be treated as needed to meet all permit requirements for discharge.

The cleanup Contractor will discharge the treated water to surface water via the City of Bellingham storm drain in accordance with a National Pollution Discharge Elimination System (NPDES) Construction Stormwater General Permit (CSGP) with project-specific Administrative Order issued by Ecology. The Port plans to obtain the CSGP with Administrative Order but, upon the execution of the contract for the soil removal project, the Port will transfer in full the permit to the Contractor. The Contractor will be required and responsible to comply with all of its provisions including but not limited to initial treatment batch testing to demonstrate achievement of permit indicator levels prior to any discharge, obtaining Ecology approval for flow-through operation and discharge based on the batch testing results, and conducting monitoring and reporting to Ecology throughout the duration of treatment and discharge.

5.7 Soil Loading and Off-Site Disposal

Prior to the start of construction, the contaminated soil waste stream will be profiled, using existing data, to obtain pre-approval for proper off-site disposal as non-hazardous waste at a permitted disposal facility. The Contractor will be responsible for selecting and subcontracting with the off-site soil disposal facility permitted to accept each of the waste streams identified in the construction plans and specifications. The Contractor will provide the Port's Engineer with copies of the certificates of disposal for material disposed of off-site, and the Engineer will include them in the As-Built Cleanup Report documenting the soil removal cleanup action (refer to Section 9).

The truck route for the cleanup project will not use residential streets. Trucks hauling contaminated materials from the Site will remain covered from the time they leave the Site until they off-load at the designated facility.

5.8 Excavation Backfill and Compaction

During placement and compaction of excavation backfill in CA 1 and CA 2, the Contractor shall control surface water and groundwater inflow such that the backfill material can be compacted to meet the contract specifications. The final surface will be graded to meet stormwater drainage requirements (draining to catch basins at location to be determined during 90 percent engineering design) as well as match the surrounding area.

5.8.1 Subgrade Preparation

Subgrade preparation will include removal of all debris, loose fill soils, roots, and any other deleterious materials. The on-Site soils contain variable amounts of fine-grained particles, which makes them moisture sensitive and subject to disturbance when wet. The Contractor must use care during Site preparation and excavation operations so that any bearing surfaces below pavement areas or below stormwater structures are not disturbed. If this occurs, the disturbed material will be removed to expose undisturbed material.

5.8.2 Separation Geotextile

A non-woven separation geotextile will be installed on excavation subgrades to prevent mixing of clean surface gravel with subsurface material and provide an indicator layer for any future subsurface work. The geotextile shall meet the requirements in the WSDOT Standard Specifications, Section 9-33, Table 3 (non-woven geotextile for separation) (WSDOT, 2023).

5.8.3 Backfill Material

The CA 1 and CA 2 excavations will be backfilled with at least 1 foot of gravel borrow from subgrades to 1 foot below finished grades. The upper foot of the excavations will be backfilled with 1 foot of CSBC (minimum). Gravel Borrow and CSBC shall meet the requirements of WSDOT Standard Specification Sections 9-03.14(1) and 9-03.9(3), respectively (WSDOT, 2023).

5.8.4 Backfill Compaction Requirements

Gravel borrow placed deeper than 2 feet bgs shall be compacted to 90 percent of the maximum dry density (MDD) as determined by ASTM D1557 or to the satisfaction of an on-site Aspect engineer or geologist. Between 0 and 2 feet bgs, the Contractor shall compact each layer of gravel borrow or CSBC to achieve minimum 95 percent of the MDD as determined by ASTM D-1557 or to the satisfaction of an on-site Aspect engineer or geologist. The Contractor shall adjust moisture content during compaction to produce a firm, stable, and unyielding embankment. The compacted cap surface shall be free from pumping and rutting due to excessive moisture.

The procedure to achieve the specified minimum relative compaction depends on the size and type of compacting equipment, the number of passes, thickness of the layer being compacted, and certain soil properties. When the size of the excavation restricts the use of heavy equipment, smaller equipment can be used, but the soil must be placed in thin enough lifts to achieve the required compaction.

When the first fill lift is placed in a given area, and/or any time the fill material changes, the area will be considered a test section. The test section will be used to establish fill placement and compaction procedures required to achieve proper compaction. An Aspect engineer or geologist shall observe placement and compaction of the test section to assist in establishing an appropriate compaction procedure and continue to monitor the Contractor's operations once a placement and compaction procedure is established.

5.9 Pipe Bedding for Stormwater Piping

The requirements for pipe bedding and trench backfill are presented below:

- Pipe bedding material, placement, compaction, and shaping shall be in accordance with the project specifications and the pipe manufacturer's recommendations. As a minimum, the pipe bedding shall meet the gradation requirements for Gravel Backfill for Pipe Zone Bedding, Section 9-03.12(3) of the WSDOT Standard Specifications (WSDOT, 2023).
- Pipe bedding materials shall be placed on relatively undisturbed native soils, or compacted fill soils. If the subgrade soils are disturbed, the disturbed material shall be compacted in place or removed and replaced with additional compacted bedding material.
- In areas where the trench bottom encounters very soft or organic-rich subgrade soils, it will be necessary to overexcavate the unsuitable material and backfill with pipe bedding material. However, the depth of overexcavation shall generally be limited to a maximum of 2 feet, and should be confirmed by the geotechnical engineer. If necessary, and as determined by the geotechnical engineer, a soil separation-grade geotextile may be utilized to limit trench-base overexcavation requirements.
- Pipe bedding shall provide a firm, uniform cradle for the pipe. We recommend a minimum of 4 inches of bedding material be placed beneath the pipe. The pipe bedding should extend at least 6 inches above the pipe crown or such greater thickness as may be required by the pipe manufacturer.
- Pipe bedding material and/or backfill around the pipe shall be placed in layers and tamped to obtain complete contact with the pipe.

5.10 Subsurface Structures

Geotechnical considerations for subsurface structures such as, manholes and vaults, will be provided in the 90 percent engineering design.

6 Monitored Natural Attenuation of Groundwater

Following the soil removal action described above, the cleanup action includes MNA for metals and PAHs in groundwater for CA 2 and CA 3, respectively. This section provides an overview of MNA activities to achieve RAO 3 as described in Section 3. The detailed monitoring approach, including locations of new monitoring wells, will be described in the Groundwater MNA Compliance Monitoring Plan for the Site, to be prepared under separate cover.

6.1 MNA of Metals in CA 2

Following the soil removal, groundwater MNA will address residual dissolved copper and zinc concentrations that exceed groundwater CULs based on protection of discharge to Bellingham Bay. The dissolved metals concentrations are expected to continue to attenuate through a combination of sorption/complexation and dispersion. Attenuation will be significantly enhanced by the soil removal project and substantive source reduction.

6.2 MNA of PAHs and Arsenic in CA 3

CA 3 is where the 2018 interim action removed contaminated soils but has residual concentrations of 1-methylnaphthalene and arsenic in groundwater exceeding CULs based on protection of discharge to Bellingham Bay. The PAH concentrations in groundwater are expected to continue to attenuate through biodegradation as discussed in Section 2.6. Likewise, the elevated dissolved arsenic concentrations were attributed to highly reducing groundwater conditions when the large quantity of petroleum contamination was in-place, and those concentrations are expected to gradually attenuate following the interim action’s removal of that contaminant mass.

6.3 Groundwater Compliance Monitoring

The Compliance Monitoring Plan for groundwater MNA will identify monitoring locations, analytes, and frequency. All existing upland monitoring wells within CA 1 and CA 2 will be decommissioned prior to the start of the soil removal action, and therefore, new monitoring wells will be installed for the MNA monitoring program after completion of the soil removal project. The MNA monitoring wells will include positions along the downgradient edge of the Site which, based on a groundwater flow direction generally toward the north, would be along the northern boundaries of the upland area adjacent to surface water, established as the conditional points of compliance for groundwater in the CAP. Specific locations for the new wells will be identified in the MNA Compliance Monitoring Plan and may consider location of utilities or other access considerations following completion of the soil removal action.

The MNA Compliance Monitoring Plan will also define requirements for data evaluation and reporting, including a decision process for adjusting the monitoring program over time and ultimately ceasing it. It will also include provisions for implementation of contingency actions if it is determined that groundwater MNA within CA 2 and CA 3 is not sufficient to prevent migration of groundwater exceeding cleanup levels to Bellingham Bay. A first indication for assessing contingency actions for groundwater

MNA would be observing a statistically significant increasing trend for contaminant concentrations in a well at the downgradient edge of the Site. An evaluation of concentration trends could be conducted after 2 to 3 years of data, allowing any temporary effects from the large-scale cleanup earthwork activities to dissipate. Depending on the data set available at that time, the trend statistical significance analysis would be conducted using either parametric methods (e.g., *t*-test on slope of linear regression) or nonparametric methods (e.g., Mann-Kendall test) as outlined in Appendix D of Ecology (2005) and Section 17.3 of EPA (2009).

If a contingent action is determined to be necessary, substantial additional information would be available at that time to determine the causes of MNA failure and, therefore, the most effective and practicable means to remedy it. The cause of increasing contaminant concentrations in groundwater would dictate the appropriate contingent action.

For example, if it is determined that increasing dissolved metals concentrations in CA 2 are a result of changes to groundwater pH, then a contingent action to restore groundwater pH to near-neutral conditions would likely be appropriate. This could be accomplished by delivering pH buffering/neutralization media into the water-bearing zone via injection or direct emplacement of a solid media in a permeable reactive barrier (PRB). In addition to delivery method, the choice of specific treatment media is further dependent on whether the goal is to mitigate acidic or alkaline pH. If PAH concentrations in CA 3 are deemed to be not protective, enhanced biodegradation could be implemented as identified in the CAP.

Alternatively, groundwater containment could be applied to limit the migration of dissolved metals to Bellingham Bay. Migration of contaminated groundwater could also be controlled using physical containment methods such as slurry walls or by groundwater extraction and treatment (pump-and-treat). While technically feasible, groundwater containment measures are likely to be deemed less practicable than *in situ* treatment methods in this case.

A plan for implementing a groundwater contingency action would be provided for review and approval by Ecology prior to implementing the action.

7 Institutional Controls (Environmental Covenant)

The Port and Ecology will develop an environmental covenant for the Site that will restrict certain activities and uses of the property to protect the integrity of the selected cleanup action and thereby protect human health and the environment. It is anticipated that institutional controls for the Site will ensure all RAOs are achieved by:

- Prohibiting interference with the completed cleanup action
- Maintaining the cap to prevent direct contact with potentially impacted soil
- Prohibiting use of groundwater
- Restricting the use of the Site to an industrial use
- Restricting future site development involving occupied structures unless soil vapor risks are evaluated
- Providing for long-term compliance monitoring and stewardship

The Port will work with Ecology and the Attorney General's Office to define the covenant's specific restrictions and requirements applicable to the Site prior to the covenant being legally recorded with Whatcom County.

8 Permits and Substantive Requirements

In accordance with MTCA, the upland cleanup action is exempt from the procedural requirements of Chapters 70.94, 70.95, 70.105, 77.55, 90.48, and 90.58 of the Revised Code of Washington (RCW), and of any laws requiring or authorizing local government permits or approvals. However, the Port must still comply with the substantive requirements of such permits or approvals (WAC 173-340-520). In addition, the cleanup action is not exempt from federal permits and requirements.

The soil cleanup action will require discharge of construction stormwater and excavation dewatering water to surface water in accordance with a NPDES CSGP with project-specific Administrative Order issued by Ecology. Construction-generated stormwater and/or dewatering water discharged to surface waters of the state will comply with all requirements of the CSGP with Administrative Order. The Port plans to obtain the CSGP with Administrative Order but, upon the execution of the contract for the soil removal project, the Port will transfer in full the permit to the Contractor.

Washington State law requires a permit for ground disturbance within the boundaries of an archaeological site (Revised Code of Washington 27.53 and Washington Administrative Code 25-48-060). Because a documented archaeological site occurs within the upland area, the Port will obtain a DAHP permit requiring oversight of excavation activities by a qualified archaeologist.

The cleanup action complies with the State Environmental Policy Act (SEPA; RCW 43.21C and WAC 197-11-250 through -259). Ecology conducted the SEPA review process, including the requisite public comment period, and in December 2020 issued a Determination of Non-Significance for the proposed cleanup action. Ecology has determined that the 2020 SEPA determination covers the planned upland cleanup action for the Harris Avenue Shipyard.

The following sections outline how substantive requirements of procedurally exempt local permits will be met during implementation of the upland cleanup action for the Site.

8.1 Permit Substantive Requirements

The soil removal action is subject to the following local requirements, but is procedurally exempt from them:

- Major Grading Permit as per City of Bellingham Grading Ordinance, Bellingham Municipal Code (BMC) 16.70.
- City of Bellingham Shoreline Master Program (SMP), BMC Title 22
- Critical Areas Permit as per City of Bellingham Critical Areas Ordinance, BMC 16.55.
- City of Bellingham Stormwater Requirements, BMC 15.42.

The applicable substantive requirements of the state and local permits or approvals, and the general manner in which the cleanup action will meet them, are identified below. The

Port will continue to coordinate with the City regarding implementation of the cleanup action project. This includes providing to the City a letter describing, with references to specific portions of the Construction Plans and Specifications, how the cleanup action work will meet the substantive requirements of their permits listed below and obtaining written concurrence from the City, as done for all prior cleanup actions conducted on similar Port properties.

8.1.1 City of Bellingham Major Grading Permit

Pursuant to the City of Bellingham Grading Ordinance (BMC 16.70.070), a Major Grading Permit is required from the City for grading projects that involve more than 500 cubic yards of grading. The permit-required standards and requirements will be integrated into the cleanup action Construction Plans and Specifications to ensure the construction complies with the substantive requirements of the City grading ordinance. Those substantive requirements include: location and protection of potential underground hazards; proper vehicle access point to prevent tracking of soil outside of the project site; erosion control; work hours and methods compatible with weather conditions and surrounding property uses; prevention of damage or nuisance; maintaining a safe and stable work site; compliance with noise ordinances and zoning provisions; and compliance with City traffic requirements when using City streets.

8.1.2 City of Bellingham Shoreline Substantial Development Permit

The upland cleanup action will occur within the regulated shoreline area designated by City of Bellingham SMP (BMC Title 22) as Urban Maritime. The cleanup action must therefore meet the substantive requirements of a City Shoreline Substantial Development Permit (SSDP). To comply with the SSDP, the project must have no unreasonable adverse effects on the environment or other uses, no interference with public use of public shorelines, compatibility with surroundings, and no contradiction of purpose and intent of SMP designation.

8.1.3 City of Bellingham Critical Areas Ordinance

This cleanup will occur on land designated as a seismic hazard area by BMC 16.55 Critical Areas because it occurs on man-made fill. However, this soil removal project is not a development proposal and does not include construction of any improvements. The planned soil removal activities, and the final excavation condition, will not exacerbate seismic hazards within the work area or surrounding property.

8.1.4 City of Bellingham Stormwater Requirements

Pursuant to the City of Bellingham Stormwater Management ordinance (BMC 15.42), the cleanup must meet the requirements of a City Stormwater Permit. The cleanup action does not include construction of any improvements, and the substantive requirements will be met by preparation of and compliance with a SWPPP to infiltrate construction stormwater and prevent its off-site runoff, control sources of pollution, and preserve natural drainage systems and outfalls.

9 Construction Documentation and Reporting

Upon completion of the cleanup, a draft As-Built Cleanup Report describing the methods and outcome of the excavation and capping will be prepared and submitted to Ecology for review and comment. The data collected during the cleanup will be uploaded to Ecology's Environmental Information Management (EIM) database.

10 Schedule

The preliminary anticipated milestones for the soil removal action are as follows:

- **December 2023 to February 2024:** Review and finalization of the Construction Plans and Specifications.
- **March to April 2024:** Port solicits competitive construction bids for the soil removal.
- **April 2024:** Port awards contract to selected Contractor.
- May to August 2024: Cleanup construction.
- **November 2024:** Submit draft As-Built Cleanup Report to Ecology for review.
- **December 2024:** Submit draft Groundwater MNA Compliance Monitoring Plan to Ecology for review.

This schedule may be adjusted based on conditions encountered during cleanup or other factors.

11 References

Aspect Consulting (Aspect), 2023, As-Built Cleanup Report, Lignin Operable Unit, Georgia-Pacific West Site, Bellingham, Washington, March 2023.

Floyd|Snider 2019a, Remedial Investigation/Feasibility Study, Port of Bellingham Harris Avenue Shipyard, June 2019.

Floyd|Snider 2019b, Interim Action Construction Completion Report, Port of Bellingham Harris Avenue Shipyard, March 2019.

United States Environmental Protection Agency (EPA), 2009, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, EPA 530/R-09-007, March 2009.

Washington State Department of Ecology (Ecology), 2005, Guidance on Remediation of Petroleum-Contaminated Groundwater by Natural Attenuation, Ecology Publication No. 05-09-091, July 2005.

WSP, 2023, Harris Avenue Shipyard – Upland Area Condition Assessment Report, February 2023.

12 Limitations

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

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

TABLES

Table 1. Summary of PRDI Soil Analytical Results

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

			Copper (mg/kg)	***Zinc (mg/kg)***
		Site Soil Cleanup Levels	390	960
Sample Location	**Date Collected**	**Sample Name**		
AB-01	4/26/2022	AB-01-2.5-4	**272**	**366**
		AB-01-5.0-6.5	**83.9**	**142**
		AB-01-7.5-8	**349**	**227**
		AB-01-12.5-13	**31.0**	**45.0**
AB-02	4/26/2022	AB-02-2.5-4.0	**470**	**1190**
		AB-02-4.0-5.0	**693**	**1720**
		AB-02-6.0-7.5	**87.1**	**320**
		AB-02-11-12	**88.4**	**262**
AB-03	4/26/2022	AB-03-2.5-4.0	**38.5**	**61.5**
		AB-03-5.0-6.5	**173**	**277**
		AB-03-7.5-8.5	**408**	**613**
		AB-03-11-12.5	**34.0**	**49.7**
AB-04	4/25/2022	AB-04-2.5-3.0	**432**	**1490**
		AB-04-5-6.5	**40.4**	**95.3**
		AB-04-7.5-9.0	**28.1**	**110**
		AB-04-12.5-14	**40.7**	**72.9**
AB-05	4/25/2022	AB-05-2.5-4.0	**65.7**	**106**
		AB-05-5.0-6.5	**126**	**195**
		AB-05-6.5-7.5	**312**	**1100**
		AB-05-12.5-13	**84.2**	**222**
AB-06	4/25/2022	AB-06-2.5-4.0	**477**	**292**
		AB-06-4.0-5.0	**277**	**250**
		AB-06-7.5-9.0	**53.5**	**104**
		AB-06-11.5-12.5	**29.7**	**47.2**
AB-07	4/25/2022	AB-07-2.5-4.0	**899**	**625**
		AB-07-5-6.5	**23.1**	**52.1**
		AB-07-7.5-8.0	**1890**	**1940**
		AB-07-12.5-14.0	**63.2**	**77.1**

Table 1. Summary of PRDI Soil Analytical Results

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

			Copper (mg/kg)	***Zinc (mg/kg)***
		Site Soil Cleanup Levels	390	960
Sample Location	**Date Collected**	**Sample Name**		
AB-08	4/25/2022	AB-08-2.5-4.0	**419**	**751**
		AB-08-5-6.5	**160**	**260**
		AB-08-7.5-9.0	**303**	**512**
		AB-08-11.5-12.5	**23.0**	**43.3**
AB-09	4/26/2022	AB-09-2.5-4	**389**	**1140**
		AB-09-5.0-6.5	**156**	**191**
		AB-09-7.5-9.0	**33.9**	**72.0**
		AB-09-11-12.5	**25.6**	**35.9**
AB-10	4/26/2022	AB-10-4.5-5.0	**55.8**	**154**
		AB-10-7.0-7.5	**51.4**	**103**
		AB-10-7.5-10	**117**	**305**
		AB-10-2.5-4.0	**65.8**	**211**

Notes:

Bold - detected

Blue Shaded - Detected result or non-detected RL exceeded screening level

mg/kg = milligrams per kilogram

Table 2. Summary of PRDI Groundwater Analytical Results

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

		Location	MW-01		MW-04		MW-06		MW-09	
		Date Collected	05/03/2022	06/14/2022	05/02/2022	06/13/2022	05/03/2022	06/13/2022	05/02/2022	06/13/2022
Analyte	Unit	Site Groundwater Cleanup Levels								
PAHs										
1-Methylnaphthalene	ug/L	1.5	**56.3**	**46.6**	--	--	**0.672**	**0.03**	**0.036 J**	**0.799**
2-Methylnaphthalene	ug/L		**36.1**	**30.6**	--	--	**0.433**	**0.015**	**0.158 J**	**0.205**
Acenaphthene	ug/L		**17.3**	**11.5**	--	--	**0.56**	**0.276**	**0.145 J**	**0.745**
Acenaphthylene	ug/L		**0.345**	**0.261**	--	--	**0.025**	**0.017**	**0.079 J**	**0.073**
Anthracene	ug/L		**0.522**	**0.462**	--	--	**0.041**	**0.002 J**	**0.042 J**	**0.042**
Benzo(g,h,i)perylene	ug/L		**0.148**	**0.033**	--	--	**0.025**	0.010 U	**0.057 J**	**0.06 J**
Benzofluoranthene	ug/L		**0.738**	**0.166**	--	--	**0.097**	0.010 U	**0.231 J**	**0.248**
Carbazole	ug/L		**17.1**	**13.8**	--	--	**0.066**	**0.002 J**	**0.105 J**	**0.196**
Dibenzofuran	ug/L		**6.13**	**4.7**	--	--	**0.162**	**0.009 J**	0.01 UJ	**0.345**
Fluoranthene	ug/L		**2.83**	**0.887**	--	--	**0.237**	0.010 U	**0.454 J**	**0.618**
Fluorene	ug/L		**14.9**	**10.5**	--	--	**0.458**	**0.146**	0.01 UJ	**2.68**
Naphthalene	ug/L		**0.457**	**0.375 J**	--	--	0.01 U	0.010 U	**0.035 J**	**0.04**
Perylene	ug/L		**0.169**	**0.042**	--	--	**0.013**	0.010 U	**0.028 J**	**0.03**
Phenanthrene	ug/L		**11.3**	**5.57**	--	--	**0.338**	**0.002 J**	**0.032 J**	**0.056**
Pyrene	ug/L		**2.52**	**0.76**	--	--	**0.283**	**0.003 J**	**0.812 J**	**0.905**
Benz(a)anthracene	ug/L		**0.48**	**0.123**	--	--	**0.049**	0.010 U	**0.167 J**	**0.193**
Benzo(a)pyrene	ug/L		**0.358**	**0.084**	--	--	**0.044**	0.010 U	**0.113 J**	**0.126 J**
Benzo(b)fluoranthene	ug/L		**0.341**	**0.068**	--	--	**0.054**	0.010 U	**0.124 J**	**0.126 J**
Benzo(b,k)fluoranthene	ug/L		**0.738**	--	--	--	**0.097**	--	**0.231**	--
Benzo(j)fluoranthene	ug/L		**0.203**	**0.049**	--	--	**0.02**	0.010 U	**0.046 J**	**0.055**
Benzo(k)fluoranthene	ug/L		**0.195**	**0.049**	--	--	**0.023**	0.010 U	**0.061 J**	**0.066 J**
Chrysene	ug/L		**0.452**	**0.11**	--	--	**0.049**	0.010 U	**0.186 J**	**0.195**
Dibenzo(a,h)anthracene	ug/L		**0.049**	**0.008 J**	--	--	**0.004 J**	0.010 U	**0.011 J**	**0.013 J**
Indeno(1,2,3-cd)pyrene	ug/L		**0.144**	**0.03**	--	--	**0.019**	0.010 U	**0.048 J**	**0.049 J**
Geochemical Indicators for Natural Attenuation										
Alkalinity, Total	mg/L		**329**	**330**	**501**	**520**	**152**	**170**	**147**	**180**
Nitrate as Nitrogen	mg/L		0.01 U	0.010 U	**2.4**	**3.9**	**0.218**	**0.136**	0.01 U	0.010 U
Sulfate	mg/L		**4.22**	**5.19**	**79.8**	**104**	**15.1**	**13.2**	**3.42**	**3.68**
Dissolved Iron	ug/L		**11100**	**12800**	**21.4 J**	**25.3 J**	**1820**	**96.6**	**1760**	**1510**
Dissolved Manganese	ug/L		**2600**	**3450**	**10.9**	**29.6**	**198**	**75.1**	**493**	**503**

Table 2. Summary of PRDI Groundwater Analytical Results

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

		Location	MW-01		MW-04		MW-06		MW-09	
		Date Collected	05/03/2022	06/14/2022	05/02/2022	06/13/2022	05/03/2022	06/13/2022	05/02/2022	06/13/2022
Analyte	Unit	Site Groundwater Cleanup Levels								
Groundwater Field Parameters										
Dissolved Oxygen	mg/L		**1.37**	**1.01**	--	**0.42**	**6.65**	**6.66**	**25.7**	**2.66**
Oxidation Reduction Potential	mV		**-110.7**	**-252**	--	**-223**	**-1.2**	**-125**	**-98**	**-261**
Temperature	deg C		**11.3**	**13.7**	--	**14.3**	**11.9**	**13.7**	**11.4**	**13.4**
Specific Conductance	uS/cm		**635.5**	**879**	--	**1435**	**334.3**	**403**	**395.4**	**435.9**
pH	pH units		**7.13**	**6.87**	--	**6.78**	**7.51**	**7.17**	**6.66**	**7.28**
Turbidity	NTU		**9.1**	**4.17**	--	**1.31**	**57.9**	**2.08**	**7.85**	**4.26**

Notes:

Bold - detected

Blue Shaded - Detected result or non-detected RL exceeded screening level

FD - field duplicate sample.

U - Analyte not detected at or above Reporting Limit (RL) shown

J - Result value estimated

"--" - indicates results not available

mg/L = milligram per liter

µg/L = microgram per liter

mV = millivolts

µS/cm = microSiemens per centimeter

deg C = degrees Celsius

NTU = Nephelometric Turbidity Units

Table 3. Cleanup Levels for Contaminants of Concern

Project No. 210195, Harris Avenue Shipyard, Bellingham, Washington

Soil Cleanup Levels (mg/kg)			
Contaminant of Concern	Based on Industrial Direct Contact	Based on Groundwater Protection	Cleanup Area where Cleanup Level Applies
Heavy Metals			
Arsenic	88	88	CA 1, CA 2, CA 3
Copper	--	390	CA 2
Zinc	--	960	CA 2
Total Petroleum Hydrocarbons (TPH)			
Total TPH	--	24,000[a]	CA 1, CA 2
		8,000[b]	CA 3

Groundwater Cleanup Levels (ug/L)	
Contaminant of Concern	Based on Discharge to Sediment & Surface Water
Heavy Metals	
Arsenic	5.0
Copper	3.1
Zinc	81
Polycyclic Aromatic Hydrocarbons (PAHs)	
1-Methylnaphthalene	1.5

Notes:

(a) Soil concentrations in CA 1 and CA 2 less than this cleanup level are protective of all pathways and are not contributing to arsenic leaching at unacceptable levels.

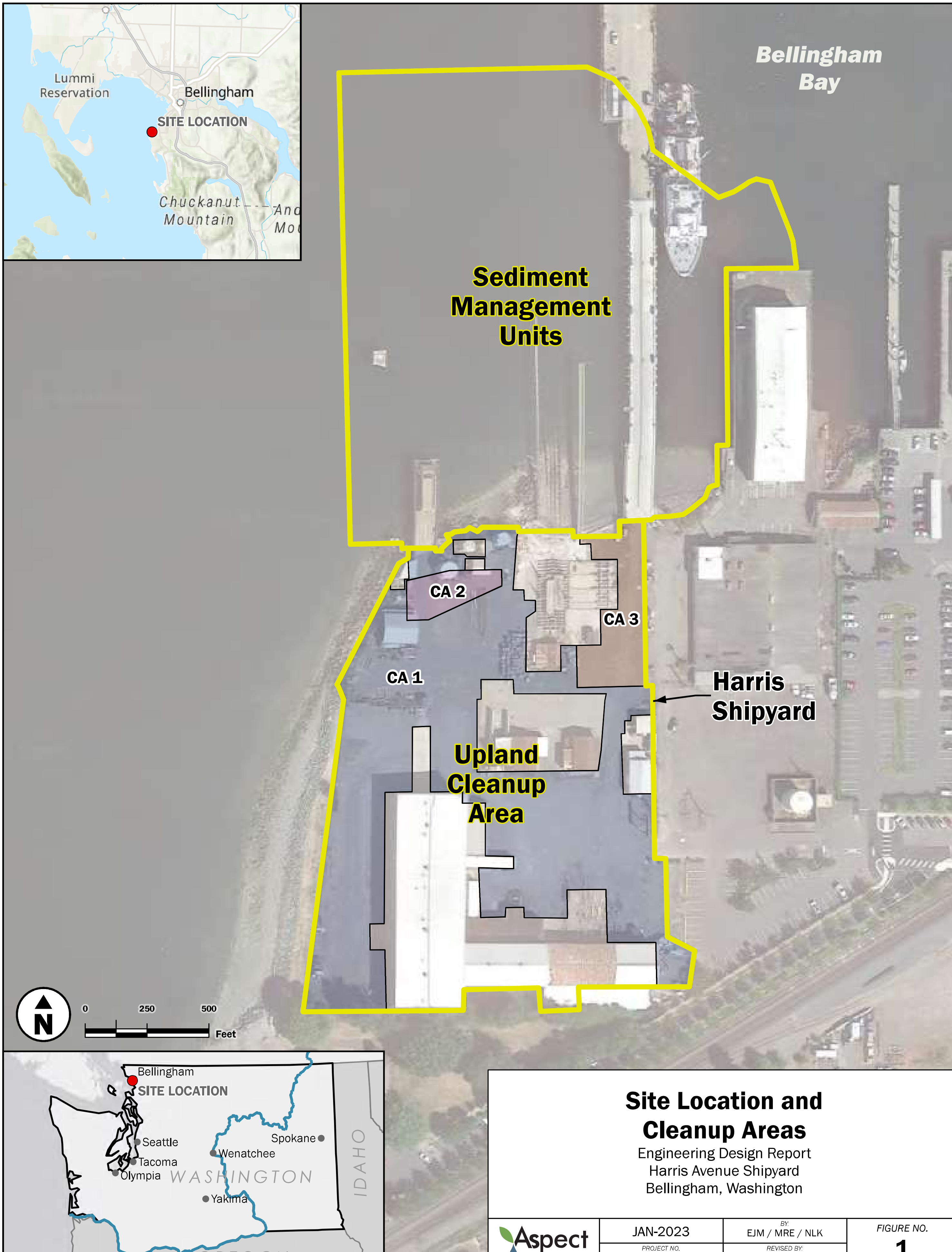
(b) Diesel concentrations in CA 3 soil exceeding 8,000 mg/kg leaching into groundwater can cause anerobic conditions that lead to the leaching of arsenic at unacceptable levels.

Abbreviations:

CA: Cleanup Area (as defined in Site CAP).

mg/kg: milligrams per kilogram. ug/L: microgram per liter.

FIGURES



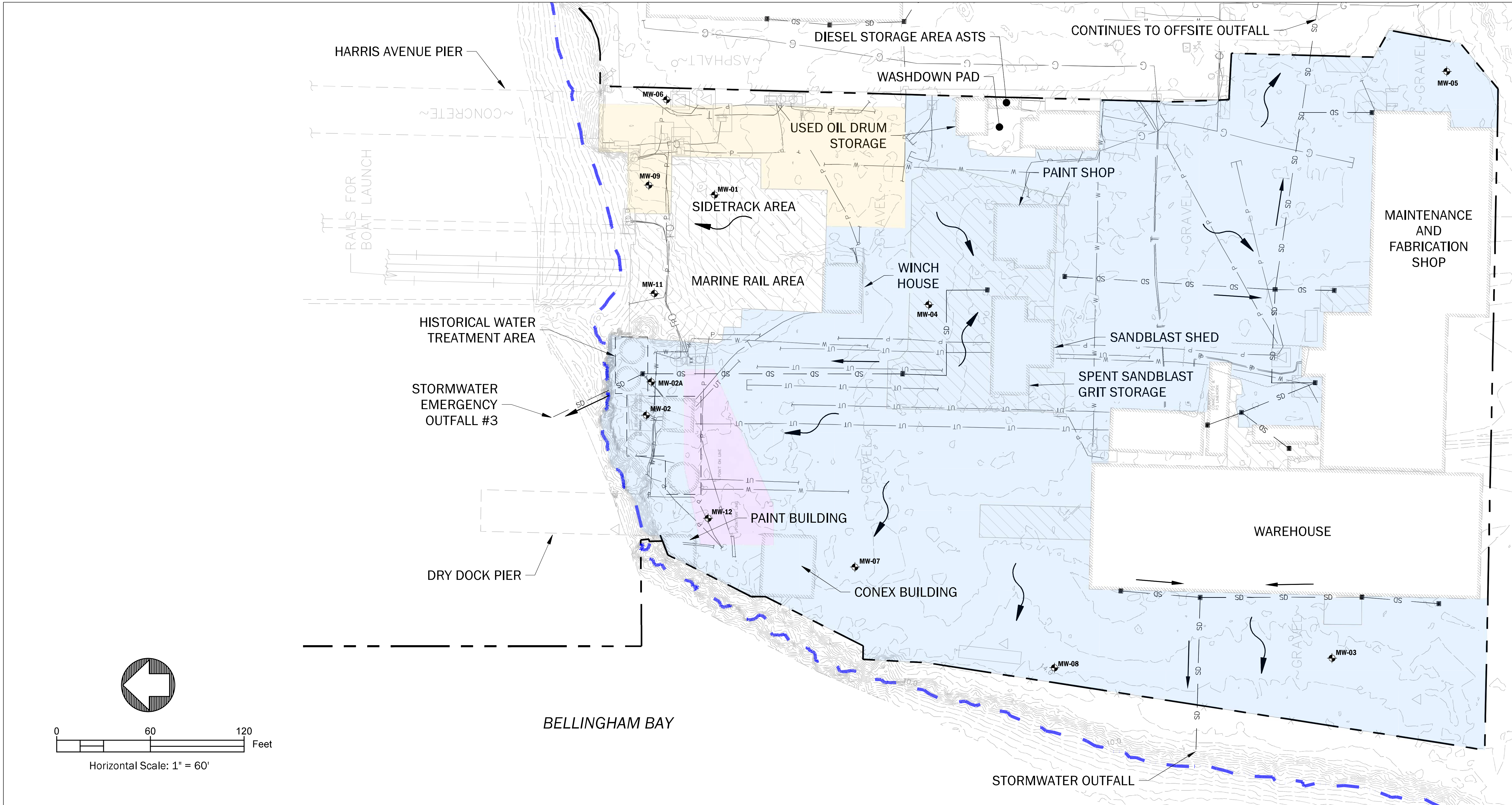
Site Location and Cleanup Areas

Engineering Design Report
Harris Avenue Shipyard
Bellingham, Washington

Aspect CONSULTING	JAN-2023	BY: EJM / MRE / NLK	FIGURE NO. 1
	PROJECT NO. 210195	REVISED BY: --- / ---	

Data source credits: None || Basemap Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA, Esri, CGIAR, USGS, City of Bellingham, Whatcom County, WA State Parks GIS, Esri Canada, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, NRCan, Parks Canada, Esri, HERE, Garmin, USGS, EPA, NPS

GIS Path: G:\projects\HarrisAveShipyard_210195\HarrisAveShipyard_210195.aprx: 01 Site Location Map || User: nkochie || Print Date: 1/26/2023



SOURCE: BASE MAP PROVIDED BY WILSON ENGINEERING, MAY 20, 2022 AND SUPPLEMENTED WITH MAPPING OF UTILITIES AND STRCTURES FROM FINAL 2019 RI/FS BY FLOYD|SNIDER

= SITE BOUNDARY
= MHHW ELEVATION (8.03 FT NAVD88)
= APPROXIMATE SURFACE FLOW DIRECTION
= PIPE FLOW DIRECTION
= EXISTING STORM DRAIN CATCH BASIN
= EXISTING IMPERVIOUS AREA (ASPHALT OR CONCRETE)

SD = EXISTING STORM DRAIN LINE
W = EXISTING WATER LINE
T = EXISTING TELEPHONE LINE
FO = EXISTING FIBER OPTIC LINE
G = EXISTING GAS LINE
P = EXISTING POWER LINE

UT = EXISTING MISC BURIED UTILITY
= ELEVATION CONTOUR (0.5 FT INTERVAL)
= EXISTING MONITORING WELL
= CLEANUP AREA 1
= CLEANUP AREA 2
= CLEANUP AREA 3

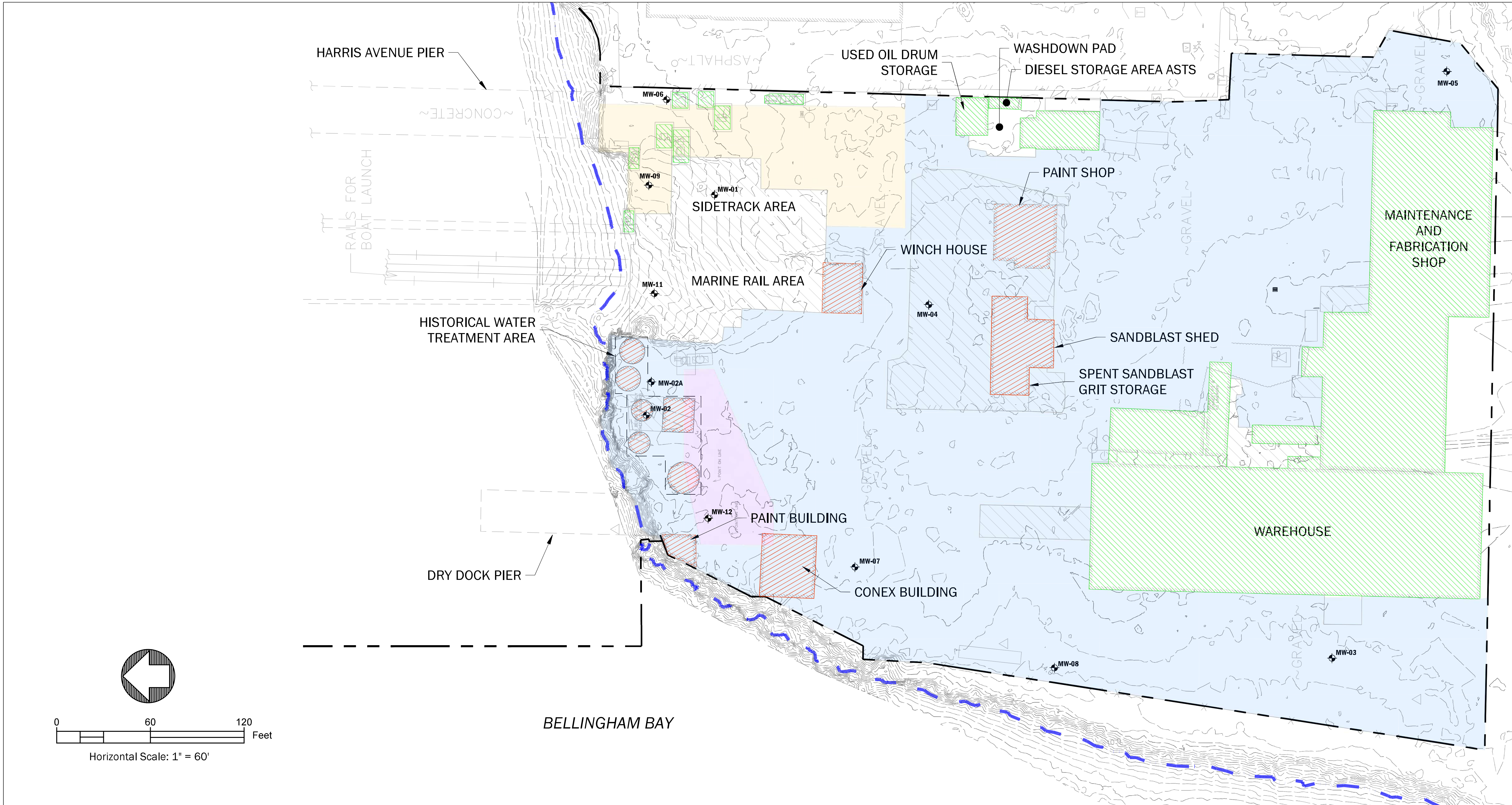
Existing Surface Conditions and Utilities

Engineering Design Report
Harris Avenue Shipyard
Bellingham, Washington

Aspect CONSULTING

Feb-2023	BY: JPR/SJG	FIGURE NO. 2
PROJECT NO. 210195	REVISED BY: EJM/SCC	

CAD Path: Q:\Port of Bellingham\210195 HarrisShipyd\2023-02 EDR Report\210195-02 (ExistDrainagePatterns-0.5ft Contours).dwg 02 Existing Surface Conditions and Utilities || Date Saved: Feb 15, 2023 10:49am || User: scudd



SOURCE: BASE MAP PROVIDED BY WILSON ENGINEERING, MAY 20, 2022 AND SUPPLEMENTED WITH MAPPING OF UTILITIES AND STRCTURES FROM FINAL 2019 RI/FS BY FLOYD|SNIDER

= SITE BOUNDARY
= MHHW ELEVATION (8.03 FT NAVD88)
= EXISTING IMPERVIOUS AREA (ASPHALT OR CONCRETE)
= ELEVATION CONTOUR (0.5 FT INTERVAL)
= EXISTING MONITORING WELL
= CLEANUP AREA 1
= CLEANUP AREA 2
= CLEANUP AREA 3

PLAN FOR EXISTING STRUCTURES

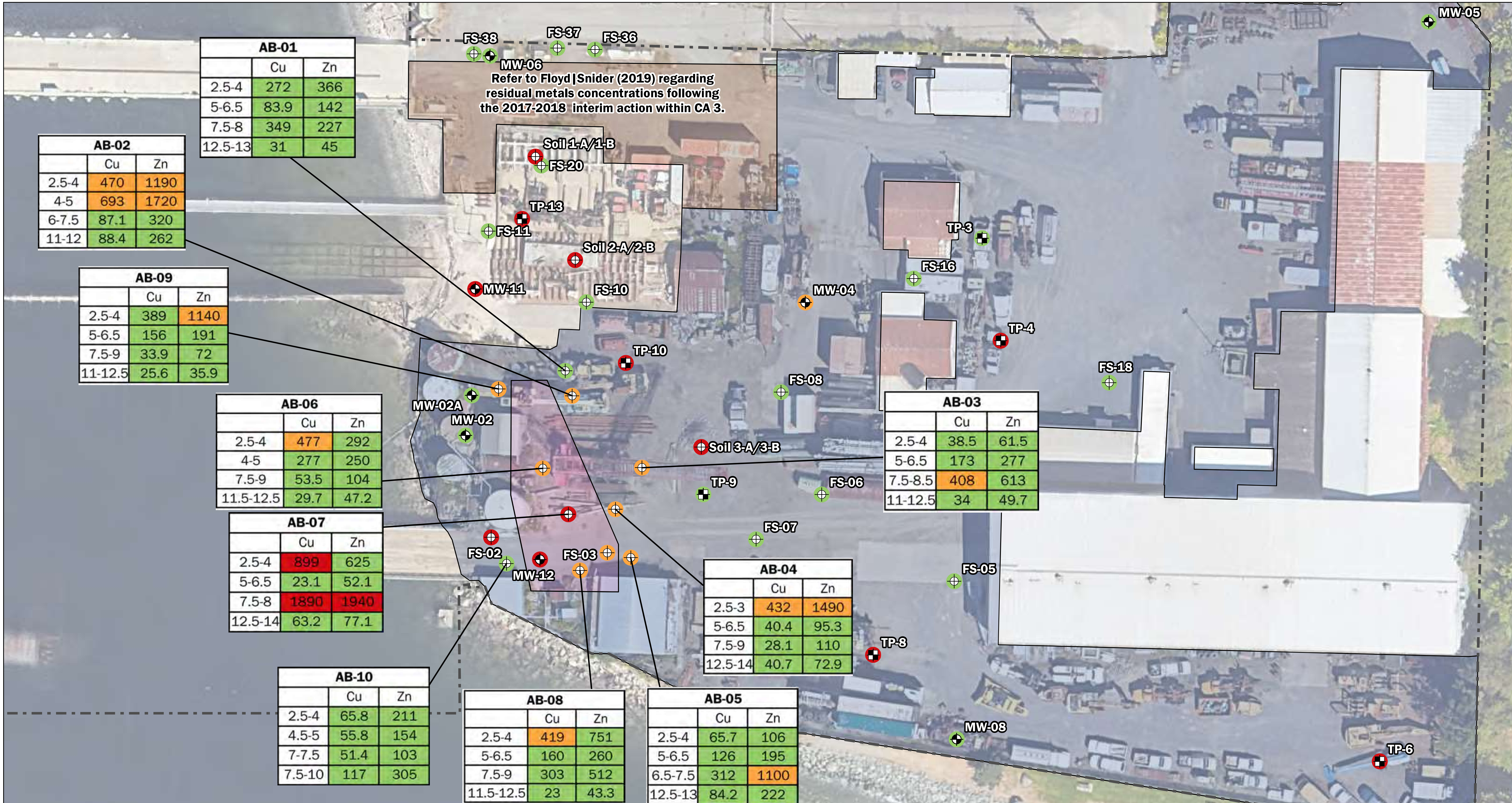
= Structure to be Removed During Cleanup
= Structure to be Retained During Cleanup

Existing Structures to be Removed

Engineering Design Report
Harris Avenue Shipyard
Bellingham, Washington

Aspect Consulting	Mar-2023	BY: JPR/SJG	FIGURE NO.
	PROJECT NO. 210195	REVISED BY: EJM/SCC	3

CAD Path: Q:\Port of Bellingham\210195 HarrisShipyd\2023-02 EDR Report\210195-03 (Structures Stay or Go).dwg 03 Existing Structures to be Removed || Date Saved: Mar 08, 2023 3:27pm || User: scudd



AB-01

	Cu	Zn
2.5-4	272	366
5-6.5	83.9	142
7.5-8	349	227
12.5-13	31	45

AB-02

	Cu	Zn
2.5-4	470	1190
4-5	693	1720
6-7.5	87.1	320
11-12	88.4	262

AB-09

	Cu	Zn
2.5-4	389	1140
5-6.5	156	191
7.5-9	33.9	72
11-12.5	25.6	35.9

AB-06

	Cu	Zn
2.5-4	477	292
4-5	277	250
7.5-9	53.5	104
11.5-12.5	29.7	47.2

AB-07

	Cu	Zn
2.5-4	899	625
5-6.5	23.1	52.1
7.5-8	1890	1940
12.5-14	63.2	77.1

AB-03

	Cu	Zn
2.5-4	38.5	61.5
5-6.5	173	277
7.5-8.5	408	613
11-12.5	34	49.7

AB-04

	Cu	Zn
2.5-3	432	1490
5-6.5	40.4	95.3
7.5-9	28.1	110
12.5-14	40.7	72.9

AB-10

	Cu	Zn
2.5-4	65.8	211
4.5-5	55.8	154
7-7.5	51.4	103
7.5-10	117	305

AB-08

	Cu	Zn
2.5-4	419	751
5-6.5	160	260
7.5-9	303	512
11.5-12.5	23	43.3

AB-05

	Cu	Zn
2.5-4	65.7	106
5-6.5	126	195
6.5-7.5	312	1100
12.5-13	84.2	222

Monitoring Well
Soil Boring
Test Pit

Copper and/or Zinc in Soil >2x CUL
Copper and/or Zinc in Soil > CUL
Copper and/or Zinc in Soil < CUL

Upland Cleanup Areas Defined in Cleanup Action Plan

Cleanup Area 1
Cleanup Area 2
Cleanup Area 3
Site Boundary

N
0 50 100 Feet

Soil Sampling Locations and Results – Metals

Engineering Design Report
Harris Avenue Shipyard
Bellingham, Washington

Aspect CONSULTING

MAY-2023	BY: EJM / MRE / NLK	FIGURE NO.
PROJECT NO. 210195	REVISED BY: ---/---	4

Data source credits: None || Basemap Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA

Monitoring Well

1-Methylnaphthalene Detected Above CUL

1-Methylnaphthalene Detected Below CUL

Potentiometric Surface Contour
(feet NAVD 88 - dashed where inferred)

Upland Cleanup Areas Defined in Cleanup Action Plan

Cleanup Area 1

Cleanup Area 3

Site Boundary

Notes:
1. Well sampled in May and June 2022.
2. Potentiometric surface contours from Floyd Snider RI/FS. Elevations measured February 25, 2015.

N

0 20 40 Feet

Groundwater Sampling Results - 1-Methylnaphthalene

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Harris Avenue Shipyard
Bellingham, Washington

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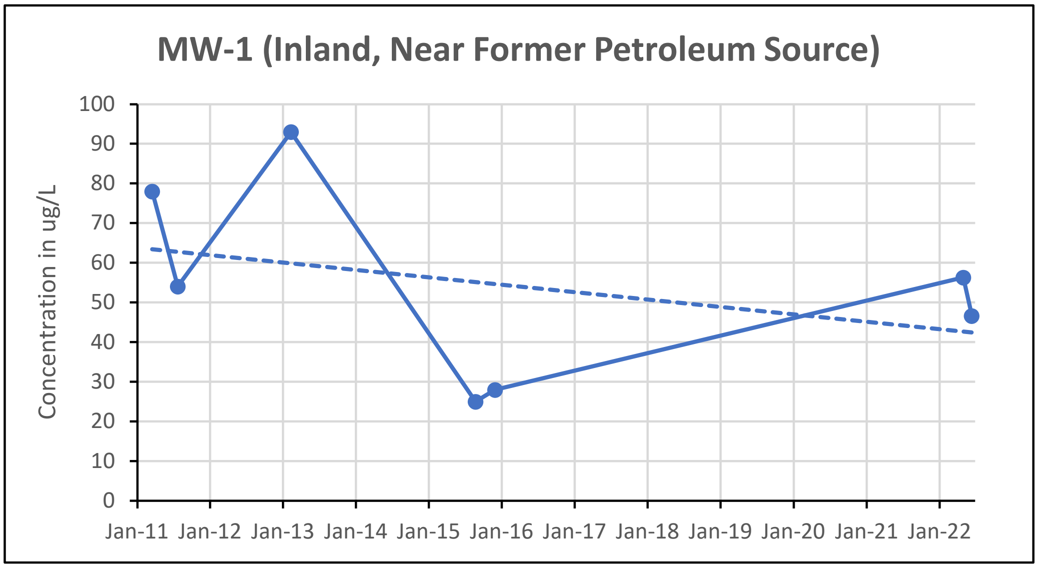
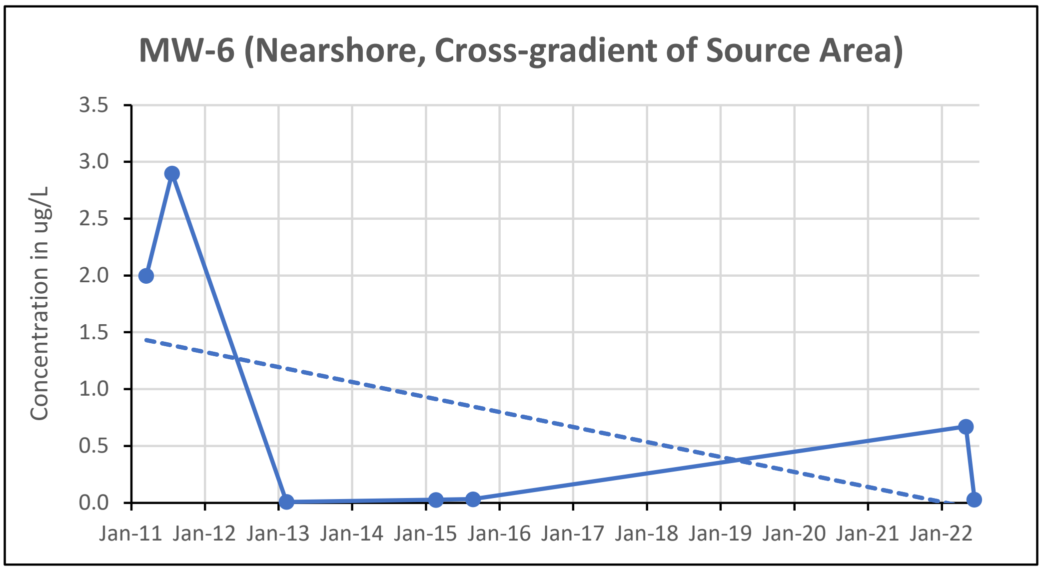
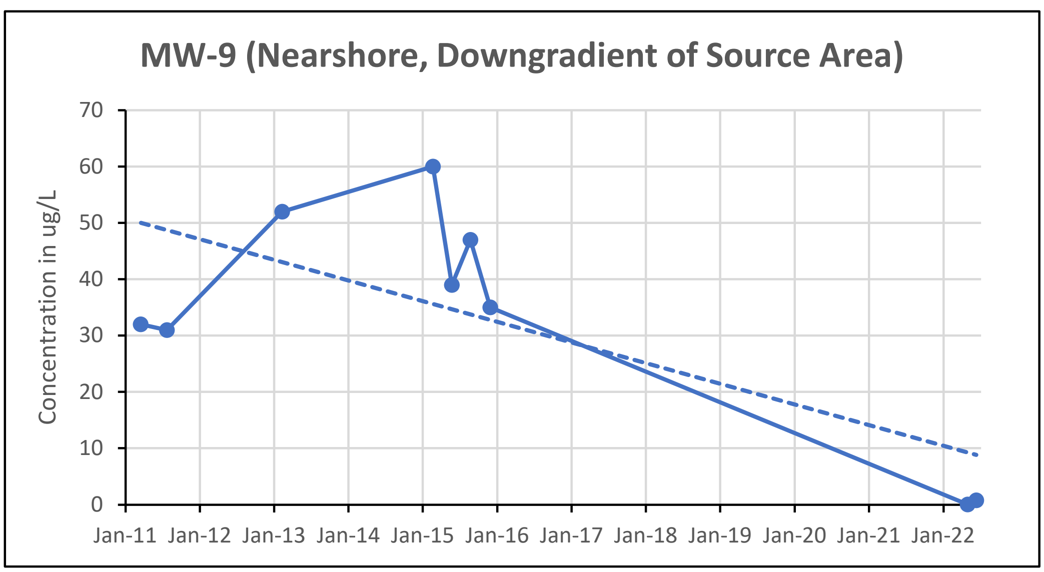
FEB-2023	BY: EJM / MRE / NLK	FIGURE NO.	
PROJECT NO. 220395	REVISED BY: --- / ---	5	







1-methylnaphthalene cleanup level = 1.5 ug/L.

Figure 6

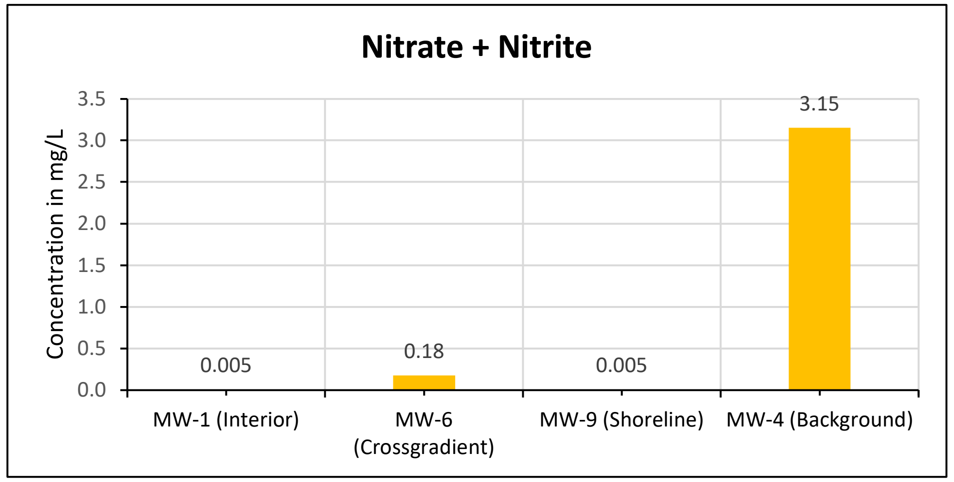
1-Methylnaphthalene Concentration Trends Over Time

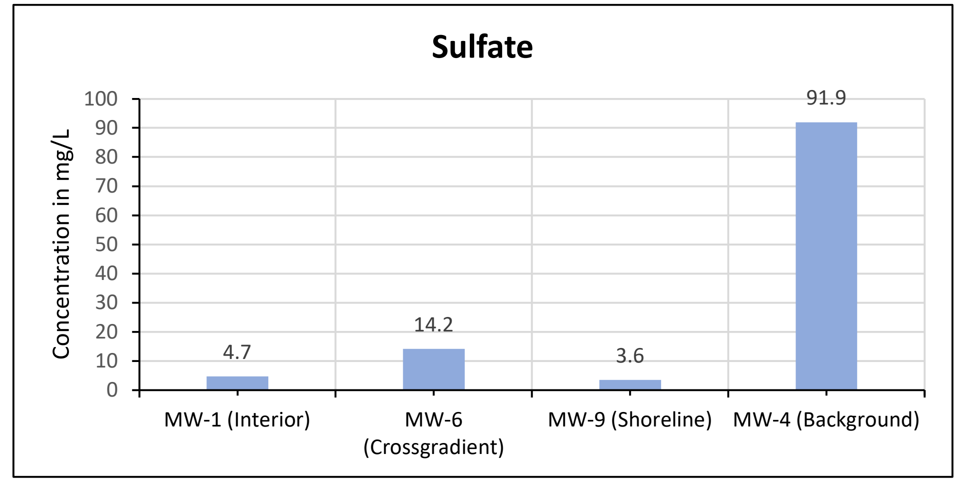
Engineering Design Report
Harris Ave Shipyard

Aspect Consulting
2/17/2023

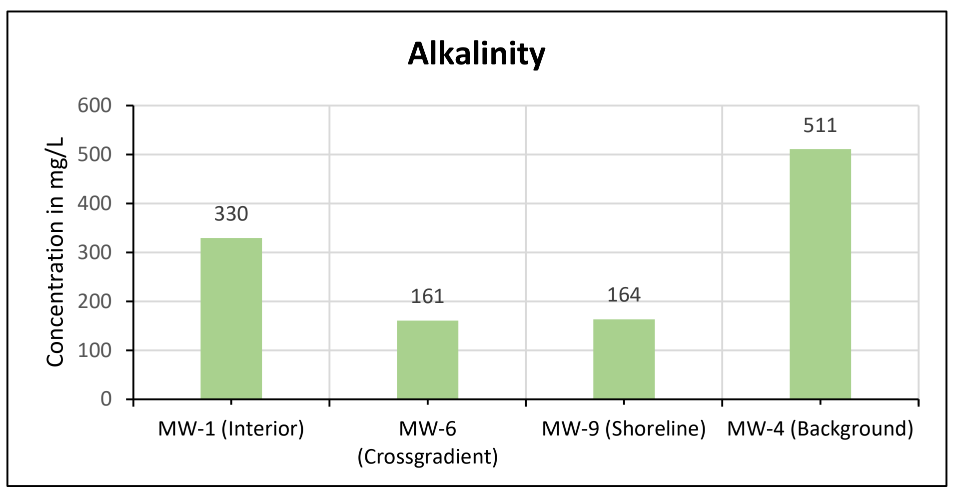
V:\210195 Harris Ave Shipyard Remedial Design\Deliverables\2023.02 EDR\Draft\Figure Set\06-07 Figure 6 & 7_geochem and time-trend

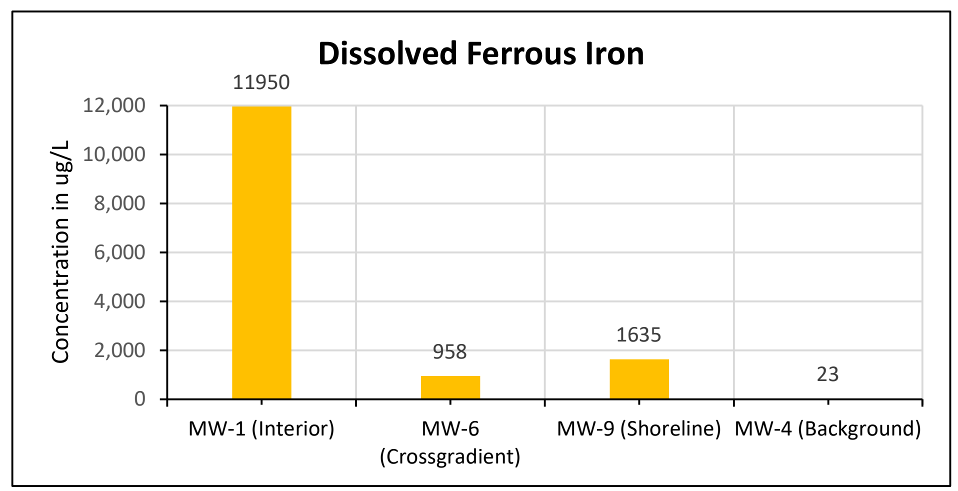
Electron Acceptors That Are Depleted Relative to Background During Hydrocarbon Biodegradation

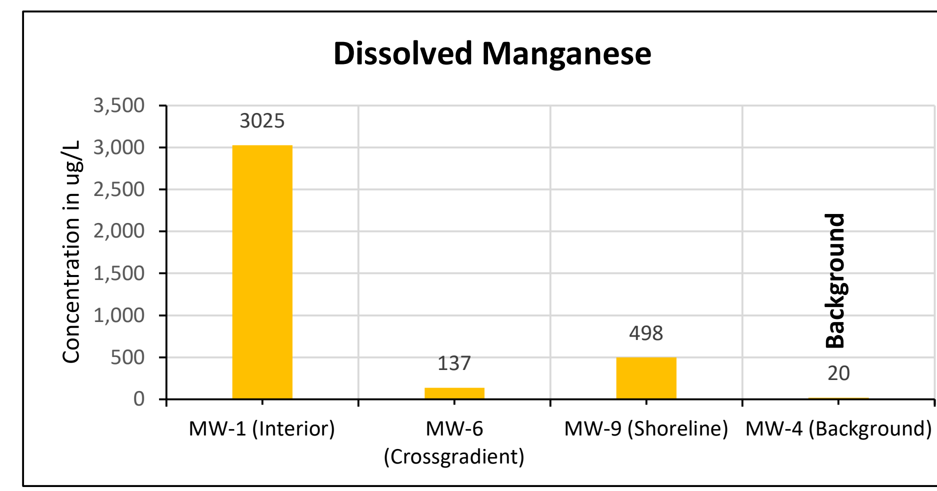




Metabolic By-Products that Increase Relative to Background During Hydrocarbon Biodegradation

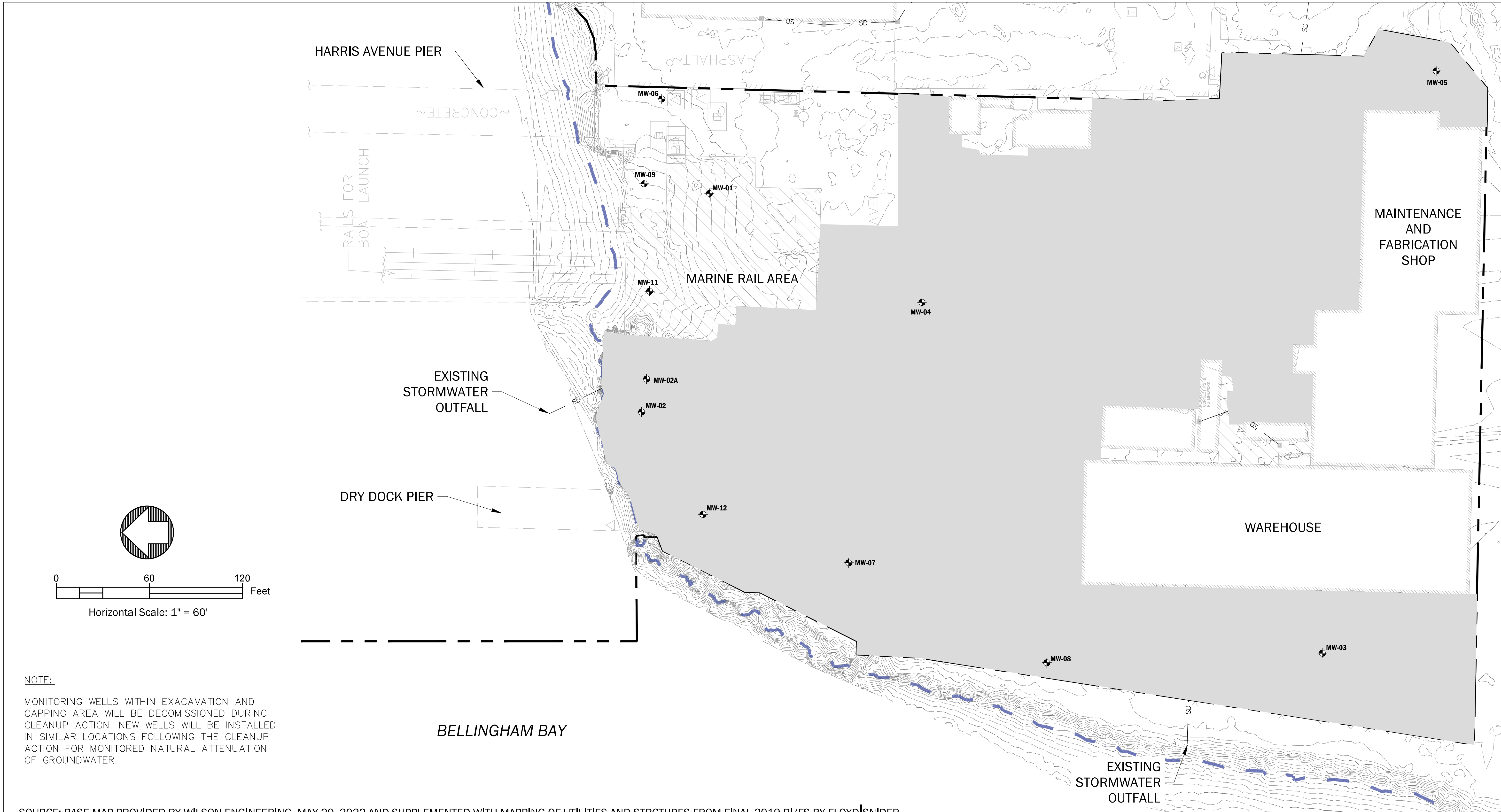






Note: Interior well MW-1 has residual sheen and is the only well exceeding the cleanup level for 1-methylnaphthalene

Figure 7
Geochemical Evidence for Hydrocarbon Biodegradation
Engineering Design Report
Harris Avenue Shipyard



SOURCE: BASE MAP PROVIDED BY WILSON ENGINEERING, MAY 20, 2022 AND SUPPLEMENTED WITH MAPPING OF UTILITIES AND STRCTURES FROM FINAL 2019 RI/FS BY FLOYD|SNIDER

- = SITE BOUNDARY
- = MHHW ELEVATION (8.03 FT NAVD88)
- = EXISTING STORM DRAIN LINE
- = EXISTING STORM DRAIN CATCH BASIN
- = EXISTING IMPERVIOUS AREA (ASPHALT OR CONCRETE)
- = EXISTING MONITORING WELL
- = 2 FOOT DEEP EXCAVATION AND CAPPING AREA
- = ELEVATION CONTOUR (0.5 FT INTERVAL)

Soil Excavation and Capping Plan for CA 1

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Aspect CONSULTING	Feb-2023	BY: JPR/SJG	FIGURE NO.
	PROJECT NO. 210195	REVISED BY: EJM/SCC	8

CAD Path: Q:\Port of Bellingham\210195 HarrisShipyd\2023-02 EDR Report\210195-04 (ExistDrainagePatterns).dwg 08 Soil Excavation and Capping Plan for CA 1 || Date Saved: Feb 15, 2023 10:59am || User: scudd

Monitoring Well

Soil Boring

Test Pit

Well Location with Groundwater Exceedance of Cu and/or Zn CUL

Well Location without Groundwater Exceedance of Cu and/or Zn CUL

Mean Higher High Water Line

Potentiometric Surface Contour
(feet NAVD 88 - dashed where inferred)

Cross Section

Proposed Minimum Excavation Area

Area of Influence for Soil Compliance Evaluation

Upland Cleanup Areas Defined in Cleanup Action Plan

Cleanup Area 2

Note:
1. Potentiometric surface contours from Floyd Snider RI/FS. Elevations measured February 25, 2015.

N

0 20 40 Feet

Soil Removal Plan for CA 2

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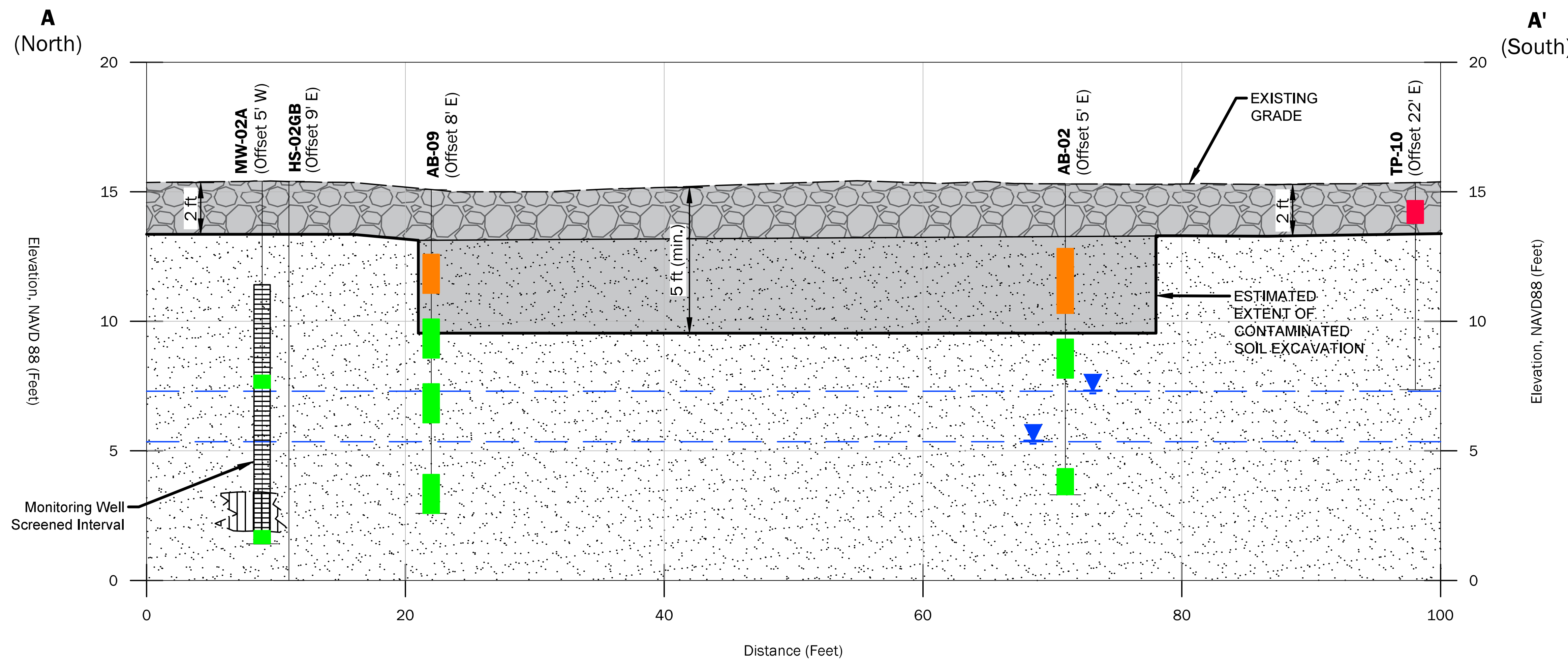
Harris Avenue Shipyard
Bellingham, Washington

Aspect CONSULTING	FEB-2023	BY: MRE / NLK	FIGURE NO.
	PROJECT NO. 220395	REVISED BY: --- / ---	9



Soil Analytical Results

- Copper and/or Zinc in Soil >2x Cleanup Levels
- Copper and/or Zinc in Soil > Cleanup Levels
- Copper and/or Zinc in Soil < Cleanup Levels

LEGEND

- CA 1 Cap
- CA 2 Deeper Excavation
- Estimated Soil Lithology Change
- Approximate Water Table (See Notes)
- Fill (Sands and Gravels with Silt and Debris)
- Fill (Silt)

AB-10 (Offset 10' SW) — Boring ID and Offset

Notes

1. Cross section location line shown on Figure 9.
2. Groundwater elevations are from continuous monitoring data in MW-02A that were collected during the Pre-Remedial Design Investigation.
3. Approximate groundwater table elevations indicate the highest and lowest elevations measured during the Pre-Remedial Design Investigation from 4/28/22 to 5/3/22.
4. Monitoring well MW-02A is screened from 4 to 14 feet bgs.

0 10 20 Feet — Horizontal Scale: 1" = 10'

0 5 10 Feet — Vertical Scale: 1" = 5'
Vertical Exaggeration 2x

Cross Section A-A'
Eastern CA 2 Excavation

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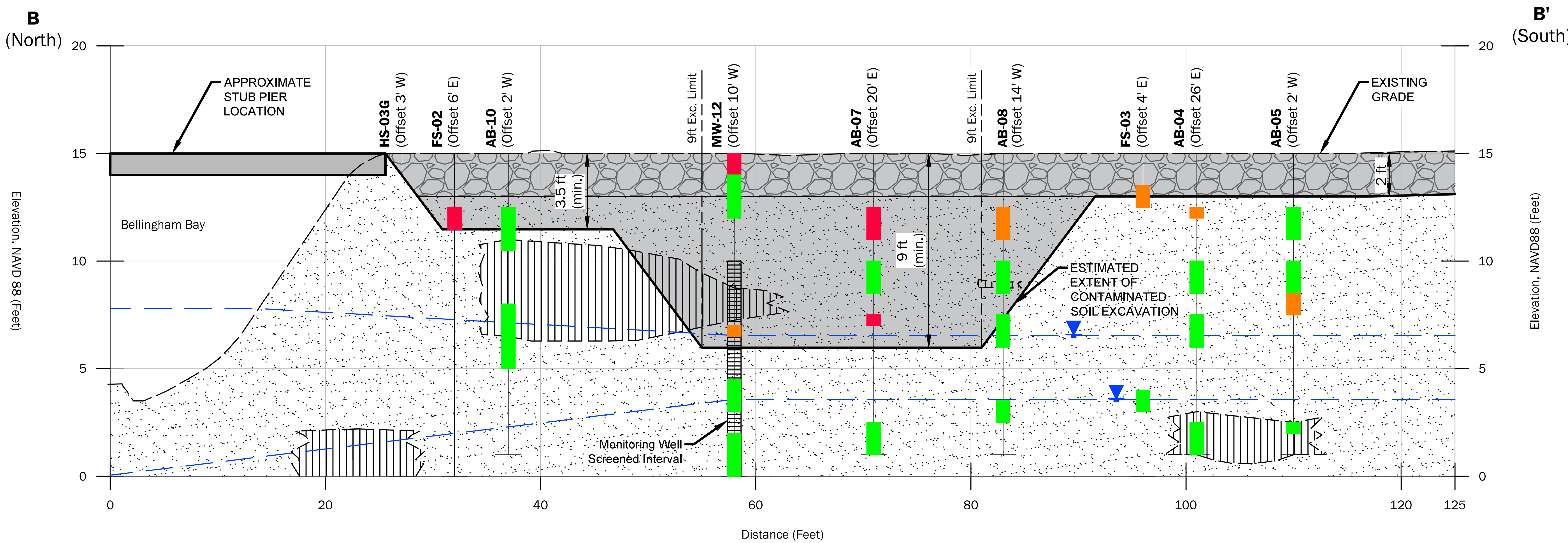
Aspect CONSULTING	Feb-2023	BY JRG	FIGURE NO.
	PROJECT NO. 210368	REVISED BY -	10



Soil Analytical Results

- Copper and/or Zinc in Soil >2x Cleanup Levels
- Copper and/or Zinc in Soil > Cleanup Levels
- Copper and/or Zinc in Soil < Cleanup Levels

LEGEND

- CA 1 Cap
- CA 2 Deeper Excavation
- Estimated Soil Lithology Change
- Approximate Water Table (See Notes 2 through 4)
- Fill (Sands and Gravels with Silt and Debris)
- Fill (Silts and Clays)

AB-10 (Offset 10' SW) ← Boring ID and Offset

Notes

1. Cross section location line shown on Figure 9.
2. Groundwater elevations are from continuous monitoring data in MW-12 that were collected during the Pre-Remedial Design Investigation.
3. Approximate groundwater table elevations indicate the highest and lowest elevations measured during the Pre-Remedial Design Investigation from 4/28/22 to 5/3/22.
4. Monitoring well MW-12 is screened from 5 to 15 feet bgs.

Horizontal Scale: 1" = 10' (0, 10, 20 Feet)

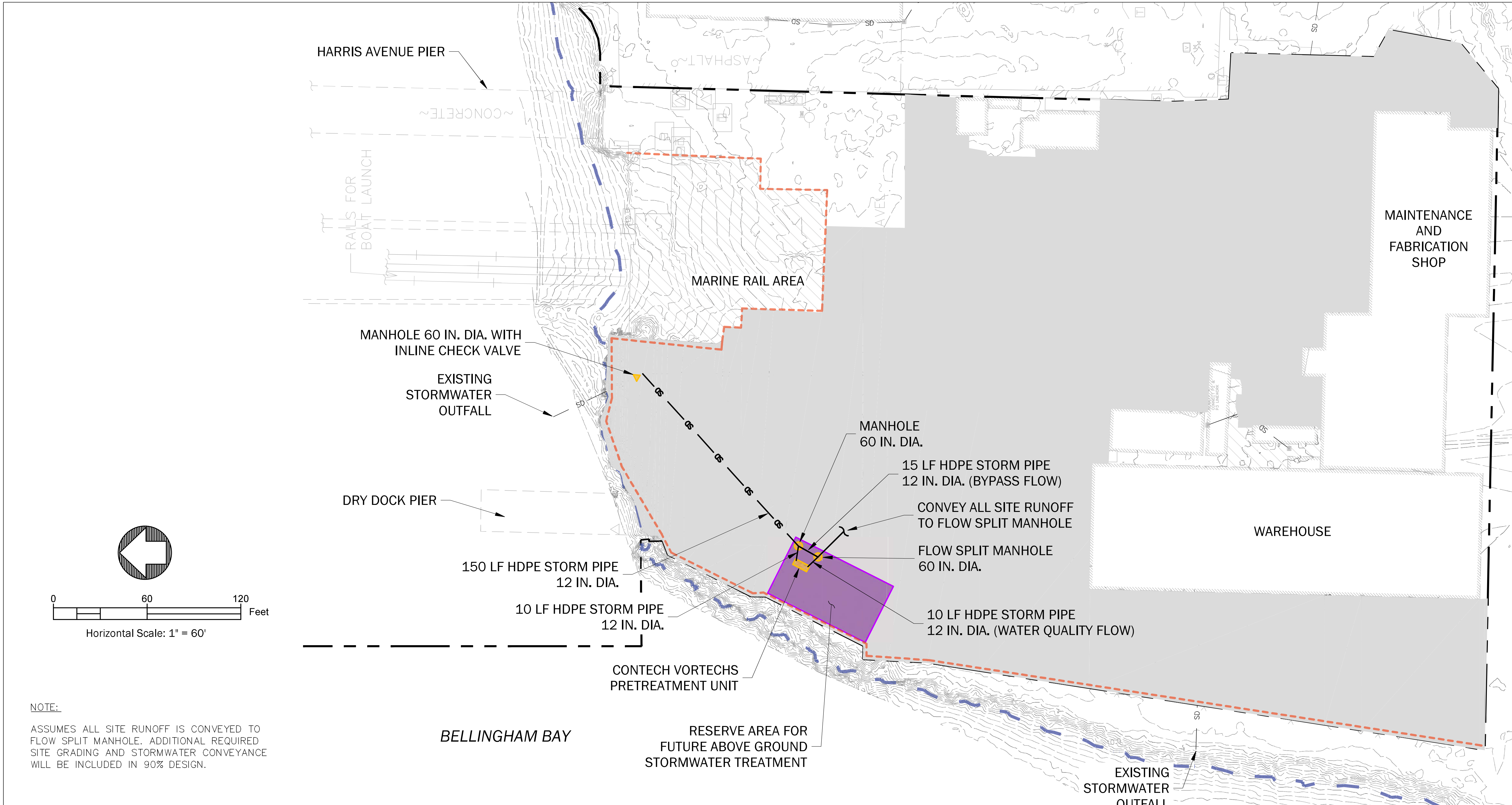
Vertical Scale: 1" = 5' (0, 5, 10 Feet)
Vertical Exaggeration 2x

Cross Section B-B'
Western CA 2 Excavation

Engineering Design Report
Harris Avenue Shipyard
Bellingham, Washington

Aspect Consulting

	By	Figure No.
Feb-2023	JRG	11
Project No. 210368	Revised By -	



NOTE:

ASSUMES ALL SITE RUNOFF IS CONVEYED TO FLOW SPLIT MANHOLE. ADDITIONAL REQUIRED SITE GRADING AND STORMWATER CONVEYANCE WILL BE INCLUDED IN 90% DESIGN.

SOURCE: BASE MAP PROVIDED BY WILSON ENGINEERING, MAY 20, 2022 AND SUPPLEMENTED WITH MAPPING OF UTILITIES AND STRCTURES FROM FINAL 2019 RI/FS BY FLOYD|SNIDER

= SITE BOUNDARY
= MHHW ELEVATION (8.03 FT NAVD88)
= EXISTING STORM DRAIN LINE
= EXISTING STORM DRAIN CATCH BASIN
= EXISTING IMPERVIOUS AREA (ASPHALT OR CONCRETE)
= 2 FOOT DEEP EXCAVATION AND CAPPING AREA
= ELEVATION CONTOUR (0.5 FT INTERVAL)
= SHEETFLOW PREVENTION BERM

Preliminary Stormwater Drainage Plan

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Harris Avenue Shipyard
Bellingham, Washington

Aspect CONSULTING

Feb-2023	BY: JPR/SJG	FIGURE NO. 12
PROJECT NO. 210195	REVISED BY: EJM/SCC	

CAD Path: Q:\Port of Bellingham\210195 HarrisShipyd\2023-02 EDR Report\210195-04 (ExistDrainagePatterns).dwg 12 Preliminary SW Drainage Plan || Date Saved: Feb 15, 2023 11:02am || User: scudd