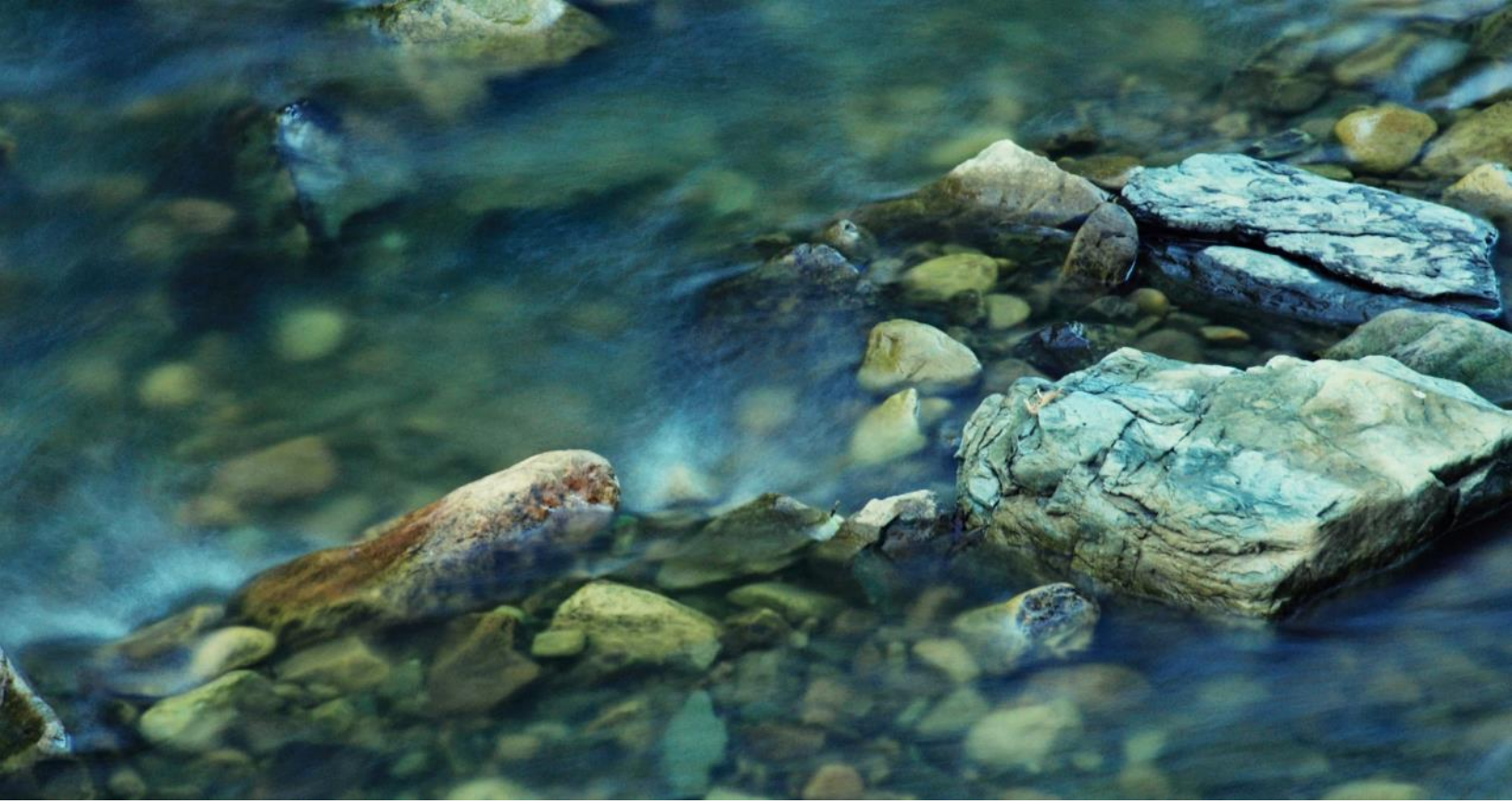

October 2021
Harris Avenue Shipyard Cleanup

ANCHOR QEA

Pre-Remedial Design Investigation Work Plan

Prepared for Washington State Department of Ecology

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Harris Avenue Shipyard Cleanup

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Prepared for
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ABBREVIATIONS

AO	Agreed Order
CA	upland cleanup area
CAP	Cleanup Action Plan
COC	contaminants of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSM	conceptual site model
CUL	cleanup level
DAHP	Department of Archaeology and Historic Preservation
DRET	Dredge Elutriate Test
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
HPAH	high molecular weight polycyclic aromatic hydrocarbon
LPAH	low molecular weight polycyclic aromatic hydrocarbon
MTCA	Model Toxics Control Act
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
Port	Port of Bellingham
PRDI Work Plan	Pre-Remedial Design Investigation Work Plan
PSAMP	Puget Sound Assessment and Monitoring Program
QAPP	Quality Assurance Project Plan
RAL	remedial action level
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
Site	Harris Avenue Shipyard Site
SMS	Sediment Management Standards
SMU	sediment management unit
SQS	Sediment Quality Standards
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbons
USACE	U.S. Army Corps of Engineers
UWI	Urban Waters Initiative
Wilson	Wilson Engineering, LLC

1 Introduction

1.1 Purpose

This *Pre-Remedial Design Investigation Work Plan* (PRDI Work Plan) has been developed for the Harris Avenue Shipyard Site (Site) located in Bellingham, Washington (Figure 1-1). This PRDI Work Plan is described in the *Schedule of Deliverables* (Exhibit C – Scope of Work and Schedule) as deliverable A.1 in Agreed Order No. DE 19450.

This PRDI Work Plan presents pre-remedial design data gaps and the field investigations that will be implemented to fill data gaps for remedial design of the upland and in-water areas of the Site. The Port proposes to complete remedial design for the upland and in-water areas in separate phases, with acceleration of the upland design, permitting, and remediation elements. Completion of the upland PRDI and sediment PRDI is anticipated by January 2022 and spring 2022, respectively. Following completion of the PRDI, two separate Engineering Design Reports (EDRs; i.e., an Upland EDR and a Sediment EDR) will summarize the PRDI findings and the results of engineering evaluations required to complete the design.

1.2 Background

Both 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 173-340, administered by the Washington State Department of Ecology (Ecology).

In 1998, the Port of Bellingham (Port) began voluntarily investigating sediment quality at the Site. Based on this work, Ecology and the Port entered into an Agreed Order (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). 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.

In 2021, Ecology issued the CAP (Ecology 2021), which describes the selected cleanup action for the Site based on the RI/FS (Floyd Snider 2019a). Ecology made a determination that a cleanup performed in accordance with the CAP would comply with the requirements for selection of a remedy under Washington Administrative Code 173-340-360.

1.3 Site Description

The Site is located at 201 Harris Avenue in Bellingham, Washington (Figure 1-1). Portions of the upland and in-water areas have been used historically and recently for industrial purposes, primarily

as a shipyard. 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 1-1). The Site is bordered on the north and west by Bellingham Bay and on the south by 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.

A Port Management Agreement with Washington Department of Natural Resources executed in 1997 granted primary property-management authority to the Port for multiple harbor-area parcels that are owned by the state and were previously managed by the Washington Department of Natural Resources. The Port manages aquatic lands and lands of historical harbor infill above the high waterline located between the inner and outer harbor lines. The Port also owns the area landward of the inner harbor line, which was leased to the former tenant Puglia until 2019. Puglia provided dry-docking and mooring capabilities and other support services for vessels.

1.4 Document Organization

Components of this PRDI Work Plan are organized as follows:

- Section 1: Introduction
- Section 2: Site Background
- Section 3: Upland Pre-Remedial Design Data Needs
- Section 4: In-Water Data Gaps Analysis and Pre-Remedial Design Data Needs
- Section 5: Summary of PRDI Activities
- Section 6: References

2 Site Background

2.1 Previous Environmental Investigations and Cleanup Actions

This section provides a summary of environmental investigations and actions that have been completed to date at or adjacent to the Site.

Upland and sediment investigations have been completed at the Site since approximately 1993. Data from the previous investigations and actions are summarized below. A summary of sampling by year, including counts of samples analyzed for each analyte group by matrix, is provided in Table 2-1. Historical sample locations are shown in Figure 2-1.

- Pre-1998: Initial Site Investigations and Ecology inspections including sampling of upland soil and sediment.
- 1998: RETEC Phase 2 Sampling in upland soil and groundwater and sediments. Soil sampling confirmed that elevated metals, diesel- and oil-range total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAHs) were present in subsurface soil. Groundwater sampling confirmed that elevated dissolved metals and TPH were present.
- 2000 and 2003: RETEC Sediment Toxicity Tests. Due to quality control issues in the 2000 and initial 2003 sediment toxicity sampling, there were questionable failures for some samples. A second round of sediment collection and additional bioassay testing was performed in 2003, and all resulting bioassay testing locations passed Sediment Management Standards (SMS) biological effects criteria.
- 2004 to 2006: A Working Draft Sediments RI/FS (RETEC 2004) was completed in 2004 and amended in 2006 (RETEC 2006) to include the findings of an Upland Source Control Evaluation (conducted in 2005). Core samples were collected in 2004 to characterize sediment suitability for open-water disposal, in accordance with the Puget Sound Dredged Disposal Analysis program and the Dredged Material Management Program.
- 2006: One sample adjacent to the Site boundary was collected by Ecology's Puget Sound Assessment and Monitoring Program's (PSAMP) Spatial/Temporal Monitoring program as part of routine ambient sediment monitoring. PSAMP investigated sediment conditions in eight Puget Sound regions sampled on an annual, rotational cycle.
- 2010: Surface sediment data at one location were collected as part of the Urban Water Initiative (UWI) through Ecology's Environmental Assessment Program. The purpose of this program was to assess sediment quality throughout selected urban bays in Puget Sound over time. The location assessed in the 2006 PSAMP study was reoccupied in 2010.
- 2011: Floyd Snider conducted a Supplemental Site Investigation to gather additional data to further characterize upland Site conditions, address the upland and sediment data gaps, and better define the preliminary Site-wide conceptual site model (CSM).

- 2013: Floyd Snider conducted a Data Gaps Investigation to fill data gaps identified as part of the Supplemental Site Investigation work and to further define the nature and extent of known contaminants of concern (COCs) for completion of the RI/FS.
- 2015: Floyd Snider conducted a Pre-Interim Action Investigation to facilitate design of an Interim Action in the uplands and sediments. In the uplands, data were used to define the lateral and vertical extent of the excavation. In the sediments, samples were used to delineate the final depths of contamination within the Interim Action Area (Floyd Snider 2015).
- 2017: The one location that was sampled in both the PSAMP (2006) and UWI (2010) studies was reoccupied in 2017 by Ecology's UWI Program.
- 2017: Interim Action cleanup activities performed at the Site included soil excavation, overwater structure removal and replacement, subtidal and intertidal sediment dredging, and intertidal sediment excavation and backfill. Work was defined in the Interim Action Work Plan as part of the Ecology-approved AO Amendment. Interim actions were completed on November 1, 2018.
- 2017 to 2018: Interim Action Confirmation Sampling was conducted to verify completion of the Interim Action and document post-construction conditions. Sample results were reported in the Interim Action Construction Completion Report finalized in March 2019 (Floyd Snider 2019b).

For additional detail on these investigations and actions, please refer to Section 2.5 in the RI/FS (Floyd Snider 2019a).

2.2 Current Site Conditions

The Site is located within the Fairhaven district of Bellingham in an area designated as multi-use and consists of a commercial core; mixed use residential development; nearby single-family residential; marine industrial waterfront; ferry, bus, and train terminals; and intact historical buildings with a tourist district (City of Bellingham 2012).

The Site is zoned by the City of Bellingham for water-dependent industrial use. Supporting upland industrial structures include a machine shop, electrical shop, steel fabrication and mechanical shop, valve shop, sandblast shed, paint shop, and water treatment building with associated aboveground tanks. The in-water portion of the Site includes two piers, a marine railway and two supporting adjacent overwater walkways, one new and one older, and various mobile cranes (Figure 2-2). A new tenant, Fairhaven Industrial Marine Repair Facility (FIMRF), began occupying the upland portion of the Site as of early 2021 and has future plans to utilize the in-water Site areas for vessel moorage, repair, and dry docking.

An extensive network of utilities exists at the shipyard (Figure 2-2), including storm drains, sanitary sewer, natural gas, water, telecommunications, and electrical. Many of these utilities have been

upgraded throughout the Site history and have not been thoroughly documented. Three outfalls discharging to Bellingham Bay from the Site uplands were observed and appeared to be in good condition during RI/FS activities (Floyd Snider 2019a): stormwater emergency outfall (Outfall No. 3) at the shipyard, an outfall to the west of the Site, and a stormwater outfall to the east of the Harris Avenue Pier.

2.3 Conceptual Site Model

The CSM was developed as part of the RI/FS for the following environmental media: subtidal and intertidal sediment, groundwater, saturated and unsaturated (i.e., vadose zone) soils, and soil gas. The CSM was created by assessing historical sources of contamination, impacted media, potential receptors, exposure pathways, and cross-media transfer of contaminants, as detailed in Table 4.1 of the RI/FS (Table 2-2 of this document; Floyd Snider 2019a).

The main sources of contamination at the Site are associated with historical shipyard activities. The property has been used as a shipyard on and off since 1915, with multiple owners and operators throughout this time performing upland and in-water vessel storage, construction, maintenance, and repair operations.

Primary COCs for soil and groundwater are metals (arsenic, copper, and zinc), diesel-range TPH, and low molecular weight PAHs (LPAHs; specifically, 1-methylnaphthalene). Sources of upland soil and groundwater contamination include the following:

- Historical operations conducted in the upland portion of the marine railway area. This was one of the most heavily used areas of the shipyard and the location where the most extensive contamination has been identified, including contaminants associated with painting and sandblasting.
- Historical releases of petroleum products (consisting of hydrocarbons and LPAHs) from south of the Harris Avenue Pier.
- Historical shipyard operations, including painting and blasting, handling sandblast grit, and ship repair activities throughout the primary shipyard property.

The primary COCs for sediment are metals (arsenic, cadmium, copper, and zinc), carcinogenic PAHs (cPAHs), high molecular weight PAHs (HPAHs: specifically, fluoranthene and pyrene), and polychlorinated biphenyls (PCBs). The primary sources of sediment contamination include the following:

- Historical overwater and nearshore operations, including those at the marine railway, former dry dock, and piers, that resulted in spills, leaks, and releases of hazardous materials directly to Site surface water and sediments.

- Impacted groundwater originating from upland areas, traveling through the fill soil and discharging to sediments.
- Historical discharges of contaminated materials to sediments from former industrial wastewater or stormwater outfalls.
- Historical discharges by sheet flow of surface contamination generated from upland activities (e.g., sandblasting).
- Contaminated nearshore fill materials that have eroded into intertidal sediments.

Cleanup standards from the CAP consist of cleanup levels (CULs) that are protective of human health and the environment and pathway-specific points of compliance that designate the areas of the Site where the CULs must be met. Tables 2-3 and 2-4 summarize the upland and sediment COCs and the applicable CULs on a surface-weighted average concentration and/or point-by-point basis.

2.4 Site Cleanup Action

Ecology's selected cleanup action in the CAP (Ecology 2021) is summarized in the following subsections for both upland and in-water areas of the Site. Cleanup actions are required to, at a minimum, comply with MTCA cleanup standards, comply with applicable or relevant and appropriate requirements, and provide for a reasonable restoration time frame.

2.4.1 Upland Cleanup Actions

The cleanup action for soil and groundwater is a comprehensive final remedy for the upland portion of the Site that will comply with all applicable remedy selection requirements under MTCA. Figure 2-3 shows the three upland cleanup areas (CAs) as proposed in the CAP. CA 1 encompasses shallow soils outside of CA 2 and CA 3 containing concentrations of metals exceeding CULs. In the northwestern portion of the uplands, CA 2 is an area of deeper soil containing concentrations of copper and zinc exceeding CULs. In the northeastern portion of the uplands, CA 3 is where the 2018 Interim Action removed contaminated soils but has residual concentration of hydrocarbons exceeding groundwater CULs. The CAP-specified cleanup action for the three upland CAs are as follows:

- **Shallow Soil Source Removal and Capping in CA 1:** One of the following remedial actions will be implemented in CA 1 where COC concentrations in shallow soil exceed CULs:
  - Removal of the top 2 feet of contaminated soil to support gravel cap placement. Excavated soil would be disposed of off site at a licensed and permitted facility. A geotextile indicator fabric would be placed in excavated areas to prevent mixing of clean surface gravel with contaminated subsurface material and to provide an indicator layer during any future subsurface work. Excavated areas would then be capped with a compacted gravel surface meeting Site operational requirement; 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. Excavated areas would be backfilled with compacted base course material as necessary, and asphalt pavement would be placed. Stormwater infrastructure would be installed in paved areas to manage stormwater runoff.
- **Deeper Soil Source Removal in CA 2:** Deeper excavation of copper- and zinc-contaminated soil contributing to copper and zinc exceedances in groundwater will be conducted in CA 2. The inferred lateral extents of excavation are shown in Figure 2-3, and the FS assumed an average excavation depth of 5 feet across that footprint. However, the lateral and vertical extents of soil excavation will be determined during remedial design based on the results of the PRDI data collection.
  - Soil solidification/stabilization is 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.
- **Natural Attenuation and Monitoring in CA 2 and CA 3:** The selected cleanup includes natural attenuation of groundwater and long-term monitoring for metals in CA 2 and hydrocarbons (PAHs, namely 1-methylnaphthalene) in CA 3 to document conditions until compliance with cleanup standards is achieved.
  - Bioremediation for treatment of hydrocarbons in CA 3 groundwater is a contingency measure that may be conducted if remedial design sampling indicates additional cleanup is required to address contamination in groundwater following the source removal accomplished during the 2018 Interim Action.
- **Institutional Controls:** The implementation of institutional controls in the form of an Environmental Covenant that will place a number of general and specific prohibitions, restrictions, and requirements on activities on certain parcel(s) at the Site. Institutional controls would also include implementation of an Operations, Management, and Monitoring Plan that would specify soil management procedures and health and safety requirements for future excavation work.

2.4.2 Sediment Cleanup Actions

Figure 2-3 shows the Sediment Cleanup Action Areas divided by sediment management units (SMUs) included in the CAP. The cleanup action to remediate Site sediments will include a combination of dredging and capping technologies based on chemical concentrations, Site operational considerations, accessibility, and existing infrastructure, as follows (Ecology 2021):

- **Dredging:** Accessible open-water areas of the Site within the active remediation area (SMU 1) will be dredged to achieve CULs or remedial action levels (RALs), depending on area. A portion of SMU 1 dredging was completed during the Interim Action in 2018. Dredging will

remove the sediment to an average depth of 2 to 4 feet below the mudline. The West Marine Walkway will be demolished to facilitate dredging and rebuilt for operational use of the marine railway after sediment remediation is complete. Dredged material will be removed from the aquatic environment for disposal.

- **Excavation and Backfill:** Open intertidal areas (SMU 2) will be excavated to an average depth of 3 feet and then backfilled to restore pre-construction elevations. A portion of SMU 2 excavation was completed during the Interim Action in 2018. Excavated material will be removed from the aquatic environment for disposal.
- **Underpier Granular Cap**: The Harris Avenue Pier (SMU 3a), West Dock (SMU 3b), and marine railway (SMU 4a and 4b) structures will be retained for current and future tenant operations. Approximately 1 to 3 feet of granular capping material will be placed beneath these structures to contain existing sediment contamination in place. Prior to capping, up to 3 feet of sediment will be removed from beneath the intertidal section of the marine railway (SMU 4b) by targeted excavation before applying the granular cap material beneath this structure up to the top of the railway girders. Excavated material will be removed from the aquatic environment for disposal.
- **Compliance Monitoring:** Compliance monitoring includes both performance and confirmation monitoring. The selected cleanup includes long-term monitoring of the intertidal excavation backfill to ensure stability and effectiveness of the constructed granular caps. Long-term monitoring will continue as long as contamination remains contained on the Site in excess of cleanup standards.
- **Institutional Controls:** The implementation of institutional controls in the form of requirements to maintain the capped areas and manage exposure to contaminated sediments that were capped will include the following:
  - Worker health and safety requirements during future redevelopment work in the intertidal area, such as bulkhead wall replacement.
  - Limits on overwater operations that may disturb the physical integrity of sediment caps, such as propeller wake restrictions, if deemed necessary through propeller wash analyses.
  - Restrictions on digging or other activities that may disturb capped areas and expose contained sediments.
  - Evaluation of more permanent remedial actions at the time the pier or marine railway structures are renovated, replaced, or demolished.

2.5 Archaeological Considerations

A subsurface archaeological site was identified on the property in 2017 during the Interim Action cleanup. The archaeological site, 45WH1026, is a multi-component shell midden, parts of which are

disturbed. The full boundaries of the archaeological site are not known and the current extent is limited to the limits of disturbance from the excavation during the Interim Action cleanup.

Proposed investigations on the Site will require review to evaluate potential impacts to cultural resources, including site 45WH1026. The Port and Ecology are responsible for evaluating impacts under the State Environmental Policy Act. In-water investigations will also require a permit from the U.S. Army Corps of Engineers (USACE). USACE must review its permitted actions under Section 106 of the National Historic Preservation Act, which requires determining the effects on historic properties (including significant archaeological sites) and mitigating adverse effects. USACE will determine whether the upland investigations also fall under their jurisdiction. If not, as Ecology is providing funding, they must review investigations (that are not reviewed under Section 106) as part of the Governor's Executive Order 21-02. The Executive Order requires a similar evaluation of effects and mitigation as Section 106. Each of these review requirements includes consultation with Native American Tribes and the Department of Archaeology and Historic Preservation (DAHP).

Washington State laws require 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). Although none of the planned sampling is within the currently defined boundaries of site 45WH1026, the extent of the archaeological site is not known, and it may be present in some of the proposed sampling locations. To comply with state laws, consult with Native American Tribes and DAHP, and reduce delays during investigations, the project will apply for an archaeological excavation permit for the sampling investigations included in this PRDI Work Plan. A revised or new permit may be required for construction of the cleanup actions, depending on the results of the investigations and design of the remedial action.

The investigations approach included in this PRDI Work Plan has been designed to minimize potential impacts to site 45WH1026, while also gathering additional archaeological information that will be used to inform the remedial design. Potential impacts to Site cultural resources will be minimized by using borings rather than test pits in the upland portion of the Site to decrease the footprint of investigation impacts. To the extent possible, borings will be continuous sonic cores, to facilitate understanding of the archaeological stratigraphy. Upland borings will be monitored by an archaeologist. In coordination with the archaeologist, Native American Tribes, and DAHP, additional borings may be advanced in strategic locations as needed to support delineation of the archaeological site boundary.

In summary, proposed remedial investigations in this PRDI Work Plan have been designed to minimize impacts to, and gather information about, site 45WH1026.

3 Upland Pre-Remedial Design Data Needs

Data gaps associated with the upland portion of the remedial design include surveyed locations of surface or subsurface structures, the location of known and unknown subsurface utilities, the three-dimensional extents of copper and zinc in soil exceeding CULs within CA 2, and current groundwater hydrocarbon concentrations in CA 3. The work included within this PRDI Work Plan will also inform the dewatering design for the CA 2 excavation and the potential need for groundwater bioremediation contingency measures as described in Section 2.4.1. Sampling methodology and analysis intervals are described in the Upland Sampling and Analysis Plan (Upland SAP; Attachment A).

3.1 Upland Surface and Subsurface Conditions

The available data on subsurface structures, building foundations, and utilities are limited. Updated surveys within the upland portion of the Site for topography, Site features, and utilities are needed to better understand CA dimensions and potential conflicts of cleanup with existing infrastructure that will be addressed in the design documents.

3.2 Cleanup Area 1 (CA 1)

At this time, there are no critical data gaps associated with soil quality characterization at CA 1 that affect the outcomes of the remedial design. Consistent with the CAP, it will be assumed for purposes of design that all soils beneath gravel surfacing and structures are contaminated and require capping; therefore, it is unnecessary to determine the exact depths and extents of soil impacts within CA 1.

In CA 1, the existing buildings and pavement currently serve as a cap to subsurface soil and are protective of the direct contact exposure pathway. It is our understanding that existing buildings and pavement will be maintained as caps, in accordance with Site institutional controls. If those areas are redeveloped, new caps will be installed to maintain protectiveness and integrate with the surrounding capping and Site reuse needs.

3.3 Cleanup Area 2 (CA 2)

Additional soil borings are required within CA 2 to determine the three-dimensional extents of deeper copper- and zinc-contaminated soil. In addition to analytical data, geotechnical properties of the existing soil are needed to inform design of the CA 2 excavation, as well as capping across CA 1. Tidal monitoring and hydraulic conductivity testing of CA 2 wells is also needed to provide basic data that the contractor can use to design their excavation dewatering approach.

3.4 Cleanup Area 3 (CA 3)

The activities included in this PRDI Work Plan assume that the completed CA 3 interim action excavation area complies with CAP requirements for the upland environmental cap. Additional

groundwater sampling will be performed within CA 3 to document current groundwater concentrations of PAHs[1] (1-methylnaphthalene) and geochemical indicators for hydrocarbon biodegradation. Comparing concentrations of geochemical indicator compounds to be analyzed (the electron acceptors dissolved oxygen, nitrate, sulfate, iron, manganese, and bicarbonate as measured by alkalinity) between wells impacted by hydrocarbons versus wells outside the area of hydrocarbon impact provides a qualitative line of evidence for biological activity degrading the hydrocarbons. This collective data on PAH concentrations and evidence for their biodegradation will be evaluated to determine the effectiveness of hydrocarbon natural attenuation following the CA 3 source removal accomplished by the 2018 Interim Action and, in turn, assess the need for groundwater contingency measures to enhance PAH biodegradation as described in Section 2.4.1. The details regarding such a contingency measure would be determined as part of design, based on contaminant conditions and logistics (e.g., subsurface access); however, it would likely include injection of a treatment reagent to temporarily increase dissolved oxygen content (e.g., Oxygen Release Compound® [2]) and thereby facilitate aerobic biodegradation of residual PAHs.

[1] The most recent groundwater quality data for the CA 3 area are from 2015.

2 Produced by Regenesis Inc. https://regenesis.com/en/oxygen-release-compound-orc/

4 In-Water Data Gaps Analysis and Pre-Remedial Design Data Needs

This section provides a summary of the in-water remedial design data gaps and the rationale for conducting the proposed sampling methods and locations. A data gaps analysis was conducted by comparing existing information with required data needs to further the design process. Data gaps were then classified by data collection rationale and objectives, and a recommended field sampling and testing program was developed. The following data gap discussion focuses on data needs that will be addressed during in-water PRDI activities.

Sampling methodology and analysis intervals are described in the In-Water SAP (Attachment B). Analytical methods are listed in the Quality Assurance Project Plan (QAPP; Attachment C).

4.1 Sediment Quality

A review of existing available sediment data was conducted by downloading Site sediment quality data from Ecology's Environmental Information Management database, based on the studies documented in Table 2-1. These data were then reviewed to determine the nature and extent of sediment contamination at the Site.

The data were divided into surficial and subsurface data in an effort to determine lateral and vertical bounding of contamination and the status of existing sediment quality relative to project CULs. Figure 4-1 and Figure 4-2 show the available data as compared against individual COC's CULs for the surface and subsurface data, respectively. Figures include a summary comparison of all of the project COCs compared against their individual CULs or screening level at each station, and "stickplots" of subsurface sediment core samples (color-coded based on a similar screening level comparison). The data shown are the maximum exceedance for any of the Site COCs at each given location or depth interval. Based on review of these data, the following data gaps have been identified and the proposed sampling will be conducted to address these data gaps.

In-water PRDI data needs include additional surface and subsurface sediment quality data from subtidal and intertidal areas, including underpier areas, to refine the extent of sediment cleanup required for compliance with cleanup standards. This includes compliance with both surface-weighted average concentration and point-by-point criteria to inform dredge and cap design.

4.1.1 Open-Water Dredging Area

A review of surface and subsurface data in the open-water dredging area (SMU 1) indicates a reasonable amount of available information to document both lateral and vertical extents of contamination. As such, sampling in this SMU will consist primarily of two areas of composite cores

for the purposes of collecting material for geotechnical and materials handling and disposal purposes, as discussed in Section 4.4. In the northern portion of SMU 1, outside of the previous Interim Action Area, two cores, along with one hand auger location in SMU 2, will be composited to characterize the portion of the SMU with higher levels of documented contamination. In the southern portion of SMU 1, four cores will be composited to characterize this area with somewhat reduced levels of contamination.

In addition to these composite cores, two additional cores will be collected. The first additional core will be collected, re-occupying previous sampling location SC-04, to confirm the results in that core, as the location has elevated COCs at depth relative to adjacent cores in the immediate vicinity. The second core will be located in the isolated northeastern portion of SMU 1, northeast of the Interim Action, as no data are known to exist in this isolated portion of the SMU.

4.1.2 Interim Action Area

Sediment data collected after the completion of the Interim Action dredging indicate the presence of contamination exceeding Site CULs within this area. Based on review of the Interim Action Construction Completion Report (Floyd Snider 2019b), no backfill or residuals management cover was placed after completion of dredging. As such, the observed contamination is due to residual contamination after dredging was completed. Typically, residual contamination falls into two categories, either generated residuals (i.e., contaminated material that settles back to the dredged surface as the dredge bucket moves up through the water column) or missed inventory (i.e., contamination present below the dredge cut that was not documented prior to dredge design and was missed during dredging). Proposed sampling in the Interim Action Area would consist of stratified grab samples to determine if the documented contamination present is generated residuals or missed inventory. Stratified grab sampling would consist of using an oversized grab sampler to collect a sample of approximately the top 12 inches of sediment. The grab would then be separated into a surface sample within the biologically active zone (top 12 centimeters or 4.7 inches) and the sediment below that. These stratified samples would help indicate whether contamination is only present in the surface or whether it goes deeper. This would inform future remedial actions in this area. Proposed sample locations have been chosen to reoccupy existing locations where post-Interim Action samples exceed Site CULs, including IASMU-1.5, IASMU-1.9, IASMU-3.3, IASMU-3.5, and IASMU-3.8. One additional grab sample was located to the north of the Harris Avenue Pier for general spatial coverage of the area.

4.1.3 Northeast Site Boundary

Along the northeastern boundary of the Site, existing data document that contamination exceeding Site CULs is present outside of SMU 1. These locations (SC-12, SG-09, and SC-09) will be reoccupied with grab samples to confirm the presence of surface contamination associated with these samples. Two additional grab samples will be collected and archived for potential future chemical analyses if

the core proposed for the isolated portion of SMU 1 demonstrates that contamination is present above Site CULs. These two archived grabs would be triggered in an effort to bound the lateral extent of contamination in this portion of the Site. Grab samples will be analyzed for Site COCs and screened against appropriate criteria.

4.1.4 Intertidal Area

In the intertidal areas, the lateral and vertical extents of contamination are generally sufficient to inform remedy design of sediment excavation and backfill. One location in SMU 2 will be sampled as part of the core composites to document geotechnical and materials handling and disposal related items, as described later in this section. One additional hand auger will be completed outside of the current Site boundaries to reoccupy an existing location (HA-06) where levels of arsenic were previously documented to exceed the project CUL for this COC. This location will be sampled to determine if this exceedance was an anomaly.

4.2 Granular Capping

Granular caps are intended in areas under the existing Harris Avenue Pier, marine railway, and West Dock where the structures will remain in place (SMUs 3a, 3b, 4a, and 4b). Data in these areas has been reviewed with respect to requirements for placing the granular cap. Currently, there is generally decent characterization of sediment quality under and adjacent to these structures. To confirm the recency and usability of these data, two additional sediment samples will be collected for Site COC bulk chemistry, with one sediment core proposed under the Harris Avenue Pier in SMU 3a to determine the vertical extent of contamination in that area and one grab sample proposed under the West Dock in SMU 3b to confirm the presence of contamination due to the age of the current sample location under this dock. Limited additional information is required at this time beyond bulk chemistry, as the bulk chemistry data can act as a surrogate for porewater by applying literature-based partitioning coefficients, in the event that cap attenuation modeling is identified as a requirement as part of the EDR. It is anticipated that granular capping will require studies to determine appropriate material sizing for stability purposes, but the inputs for these studies would be based on currently available information, such as local wind and wave data, and no additional field data are needed to be collected for these analyses.

4.3 Geotechnical Investigations

4.3.1 Dredgeability Review and Materials Handling

Physical testing data are needed within planned dredge areas to assess the dredgeability and materials handling properties of the dredge materials. Limited geotechnical data are available for Site sediments. As such, subsurface sediment samples are needed from proposed dredge and excavation

areas (i.e., SMU 1 and SMU 2) as part of the sediment PRDI. Geotechnical sample results will also be used to inform stability of proposed dredge cuts and any additional requirements that may be needed for handling the sediment after it has been dredged. Physical tests including grain size, Atterberg Limits, specific gravity, moisture content, and bulk density will be performed on selected subsurface samples from SMUs 1 and 2.

4.3.2 Shoreline Bulkhead Stability

Additional geotechnical sampling is needed to assess subsurface conditions and shoreline stability in the upland portion of the Site in the vicinity of the marine railway, shoreline bulkhead north of CA 2, and the existing water storage tanks on the Site (Figure 2-2). The shoreline bulkhead was observed to be in disrepair, causing erosion of contaminated upland soils and potential instability in the vicinity of the water storage tanks. Additionally, because the upland area behind the bulkhead will be capped as part of the remedial actions associated with CA 1, the bulkhead will need to be repaired to protect the remedy. Existing geotechnical information is available in the vicinity of this area associated with monitoring wells MW-01, MW-11, and MW-12. These borings include information regarding soil strength in the adjacent portions of the Site. Two additional borings immediately adjacent to the failing bulkhead will be conducted to document localized conditions that will determine specific requirements associated with repair of the shoreline bulkhead. While repairs associated with this bulkhead would be part of the in-water remediation work, the geotechnical investigation will capitalize on the drill rig being used for the upland soil investigations and will be conducted during the upland PRDI. One additional boring will be completed in the vicinity of the marine railway to support design of the replacement marine walkway structure and to inform potential future use best management practices.

Geotechnical investigations will consist of completing roto sonic borings to approximately 60 feet below the ground surface with sampling via a driven split spoon sampler at 5-foot intervals to collect material for geotechnical laboratory analyses, as well as collecting data regarding in situ density of soils in this area. The depth of the borings is required to allow for American Society of Civil Engineers site classification to support potential future design of a shoreline bulkhead as part of the upland and in-water cleanup action. Samples will be collected during completion of geotechnical borings for moisture content, grain size, and Atterberg Limits testing. Samples will be collected from each 5-foot sample interval, and laboratory testing assignments will be identified following completion of all field work.

4.4 Materials Handling and Disposal

Physical and chemical testing data are needed to support materials handling evaluations and to inform disposal of dredged/excavated materials (e.g., landfill disposal or other authorized disposal options). The same physical tests that provide information on dredgeability of sediments will be useful in evaluating materials handling properties. In addition, dredge elutriate testing is needed to

model potential water quality impacts during dredging, and leachability testing is needed to develop a waste profile of materials that will be removed by dredging or excavation for either landfill or other authorized disposal options, as described in the following sections.

4.4.1 Water Quality Effects

Because mechanical dredging is likely to be employed as part of sediment removal at the Site, an understanding of potential water quality impacts from dredging is required to determine best management practices to be employed during dredging activities. A Dredge Elutriate Test (DRET) will be performed to provide data for predicting the concentration of contaminants present in the water column at the point of dredging. Representative composite samples will be tested from each dredge area. DRET sample aliquots will also be to inform whether passive dewatering will be used or if the water needs to be contained and treated prior to discharge. DRET sample aliquots will be analyzed for all Site COCs.

4.4.2 Landfill Disposal

Toxicity characteristic leaching procedure (TCLP) analysis of dredge materials is needed to inform disposal decisions. Representative composite samples of dredge and/or excavation materials (i.e., subtidal and intertidal sediment) that exhibit the highest levels of bulk chemistry COCs for metals will be collected and submitted for TCLP metals analyses.

4.4.3 Alternate Disposal Options

Because there is the possibility that dredged material from this project could be disposed of via another authorized disposal option, additional leachability or physical characteristic analyses may be required to determine suitability or if additional amendments are required for an alternate disposal location. In the event that additional disposal testing is required for an alternate authorized disposal option, composite samples will be collected and archived for future testing. It is currently assumed that archived samples will be stored for 1 year from the time of collection while requirements for an alternate disposal option are determined.

4.4.4 Additional Bioassay Testing

Compliance with CULs in surface sediment (0 to 12 centimeters below mudline) is to be determined using a combination of chemical testing and contingent bioassay testing. The CAP defined CULs are based on Ecology's Sediment Quality Standards (SQS; Ecology 2019), or Site-specific concentrations calculated during the RI/FS, to protect the functions and integrity of the benthic community. Therefore, bioassay data may be needed to confirm or override the chemistry results in surface sediment grabs in the event of Site CUL exceedances. Samples that exceed the Site CULs, but pass bioassay testing, are considered to comply with the benthic SQS and Site CULs, consistent with

Washington's SMS regulations. Contingent toxicity testing will be conducted if surface sediment analytical chemistry results exceed Sediment Cleanup Objective levels. Toxicity testing will include three standard bioassays:

- 10-day amphipod mortality test
- 20-day juvenile polychaete growth test
- Larval bivalve or echinoderm development test

Test methods will follow guidance from Puget Sound Estuary Program (PSEP; 1995), the Sediment Cleanup User's Manual (Ecology 2019), and Sediment Management Annual Review Meeting updates. Test results will be compared to SMS Biological Effects Criteria Sediment Cleanup Objective/SQS and cleanup screening levels for Puget Sound marine waters.

4.5 Overwater Structural Inspections

Structural inspections are needed to understand the current conditions of the structures that will remain in place where active remediation is anticipated (Figure 2-2) and how these structures may be impacted by the remedial actions. Existing available structural assessments focused on structures that were part of the Interim Action, such as the demolished portions of the Harris Avenue Pier. Structural inspections will be conducted on overwater structures outside of the Interim Action Area that are within the in-water cleanup portion of the Site. The findings of the structural inspections will be summarized in conditions assessment memoranda and will include observed conditions and considerations for the proposed remedial actions.

4.6 Surveys

Site condition surveys are needed to prepare remedial design plans and permitting figures, identify utilities and habitat areas, and develop accurate volume estimates for dredging and excavation. Available survey data are either outdated or only cover portions of the Site. Site condition surveys will include utility locates, updated multibeam bathymetry in subtidal and intertidal areas, an eelgrass and macroalgae survey, and diver surveys to locate debris and in-water utilities (e.g., outfalls) that are not on current Site maps, as further described in the following subsections.

4.6.1 Utilities

Current maps of Site utility locations are required to support remedial design and permitting. In-water utilities are located in remediation areas that will be physically impacted by construction. In other cases, utilities may be required to support remedial activities (e.g., power connections for contractor work areas or stormwater/wastewater connections for sediment staging areas).

Site utility maps currently do not show at least one observed in-water outfall and will be updated with the limited available information provided by the Port, with public utility information, and field

surveys. The location of surficial utilities will also be documented through use of a diver survey to locate outfalls and other similar Site features that are at or near the surface of the sediment.

4.6.2 Debris

A significant amount of debris and existing marine infrastructure (e.g., anchors and chains) are expected to be encountered during dredging, as observed during the Interim Action (Floyd Snider 2019b). No additional information regarding debris, other than anecdotal, is available. An example of anecdotal information is an outcropping of rock that is purportedly located within the boundary of SMU 1 and/or SMU 3b (Figure 2-3), which may be an obstruction to dredging and remediation activities. As such, surveys are needed in intertidal areas at low tide and subtidal areas by divers where significant debris is expected to be encountered during dredging activities to assist in dredge design and project planning.

4.6.3 Bathymetry

It is known that dredging was completed in 1982 in the vicinity of the former dry dock. The footprint of that historical dredging is still evident in the bathymetry data collected in 1998. An additional bathymetric survey was conducted in 2011; however, it was not comprehensive and did not include the entire in-water area of the Site. Figure 2-3 shows the extent of available bathymetry in the project Site. Additional site-wide coverage of bathymetry will be required to complete remedial design.

4.6.4 Eelgrass and Macroalgae Surveys

As part of agency guidance and best practices, a current eelgrass and macroalgae survey is needed in shallow subtidal areas of the Site where the project construction activities could potentially disturb eelgrass or macroalgae beds. Eelgrass beds have been identified in areas in the southern portion and to the west of the Site, but this information requires updating given the elapsed time since the areas were identified.

5 Summary of PRDI Activities

5.1 Upland

The upland pre-design investigation includes the following tasks to further assess and quantify Site and contaminant conditions within the cleanup areas as defined in the CAP. All investigation field procedures will be performed in accordance with the Upland SAP (Attachment A) and Upland Health and Safety Plan (HASP; Attachment E). Chemical analyses will be conducted in accordance with the QAPP (Attachment C).

5.1.1 Survey of Surface and Utility Conditions in CA 1 and CA 2

A professional land surveyor, Wilson Engineering, LLC (Wilson), will complete a detailed survey of the existing topography and Site features across the upland area. Construction as-built records for existing structures, if available, will be reviewed for foundation type and condition. Data from this review will inform design requirements for the excavations near or against structures in both CA 1 and CA 2.

Likewise, drawings or other information on existing subsurface utility locations within the limits of the Site, if available, will be evaluated. A public on-call utility locating service will be used, and a private utility locating service will be subcontracted to identify utility locations to the extent practical, as well as clear the proposed areas of subsurface exploration. Marked utility locations will be surveyed by Wilson and incorporated into Site plans.

During the PRDI, existing pavements will be inspected outside of structures to determine where repairs or replacement are required to meet cap performance (integrity) requirements. This information will be used to design the CA 1 and CA 2 excavation and capping extents and identify existing paved areas that require repair/replacement to meet the CAP's capping performance standards.

5.1.2 Upland Structural Inspection

The upland structural inspection will focus on upland structures and foundations located within cleanup extents. The upland inspection will document conditions at the railway winch house, stormwater tank foundations, and mechanical/electrical out buildings, all of which are adjacent to proposed deeper removal actions. Warehouse buildings and office/security buildings will not be considered in this assessment because they are not expected to be impacted by the remedial actions. A cursory review of other foundations or slabs within the cleanup extent will be noted/photographed should cleanup effort require structures to be demolished in the future.

5.1.3 Additional Soil Characterization in CA 2

Ten soil borings (AB-01 through AB-15) will be advanced to a depth of 15 feet below ground surface to better delineate the lateral and vertical extents of copper-/zinc-contaminated soils requiring excavation in CA 2. Figure 5-1 depicts locations of the 10 borings within and surrounding the currently defined CA 2 excavation extent. The borings may have to shift from planned locations if thick concrete slabs or other surface/subsurface obstructions are encountered that cannot be cored through or otherwise avoided with reasonable effort, or if refusal is encountered at shallow depth.

The borings will be advanced by a state-licensed resource protection well driller using rotosonic-core drilling methods. Disturbed soil samples will be obtained from each boring in accordance with Standard Penetration Test methods. Split spoon samples will be collected from each boring at 2.5-foot intervals or as determined based on field conditions. The number of samples and depth in each boring may be adjusted based on field observations, sample recovery, and other factors.

As previously noted, archaeological monitoring will be performed continuously during drilling in accordance with the Inadvertent Discovery Plan (Attachment D). Results of monitoring will be documented in a report prepared in consultation with Ecology and DAHP.

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

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

5.1.4 Tidal Study and Hydraulic Testing in CA 2

Because the CA 2 contaminated soils extend below the water table, the construction contractor will likely need to dewater the excavation area to allow handling of unsaturated soil, as will be required in the technical specifications. To assist the contractor in designing the dewatering approach, Aspect Consulting will perform hydraulic conductivity testing to estimate aquifer permeability in the vicinity of CA 2. Testing will include single-well slug tests in existing monitoring wells MW-2A and MW-12 located along and outside of the planned excavation's eastern edge, nearest to Bellingham Bay (Figure 5-2). In addition, continuous water level monitoring will be performed for a minimum of

72 hours in those wells to document groundwater elevations and the magnitude of tidal influence on them in the excavation area. If the conditions of wells MW-2A or MW-12 are determined to be unsuitable for the hydraulic testing, replacement well(s) will be installed when the CA 2 soil borings described in Section 5.1.3 are completed.

5.1.5 Groundwater Sampling in CA 3

Two rounds of groundwater will be collected, approximately 1 month apart, from wells contiguous to CA 3 to document concentrations of PAHs and geochemical indicators and thereby assess PAH natural attenuation progress and the necessity for implementing a contingency measure to enhance hydrocarbon biodegradation as described in Section 3.4. Groundwater samples from existing wells MW-01, MW-06, and MW-09 near the downgradient edge of CA 3 (Figure 5-2) will be analyzed for PAHs (including 1-methylnaphthalene). The samples will also be analyzed for geochemical indicators for hydrocarbon natural attenuation, including sulfate, nitrate, iron, manganese, and bicarbonate measured as alkalinity. To provide a basis for comparison of geochemical conditions in groundwater, well MW-04, located outside (cross-gradient of) the area of CA 3 hydrocarbon impact, will also be sampled for geochemical indicators. Field parameters including dissolved oxygen, oxidation-reduction potential, and pH will also be measured for each monitoring well sampled, as noted below. If the condition of any of these wells is determined to be unsuitable for the hydraulic testing, a replacement well(s) will be installed as described in Section 5.1.7.

The groundwater samples will be 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 will be submitted to an Ecology-accredited analytical laboratory (Analytical Resources, Incorporated) for chemical analysis using analytical methods and quality control protocols specified in the QAPP (Attachment C).

5.1.6 Investigation-Derived Waste Handling and Disposal

Excess soil cuttings from borings and purge water from well sampling will be drummed on site, profiled, and disposed of in accordance with the Upland SAP (Attachment A).

5.1.7 Contingency Monitoring Well Installation

If existing monitoring wells MW-2A and MW-12 are determined to be in poor condition (i.e., physically damaged or obstructed by silt deposits), new monitoring wells will be installed within one or two of the 10 soil borings, within or on the north side of the CA 2 excavation area, while the drilling contractor is on site. Likewise, CA 3 wells planned for monitoring could be replaced if deemed unusable. Each newly installed monitoring well will be developed to remove fine-grained material from inside the well casing and filter pack, and to improve hydraulic communication

between the well screen and the surrounding water-bearing formation. The details of well installation and development, if needed, are described in Attachment A.

5.2 In-Water

The in-water pre-design investigation includes the following sampling and surveys to further assess and quantify Site and contaminant conditions within the SMUs as defined in the CAP. All investigation field procedures will be performed in accordance with the In-Water SAP (Attachment B) and In-Water HASP (Attachment F). Chemical analyses will be conducted in accordance with the QAPP (Attachment C).

5.2.1 Sediment Grabs

Twelve sediment grabs will be collected as depicted in Figure 5-3. Sample locations may be adjusted in the field as necessary if obstructions or refusal are encountered at the target location. Grabs will be collected from a vessel operated by a marine sampling subcontractor using a large Van Veen grab or equivalent.

Of the 12 total grab locations, six stratified grab samples will be collected in the Interim Action Area to determine if the documented contamination present is generated residuals or missed inventory and to inform future remedial actions in this area. Stratified grabs will test surface sediment material as two discrete intervals: the biologically active zone (top 12 centimeters or 4.7 inches), and the sediment below that. Five stratified grab samples will be collected in locations where post-Interim Action grab samples exceed Site CULs, and one additional grab sample will be located south of the Harris Avenue Pier for general spatial coverage of the area.

Five surface sediment grabs (0 to 12 centimeters) will be collected in the northeastern Site boundary area. Three surface sediment grab samples will reoccupy historical sample locations to confirm surface contamination. Two additional grab samples will be collected and archived to confirm concentrations in the SMU 1 subsurface core in the event of exceedances.

One additional sediment grab will be collected under the West Dock to confirm a previous sample from under the dock.

The details of stratified grab and surface grab collection and processing methodology are described in Attachment B.

5.2.2 Sediment Cores

Nine subsurface sediment cores will be collected as depicted in Figure 5-3. Sample locations may be adjusted in the field as necessary if obstructions or refusal are encountered at the target location.

Sediment cores will be collected using a vibracore from a vessel operated by a marine sampling subcontractor.

Six composite cores will be collected for the purposes of collecting material for geotechnical and materials handling and disposal. Two cores will be collected in the northern portion of SMU 1 (Composite A). These will be composited along with a hand auger sample (Section 5.2.4) to characterize the portion of the SMU with higher levels of documented contamination. Four composite cores will be collected in the southern portion of SMU 2 to characterize this area with reduced levels of contamination (Composite B).

Three discrete cores will be collected in other Site areas. One core will be collected at historical location SC-04 to confirm elevated COCs at depth, one core will be collected in SMU 1 to the northeast of the Interim Action Area for spatial coverage of lateral and vertical contamination, and one core will be collected in SMU 3a under the Harris Avenue Pier.

Sediment core collection and processing methodology and compositing details are described in Attachment B.

5.2.3 Investigation-Derived Waste

Excess sediment from sediment grabs and cores sampling will be drummed on site, profiled, and disposed of in accordance with the In-Water SAP (Attachment B).

5.2.4 Hand Auger

Two hand auger samples will be collected as depicted in Figure 5-3. Locations may be adjusted in the field as necessary if obstructions or refusal are encountered at the target location. Hand augers will be collected from intertidal areas at low tide using an auger.

One hand auger sample will be collected in SMU 2 and composited with the cores in SMU 1 (Section 5.2.2; Composite A) to characterize the portion of the SMU with higher levels of documented contamination.

One hand auger will be collected to reoccupy existing location HA-06 to confirm historical arsenic concentration data. This location only requires surface sampling and could be conducted with a shovel.

Hand auger collection and processing methodology and compositing details are described in Attachment B.

5.2.5 Materials Handling and Disposal Testing

In general, analyses to support materials handling and disposal testing will be conducted on the samples associated with the composite cores collected as described above.

5.2.5.1 DRET Testing

The composite cores will be used to conduct two DRET tests, with the extraction process occurring in Anchor QEA's geochemistry laboratory and further water analytical testing conducted by an Ecology-accredited analytical laboratory for chemical analysis using analytical methods and quality control protocols specified in the QAPP (Attachment C).

5.2.5.2 TCLP Sampling

TCLP sampling will be conducted on up to 10 individual samples. TCLP samples will be chosen based on the preliminary results of bulk metals sampling and triggered using archived materials from the samples. TCLP samples will be conducted on the samples with the highest measured concentrations of metals. Given review of available data, it is unlikely that hazardous waste level materials will be present in Site sediments, but TCLP testing will be used to document conditions for disposal purposes.

5.2.5.3 Archived Samples

As noted previously, archived samples will be retained after completion of preliminary analysis of bulk chemicals and the noted materials handling and disposal characterization analyses. These archives will be used in the event additional analyses are identified as the preliminary analyses are reviewed and design documentation is developed.

5.2.6 Structural Inspections: In-Water

The overwater structural inspection will include an above-deck and below-deck assessment of the West Dock, East Marine Walkway, and marine railway elements (Figure 2-2). It is assumed that the West Marine Walkway will be demolished as part of the project and will not require a structural assessment. Above-deck observations will focus on east pier appurtenances, bullrail, mooring fittings, and fender elements. The below-deck condition assessment will focus on the condition of the deck framing elements, pile caps, above-water portion of piles, fender system, and general condition of the shoreline.

5.2.7 Surveys

The following surveys will be conducted to document in-water Site conditions.

5.2.7.1 Utilities and Debris

Diver surveys are needed in subtidal areas where significant debris is expected to be encountered during dredging activities to assist in dredge design and project planning. The dive survey will also map the extent of visible utilities (e.g., outfalls) that are present on site. The dive survey will consist of a diver swimming transects throughout the Site and documenting observations with a GPS and communications with a note taker above the surface. The diver will also probe the sediment in areas of anticipated significant debris and in nearshore excavation areas to determine the presence of debris below the surface of the sediment. A similar probing survey will also occur in the intertidal area at low tide to document the presence of debris in the area of proposed excavation (SMU 2).

5.2.7.2 Bathymetry

An updated bathymetric survey is needed to provide the level of recency and completeness needed for remedial design and permitting. A survey capturing full coverage of the Site using a multi-beam bathymetric survey method and licensed surveyor will be employed. To the extent possible, the survey will also capture under-dock areas. It is assumed that, given the relatively narrow width of the Harris Avenue Pier and the West Dock and the decent bent spacing on the portions of these structures in the proposed remedial action area, coverage should be relatively complete beneath both structures with standard multi-beam methods.

5.2.7.3 Eelgrass and Macroalgae

An eelgrass and macroalgae survey will be conducted to document the presence of eelgrass and macroalgae, specifically in areas that are to be dredged or excavated to determine the extent of potential impacts to eelgrass and macroalgae. The surveys will be conducted using a combination of direct visual assessment of the intertidal areas coupled with a towed camera survey of shallow subtidal areas, in accordance with Washington Department of Fish and Wildlife Eelgrass/Macroalgae Habitat Interim Survey Guidelines (WDFW 2008; provided in Attachment B of this PRDI Work Plan). Eelgrass shoot and macroalgae density will be measured in planned sediment disturbance areas. The survey patterns will include a combination of transects and roving to delineate the margin of eelgrass beds.

6 References

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Tables

Table 2-1
Summary of Previous Investigations

Year	EIM Study ID	Performed by	Study	Sample Location	Matrices	Count of Samples by Analyte Group																	Total Samples of Each Matrix by Year
						Conventional Parameters	Dioxin Furans	Grain Size	Metals	n-Alkanes and Isoprenoids	Organometallic Compounds	PCB Aroclors	PCB Congeners	Pesticides	Pharmaceuticals and Personal Care Products	Polybrominated diphenyl ethers	Polycyclic Aromatic Hydrocarbons	Semivolatile Organics	Surrogates	Total Petroleum Hydrocarbons	Volatile Organics	Bioassay	Other Analytes	
Pre-1998	HARISHST	Ecology	Initial Site Investigations	Upland	Soil				78		24	30					120	47					13	**312**
				In-water	Sediment	12		24	51		9			6				6						**108**
1998		RETEC	Phase 2 sampling	Upland	Groundwater				156								6			18	78			**258**
					Soil				221								72	6		46	106			**451**
				In-water	Porewater						6													**6**
					Sediment	50			150			184					60	44			3		1	**492**
2000	HARRIS00	RETEC	Sediment Toxicity Testing	In-water	Sediment	82			235			168					576	589			31		15	**1,696**
2003	HARIS03A, HARIS03B			In-water	Sediment	20		8	18		10	14		16			38	42			4			**170**
2004	HARIS04	RETEC	Working Draft Sediments RI/FS	In-water	Porewater						12													**12**
					Sediment	42		12	70		33	56		63			153	119			41		7	**596**
2005	HARISINT	RETEC	Upland Source Control Evauation	Upland	Groundwater				20			7					18			3				**48**
					Soil	24			121		12	84				12	236	569		36	540		3	**1,637**
2006	PSAMP_SP	Ecology	Puget Sound Assessment and Monitoring Program Spatial/Temporal Monitoring	In-water	Sediment	4		20	22			18	36	45	2		54	54	38		6		53	**352**
					Sediment Bioassay																	18		**18**
2010	UWI	Ecology	Urban Waters Initiative	In-water	Sediment	1		20	11			9	18	22	2		25	22			2		30	**162**
					Sediment Bioassay																	37		**37**
2011	HARIS11	Floyd Snider	Supplemental Site Investigation	Upland	Groundwater				221			162				18	419	902		69	1,426		36	**3,253**
					Soil				520		4	144				57	1,311	2,786		171	3,534		120	**8,647**
				In-water	Sediment	16			96		8	72				8	184	392		18	8		16	**818**
2013			Data Gaps Investigation	Upland	Groundwater				195	4						14	280	686		59	640		59	**1,937**
					Soil	7	100		234	4						18	360	882		56	66		72	**1,799**
				In-water	Sediment	16	75	126	68			50		21			140	140			7			**643**
2015			Pre-Interim Action Investigation	Upland	Groundwater				99	15							618			21	18		33	**804**
					Soil				191	20							152			159	24		24	**570**
				In-water	Sediment	134		70	234			609					1,494			8			4	**2,553**
2017			Interim Action Confirmation Sampling	Upland	Soil				60											40				**100**
				In-water	Sediment				63			168					378							**609**
	UWI	Ecology	Urban Waters Initiative	In-water	Sediment	6		20	22			18	36				56	14					39	**211**
					Sediment Bioassay																	109		**109**
2018	HARIS11	Floyd Snider	Interim Action Confirmation Sampling	In-water	Sediment				45			136					436							**617**
Total Samples by Analyte Group						**414**	**175**	**300**	**3,201**	**43**	**118**	**1,929**	**90**	**173**	**4**	**127**	**7,186**	**7,300**	**38**	**704**	**6,534**	**164**	**689**	**29,025**

Notes:

Ecology: Washington State Department of Ecology

PCB: polychlorinated biphenyl

Table 2-2

Overview of Media, Receptors, and Exposure Routes

Media	Receptors	Direct Exposure Description	Media Data Availability	Cross-Media Protection	
				From	To
Fish and Shellfish	Humans	Tribal consumption of resident fish/shellfish	Limited data available nearby on bioaccumulatives	Sediment and Surface Water	None
	Higher Trophic Level Species	Consumption of resident fish/shellfish			None
Subtidal Sediments	Humans	Direct contact via net fishing	Good data set, including bioassays	Intertidal Sediment	Fish/Shellfish
	Benthic Species	Direct exposure by organism living in and on the sediments			
Intertidal Sediments	Humans	Industrial worker direct contact	Good data set	Groundwater and Soil (via Erosion)	Subtidal Sediment
	Benthic Species	Direct exposure by organism living in and on the sediments			
Surface Water	Humans	Limited direct exposure	No data available	Groundwater	Fish/Shellfish
	Aquatic Species	Direct exposure by living in the bay	No data available		
Groundwater	Humans	No direct exposure – non-potable	Good data set	Soil	Surface Water
	Terrestrial Species	No direct exposure – industrial site			Sediments
					Ambient Air
Saturated Soil	Humans	Limited direct exposure during construction activities	Good data set	None	Groundwater
Unsaturated Soil	Humans	Industrial worker direct contact	Good data set	None	Groundwater via Stormwater Infiltration
	Terrestrial Species	No direct exposure – industrial site			Ambient Air
Ambient Air	Humans	Industrial worker direct contact	No structures of interest; soil gas data available	Groundwater and Soil	None

Note:

Reproduced from Floyd Snider, 2019a. *Port of Bellingham Harris Avenue Shipyard Final Remedial Investigation/Feasibility Study* . Prepared for the Port of Bellingham. June, Table 4.1.

Table 2-3
Cleanup Levels for Upland Contaminants of Concern

Contaminant of Concern	Groundwater CUL[1,2] (µg/L)	Soil CULs (mg/kg)	
		Shallow Soil[3]	Protection of Groundwater[4]
Arsenic	5	88	88
Copper	3.1	--	390
Zinc	81	--	960
1-Methylnaphthalene	1.5	--	8,000[5]
Total TPH[6]	--	--	24,000[7]

Notes:

1. For metals, compliance with the proposed CULs is assessed using filtered groundwater samples; in surface water, the criteria are applicable to dissolved metals in the water column.

2. Point of compliance is measured where groundwater discharges to surface water and/or sediments.

3. The point of compliance is 0-15 feet below ground surface throughout the Site as a protection of direct human contact, based on an industrial worker scenario.

4. The point of compliance for groundwater protection is the top 8 feet of soil in the unsaturated zone, and soil below 8 feet in the saturated zone.

5. This CUL is applicable to AOC 3, where diesel concentrations in soil exceeding 8,000 mg/kg leaching into groundwater can cause anerobic conditions that lead to the leaching of arsenic at unacceptable levels.

6. TPH is totaled based on site-specific TPH criteria (extractable petroleum hydrocarbon/volatile petroleum hydrocarbon).

7. This CUL is applicable to the area outside of AOC 3. Concentrations less than this CUL are protective of all pathways and are not contributing to arsenic leaching at unacceptable levels.

--: no criteria available

µg/L: microgram per liter

CUL: cleanup level

mg/kg: milligram per kilogram

TPH: total petroleum hydrocarbon

Table 2-4
Cleanup Levels for Sediment Contaminants of Concern

Contaminant of Concern (mg/kg)	Protection of Benthic Species and Human Direct Contact[1]		Protection of Seafood Consumption by Human or Wildlife[2]
	Intertidal Area	Subtidal Area	
Arsenic	20	13	13
Cadmium	--	--	0.8
Copper	390	390	--
Zinc	410	410	--
Total PCB Aroclors[3,4]	--	0.13	0.033
cPAH TEQ[3,5]	--	--	0.14
Fluoranthene	--	1.7	--
Pyrene	--	2.6	--

Notes:

1. Point of compliance for benthic and direct contact protection is the upper 12 centimeters of sediment, evaluated on a point-by-point basis.

2. Per SCUM guidance, bioaccumulative exposures occur on an area-wide basis. Therefore, the point of compliance is the upper 12 centimeters of sediment concentrations averaged on an area-weighted basis (i.e., SWAC).

3. Non-detections are treated as U=0 when totaling per SMS guidance.

4. Total PCBs are derived based on the sum of the concentrations of Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260.

5. cPAH TEQ is calculated based on toxicity equivalency factors provided in SCUM guidance (Ecology 2019). The included PAHs are: benzo[a]pyrene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene.

--: no criteria available

cPAH: carcinogenic polycyclic aromatic hydrocarbon

mg/kg: milligram per kilogram

PCB: polychlorinated biphenyl

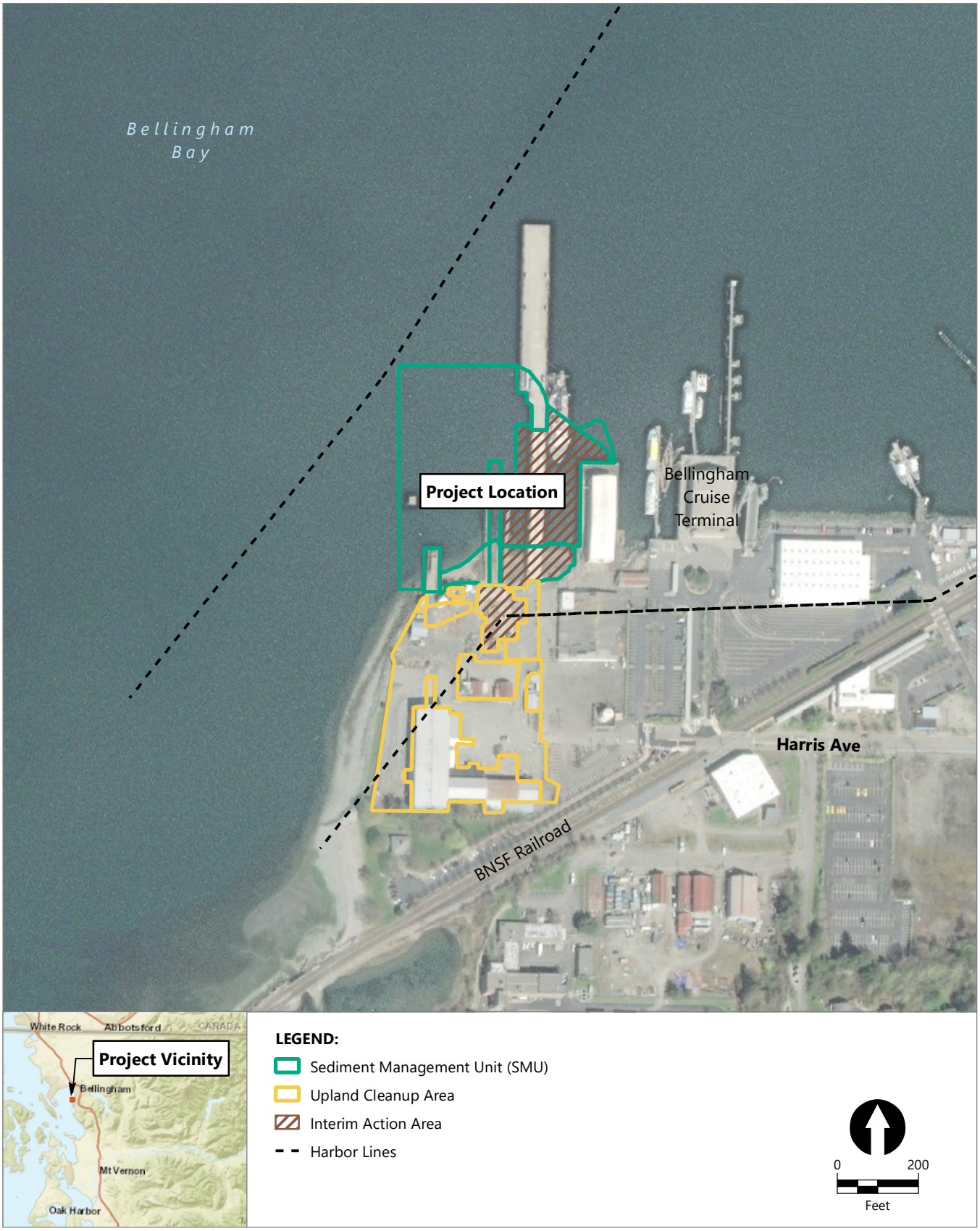
SCUM: Sediment Cleanup User's Manual

SMS: Sediment Management Standards

SWAC: surface-weighted average concentration

TEQ: toxic equivalent

Figures



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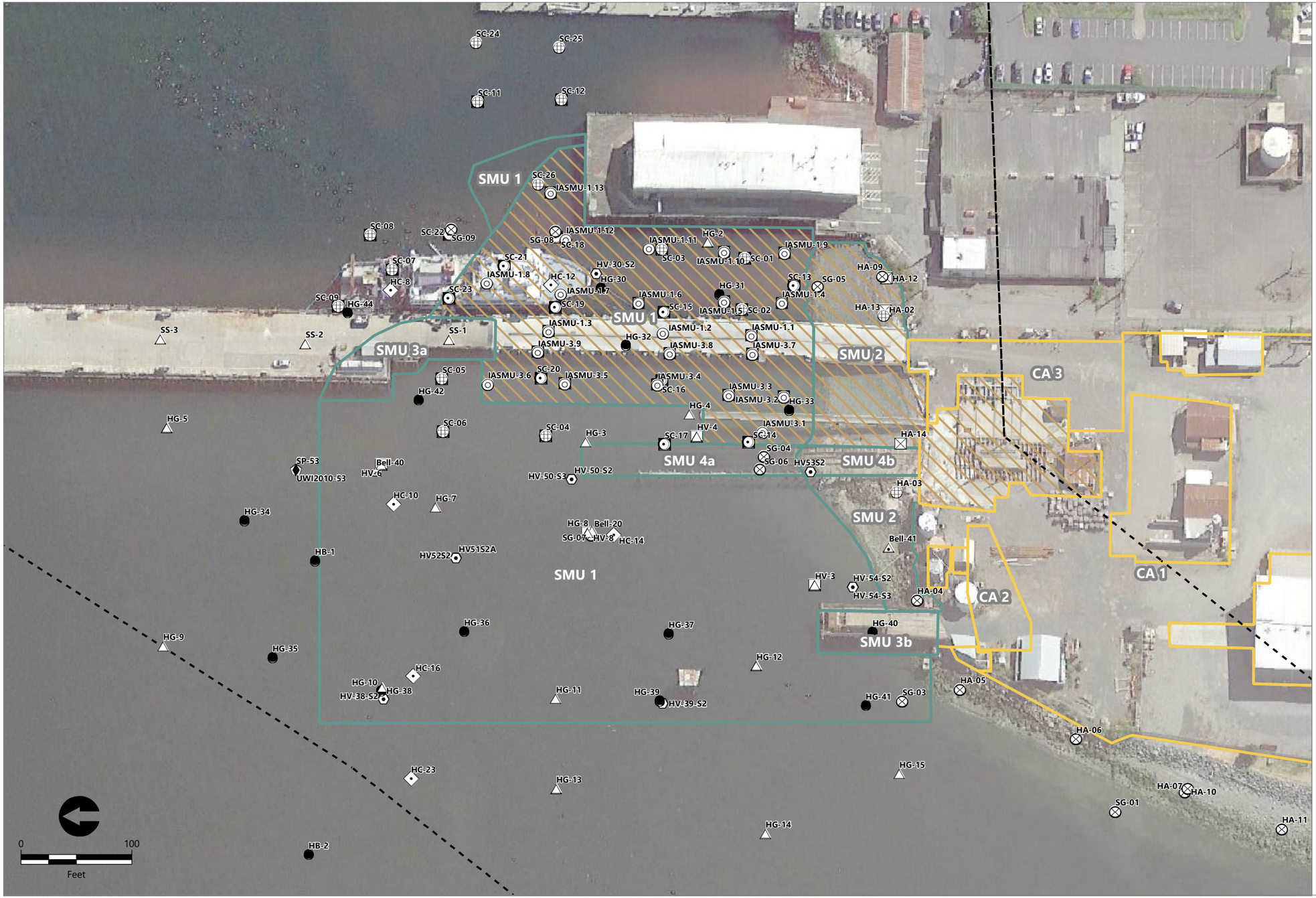
ANCHOR QEA

NOTES:
1. Horizontal datum: Washington State Plane North Zone, North American Datum of 1983, U.S. Survey Feet.
2. Aerial image is Esri ArcGIS Online.
3. Sediment Management Units and Upland Cleanup are from Harris Avenue Shipyard Cleanup Action Plan.

Figure 1-1
Site Vicinity Map
Pre-Remedial Design Investigation Work Plan
Harris Avenue Shipyard Cleanup



LEGEND:

- Sediment Management Unit (SMU)
- Upland Cleanup Area
- Interim Action Area
- Harbor Lines

Surface Sediment Sample Location

- Floyd|Snider Grab Sample (2011, 2013)
- Floyd|Snider Grab Sample (2015)
- Floyd|Snider Grab Sample (2017, 2018)
- RETEC Grab Sample (1993)
- RETEC Grab Sample (1998)
- RETEC Grab Sample (2000, 2003)
- RETEC Grab Sample (2006)
- UWI Grab Sample (2017)

Subsurface Sediment Sample Location

- Floyd|Snider Hand Auger (2015, 2017)
- Floyd|Snider Vibracore (2015)
- Floyd|Snider Vibracore (2017, 2018)
- RETEC Vibracore (1998)
- RETEC Vibracore (2000)
- RETEC PSDDA Vibracore (2004)

NOTES:
1. Sediment data presented are provided by Ecology EIM.
2. Aerial imagery acquired from Google Earth Pro v.7.3.3.7786. Image date August 15, 2020.

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Figure 2-1
Historical Sediment Sample Locations
Pre-Remedial Design Investigation Work Plan
Harris Avenue Shipyard Cleanup

LEGEND:

- Major Topographic Contour (5' Interval)
- Minor Topographic Contour (1' Interval)
- Harbor Lines
- Stormwater Sewer
- Culvert
- Sanitary Sewer
- Water Line
- Overhead Power
- Buried Power
- Overhead Communications
- Buried Communications
- Natural Gas
- Buried Air
- Propane Tank
- Utility Vault
- O/W Separator
- Utility Switch
- Floyd|Snyder Monitoring Well
- RETEC Monitoring Well

0 100
Feet

NOTE:
1. Aerial imagery acquired from Google Earth Pro v.7.3.3.7786. Image date August 15, 2020.

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Figure 2-2
Existing Site Features
Pre-Remedial Design Investigation Work Plan
Harris Avenue Shipyard Cleanup

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Figure 2-3
Cleanup Action Areas
Pre-Remedial Design Investigation Work Plan
Harris Avenue Shipyard Cleanup

LEGEND:

- Sediment Management Unit (SMU)
- Upland Cleanup Area
- Interim Action Completed

Cleanup Action

- Dredge to CULs/RALs
- Intertidal Sediment Excavation and Backfill
- Underpier Granular Cap
- Marine Railway Intertidal Sediment Excavation and Granular Cap
- Marine Railway Subtidal Sediment Granular Cap

Screening Level Classification

- < Lowest Screening Level
- >= Site-Wide SWAC
- >= SMS SCO (AET) or RAL
- >= 2x RAL or > 2x SCO

NOTES:

1. Sediment data presented are provided by Ecology EIM.
2. Result value units are mg/kg.
3. Cleanup actions are from Harris Avenue Shipyard Cleanup Action Plan. Ecology, 2019.
4. Aerial imagery acquired from Google Earth Pro v.7.3.3.7786. Image date August 15, 2020.

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Figure 4-1
Surface Sediment Contaminants of Concern Exceeding Site Cleanup Levels
Pre-Remedial Design Investigation Work Plan
Harris Avenue Shipyard Cleanup

LEGEND:

- Sediment Management Unit (SMU)
- Upland Cleanup Area
- Interim Action Completed

Cleanup Action

- Dredge to CULs/RALs
- Intertidal Sediment Excavation and Backfill
- Underpier Granular Cap
- Marine Railway Intertidal Sediment Excavation and Granular Cap
- Marine Railway Subtidal Sediment Granular Cap

Classification

- < Lowest Screening Level
- >= Site-Wide SWAC
- >= SMS SCO (AET) or RAL
- >= 2x RAL or > 2x SCO

Core Log Intervals

0.5' 0' 1' 3' 8'

NOTES:

1. Sediment data presented are provided by Ecology EIM.
2. Result value units are mg/kg.
3. Cleanup actions are from Harris Avenue Shipyard Cleanup Action Plan. Ecology, 2019.
4. Aerial imagery acquired from Google Earth Pro v.7.3.3.7786. Image date August 15, 2020.
5. Core Stick logs may not accurately represent conditions in the Interim Action Area, as the cores have not been updated to account for the dredging in those areas.

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Figure 4-2
Subsurface Sediment Contaminants of Concern Exceeding Site Cleanup Levels
Pre-Remedial Design Investigation Work Plan
Harris Avenue Shipyard Cleanup

LEGEND:

- Proposed Cleanup Area 2 Soil Boring Location
- Cleanup Action Area
- Monitoring Well
- Historical Upland Exploration Location

NOTES:

1. Monitoring wells and historical upland exploration locations presented are provided by Ecology EIM.
2. Cleanup Action Area from Harris Avenue Shipyard Cleanup Action Plan. Ecology, 2019.
3. Aerial imagery acquired from Google Earth Pro v.7.3.3.7786. Image date August 15, 2020.

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Figure 5-1
Upland Soil Sampling Locations
Pre-Remedial Design Investigation Work Plan
Harris Avenue Shipyard Cleanup

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Filepath: Q:\Jobs\Port_of_Bellingham_0007\Harris_Ave_Shipyard\Maps\Work Plan\Aspect WP 5-2 GW Monitoring and Testing Locations.mxd

ANCHOR QEA

Figure 5-2
Groundwater Monitoring and Testing Locations
Pre-Remedial Design Investigation Work Plan
Harris Avenue Shipyard Cleanup

LEGEND:

- Sediment Management Unit (SMU)
- Upland Cleanup Area
- Interim Action Completed

Cleanup Action

- Dredge to CULs/RALs
- Intertidal Sediment Excavation and Backfill
- Underpier Granular Cap
- Marine Railway Intertidal Sediment Excavation and Granular Cap
- Marine Railway Subtidal Sediment Granular Cap
- Historical Surface Sediment Location

Proposed Sampling Locations

- Geotechnical Boring
- Grab
- Grab (archive only)
- Stratified Grab
- Core
- Composite Core
- Hand Auger

NOTES:

1. Sediment data presented are provided by Ecology EIM.
2. Cleanup actions are from Harris Avenue Shipyard Cleanup Action Plan. Ecology, 2019.
3. Aerial imagery acquired from Google Earth Pro v.7.3.3.7786. Image date August 15, 2020.

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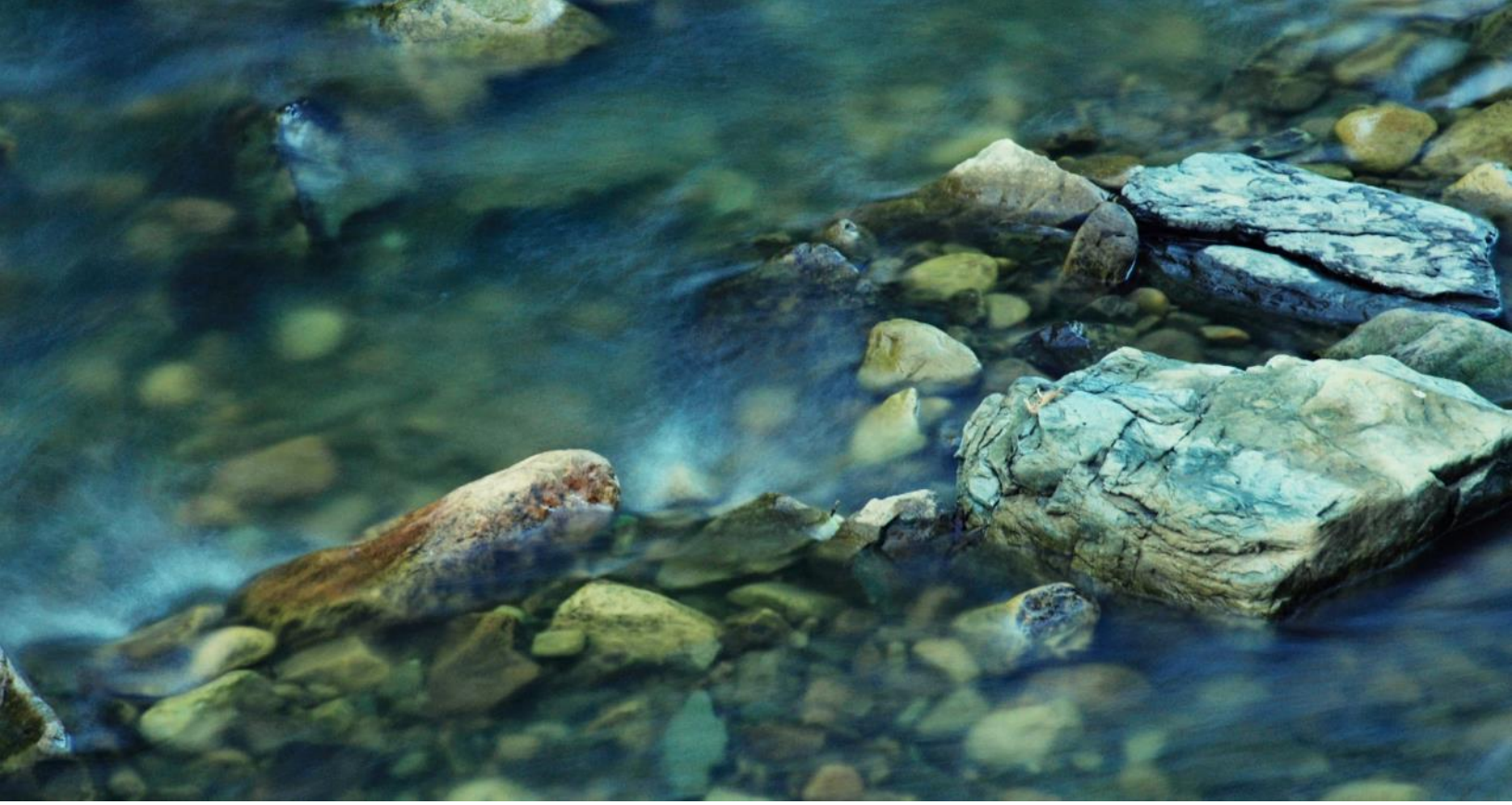
ANCHOR QEA

Figure 5-3
In-Water Sampling Locations
Pre-Remedial Design Investigation Work Plan
Harris Avenue Shipyard Cleanup

Attachment A
Upland Sampling and Analysis Plan



October 2021
Harris Avenue Shipyard Cleanup

ANCHOR QEA

PRDI Work Plan Attachment A
Upland Sampling and Analysis Plan

Prepared for Washington State Department of Ecology

October 2021
Harris Avenue Shipyard Cleanup

PRDI Work Plan Attachment A
Upland Sampling and Analysis Plan

Prepared for
Washington State Department of Ecology
Bellingham Field Office
913 Squalicum Way No. 101
Bellingham, Washington 98225

Prepared by
Anchor QEA, LLC and Aspect Consulting, LLC

Prepared on behalf of
Port of Bellingham
1801 Roeder Avenue
Bellingham, Washington 98227

Project Number: 210007-02.01
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FIGURES

ATTACHMENT

ABBREVIATIONS

ASTM	ASTM International
bgs	below ground surface
CA	upland cleanup area
CAP	Cleanup Action Plan
COC	chain of custody
DAHP	Department of Archaeology and Historic Preservation
DOT	Department of Transportation
Ecology	Washington State Department of Ecology
EIT	engineer-in-training
GIT	geologist-in-training
GPS	Global Positioning System
IDW	investigation-derived waste
L	liter
LG	licensed geologist
mg	milligram
min	minute
mL	milliliter
mV	millivolt
MW	monitoring well
NAVD88	North American Vertical Datum of 1988
N-value	standard penetration resistance
ORP	oxygen reduction potential
PAH	polycyclic aromatic hydrocarbon
PE	licensed professional engineer
pH	quantitative measure of the acidity or basicity of aqueous or other liquid solutions
PRDI	Pre-Remedial Design Investigation
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
SAP	Sampling and Analysis Plan
Site	Harris Avenue Shipyard Site
SPT	Standard Penetration Test
WAC	Washington Administrative Code
Wilson	Wilson Engineering, LLC
YYMMDD	date format (year as two digits, month as two digits, day as two digits)

1 Introduction and Purpose

This *Upland Pre-Remedial Design Investigation Sampling and Analysis Plan* (Upland SAP) is prepared as Attachment A to the Pre-Remedial Design Investigation (PRDI) Work Plan for the Harris Avenue Shipyard Site (Site) located in Bellingham, Washington. Both upland and in-water portions of the Site are regulated by the cleanup process under the Model Toxics Control Act, Revised Code of Washington 70.105D, and of the Washington Administrative Code (WAC) 173-340, administered by the Washington State Department of Ecology (Ecology).

In 2021, Ecology authored a *Cleanup Action Plan* (CAP; Ecology 2021), which describes the selected cleanup action for the Site based on the *Remedial Investigation/Feasibility Study* (Floyd Snider 2019) and other relevant documents in the administrative record. Ecology made a preliminary 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.

The PRDI Work Plan presents data gaps in the existing dataset to support engineering and design activities for cleanup of the upland and in-water sediment areas of the Site. This Upland SAP presents the methods and procedures that will be followed for the work to obtain the additional data and information needed for the upland areas of the Site. The Upland SAP identifies the proposed number and location of samples and defines field protocols for sample collection and for groundwater hydraulics data collection. It is the responsibility of field personnel and subcontractors (e.g., drillers) performing the data collection activities to adhere to the requirements of the Upland SAP.

Upland pre-remedial design data needs include updated surveys, additional subsurface quality data from the Upland Cleanup Action Area (CA) 2 to refine the extent of soil excavation, geologic and hydrogeologic data from CA 2 to inform excavation and dewatering design, and groundwater sampling from CA 3 to assess the efficacy of hydrocarbon natural attenuation and thereby inform the need for contingency bioremediation enhancements to accelerate the attenuation. As described in the main body of the PRDI Work Plan, pre-design data collection activities for the upland portion of the Site include the following:

- Topography and site surveys, including utility locates across the upland area
- Within CA 2:
  - Advancement of 10 soil borings extending to 15 feet below ground surface (bgs), with laboratory analysis of select soil samples for identified contaminants of concern
  - Groundwater level monitoring and hydraulic testing in two existing wells
- Within CA 3, groundwater sampling and laboratory analysis to assess current concentrations of polycyclic aromatic hydrocarbons (PAHs) and geochemical indicators of hydrocarbon biodegradation as a component of natural attenuation

2 Pre-Sampling Activities

The following field-related activities must be accomplished prior to initiating the drilling and sample collection:

- Field locating borings and surveying drilling locations with a hand-held Global Positioning System (GPS) unit
- Inspecting the Site for surface indications of utilities or other infrastructure features not already presented on existing utility maps, and surveying the locations with a hand-held GPS unit
- Public (one-call) and private utility locating for locations where subsurface disturbance will be conducted
- Because the upland area is a known archaeological site, coordination with Ecology and Department of Archaeology and Historic Preservation (DAHP) to obtain a permit allowing the planned subsurface disturbance activities subject to complying with the Inadvertent Discovery Plan and other permit requirements

All of these activities will be documented in field notes and photographs and, in the case of DAHP coordination, separate correspondence.

3 Data Collection Methods

The rationale for the upland data collection is described in the PRDI Work Plan. The following sections describe methods to be employed to collect the upland pre-design data. Soil borings and groundwater sample locations are shown in Figures A-1 and A-2, respectively. Explorations may be adjusted in the field based on the presence of utilities, structures, or other obstructions that may be encountered.

3.1 Survey of Surface Conditions

Wilson Engineering, LLC (Wilson), under subcontract to Anchor QEA, will complete a detailed survey of the existing topography and site features across the upland area. The survey will include the following elements:

- Re-establish on-site survey control tied to the City of Bellingham's NAD83/98 Washington State Plane (North Zone) Coordinate Control schema, and to the North American Vertical Datum of 1988 (NAVD88). Elevations will be converted to mean lower low water vertical datum as needed.
- Perform a topographic survey on a nominal 25-foot grid. The following data attributes will be collected at each grid intersection point:
  - Northing, Easting, and Elevation
  - Surface Type (Concrete, Asphalt, Soil, Quarry Spalls, Crushed Concrete, or Other to be described)
  - Condition of Hard Surface (e.g., competent vs. degraded)
- Observe and collect a data point at the transitional point between surface types if it occurs between pre-defined grid points. Likewise, if a clear transition in surface cover, or substantive change in elevation, is apparent in between transect lines, that transition will be recorded. The data attributes listed above will be collected at such transition points.
- Record x, y, z coordinates of building corners, monitoring wells, utilities, catch basins, and other visible site features.

To the extent practicable using conventional techniques, subsurface utilities will be marked using the public one-call utility locating service and with a private utility locating service. Wilson will provide drone survey of the marked utilities that will be integrated into the topography and site features basemap.

3.2 Soil Borings in CA 2

Aspect will subcontract with a Washington-licensed resource protection well driller to complete soil borings within CA 2 in accordance with requirements of WAC 173-160. Soil borings will be advanced to depths of 15 feet bgs using sonic drilling methods; use of this drilling method will allow

simultaneous collection of data for chemical characterization and geotechnical characterization to support project design. If the drilling encounters refusal on subsurface conditions, the drillers will step out the boring a minimum of 3 feet and attempt to reach the target depth.

The drilled soil borings will be supervised and logged by an Aspect field engineer or field geologist and used to directly observe subsurface soil and groundwater conditions. Sampling will be completed in accordance with Standard Penetration Test (SPT) methods in general accordance with ASTM International (ASTM) D1586, Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils. The SPT involves driving a 2-inch-outside-diameter split-barrel sampler 18 inches into the soil with a 140-pound automatic-trip hammer free falling from a distance of 30 inches. The number of blows for each 6-inch interval is recorded. The number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils.

The decontaminated 18-inch-long split spoon sampler will be used to collect soil at 2.5-foot depth intervals to the 15-foot boring depth. Four soil samples from each boring will be collected for chemical analysis at varying representative depths. The soil sample depth intervals will be selected based on field screening indications of contamination (Section 3.2.2) and/or sample recovery volume. In the absence of indications of contamination (e.g., visual evidence of debris, sand blast grit, or other materials suspected of containing high metals concentration), and assuming adequate sample recovery, sample depths for chemical analysis will be as follows:

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

The procedures for logging soils and field screening for potential contamination are outlined in the following sections. The soil samples will be removed from the sampler and homogenized using a clean, stainless-steel spoon and placed into certified-clean jars supplied by the analytical laboratory. Materials greater than approximately 0.5 inch will be removed from the sample. Table A-1 presents a list of containers, preservatives, and holding times to be used for CA 2 soil sample collection.

Each soil boring will be decommissioned by pressurized grouting or hydrated bentonite chips, in accordance with requirements of WAC 173-160. Decommissioning notes will be documented on boring logs. If a boring is to be completed as a (contingency) groundwater monitoring well, the installation procedure is described in Section 3.9. Surplus soil cuttings produced during drilling will be managed as described in Section 5.

3.2.1 Logging and Soil Descriptions

A qualified individual with field logging experience, under the direction of a licensed geologist (LG), will oversee the drilling activities, conduct all soil sampling, and prepare a geologic log for each of the explorations completed. For the purposes of this Upland SAP, a qualified individual for soil logging is defined as an LG, licensed professional engineer (PE), or a geologist- or engineer-in-training (GIT/EIT) under the direction of an LG. The qualified individual will visually classify the soils in accordance with ASTM International (ASTM) D2488 and record soil descriptions, amount of soil recovery, field screening results, and other relevant details (e.g., debris, staining, odors) on the boring log form (Attachment A-1). If samples are collected for chemical analysis, the sample ID and depth will also be recorded on the log.

3.2.2 Field Screening

The qualified individual will conduct field screening of soil samples/soil cores that includes a visual examination to note presence of debris, sheens and/or staining, and olfactory observations. Because metals are the contaminants of concern for CA 2, the field screening will focus on visual evidence of debris, sand blast grit, or other materials suspected of containing high metals concentration. Field screening observations will be documented on the boring log form.

3.3 Tidal Study for CA 2

The two monitoring wells (MW) near CA 2 (MW-2A and MW-12) will be equipped with a downhole pressure transducer/data logger to allow automated collection of water level data at 6-minute intervals continuously for a minimum duration of 72 hours. A data logger will also be placed in Bellingham Bay to directly record tidal fluctuations on the same interval. A barometric pressure data logger will also be installed on site to allow water level data to be corrected for changes in atmospheric pressure throughout the study. Data loggers will be suspended securely using Kevlar or heavy monofilament line to avoid movement during the test and will be set to measure synchronously at the same time (within a minute).

During installation of the data loggers, a manual depth-to-water measurement will be collected in each well approximately when the data logger takes its first reading, and again at the end of the test prior to removing the logger. The depth-to-water measurements (below surveyed top of well casing) provide groundwater elevations that will be used to convert the data logger readings into water elevations.

3.4 Hydraulic Conductivity Testing (Slug Testing) for CA 2

Slug tests will be performed in wells MW-2A and MW-12 to estimate the hydraulic conductivity of the shallow water-bearing materials adjacent to the CA 2 excavation. The test method involves quickly displacing a volume of water within a well and measuring water level recovery rate. Analytical methods are then used to estimate hydraulic conductivity of the soil from the recorded water level data.

A slug test can consist of a "slug-in" or falling head test, where the water level in the well is rapidly raised, or a "slug-out" or rising head test, where the water level in the well is rapidly lowered. A minimum of two slug tests will be performed at each well to be tested. An electric well sounder will be used to determine the depth from the top of the casing to the water table. The depth-to-water measurement will be compared to the well construction log to determine if the well screen is fully saturated. Rising and falling head tests will be performed in wells where the screen section is fully saturated. Only rising head tests will be conducted if the well has a partially saturated screen at the time of testing.

Slug tests will be performed using a solid polyvinyl chloride (PVC) slug rod to perturb the water level in the well. A pressure transducer and data logger will be used to measure and record displacement and recovery of the water in the well. For a falling head test, the slug rod will be rapidly lowered into the well and water levels monitored until they approach the pre-test measured water level. For a rising head test, the slug rod will be lowered into the well and the water level allowed to re-equilibrate. The slug rod will then be rapidly removed and water levels will be monitored until they approach the pre-test measured water level. During testing, the water levels in the wells will be measured using a vented pressure transducer and collected electronically on a data logger set to a nearly continuous time interval (1 second or less).

3.5 Groundwater Sampling Procedures for CA 3

Groundwater samples from existing wells MW-01, MW-06, and MW-09 near the downgradient edge of CA 3 will be analyzed for PAHs and geochemical indicators for hydrocarbon natural attenuation, including sulfate, nitrate, iron, manganese, and bicarbonate measured as alkalinity. The groundwater sample from well MW-04 will also be analyzed for geochemical indicators. Table A-1 presents a list of containers, preservatives, and holding times to be used for CA 3 groundwater sample collection.

Groundwater samples will be collected and handled in accordance with the following procedures:

- If a contingency replacement well is installed, groundwater sampling will occur 1 week after development to allow for equilibration and settling of any suspended solids that may remain inside the well casing.
- Groundwater samples from wells located within 100 feet of the Bellingham Bay shoreline will be sampled during the 3-hour window between 1 hour preceding and 2 hours following lower-low tide stage.
- The locking well cap will be removed, and the well will be allowed to equilibrate with atmospheric pressure for at least 15 minutes. Once equilibrated, the depth-to-groundwater will be measured from the surveyed location (marked on the casing with a "V" notch or black mark) to the nearest 0.01 foot using an electronic water level measuring device.

- Each monitoring well will be purged at a low-flow rate using a peristaltic pump and new, clean tubing dedicated for each well. The dedicated tubing will consist of polyethylene tubing down well with a short length of silicon tubing through the pump head. The tubing intake will be placed just below the center of the saturated section of well screen.
- The flow rate will be adjusted to minimize drawdown and generation of turbidity in pumped groundwater; however, a minimum purge flow rate of 100 milliliters per minute (mL/min) will be maintained throughout purging and sampling.
- During well purging, field parameters (temperature, pH, specific electrical conductance, dissolved oxygen, and oxygen reduction potential [ORP]) will be monitored using a YSI meter and flow-through cell, or equivalent. Additionally, the depth-to-water will be recorded during purging and turbidity will be recorded using a turbidimeter once other field parameters have stabilized. These field parameters and depth-to-water will be recorded at 2- to 5-minute intervals on the groundwater sampling form (Attachment A-1) throughout well purging until they stabilize. Stabilization is defined as three successive readings where the following applies:
  - Temperature varies by less than 0.1°C.
  - Specific conductance varies by less than 3%.
  - Dissolved oxygen varies by less than 10% (or 0.5 milligrams per liter [mg/L] if the readings are below 1 mg/L).
  - pH varies by less than 0.1.
  - ORP varies by less than 10 millivolts (mV).
  - However, no more than three well casing volumes will be purged prior to groundwater sample collection.
- Once purging is complete, the groundwater samples will be collected using the same low-flow rate from the dedicated tubing upstream of the flow-through cell to avoid potential cross-contamination and directly into laboratory-supplied sample containers for analysis.
- If the monitoring well is completely dewatered during purging, or if drawdown is significant even with a 100 mL/min purge rate, the well will be dewatered and samples will be collected, without further purging, when sufficient recharge has occurred to allow all sample containers to be filled.
- After sample collection is complete, the depth to the bottom of the monitoring well will also be measured to evaluate siltation of the monitoring well.
- Following sampling, the well cap and monument cap will be secured. Damaged or defective well caps or monuments will be noted and scheduled for replacement, if necessary.
- Groundwater produced during well purging will be managed as described in Section 5.

3.6 Sample Nomenclature and Labeling

Sample nomenclature for the PRDI collection program is described below. The sample prefix used for the different types of samples to be collected will include the following:

- AMW: groundwater sample from monitoring well
- AB: soil sample from Aspect boring

3.6.1 Soil Samples

Each soil sample collected from a boring will be assigned a unique sample identification number, including the boring number and the depth from which the sample was collected. For example, the soil sample collected from boring AB-05 at a depth of 7 to 8 feet bgs would be identified as AB-05-7-8.

3.6.2 Groundwater Samples

Each groundwater sample will be assigned a unique sample identification number that includes the well number and the 6-digit date (YYMMDD) on which the sample was collected. For example, a groundwater sample collected from monitoring well MW-04 on November 30, 2021, would be identified as MW-04-211130.

3.7 Field Documentation

While conducting field work, the field representative will document pertinent observations and events specific to each activity on field forms (Attachment A-1) and/or in a field notebook, and, when warranted, provide photographic documentation of specific sampling efforts. Field notes will include a description of the field activity, sample descriptions, and associated details such as the date, time, and field conditions.

3.8 Survey of Exploration Locations

For each exploration location, a short description of relative location will be recorded (e.g., 5 feet north of NE corner of shed). Horizontal coordinates for each soil sampling location not completed as a monitoring well will be recorded using a hand-held GPS instrument with real-time differential correction at the time of sample collection.

If a contingency replacement well is installed, its horizontal coordinates and elevation will be surveyed by a professional land surveyor relative to the Washington State Plane South horizontal coordinate system and the NAVD88 vertical datum. Monitoring well top-of-casing elevations will be surveyed to the nearest 0.01 foot, and horizontal coordinates to the nearest 0.1 foot, or better. Each well will be surveyed at the marked spot (i.e., notch in the PVC casing, or permanent ink mark, etc.) on the top of the PVC well casing from which depth-to-water measurements are collected.

3.9 Contingency Monitoring Well Installation and Development

In the event that a well being monitored during the PRDI is damaged or must otherwise be replaced during the monitoring program, new monitoring wells will be installed by a state-licensed resource protection well driller and constructed in accordance with WAC 173-160. The replacement wells will be installed as close as practicable to the original well, and will be constructed of 2-inch-diameter PVC well casing with 10-foot-long, 10- or 20-slot well screens. The well screen for each replacement well will be placed at an elevation interval approximately equivalent to that of the well being replaced. Screens will be filter-packed with 10/20 silica sand, and an annular seal consisting of bentonite chips will be placed above the filter pack. A concrete surface seal will be set at grade. The finished monitoring wells will be protected with flush-mount steel monuments.

Each newly installed monitoring well will be developed to remove fine-grained material from inside the well casing and filter pack, and to improve hydraulic communication between the well screen and the surrounding water-bearing formation. Well development will be performed using a peristaltic pump with a surge block, gently surging the entire length of the well screen. Each well will be developed until visual turbidity is reduced to minimal levels, or until 10 casing volumes of water plus a volume equal to any water added during drilling has been removed. Groundwater produced during well development will be managed as described in Section 5.

4 Equipment Decontamination

All non-disposable sampling equipment (e.g., stainless-steel spoons and bowls) will be decontaminated before collection of each sample. The decontamination sequence consists of a scrub with a non-phosphate detergent solution, followed by a distilled water rinse.

5 Investigation-Derived Waste

Investigation-derived waste (IDW) water generated during equipment decontamination and monitoring well development and sampling will be placed in labeled United States Department of Transportation (DOT)-approved drums pending the analytical results to determine appropriate disposal. The drums of water will be temporarily consolidated on site, profiled based on available analytical data, and disposed of appropriately at a permitted off-site disposal facility or, with approval of the local sewer authority, to the on-site sanitary sewer system.

Soil cuttings from borings will be placed in labeled DOT-approved drums pending the analytical results to determine appropriate disposal. The drums will be temporarily consolidated on site, profiled based on available analytical data, and disposed of appropriately at a permitted off-site disposal facility.

Documentation for off-site disposal of IDW will be maintained in the project file.

Disposable personal protective equipment, paper towels, baggies, and other disposable field supplies will be placed in a garbage bag, sealed, and placed in a municipal dumpster.

6 Sample Handling and Chain-of-Custody Requirements

The collected sample containers will be placed upright in a cooler. Ice or "Blue Ice" will be placed in each cooler to maintain the samples at a temperature of 2°C or less until they are delivered to the laboratory. Inert cushioning material will be placed in the remaining space inside the cooler as needed to limit movement of the sample containers. Whenever the sample coolers are shipped to the laboratory, the chain-of-custody (COC) form will be placed in a waterproof bag within the cooler for shipment.

After collection, samples will be maintained in Aspect's custody until formally transferred to the analytical laboratory, courier, or the shipper. For purposes of this work, custody of the samples is defined as one of the following:

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

A COC record provided by the laboratory will be initiated at the time of sampling for all samples collected. The record will be signed by the field representative and others who subsequently take custody of the sample. Couriers or other professional shipping representatives are not required to sign the COC form; however, shipping receipts will be collected and maintained in project files as a part of custody documentation. A copy of the COC form with appropriate signatures will be kept by Aspect's project coordinator.

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

7 Quality Assurance and Quality Control

Requirements for quality assurance/quality control (QA/QC) will include the collection of field QC samples as well as laboratory QC analyses. Field and laboratory QA/QC requirements are discussed in detail in the Quality Assurance Project Plan (QAPP; Attachment C to the PRDI Work Plan). The overall data quality objective for field sampling and laboratory analysis is to produce data of known and appropriate quality to support the upland cleanup design objectives.

8 References

Ecology (Washington State Department of Ecology), 2021. *Cleanup Action Plan. Harris Avenue Shipyard, Port of Bellingham.* Issued by Washington State Department of Ecology Toxics Cleanup Program, Southwest Regional Office, Olympia, Washington. February 2, 2021.

Floyd Snider, 2019. *Port of Bellingham Harris Avenue Shipyard Final Remedial Investigation/Feasibility Study*. Prepared for the Port of Bellingham. June 2019.

Table

Table A-1

Analytical Methods, Sample Containers, Preservation, and Holding Times

Sample Matrix	Analytical Parameter	Analytical Method	Sample Container	No. Containers	Preservation Requirements	Holding Time
Soils	Metals (Cu, Zn)	EPA 6020A	4 oz jar	1	Cool 0 – 6ºC	6 months
Ground water	Polynuclear Aromatic Hydrocarbons - low level	EPA 8270E-SIM	500 mL glass amber	2	Cool 0 – 6ºC	7 days
	Alkalinity, Total	SM 2320 B-97	250 mL HDPE	1	Cool 0 – 6ºC	14 days
	Nitrate + Nitrite as N	EPA 353.2	500 mL HDPE	1	pH <2 with 1:1 H_2SO_4 Cool 0 – 6ºC	28 days
	Sulfate	EPA 300.0	250 mL HDPE	1	Cool 0 – 6ºC	28 days
	Iron and Manganese (dissolved)	EPA 6020B	500 mL HDPE, field-filtered	1	pH <2 with 1:1 HNO_3 Cool 0 – 6ºC	6 months

Notes:

HDPE: high density polyethylene

mL: milliliter

oz: ounce

Figures

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ANCHOR QEA

Figure A-1
Upland Soil Sampling Locations
Upland Sampling and Analysis Plan
Harris Avenue Shipyard Cleanup

LEGEND:

- Cleanup Action Area
- Cleanup Action Area Well for Groundwater Monitoring
- Cleanup Action Area Well for Hydraulic Testing
- Monitoring Well
- Historical Upland Exploration Location

0 50
Feet

NOTES:
1. Monitoring wells and historical upland exploration locations presented are provided by Ecology EIM.
2. Cleanup Action Area from Harris Avenue Shipyard Cleanup Action Plan. Ecology, 2019.
3. Aerial imagery acquired from Google Earth Pro v.7.3.3.7786. Image date August 15, 2020.

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ANCHOR QEA

Figure A-2
Groundwater Monitoring and Testing Locations
Upland Sampling and Analysis Plan
Harris Avenue Shipyard Cleanup

Attachment A-1
Field Forms for Upland Data Collection

Aspect CONSULTING

SOIL BORING FIELD LOG

Boring No.: _____

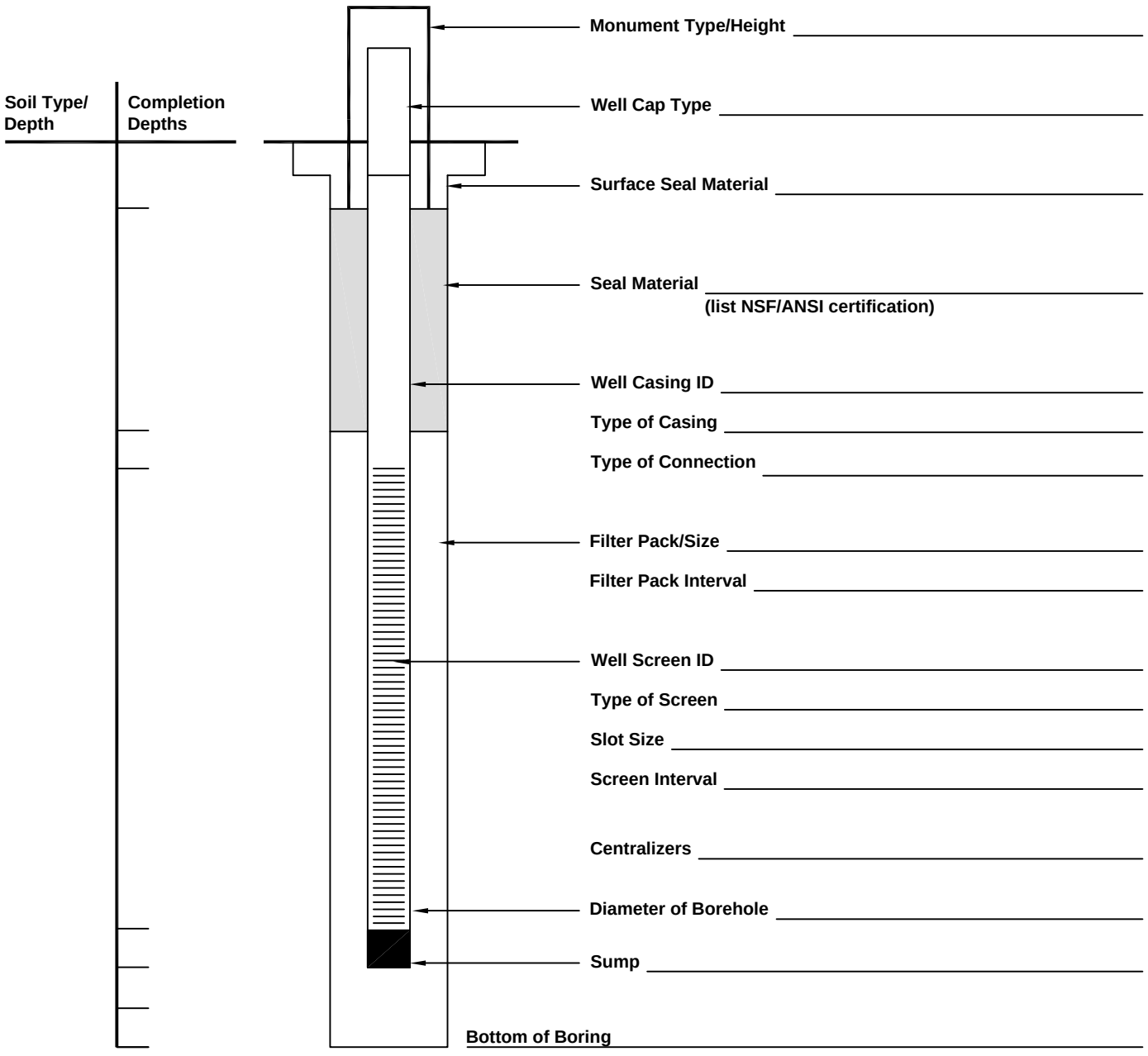
Project Number:	**Project Name:**	**Drilling Equipment/Method:**
Date Begin/End:	**Location:**	**Drilling Company/Driller:**
Boring Total Depth:	**Coordinates (X/Y, Lat/Lon, Sta.):**	**Bit Type/Size:**
Surface Conditions:	**Elevation (ft.msl):** **Source:**	**Hammer Type/Wt./Efficiency:**
Logged By:	**Depth to GW (ft.)** **Initial/Time:**	**Final/Time:**

Depth	Driven Length (in.) with Sample Type Symbol	Recovery (in.)	Blows Per 6 inches	Sample Number	Consistancy/R. Density	Field Soil Description & Classification (ASTM D 2488)										Field Notes/Add. Soil Descriptors	
						Color, ASTM Soil Name (ASTM Symbol)	Plasticity (NP, LP, MP, HP)	Size Range Sand (F, M, and/or C)	Size Range Gravel (F and/or C)	Shape of Gravel (R, SR, SA, A)	Cobbles/Boulders (Y/N), Shape	Percent Fines	Percent Sand	Percent Gravel	Moisture Content (D, M, W)	Drilling Rates, Conditions, Casing/ Organics, Cementation, HCL, Odor/ Pocket Pen., Torvane	Well Construction
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
0																	
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
0																	
1																	

As-Built Well Completion Diagram

Project Number:	Boring/Monitoring Well Number: Sheet: of:
Project:	Location:
Elevation:	Drilling Contractor:
Drilling Method and Equipment Used:	Logged By:
Water Levels:	Completion Start: Finish:

Ecology Well ID _____



Aspect consulting
earth+water
www.aspectconsulting.com
a limited liability company

Materials Used:	Screen:
Sand:	Bentonite:
Blank:	Monument:
Concrete:	Other:

Q:_ACAD Standards\Standard Details\Well Diagram.dwg

WELL DEVELOPMENT RECORD

WELL NUMBER:

Project Name: _____ Project Number: _____

Date: _____ Starting Water Level (ft TOC): _____

Developed by: _____ Casing Stickup (ft BGS): _____

Measuring Point of Well: _____ Total Depth (ft TOC): _____

Screened Interval (ft. BGS): _____ Casing Diameter (inches): _____

Filter Pack Interval (ft. BGS):

Casing Volume: ft Water x gpf =

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf

DEVELOPMENT MEASUREMENTS

Elapsed Time (min)	Cumul. Vol. (gallons)	Purge Rate (gpm)	Temp. (C or F)	pH	Specific Conductance (µmhos/cm)	Turbidity (NTU)	Imhoff Cone (ml/L)	Comments

Total Discharge (gallons): _____ Total Casing Volumes Removed (gallons): _____

Ending Water Level (ft TOC): _____ Ending Total Depth (ft TOC): _____

METHODS

Cleaning Equipment: _____

Development Equipment: _____

Disposal of Discharged Water: _____

Observations/Comments: _____

Aspect CONSULTING

Sample number _____

GROUNDWATER SAMPLING RECORD

WELL NUMBER: _____ **Page:**____ **of** ____

Project Name: _____ Project Number: _____

Date: _____

Sampled by: _____

Measuring Point of Well: TOC

Screened Interval (ft. TOC) _____

Filter Pack Interval (ft. TOC) _____

Starting Water Level (ft TOC): _____

Casing Stickup (ft): _____

Total Depth (ft TOC): _____

Casing Diameter (inches): _____

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)

Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf

3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): _____

PURGING MEASUREMENTS

Criteria:		Typical 0.1-0.5 Lpm	Stable	na	± 3%	± 10%	± 0.1	± 10 mV	± 10%	
Time	Cumul. Volume (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (°C)	Specific Conductance (µS/cm)	Dissolved Oxygen (mg/L)	pH	ORP (mv)	Turbidity (NTU)	Comments

Total Gallons Purged: _____ Total Casing Volumes Removed: _____

Ending Water Level (ft TOC): _____ Ending Total Depth (ft TOC): _____

SAMPLE INVENTORY

Time	Volume	Bottle Type	Quantity	Filtration	Preservation	Appearance		Remarks
						Color	Turbidity & Sediment	

METHODS

Parameters measured with (instrument model & serial number): _____

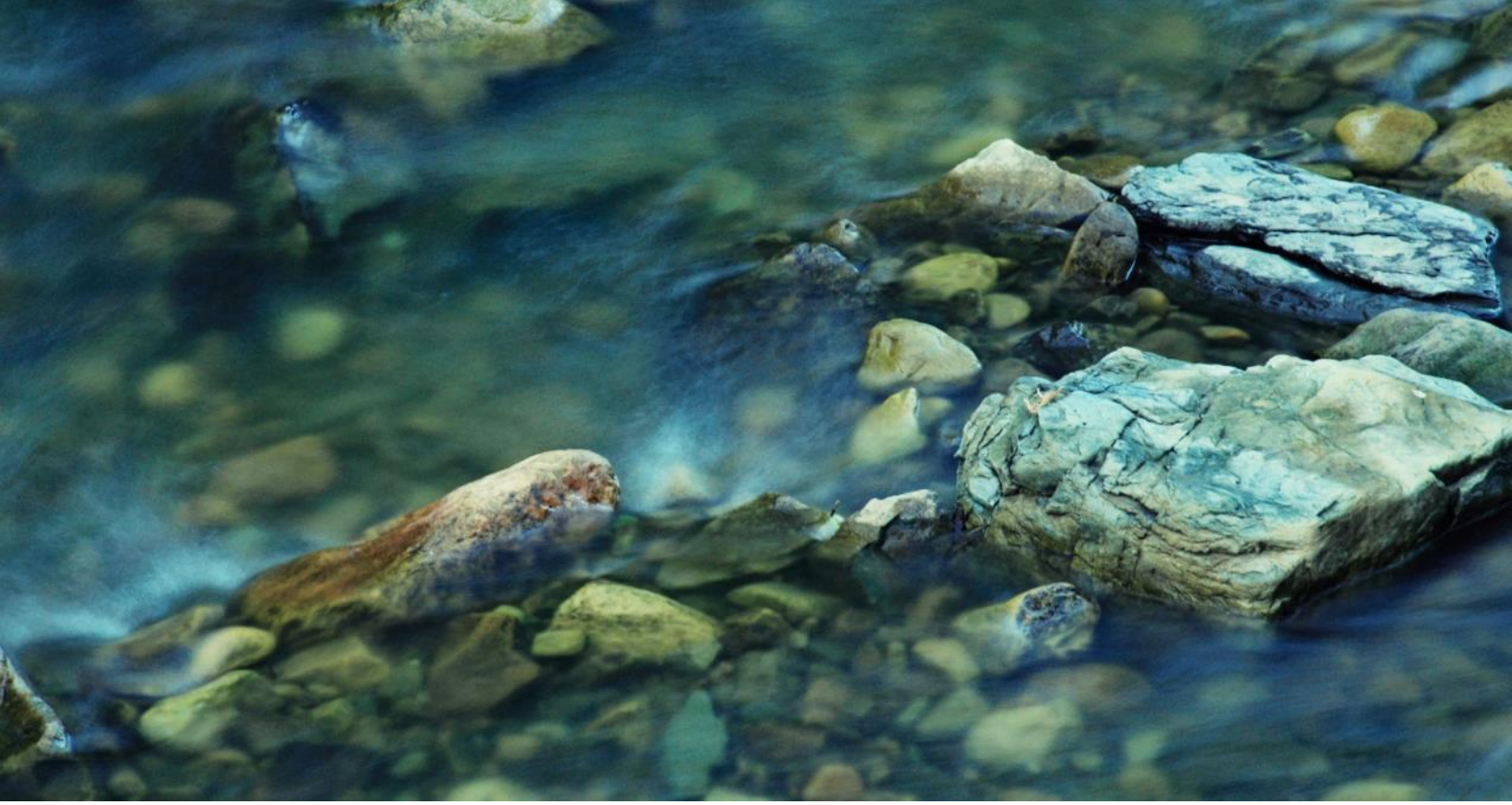
Purging Equipment: _____ Decon Equipment: _____

Disposal of Discharged Water: _____

Observations/Comments: _____

_____

Attachment B
In-Water Sampling and Analysis Plan



October 2021
Harris Avenue Shipyard Cleanup

ANCHOR QEA

PRDI Work Plan Attachment B
In-Water Sampling and Analysis Plan

Prepared for Washington State Department of Ecology

October 2021
Harris Avenue Shipyard Cleanup

PRDI Work Plan Attachment B
In-Water Sampling and Analysis Plan

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Project Number: 210007-02.01
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ATTACHMENTS

ABBREVIATIONS

ARI	Analytical Resources, Inc.
ASTM	ASTM International
bgs	below ground surface
CAP	Cleanup Action Plan
cm	centimeter
COC	chain of custody
CUL	cleanup level
DGPS	Differential Global Positioning System
DRET	Dredge Elutriate Test
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
GPS	Global Positioning System
MLLW	mean lower low water
MTC	Materials Testing and Consulting
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PRDI	Pre-Remedial Design Investigation
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
RTK	real-time kinematic
SAP	Sampling and Analysis Plan
Site	Harris Avenue Shipyard Site
SMU	sediment management unit
SPT	Standard Penetration Test
TCLP	toxicity characteristic leaching procedure
TOC	total organic carbon
TS	total solids
WAC	Washington Administrative Code
YYMMDD	date format (year as two digits, month as two digits, day as two digits)

1 Introduction and Purpose

This *In-Water Pre-Remedial Design Investigation Sampling and Analysis Plan* (In-Water SAP) is prepared as Attachment B to the Pre-Remedial Design Investigation (PRDI) Work Plan for the Harris Avenue Shipyard Site (Site) located in Bellingham, Washington. Both upland and in-water portions of the Site are regulated by the cleanup process under the Model Toxics Control Act, Revised Code of Washington 70.105D, and Washington Administrative Code (WAC) 173-340, administered by the Washington State Department of Ecology (Ecology).

In 2021, Ecology issued the *Cleanup Action Plan* (CAP; Ecology 2021), which describes the selected cleanup action for the Site based on the *Remedial Investigation/Feasibility Study* (Floyd Snider 2019). 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.

The PRDI Work Plan presents pre-remedial design data gaps and the field investigations that will be used to fill data gaps for remedial design of the in-water areas of the Site. This In-Water SAP presents the methods and procedures that will be used to fill in-water data gaps at the Site. A separate SAP has been developed to fill upland data gaps and is provided as Attachment A to the PRDI Work Plan.

In-water pre-remedial design data needs include the following additional surveys and data collection:

- Site surveys, including:
  - Eelgrass and macroalgae survey
  - Bathymetric survey
  - Over-water structural assessments
  - In-water utility and debris locates
- A geotechnical investigation of the Site bulkhead area
- Additional surface and subsurface sediment quality data from subtidal and intertidal areas, including:
  - Underpier areas
  - Geotechnical data
  - Dredge elutriate and leachability testing data

In-water data gaps will be filled, as described in this In-Water SAP, to inform remedial design for in-water areas of the Site.

2 Surveys

Eelgrass and macroalgae surveys will be conducted to update previous survey data and support remedial design. Updated bathymetric surveys will also be conducted to provide the coverage and level of recency needed for remedial design and permitting.

2.1 Eelgrass and Macroalgae Survey Methods

Intertidal and subtidal eelgrass and macroalgae surveys will be conducted to determine geographic extent and associated shoot densities of eelgrass beds in the Site cleanup area and adjacent areas. The surveys will be conducted using a combination of direct visual assessment of the intertidal areas coupled with a towed camera survey of shallow subtidal areas, in accordance with Washington Department of Fish and Wildlife *Eelgrass/Macroalgae Habitat Interim Survey Guidelines* (WDFW 2008; provided in Attachment B-1). Eelgrass shoot and macroalgae density will be measured in planned sediment disturbance areas.

The survey patterns will include a combination of transects and roving to delineate the margin of eelgrass beds. Survey transects are anticipated to be placed along transects spaced 15 to 20 feet apart in the areas shown in Figure B-1 along depth contours established relative to mean lower low water (MLLW) equal to 0 feet elevation. At average visibility, the survey will be conducted at a maximum of 15-foot transects; in an exceptional visibility scenario, the survey will be conducted at a maximum of 20-foot transects. Transect coverage will extend at least 25 feet waterward of the expected project footprint and at least to depths of -20 feet MLLW. If possible, the outer margin of the eelgrass or macroalgae beds will also be mapped where it extends beyond these boundaries.

The primary survey method will be towed underwater video camera. Video survey will be conducted throughout as much of the project area as is feasible. An underwater video camera will be deployed from an appropriately outfitted vessel, using a winch and lowered to approximately 1 foot above the seabed surface. The camera will be lowered or raised, as needed, depending upon the geography and visibility, and towed at a speed of 1 to 2 knots along a transect at each area. Global Positioning System (GPS) coordinates will be recorded along the length of the transect. Following data collection, the video transects will be viewed to qualitatively identify the presence of eelgrass and macroalgae, and the results will be logged. Video data will be interpreted to delineate the boundaries of eelgrass beds, and other macroalgae and biological resources will be noted. Following field surveys, eelgrass will be noted as present or absent and linked to location data to map the eelgrass beds.

A land-based (wading) survey at low tide will be conducted in areas that are inaccessible by boat (e.g., underpier areas) or too shallow for video use. The presence or absence of eelgrass will be verified in these areas and recorded on data sheets by field staff.

Observations will be made at approximate 20-foot intervals along each transect. Additional observations will be recorded between the 20-foot observation points if an important change in biological resources is observed. The survey will focus on identifying and/or documenting the following conditions:

- **Eelgrass:** The presence or absence of eelgrass will be documented. If eelgrass is found, the number of shoots will be observed by a diver and will be counted and recorded.
- **Macroalgae:** Dominant and secondary species of macroalgae will be documented. For dominant species at an observation point, the species and estimated percent cover will be recorded. Secondary species present will also be documented.
- **Turbidity and Visibility:** Turbidity will be assessed visually by the survey team to determine the width that the transects will cover.
- **Vertebrate and Invertebrate Species:** Observations of any vertebrate or invertebrate species will be recorded. Species will be identified to the lowest taxonomic level possible, typically to species.
- **Habitat Characteristics:** Habitat conditions will be characterized based on the presence of any rocky outcroppings, debris, or other habitat features.

All information collected from the survey efforts will be compiled into a report that will meet Washington Department of Fish and Wildlife and U.S. Army Corps of Engineers criteria for eelgrass and macroalgae reporting (USACE 2018) and will be attached to the In-Water Engineering Design Report (EDR). A project site map indicating all survey transects and showing the qualitative distribution of eelgrass and macroalgae (boundaries of each patch), substrate characterization along each transect, approximate depth contours, and the approximate location of the proposed project footprint.

2.2 Bathymetric Surveys

Site wide, multi-beam bathymetric surveys will be conducted in subtidal and intertidal areas (Figure B-1) to support dredge and cap design. These surveys will be conducted by Northwest Hydro, Inc., a licensed surveyor.

Bathymetric surveys will be performed using multi-beam bathymetry equipment. A licensed surveyor will perform and review all hydrographic survey work. This work will include surveying of underpier areas to the extent possible, as well as open-water areas.

Prior to conducting the bathymetric surveys, a depth sensor will be placed on the Harris Avenue pier to record tidal elevations. The depth sensor will consist of a pressure sensor and survey grade real-time kinematic (RTK) rover. After sensor installation, a vertical reference will be surveyed, and the sensor data are then broadcasted to a secure website and logged. This allows access to accurate referenced water level data in real-time via an internet connection. The tide data will be logged on a

specified time interval for the duration of the deployment. These elevation data will be used to correct the lead-line elevations for sediment sampling activities described in the following sections.

2.3 Structural Assessment

A structural assessment will be conducted of the piers and docks that are within the remedial footprint to determine if the structures will be impacted by the proposed remedial actions or if additional considerations are warranted. WSP will observe the general condition and layout of the above-water portions of the following structures. The inspection will include an above-deck and below-deck assessment of the West Dock, East Railway Walkway, and Marine Railway elements (Figure B-1). Above-deck observations will focus on West Dock appurtenances, bullrail, mooring fittings, and fender elements. The below-deck condition assessment will focus on the condition of the deck framing elements, pile caps, above-water portion of piles, fender system, and general condition of the shoreline. No underwater inspection will be performed within this task. A condition assessment memorandum will be prepared in order to document findings and will be attached to the EDR.

2.4 In-Water Utility and Debris Locates

To aid in determining the location of in-water utilities and debris locations, a survey will be conducted by divers in subtidal areas and land-based observations at low tide to document observed debris, utilities, and other obstructions to dredging. Divers will swim transects that cover the majority of the in-water portion of the Site outside of the Interim Action areas (Figure B-1) and document their observations through the use of a surface GPS and communication with an upland observer who will be recording notes regarding observations. In areas where observations indicate the presence of debris, divers will insert a probe into the sediment as deep as possible to determine the extents and possible makeup of the observed debris. Areas where significant refusal is encountered will be recorded and observations noted through the documentation process described previously. Divers will also document utilities, structures, or other obstructions (e.g., bedrock outcrops) that may be present at the surface of the seabed. At least one outfall, several anchors, and an area of bedrock were noted anecdotally, and an attempt will be made to locate these with greater certainty through dive survey observations. Similar survey methods will be employed in the intertidal area, which will be walked during a low tide and probed in an effort to document the extent of debris present. Utilities (e.g., outfalls) in the intertidal area will be documented with a GPS for incorporation into the Site basemap.

3 Sediment

Surface sediment and subsurface sediment samples will be collected at the locations shown in Figure B-2. Surface sediment will be collected in areas to bound the lateral extent of contamination and to support cap design. Additional geotechnical and chemical testing will also be performed to supplement information available from previous studies. To determine the vertical extent of contamination in the area and characterize the anticipated new surface, sediment cores will be collected.

3.1 Sediment Collection Methods

This section describes methods to be applied to all surface and subsurface sediment collection. Sediment collection will be conducted by Anchor QEA and a subcontractor.

3.1.1 Navigation and Positioning

In all open-water areas, sample positioning shall be verified using a vessel-mounted or hand-held Differential GPS (DGPS). Planned coordinates for sampling stations are provided in Tables B-1 and B-2.

Samples will be collected from within plus or minus (±) 10 feet of the target locations unless sample recovery cannot be obtained at the planned location or the location is inaccessible for other reasons. The coordinates will be recorded for the actual sampling location relative to the Washington State Plane Coordinates, North, feet, North American Datum of 1983.

In cases where sampling cannot be performed at the target location, the sampling location may be adjusted to the nearest practicable sample location. The actual sample coordinates and reason that the location had to be moved will be documented as a deviation in the Data Report.

Vertical positioning will be achieved using a lead line collected at the sample location (i.e., lead-line measurement will be taken adjacent to the deployed sampler) and measured to the nearest tenth of a foot. The recorded measurement will include the time the sample was collected (to the nearest minute) and the depth will represent the average surface water depth (average between the wave crests and troughs). If wavy conditions result in uncertainty regarding the depth measurement, the estimated uncertainty will be recorded.

Following data collection, the water depths will be converted to MLLW elevations using real-time water elevations measured using a pressure sensor and survey grade RTK rover (see Section 2.2).

3.1.2 Eelgrass Protection Methods

During collection of surface and subsurface samples, methods shall be employed to avoid disturbance of existing eelgrass beds. These methods shall be applied at all locations shallower than -20 feet MLLW.

Eelgrass protection methods to be applied during vessel-deployed vibracore and Van Veen grab sampling include the following:

- A video camera shall be fixed to the sampling equipment to provide real-time video observations of the sediment surface at the point of collection.
- The sampling equipment shall be deployed to near the mudline at each target location.
- The video camera feed shall be observed by the sampling team prior to landing the sampling equipment on the mudline.
- If no eelgrass is present at the target location, then the sampler may be deployed as intended.
- If eelgrass is present at the target sampling location, the location shall be adjusted within ± 10 feet to a nearby location with no eelgrass present. Relocation along slopes shall generally be at the same elevation.
- Return of unused grab sample materials shall follow the same procedures described above. Unused core samples will not be returned to the sampling locations.

For diver-collected cores or grab samples, the same procedures described above shall be used, except that the diver will select the final sample location (avoiding any eelgrass present at the target location) based on direct visual observations.

3.1.3 Station and Sample Identification

Station and sample identifications for sediment testing are provided in Tables B-1 and B-2 and Figure B-2. Each sample will be assigned a unique alphanumeric identifier. Sample identifiers will be determined by the following procedure:

- All samples will begin with the site identifier HS (Harris Avenue Shipyard).
- The station ID will correspond to a numeric station identifier, and the sample method, except for composite samples:
  - SS: surface sediment grab
  - SG: stratified surface sediment grab
  - SC: subsurface sediment core
  - COMP: composite sample
  - HA: hand auger sample
  - GB: geotechnical boring
- For discrete core samples and stratified grab samples, the sample interval will be the depth at which the sample is collected in decimal feet below the mudline. For subsurface cores, this will be estimated in situ depth after correcting for compaction (see Section 3.3.2).
- Date of collection will be recorded in the form of YYMMDD.

Example IDs are as follows:

- A surface sediment sample collected on February 6, 2022, from station 4 will have an ID of HS-04SS-220206.
- A stratified surface grab collected from the 0- to 12-centimeter (cm) interval on February 18, 2022, at station 1 will have an ID of HS-01SG-0-0.39-220218.
- A sediment core sample collected from the 1- to 2-foot interval mudline below on February 14, 2022, from station 7 will have an ID of HS-07SC-1-2-220214.
- A composite sample collected on March 1, 2022, will have an ID of HS-COMP-01-220301.
- A geotechnical boring sample collected from the 2.5- to 5-foot interval mudline below on March 14, 2022, from station 2 will have an ID of HS-02-2.5-5-220314.

Each sample will have an adhesive plastic or waterproof paper label affixed to the container or baggie and will be labeled at the time of collection. The following information will be recorded on the container label at the time of collection:

- Project name
- Sample identifier
- Date and time of sample collection
- Analysis to be performed

3.1.4 Decontamination Procedures

The following general decontamination procedures will be followed for field sampling equipment:

1. Pre-wash rinse with tap or site water.
2. Wash with solution of tap water or site water and phosphate-free soap (e.g., Alconox).
3. Rinse three times with distilled water.
4. Cover (no contact) all decontaminated items with aluminum foil.
5. Store in a clean, closed container for next use.

All sampling containers used for sediment samples shall consist of certified pre-cleaned jars obtained from the analytical testing laboratory.

3.2 Surface Sediment Sampling Methods

This section describes the design for the sediment sampling activities. Surface sediment samples will be collected at the locations shown in Figure B-2.

3.2.1 Sample Collection

Surface sediment samples will be collected from the locations shown in Figure B-2 and Table B-1. Sample locations shall be verified and recorded as described in Section 3.1.1.

A Van Veen grab sampling device will be used to collect subtidal surface sediment samples. The grab sampler will be lowered from a cable wire. When the sampler reaches the mudline, the cable will be drawn taut and DGPS measurements will be recorded. Each surface grab sample will be retrieved aboard the vessel and evaluated for the following acceptance criteria:

- Overlying water is present and has low turbidity.
- Adequate penetration depth is achieved.
- Sampler is not overfilled.
- Sediment surface is undisturbed.

Grab samples not meeting these criteria will be rejected and returned as near to the location of sample collection as possible. The vessel will be adjusted so as not to collect from the same exact location. The process will be repeated until criteria have been met or three attempts have been made. Deployments will be repeated within a 10-foot radius of the proposed sample location. If adequate penetration is not achieved after three attempts, the location of the sample station may be adjusted, or a shallower depth of penetration may be accepted. These adjustments shall be noted as deviations in the Data Report.

The sampling equipment will be decontaminated between stations following the methods described in Section 3.1.4.

The following information will be recorded on the sediment sampling form (Attachment B-2):

- Date, time, and name of person logging sample
- Sample location number and coordinates
- Depth of water at the location and surface elevation
- Sediment penetration and depth
- Sample recovery
- Whether the grab was accepted

3.2.2 Sample Processing and Analysis

Once a grab is accepted, overlying water will be siphoned off. Then, a decontaminated stainless-steel trowel, spoon, or equivalent will be used to collect only the upper 12 cm of sediment for surface grab samples and the upper 12 cm and 12 cm to the bottom of the grab for stratified grab samples. Sediment will be collected from inside the sampler without collecting any material that is touching the sidewalls. Debris and materials more than 0.5 inch in diameter will be omitted from sample containers. Sediment will be homogenized in a pre-cleaned stainless-steel bowl.

Surface sediment processing at all locations will include physical characterization in accordance with ASTM International (ASTM) D2488 modified. Physical characterization includes the following elements, to be recorded on a surface sediment sample collection form (Attachment B-2):

- Grain size distribution
- Density and consistency
- Plasticity
- Color and moisture content
- Biological structures (e.g., shells, tubes, macrophytes, and bioturbation)
- Presence of debris and quantitative estimate (e.g., wood chips or fibers, concrete, and metal debris)
- Presence of oily sheen
- Odor (e.g., hydrogen sulfide and hydrocarbon)

Sediment grab samples will be analyzed for polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), metals, total solids (TS), grain size, and total organic carbon (TOC). Analyte lists, analytical methods, and target reporting limits are listed in the Quality Assurance Project Plan (QAPP), provided as Attachment C to the PRDI Work Plan.

3.2.2.1 Surface Sediment for Bioassay Samples

An appropriate size aliquot of sediment will be collected from the surface grabs for potential bioassay analyses to assess benthic toxicity. All bioassay sample aliquots will be archived until the samples have been analyzed for chemistry. Bioassays will be triggered if chemical concentrations exceed the sediment cleanup objective values for marine sediment for site COCs as provided in Table 8-1 of the Sediment Cleanup User's Manual II (Ecology 2019).

The following sediment toxicity tests will be performed for all triggered bioassay samples:

- 10-day amphipod mortality test
- 20-day juvenile polychaete growth test
- Larval bivalve or echinoderm development test

Bioassay data will be evaluated and interpreted as shown in Table C-5 of the QAPP.

3.3 Subsurface Sediment Sampling Methods

This section describes the design for the subsurface sediment sampling activities in Site areas.

3.3.1 Subsurface Sediment Vibracore Collection

Subsurface sediment cores will be collected at locations shown in Figure B-2 with a vibracore deployed by one of three methods, depending on location. Sample positioning and eelgrass

avoidance methods will be followed for each method as described in Section 3.1.1 and 3.1.2. The two core sampling methods include the following:

- **Open-Water Vibracore Locations:** The open-water cores will be collected using a vessel-mounted vibracore. The vibracore will be deployed from the vessel using the A-frame and hydraulic winch. The vibracore will be energized as it nears the bottom and supported upright with the winch line during penetration into the sediment. Sediment cores will be collected to a target depth of 6 feet below mudline for the open-water locations.
- **Underpier Vibracore Locations:** The vibracore will be deployed on a remote floating platform for the underpier locations. This limited-access equipment will be required in some areas due to the underpier elevations and pile spacing. Expected sample penetration for underpier locations is at least 4 feet below mudline, or until refusal is encountered.

Upon completing penetration at a given station, the vibracore will be shut down, the position recorded, and the sampler recovered. Once on board the vessel, the depth of core penetration will be measured and recorded (i.e., the total core length minus the void space within the core). The following data will be recorded on the sediment core collection log:

- Sampling location and time
- Depth of water to sediment mudline (as measured by lead line following procedures listed in Section 3.1.1)
- Approximate elevation of location as calculated from MLLW using measured depths and tide tables (this estimate will later be corrected based on actual tide elevations measured using the logging transducer installed as described in Section 2.2)
- Location coordinates from DGPS (and offsets as required for under-dock measurements where DGPS cannot be directly used)
- Names of field personnel collecting and handling the cores
- Observations made during core collection, including weather conditions, complications, ship traffic, and other details associated with the sampling effort
- Physical description of core tube (e.g., intact, bent, full core-catcher)
- Length and depth intervals of each core section and estimated recovery for each sediment sample as measured from MLLW
- Qualitative notation of apparent resistance of sediment column to coring (how the core drove)
- Any deviation from the approved SAP

Acceptance criteria for sediment core samples are as follows:

- Overlying water is present and the surface is intact.
- Recovery is greater than 75% of drive length.
- The required penetration depth is achieved.

If refusal is encountered, or the recovery criteria are not met, the vessel will be slightly moved and a second core attempted, then, based on the field lead's professional judgment, a third attempt. If refusal is encountered with the third attempt or recovery criteria are not met, additional cores will not be attempted unless operational problems are suspected. Refusal is defined as less than 5 cm of penetration per minute. Field personnel will determine which of the cores will be retained for processing and analyses but, in general, the longest of the three cores will be retained.

After the core is on deck and has been accepted, it will be stored upright until it can be transferred to shore for processing. The cutterhead will be removed, the upper liner tied off, and a cap will be placed over the end of the tube and secured firmly in place with duct tape. The core tube will then be removed from the sampler, and the other end of the core will be capped and taped. The core tube will be clearly labeled with permanent black pen with the location ID and an arrow pointing to the top of core. The core will be processed on the same day as collection, if possible, or stored upright and cool (4°C) overnight. Cores will be processed within 72 hours of collection at the latest.

3.3.2 Subsurface Sediment Processing

The vibracore processing station will be located in a well-ventilated area within the Port of Bellingham property and processing will be overseen by an archaeologist. Cores will be stored and transported according to ASTM D4220 procedures. This procedure recommends that cores are stored upright and cool until processed. Cores will be tied upright on the vessel and then transported upright from the boat to the processing crew.

When processed, the entire core length contained within the polyethylene liner will be extracted from the core tube with the ends tied off and laid in a core processing tray. The liner will be cut open using a decontaminated stainless-steel box cutter. The core will then be split with decontaminated stainless-steel wire core splitters or spatulas into two halves for sampling. If aluminum core tubes are utilized, the core will be cut open horizontally on opposing sides and split in half.

Prior to further sampling, Anchor QEA field staff will delineate sampling intervals, take color photographs, and record a sediment description of each core on a standard core processing log (see Attachment B-2). Logs will include the following information:

- Drive length, recovered length, and percent sample recovery
- Physical soil description in accordance with ASTM D2488 and ASTM D2487 – Unified Soil Classification System procedures including soil type, density/consistency of soil, and color.
- Odor (e.g., hydrogen sulfide and petroleum)
- Visual stratification, structure, and texture
- Vegetation and debris (e.g., wood waste or fibers, paint chips, concrete, sand blast grit, and metal debris)

- Biological activity (e.g., detritus, shells, tubes, bioturbation, and live or dead organisms)
- Presence of oil sheen

All core samples will be processed based on estimated in situ depths calculated using site-specific water depths measured using the logging transducer. Sample archives will be collected from individual intervals. Core recovery correction will be applied.

Samples will be generated by placing sediment from each interval into a decontaminated stainless-steel bowl and mixing until consistent in color and texture. Homogenized sediment will be spooned into pre-labeled laboratory-supplied jars for analyses.

3.3.3 Subsurface Sediment Testing Intervals Analyses

Core samples will be processed as shown in Table B-2. Composite core samples will be processed in 1-foot intervals and the discrete samples stored in frozen archive for potential future analyses. Samples from these cores will also be composited whole and combined with other composites as shown in Table B-2. Two composites will be created from each of the composite areas shown in Figure 5-3 of the PRDI Work Plan. Sediment composite samples will be analyzed for toxicity characteristic leaching procedure (TCLP) and Dredge Elutriate Test (DRET) analyses.

Non-composite cores will be divided into one 2-foot interval from the top 2 feet and processed in 1-foot intervals below 2 feet. The top two sample intervals will be submitted for analyses and the intervals below archived for potential additional analyses. Archive samples will be triggered for analyses if the interval above exceeds any of the Site cleanup levels (CULs). Samples will be triggered until all analytical results are below Site CULs and a clean bottom depth for the core can be determined, or until the deepest interval has been analyzed. Non-composite core samples will be analyzed for PAHs, PCBs, metals, TS, grain size, and TOC.

Analyte lists, analytical methods, and target reporting limits are listed in the QAPP.

3.3.4 Subsurface Geotechnical Borings

Three geotechnical borings will be advanced from the uplands with a sonic core rig immediately adjacent to the failing bulkhead and at the marine railway to document localized conditions that will determine specific requirements associated with repair of the shoreline bulkhead (Figure B-2). Upland borings will be collected using a track-mounted sonic drill rig with a 5- or 6-inch-diameter 5-foot-length steel core barrel. Sonic drilling is proposed for this study due to the need for continuous boring for archaeological considerations at the Site. A small amount of sample disturbance is inherent to sonic drilling methods when material is extruded from the core barrel into plastic liners using vibration. Sample intervals will be selected at no less than 5-foot increments to maintain precision from potential disturbance during collection.

The 5-foot core barrel will be rinsed clean of soil and decontaminated before each use, including between stations, to eliminate the possibility of cross-contamination. A steel catcher (drill shoe) may be used, if necessary, to retain the soil. The core barrel (with drill shoe as needed) will be attached to the drill rod, and the cutting head will be attached to the core barrel. The drill will be deployed from the rig and lowered down to the soil surface.

The core barrel will be driven into the soil to the targeted depth and retrieved upon either full penetration of the core tube segment, penetration to specified elevations, or at refusal. The depth of core penetration will be measured and recorded, along with conditions and/or obstructions observed during drilling (e.g., difficult drilling conditions). As part of core retrieval, a casing will be advanced over the core barrel before the core barrel is extracted from the cased hole. The cutting bit (and core-catcher, if used) will be removed by the drilling operator. Soil within the core tube will be extruded out of the core barrel and into a disposable plastic liner (sleeve) using a low-frequency sonic vibration (i.e., to minimize sample disturbance). Before proceeding with the next sample interval, a measurement will be taken in the cased sample hole to determine if heaving sands have reoccupied the casing, and to verify the top depth and elevation of the next sample interval. If heaving sands are encountered and the casing is occupied by heave, the driller may not blow out this material using water or any other type of pressurized method but must instead determine the length of the core tube that has been reoccupied and collect that material first before proceeding with the next sampling interval. Water pressure may be maintained in the cased hole prior to and during core extraction to minimize heaving sands from occupying the casing.

Acceptance criteria for upland boring samples are as follows:

- The core segment appears intact without obstruction or blocking.
- The core was advanced to the target depth.
- The material in the core supports design objectives (recovery meets elevation targets).

If sample acceptance criteria are not achieved, the sample is rejected unless modified acceptance criteria are approved by the field coordinator and/or multiple attempts have been made at the sampling location. Substantial buried debris exists at the Site from former structures and operations and are likely to result in poor recovery for some depth intervals. Poor recovery due to buried debris at the Site may result in the adjustment of sample intervals to achieve adequate sample volume while still meeting project objectives. These situations will be evaluated on a case-by-case basis by the field coordinator.

Geotechnical Standard Penetration Tests (SPTs) will be conducted. Borings will be advanced to a nominal depth of 60 feet below ground surface (bgs) but may be terminated based on the presence of glacial till. SPT tests will be conducted every 5 feet in each boring. After advancing the sonic core barrel (and retrieving the soil for geotechnical analyses) to the desired elevation bgs, a 2- or 3-inch

outside-diameter, decontaminated split spoon will be advanced into the soil using a 140-pound hammer dropped 18 inches. After retrieving the split spoon sampler, sonic coring for the collection of geotechnical parameters will continue until the next SPT interval.

Temporary boreholes will be decommissioned in accordance with state regulations (WAC 173-160). Each borehole will be abandoned by backfilling with bentonite chips.

3.3.4.1 Geotechnical Borings Processing

Boring samples will be processed adjacent to the station location. For geotechnical analyses, the plastic liner for each sampling interval will then be cut lengthwise and opened for processing. Each boring will be continuously examined to develop a lithologic boring log and will be photographed. Physical characteristics of each core will be noted on a soil boring log and will include color, structure, texture, mineral composition, moisture, and recovery, in accordance with ASTM D2488.

Additionally, the following parameters will be noted:

- Sample recovery
- Odor (e.g., hydrogen sulfide or petroleum)
- Visual stratification, structure, and texture
- Vegetation and debris (e.g., wood chips or fibers, concrete, or metal debris)
- Biological activity (e.g., detritus, shells, tubes, bioturbation, or live or dead organisms)
- Presence of oil sheen

Discrete samples will be collected from specified depth intervals, as outlined in Table B-2 and spooned into a clean stainless-steel bowl for homogenization. The soil will be placed into ziptop plastic bags for testing. Samples will be analyzed for grain size, moisture content, and Atterberg limits.

3.4 Hand Auger Sampling Methods

Sediment samples will be collected from intertidal areas at low tide using a hand auger at the locations shown in Figure B-2. If using a shovel, sediment will be excavated to the appropriate depth and material collected from the required interval. The hand auger location in SMU 2 (HS-01HA) will need to be completed with a hand auger to achieve the target depth of 4 feet with 1-foot sample intervals, but the hand auger location that is reoccupying former sample location HA-06 (HS-02HA) can be collected with a shovel because only a surficial sample with a target depth of 12 cm is required. Also note that the hand auger location in SMU 2 will be part of Composite A and additional volume may be required for the purposes of collecting both the discrete sample intervals and the composite.

3.4.1 Hand Auger Sample Collection

Samples will be collected by a hand auger as follows:

- Locate the sample station. If the station cannot be accessed due to the presence of blockage or debris, relocate the station as nearby as possible and record the coordinates of the new location.
- Expose the sediment surface by clearing an approximately square foot area of any rocks or organic material greater than approximately 3 inches in size. Note any material removed on the collection form.
- Excavate or auger the sediment to the top of the sampling interval specified using a decontaminated sampling tool (i.e., manual hand auger, power hand auger, shovel, scoop, trowel, or spoon).
- If caving sediments are a problem, cut a length of polyvinyl chloride (PVC) pipe to the length of the sample depth and push it into the excavated hole. Clean out the base of the hole with a shovel, scoop, trowel, spoon, or post-hole digger, taking care not to excavate into the elevation range of the sample interval.
- For an auger hole with multiple depth intervals, lengths of PVC casing can be sequentially stacked on top of one another and advanced to the top of each sampling depth interval prior to sample collection. The sample hole should always be cleaned out after advancing the casing.
- Using a long-handled stainless-steel hand auger and starting at the top of the sampling interval, advance the hand auger bucket to the depth of the sample interval. If the sample interval is longer than the bucket length, the auger bucket can be replaced by a newly decontaminated auger bucket by unscrewing the bucket from the long handlebar.
- Mark the handle of the auger to confirm proper sampling depths are achieved.
- Advance a thoroughly cleaned and decontaminated bucket auger into the sediment incrementally by twisting the handle in a clockwise motion.
- After sampling is complete, backfill the sample location with excess sediment and remove any PVC casings used.

3.4.2 Hand Auger Sample Processing

Once the auger bucket is full or has attained the penetration depth specified, use a decontaminated stainless-steel spoon to transfer the sediment into a decontaminated stainless-steel bowl, and cover the bowl with foil if needed until all sample volume has been collected for that sample interval. If the sediment is difficult to remove from the auger bucket, the contents can be loosened by carefully tapping on the outside of the bucket with a separate implement from the one used to collect and composite the sample (i.e., the decontaminated spoon). Care should always be taken to ensure that

any substance on the outside of the corer does not enter the sample collection bowl. Debris and materials more than 0.5 inch in diameter will be omitted from sample containers.

Intertidal sediment processing at all locations will include physical characterization in accordance with ASTM D2488. Physical characterization includes the following elements, to be recorded on the sample collection form (Attachment B-2):

- Grain size distribution
- Density and consistency
- Plasticity
- Color and moisture content
- Biological structures (e.g., shells, tubes, macrophytes, and bioturbation)
- Presence of debris and quantitative estimate (e.g., wood chips or fibers, concrete, and metal debris)
- Presence of oily sheen
- Odor (e.g., hydrogen sulfide and hydrocarbon)
- Sediment grab samples will be analyzed for PAHs, PCBs, metals, TS, and TOC. Analyte lists, analytical methods, and target reporting limits are listed in the QAPP.

4 Investigation-Derived Waste

Based on historical Site investigation, no sediments classifying as a hazardous waste are anticipated during the PRDI. No hazardous materials requiring special disposal will be used during PRDI sampling.

All disposable sampling materials and personal protective equipment used in sample collection and processing (e.g., disposable gloves and paper towels) will be placed in heavy-duty garbage bags for disposal as non-hazardous solid waste.

Sediment collected in grab samples not retained for chemical analysis will be returned as close to the sampling location as possible, as adjusted to avoid areas of potential eelgrass.

Core samples will be processed at an upland location. Leftover sediment not retained for chemical analyses will be stored in buckets or drums at the processing location and will be managed as investigation-derived waste. This material will be characterized for disposal at a licensed upland facility in compliance with applicable regulations.

5 Sample Handling and Chain-of-Custody Requirements

Sample container requirements, holding times, and preservation requirements are listed in Table B-3. Sample containers, instruments, working surfaces, technician protective gear, and other items that may come into contact with sample material must meet high standards of cleanliness. All equipment and instruments that will be used and are in direct contact with various media collected for chemical analyses must be made of glass, stainless steel, high density polyethylene, or polytetrafluoroethylene and will be cleaned prior to each day's use and between sampling or compositing events.

Samples are considered to be in one's custody if they are: 1) in the custodian's possession or view; 2) in a secured location (under lock) with restricted access; or 3) in a container that is secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s). Chain-of-custody (COC) procedures will be followed for all samples throughout the collection, handling, and analysis process. The principal document used to track possession and transfer of samples is the COC form. Each sample will be represented on a COC form the day that it is collected. All data entries will be made using an indelible ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, and then dating and initialing the change. Blank lines and spaces on the COC form will be lined-out and dated and initialed by the individual maintaining custody.

All samples will be shipped or hand delivered to the analytical laboratory by Anchor QEA staff. Upon transfer of sample possession to the analytical laboratory, the person transferring custody of the sample container will sign the COC form. Upon receipt of samples at the laboratory, the receiver will record the condition of the samples on a sample receipt form. Table B-3 presents the sample handling and storage requirements to be followed by field and laboratory staff.

Shipping procedures are as follows:

- Each cooler will be shipped via overnight delivery to the laboratory. In the event that Saturday delivery is required, staff will contact the analytical laboratory before 3 p.m. on Friday to ensure that the laboratory is aware of the number of containers and associated tracking numbers.
- Ice adequate to keep samples cool overnight will be sealed in separate plastic bags and placed in the shipping containers.
- Sample containers will be placed in a sealable plastic bag, packed to prevent breakage, and transported in a sealed ice chest or other suitable container.
- COC forms will be enclosed in a plastic bag and placed inside the cooler.
- Each cooler will be wrapped securely with packing or strapping tape, labeled fragile, and will be clearly labeled with the laboratory's shipping address and the consultant's return address. A signed and dated custody seal will be placed on each cooler prior to shipping.

6 Laboratory Analytical Methods

Chemical analyses will be conducted at Analytical Resources, Inc. (ARI), an Ecology and National Environmental Laboratory Accreditation Program accredited laboratory. Geotechnical analyses will be conducted by Materials Testing and Consulting (MTC). Preliminary processing of DRET samples will be conducted by Anchor QEA's geochemical laboratory and the chemical analysis of the resulting water samples will be conducted by ARI. The proposed analytes, evaluation criteria, analytical methods to be used, and target detection and reporting limits for the evaluation of sediment, porewater, and elutriate samples are listed in the QAPP (Attachment C to the PRDI Work Plan). All sample analyses will be conducted in accordance with methods approved by the Puget Sound Estuary Program (PSEP 1997) and Ecology, as applicable. Prior to analyses, all samples will be maintained according to appropriate holding times and required temperatures for each analysis (Table B-3).

7 Quality Assurance and Quality Control Samples

Requirements for quality assurance/quality control (QA/QC) will include the collection of field QC samples as well as laboratory QC analyses. Field and laboratory QA/QC requirements are discussed in detail in the QAPP (Attachment C to the PRDI Work Plan). The overall data quality objective for field sampling and laboratory analysis is to produce data of known and appropriate quality to support the project objectives.

7.1 Field QC Samples

Field duplicate samples will be collected to evaluate the variability attributable to sample homogenization and subsequent sample handling. Field duplicate samples will be collected from the same homogenized material as the original sample and analyzed as a separate sample at a frequency of one per 20 samples collected.

7.2 Laboratory QC Samples

Before analyzing the samples, the laboratory must develop written protocols for the analytical methods to be used, calculate method detection limits for each analyte in each matrix type, and establish an initial calibration curve for all analytes. The laboratory will analyze QC samples at the method-required frequencies and results must be within laboratory compliance standards as described in their standard operating procedures.

8 References

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WDFW (Washington Department of Fish and Wildlife), 2008. *Eelgrass/Macroalgae Habitat Interim Survey Guidelines*. June 2008.

Tables

Table B-1
Sediment Grab and Porewater Sampling Summary

Station ID	Target Coordinates[1,2] (NAD83 WA State Plane) Easting (X)	Northing (Y)	Sample Depth (cm)[2]	Sample ID[3,4]	Analyses/Archive
Stratified Surface Grabs					
HS-01SG	1234714.3	632588.1	0 – 12	HS-01SG-DEPTH-DATE	PAHs, PCBs, Metals, TS, TOC
			12 – bottom	HS-01SG-DEPTH-DATE	
HS-02SG	1234714.1	632400.2	0 – 12	HS-02SG-DEPTH-DATE	PAHs, PCBs, Metals, TS, TOC
			12 – bottom	HS-02SG-DEPTH-DATE	
HS-03SG	1234670.4	632454.8	0 – 12	HS-03SG-DEPTH-DATE	PAHs, PCBs, Metals, TS, TOC
			12 – bottom	HS-03SG-DEPTH-DATE	
HS-04SG	1234624.9	632623.3	0 – 12	HS-04SG-DEPTH-DATE	PAHs, PCBs, Metals, TS, TOC
			12 – bottom	HS-04SG-DEPTH-DATE	
HS-05SG	1234623.3	632504.1	0 – 12	HS-05SG-DEPTH-DATE	PAHs, PCBs, Metals, TS, TOC
			12 – bottom	HS-05SG-DEPTH-DATE	
HS-06SG	1234585.7	632450.7	0 – 12	HS-06SG-DEPTH-DATE	PAHs, PCBs, Metals, TS, TOC
			12 – bottom	HS-06SG-DEPTH-DATE	
Surface Grabs					
HS-07SS	1234889.2	632521.5	0 – 12	HS-07SS-DATE	Archive
HS-08SS	1234817.2	632709.8	0 – 12	HS-08SS-DATE	PAHs, PCBs, Metals, TS, TOC
HS-09SS	1234853.2	632601.9	0 – 12	HS-09SS-DATE	Archive
HS-10SS	1234736.5	632701.4	0 – 12	HS-10SS-DATE	PAHs, PCBs, Metals, TS, TOC
HS-11SS	1234666.4	632803.5	0 – 12	HS-11SS-DATE	PAHs, PCBs, Metals, TS, TOC
HS-12SS	1234372.1	632321.3	0 – 12	HS-12SS-DATE	PAHs, PCBs, Metals, TS, TOC

Notes:

1. NAD 83/98 (Washington State Plane NAD 83 Lambert Conformal North Zone Grid, Per the 1998 Adjustment)
2. Actual locations and penetration depths will be dependent on field conditions.
3. Depths will be in decimal feet below mudline.
4. Depths and dates will be determined during sample collection.

cm: centimeter
ID: identification
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl Aroclors
TOC: total organic carbon
TS: total solids

Table B-2
Sediment Core, Hand Auger, and Geotechnical Boring Sampling Summary

Station ID	Target Coordinates[1,2] (NAD83 WA State Plane)		Target Penetration (feet)[2]	Sample Intervals (feet)[3]	Testing Intervals (feet)[3]	Discrete Sample ID[3,4]	Discrete Analyses	Composite Sample ID[3,4]	Composite Analyses
	Easting (X)	Northing (Y)							
HS-01SC	1234551.8	632737.6	6	1	0 - 1	HS-01SC-DEPTH-DATE	Archive	HS-COMP-A-DATE	TCLP metals; DRET metals, DRET PAHs, DRET PCBs; archive[1]
				1	1 - 2		Archive		
				1	2 - 3		Archive		
				1	3 - 4		Archive		
				1	4 - 5		Archive		
				1	5 - 6		Archive		
HS-02SC	1234558.1	632547.2	6	1	0 - 1	HS-02SC-DEPTH-DATE	Archive		
				1	1 - 2		Archive		
				1	2 - 3		Archive		
				1	3 - 4		Archive		
				1	4 - 5		Archive		
				1	5 - 6		Archive		
HS-01HA	1234480.9	632327.5	4	1	0 - 1	HS-01HA-DEPTH-DATE	Archive		
				1	1 - 2		Archive		
				1	2 - 3		Archive		
				1	3 - 4		Archive		
HS-03SC	1234455.5	632653.0	6	1	0 - 1	HS-03SC-DEPTH-DATE	Archive	HS-COMP-B-DATE	TCLP metals; DRET metals, DRET PAHs, DRET PCBs; archive[1]
				1	1 - 2		Archive		
				1	2 - 3		Archive		
				1	3 - 4		Archive		
				1	4 - 5		Archive		
				1	5 - 6		Archive		
HS-04SC	1234433.3	632497.5	6	1	0 - 1	HS-04SC-DEPTH-DATE	Archive		
				1	1 - 2		Archive		
				1	2 - 3		Archive		
				1	3 - 4		Archive		
				1	4 - 5		Archive		
				1	5 - 6		Archive		
HS-05SC	1234328.1	632765.8	6	1	0 - 1	HS-05SC-DEPTH-DATE	Archive		
				1	1 - 2		Archive		
				1	2 - 3		Archive		
				1	3 - 4		Archive		
				1	4 - 5		Archive		
				1	5 - 6		Archive		
HS-06SC	1234344.5	632409.7	6	1	0 - 1	HS-06SC-DEPTH-DATE	Archive		
				1	1 - 2		Archive		
				1	2 - 3		Archive		
				1	3 - 4		Archive		
				1	4 - 5		Archive		
				1	5 - 6		Archive		

Table B-2
Sediment Core, Hand Auger, and Geotechnical Boring Sampling Summary

Station ID	Target Coordinates[1,2] (NAD83 WA State Plane)		Target Penetration (feet)[2]	Sample Intervals (feet)[3]	Testing Intervals (feet)[3]	Discrete Sample ID[3,4]	Discrete Analyses	Composite Sample ID[3,4]	Composite Analyses
	Easting (X)	Northing (Y)							
HS-07SC	1234549.3	632616.0	6	2	0 - 2	HS-07SC-DEPTH-DATE	PAHs, PCBs, metals, TS, TOC	--	--
				1	2 - 3		PAHs, PCBs, metals, TS, TOC		
				1	3 - 4		Archive		
				1	4 - 5		Archive		
				1	5 - 6		Archive		
HS-08SC	1234779.2	632655.8	6	2	0 - 2	HS-08SC-DEPTH-DATE	PAHs, PCBs, metals, TS, TOC	--	--
				1	2 - 3		PAHs, PCBs, metals, TS, TOC		
				1	3 - 4		Archive		
				1	4 - 5		Archive		
				1	5 - 6		Archive		
HS-09SC	1234631.1	632745.0	6	2	0 - 2	HS-09SC-DEPTH-DATE	PAHs, PCBs, metals, TS, TOC	--	--
				1	2 - 3		PAHs, PCBs, metals, TS, TOC		
				1	3 - 4		Archive		
				1	4 - 5		Archive		
				1	5 - 6		Archive		
HS-02HA	1234275.5	632137.0	0.39	0.39	0 - 0.39	HS-02HA-DEPTH-DATE	PAHs, PCBs, metals, TS, TOC	--	--
HS-01GB	1234499.843	632265.7953	62.5	2.5	5-7.5	HS-01GB-DEPTH-DATE	Grain size, moisture content, Atterberg limits - specific intervals to be selected for analysis based on observed lithology	--	--
					10-12.5				
					15-17.5				
					20-22.5				
					25-27.5				
					30-32.5				
					35-37.5				
					40-42.5				
					45-47.5				
					50-52.5				
					55-57.5				
					60-62.5				
HS-02GB	1234454.3	632273.1	62.5	2.5	5-7.5	HS-02GB-DEPTH-DATE	Grain size, moisture content, Atterberg limits - specific intervals to be selected for analysis based on observed lithology	--	--
					10-12.5				
					15-17.5				
					20-22.5				
					25-27.5				
					30-32.5				
					35-37.5				
					40-42.5				
					45-47.5				
					50-52.5				
					55-57.5				
					60-62.5				

Table B-2
Sediment Core, Hand Auger, and Geotechnical Boring Sampling Summary

Station ID	Target Coordinates[1,2] (NAD83 WA State Plane)		Target Penetration (feet)[2]	Sample Intervals (feet)[3]	Testing Intervals (feet)[3]	Discrete Sample ID[3,4]	Discrete Analyses	Composite Sample ID[3,4]	Composite Analyses
	Easting (X)	Northing (Y)							
HS-03GB	1234416.8	632265.5	62.5	2.5	5-7.5 10-12.5 15-17.5 20-22.5 25-27.5 30-32.5 35-37.5 40-42.5 45-47.5 50-52.5 55-57.5 60-62.5	HS-03GB-DEPTH-DATE	Grain size, moisture content, Atterberg limits - specific intervals to be selected for analysis based on observed lithology	--	--

Notes:
1. Additional geotechnical and/or leachate testing may be required on composite cores for placement of materials in the ASB. Composite aliquots will be archived pending additional analyses.
DRET: Dredge Elutriate Test
ID: identification
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl Aroclors
TCLP: toxicity characteristic leaching procedure
TOC: total organic carbon
TS: total solids

Table B-3
Sample Preservation and Handling Requirements

Analysis	Container	Holding Time	Preservative
Grain size	1-gallon ziptop bag	6 months	Ambient
Atterberg limits		None	
Bulk density		None	
Specific gravity		None	
Moisture content		None	
Total organic carbon/ total solids	8 oz glass	14 days	< 6°C
		6 months	< 0°C
Metals	4 oz glass	6 months	< 6°C
		2 years	< 0°C
PAHs/PCBs	16 oz glass	14 days to extraction	< 6°C
		1 year to extraction	< 0°C
		40 days to analysis	< 6°C
Archive	8 or 16 oz glass	--	< 0°C
TCLP Metals	4 oz glass	6 months to leachate extraction	< 6°C
	500 mL HDPE[1]	6 months to analysis	HNO_3 to pH < 2
DRET Metals[2]	8 oz glass	6 months to leachate extraction	< 6°C
	500 mL HDPE[1]	6 months to analysis	HNO_3 to pH < 2
DRET PAHs	From DRET metals jar	14 days to leachate extraction	< 6°C
	2 x 1L Amber glass[1]	7 days to extraction	2°C – 6°C
		40 days to analysis	
DRET PCBs	From DRET metals jar	14 days to leachate extraction	< 6°C
	2 x 1L Amber glass[1]	7 days to extraction	2°C – 6°C
		40 days to analysis	

Notes:

1. TCLP and DRET elutriate sample will be created by the laboratories.

2. Aliquots for totals and dissolved analyses will be created. Dissolved aliquots will be filtered prior to preservation.

DRET: Dredge Elutriate Test

HDPE: high density polyethylene

L: liter

mL: milliliter

oz: ounce

PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl

TCLP: toxicity characteristic leaching procedure

Figures

LEGEND:

- SMA Boundary
- Interim Action Completed
- Harbor Lines
- Major Topographic Contour (5' Interval)
- Minor Topographic Contour (1' Interval)
- Eelgrass and Macroalgae Survey (approximate location)

Survey Areas

- Structural
- Utility and Debris
- Bathymetric

0 100
Feet

NOTE:
1. Aerial imagery acquired from Google Earth Pro v.7.3.3.7786. Image date August 15, 2020.

Publish Date: 2021/08/27, 1:46 PM | User: epipkin
Filepath: Q:\Jobs\Port_of_Bellingham_0007\Harris_Ave_Shipyard\Maps\SAP\AQ_HarrisAve_Fig1_SurveyLocations.mxd

ANCHOR QEA

Figure B-1
Survey Locations
In-Water Sampling and Analysis Plan
Harris Avenue Shipyard Cleanup

LEGEND:

- Sediment Management Unit (SMU)
- Upland Cleanup Area
- Interim Action Completed

Cleanup Action

- Dredge to CULs/RALs
- Intertidal Sediment Excavation and Backfill
- Underpier Granular Cap
- Marine Railway Intertidal Sediment Excavation and Granular Cap
- Marine Railway Subtidal Sediment Granular Cap

Proposed Sampling Locations

- Geotechnical Boring
- Grab
- Grab (archive only)
- Stratified Grab
- Core
- Composite Core
- Hand Auger

NOTES:
1. Cleanup actions are from Harris Avenue Shipyard Cleanup Action Plan. Ecology, 2019.
2. Aerial imagery acquired from Google Earth Pro v.7.3.3.7786. Image date August 15, 2020.

Publish Date: 2021/08/27, 1:51 PM | User: epipkin
Filepath: Q:\Jobs\Port_of_Bellingham_0007\Harris_Ave_Shipyard\Maps\SAP\AQ_HarrisAve_Fig2_Surface_Sediment_Locations.mxd

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Figure B-2
In-Water Sampling Locations
In-Water Sampling and Analysis Plan
Harris Avenue Shipyard Cleanup

Attachment B-1
Washington Department of Fish and Wildlife Eelgrass Survey Guidance

Eelgrass/Macroalgae Habitat Interim Survey Guidelines

Introduction

Under the Washington Administrative Code (WAC), eelgrass and macroalgae are defined as saltwater habitats of special concern (WACs 220-110-250 (3)(a, b)). In administering the Hydraulic Project Approval (HPA) process, the Washington Department of Fish and Wildlife (WDFW) requires proponents for projects to: 1) avoid impacting eelgrass and macroalgae, 2) minimize unavoidable impacts, and 3) mitigate for any impacts. Mitigation for the loss of eelgrass typically entails providing eelgrass enhancement away from the project footprint. Because establishment of new eelgrass for mitigation is often unsuccessful, project proponents need to address this uncertainty by increasing the scope of their mitigation effort, such as planting an area larger than the project impact footprint. For macroalgae mitigation measures, the WDFW Area Habitat Biologist (AHB) shall be consulted.

In known or suspected eelgrass areas, proponents shall survey to delineate the spatial extent of eelgrass and macroalgae presence in the project area. If the project cannot be moved or redesigned to avoid direct eelgrass and macroalgae impacts, surveys are required for quantifying potential impacts. Surveys shall be conducted by divers/biologists who are qualified to identify the predominant eelgrass and macroalgae species in the project area. Deviations from the survey guidelines shall be approved by the AHB prior to conducting eelgrass or macroalgae surveys. Survey results and interpretation will be subject to WDFW approval.

Preliminary Surveys

Preliminary surveys are conducted to:

1) determine if eelgrass or macroalgae are present at the proposed project site,

2) evaluate if the project can be located and constructed to avoid impacting eelgrass or macroalgae, and

3) establish a location for the project that will minimize impacts when avoidance is not possible.

Preliminary surveys shall provide:

- A project site map indicating all survey transects and showing the qualitative distribution of eelgrass and macroalgae (boundaries of each patch), as well as substrate characterization along each transect. The map should also indicate approximate depth contours and the approximate location of the proposed project footprint (e.g., the dimensions of the pier, ramp and float).

Protocol Guidance

1. Transects should be referenced to a permanent physical feature at the project site in such a way that transects can be precisely relocated in the future.

2. Transect length and location should be determined by project and site specifics, and should include the landward margin of the eelgrass or macroalgae habitat, if present. Transect coverage should extend at least 25 feet waterward of the project footprint, and, if possible, to the outer margin of the eelgrass or macroalgae bed.

3. To document the potential for eelgrass or macroalgae impacts from a project, at least one transect should be aligned along the proposed centerline of the project footprint. Additional transects shall be conducted on either side of the project footprint at 10 and 25 feet from the outer edges of the proposed structure. The inner and outer edges of each eelgrass or macroalgae patch shall be documented along each transect and noted on the site map.

4. Depth contours should be established relative to mean lower low water equal to 0.0 feet elevation (MLLW=0.0 ft.). Tidal reference and correction should be noted on the site map.

5. Survey documentation must include the date and time of the survey, name of the surveyor and their affiliation, turbidity/visibility measurements, presence of invertebrate and vertebrate species, and anecdotal observations pertinent to habitat characterization of the project site (e.g., presence of rocky outcroppings, debris, etc.).

6. Conducting surveys between June 1 and October 1 is strongly preferred because the full extent of eelgrass and macroalgae distribution can be more accurately mapped. However, preliminary surveys may be conducted at any time during the year.

To meet the need to minimize eelgrass and macroalgae impacts, and the requirement to document the centerline of the project footprint, some flexibility at the time of the survey may be necessary. A preferred method is to establish a transect parallel to the shoreline, along the midpoint of the eelgrass or macroalgae bed, to locate any open patches where a

new centerline for the project could be placed. Typically, an open area sufficient to accommodate a ten-foot buffer around the project footprint will be necessary.

If the preliminary survey shows that the project can be located and built without impacting eelgrass or macroalgae, the preliminary survey will meet the needs for mapping the project area. However, if the project footprint potentially impacts existing eelgrass or macroalgae beds, advanced surveys to quantify the extent of impact and document mitigation success, will be required.

Advanced Surveys

Advanced surveys shall occur between June 1 and October 1 and are conducted to:

1. quantify the impact from the project to eelgrass and macroalgae, and

2. quantify the performance of mitigation actions.

Quantifying Impacts

The standard protocols described below are designed to give accurate estimates of project impacts. Eelgrass density is determined by sampling with quadrats along transects. Two methods are typically used to determine project impacts and required mitigation. Project impacts are calculated as the total area of eelgrass affected by the project, as determined by the AHB. Alternatively, project impacts can be monitored in the project area to determine eelgrass or macroalgae loss and required mitigation. Sampling results are used to calculate the size of the mitigation project required to compensate for impacts that cannot be avoided.

As noted above, a project proponent may choose to monitor post-project impacts directly. The size of the required mitigation obligation may be reduced by this approach (e.g., in cases where post project impacts were less than anticipated). However, this approach will require additional monitoring of survey transects for a number of years to evaluate potential changes to eelgrass densities in the project area and within a reference site. This approach involves potentially higher mitigation ratios due to the delay in mitigation project construction (e.g., adjusting for temporal loss of function).

Alternative sampling designs are allowed, when agreed to in consultation with the AHB. This may be particularly appropriate when the potential impacts have been avoided to the maximum extent possible, and only a few small patches of eelgrass remain within or near the project footprint. In such a case, a full census of impacted eelgrass may be the most cost-effective option (e.g., counting all eelgrass shoots in the impact area). Alternatively, a stratified sampling of the existing patches may be a better choice (e.g., taking density estimates in the eelgrass patches only).

Statistical Considerations

1. Measuring mitigation success (or direct impacts of a project) requires comparing eelgrass densities at a mitigation (or impact) site versus a reference site. These comparisons must be statistically rigorous, and include the following statistical considerations:

    - Low probability of a Type I error - concluding there is loss of eelgrass when, in fact, there is not. This issue is addressed by selecting a small value for α in statistical analyses, usually 0.10.
    - Low probability of a Type II error - failing to detect a loss of eelgrass when, in fact, there is one. Selecting a small value for β (applying high statistical power, $(1-\beta)$) ensures this. Power set at 0.90 provides low probability of a Type II error.
    - Effect threshold - the difference in mean eelgrass density between sites.

The WDFW has established monitoring standards for these surveys: a) $\alpha = 0.10$, b) power $(1 - \beta) = 0.90$, and c) a difference of mean eelgrass density of $\geq 20\%$. Surveys using an alternative design must meet or exceed these standards.

Standard Protocols for Quantifying Impact

1. For a linear project, a single transect should be aligned along the centerline of the footprint.
2. A minimum of 30 samples must be taken within the area of eelgrass or macroalgae. Samples consist of eelgrass shoot counts within a (minimum) ¼ m^2 area quadrat. Sampling stations may be placed randomly along the transect, or for simplicity, evenly spaced along the same line starting at a random point (i.e., stratified random). Convert raw sample counts to shoot densities per square meter ($\#/m^2$).
3. Using the sample data, calculate mean eelgrass density ($\bar{x}_{project}$) in the impact area, as well as sample variance (s^2).

Assessing Mitigation Performance

Eelgrass density often varies substantially among locations and through time, making it difficult to measure mitigation success. To address this uncertainty, WDFW requires the use of a reference site to account for regional differences in eelgrass density and temporal variability. Use of a reference site can also improve monitoring efficiency, supporting rigorous results with fewer samples. The reference site should be chosen to match the characteristics of the mitigation area.

Quantifying Mitigation Performance

Reference Site Characterization

1. Choose a reference site near the proposed mitigation site. The reference site should be similar to the mitigation site in depth profile, substrate, turbidity, and disturbance regimes.
2. Within the reference site, take a minimum of 30 samples, either randomly or stratified randomly. Samples involve counting eelgrass shoots within a (minimum) ¼ m^2 area quadrat. Samples can be larger than ¼ m squares, but all samples need to reference the area from which they were taken so that the data can be converted to shoot densities (#/m^2).
3. Calculate the mean density of eelgrass at the reference site ($\bar{x}_{reference}$) as well as sample variance (s^2).

Mitigation Area Extent

The objective of eelgrass mitigation is to replace lost shoots and an area equivalent to the impacted area. If the mean density of eelgrass is lower at the reference site than within the impact area, the size of the mitigation project needs to be enlarged such that the reference site has the same total number of shoots as the impact site. For example, if the project impacts an area of 10 m^2, with a mean eelgrass density of 20 shoots/m^2, while the reference area has a mean shoot density of 10 shoots/m^2, the mitigation area would need to be at least 20 m^2 (to achieve a 1:1 mitigation ratio). However, if the reference site has greater density than the impact area, no area adjustment to the mitigation site would be necessary to address density differences. In addition, other factors can influence mitigation ratios and thus the required size of the mitigation area.

Mitigation Sampling and Performance

Mitigation monitoring consists of sampling both the reference site and the mitigation area at three and five-years following the completion of the mitigation project. Sampling one year following project completion is recommended to detect early failures at the mitigation site, but the need for this can be determined on a site-specific basis. Enough samples must be taken at the two sites to be able to detect significant differences in eelgrass density at the mitigation site versus the reference site using the statistical considerations noted above. A Microsoft Excel spreadsheet (Sample_Size_Calculator.xls) programmed to calculate the required sample size is provided by WDFW. Specific directions for entering data are included on the spreadsheet. The sample size calculator uses the following formula, modified from Zar (1999).

$$N = [2*s^2_{reference}/(\bar{x}_{reference} - \bar{x}_{mitigation})^2] * (t_{\alpha(1),\nu} + t_{\beta(1),\nu})^2$$

Where: N = required sample size in each site (i.e., mitigation and reference),
$s^2_{reference}$ = sample variance from the reference site,
$\bar{x}$ = sample mean
t = percentage values from Student's t-distribution
$_v$ = degrees of freedom

If the required number of samples is prohibitively expensive, due to inherent variability of eelgrass density, the statistical power of the monitoring may be lowered. This will entail a larger mitigation project to account for the increased statistical uncertainty.

Statistical Testing

At year three and five post construction, the proponent is required to re-sample and compare (statistically) eelgrass densities at the reference and mitigation site (using the prescribed number of plots defined in the equation above). We suggest using a two-sample, one-tailed t-test for comparison of eelgrass mean densities from mitigation versus reference areas. The statistical null hypothesis in this case is - H_0: eelgrass density at the mitigation site ≥ eelgrass density at the reference site.

The year-three sample is designed to detect potential early failures in eelgrass growth at the mitigation site, relative to the reference site, that may suggest the need for additional actions at the mitigation site (e.g., additional transplants). Final mitigation success or failure will be based on year-five survey results and statistical testing (H_0: eelgrass density at the mitigation site ≥ density at reference site, and total shoot abundance criteria has been met). Failure to meet prescribed eelgrass density (i.e., rejecting the null hypothesis) and shoot abundance will require implementation of contingency actions identified in the mitigation plan.

Attachment B-2
Field Forms

Daily Log

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PROJECT NAME: **DATE:**

SITE ADDRESS: **PERSONNEL:**

WEATHER: **WIND FROM:**

N	NE	E	SE	S	SW	W	NW	LIGHT	MEDIUM	HEAVY

SUNNY	CLOUDY	RAIN	?

TEMPERATURE: ° F . ° C

[Circle appropriate units]

TIME	COMMENTS

Signature: _____

Sediment Core Collection Log

Job:	**Station ID:**
Job No:	**Attempt No.**
Field Staff:	**Date:**
Contractor:	**Logged By:**
Vertical Datum:	**Horizontal Datum: NAD83 WA State Plane North, feet**

Field Collection Coordinates:

Lat/Northing: Long/Easting:

A. Water Depth

DTM Depth Sounder:

DTM Lead Line:

B. Water Level Measurements

Time:

Height:

Source:

C. Mudline Elevation

Recovery Measurements (prior to cuts)

Core Collection Recovery Details:

Core Accepted: Yes / No

Core Tube Length:

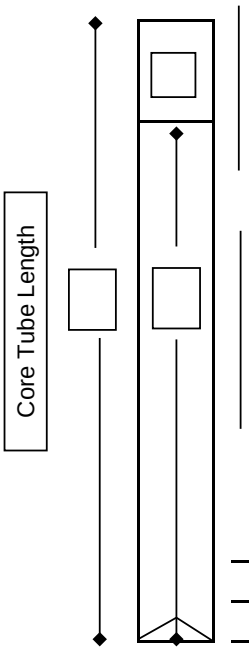
Drive Penetration:

Headspace Measurement:

Recovery Measurement:

Recovery Percentage:

Total Length of Core To Process:



Sections To Process:

A:

B:

C:

D:

Drive Notes:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:

Sediment Core Processing Log

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Job:	Station ID:
Job No.	Date/Time:
No. of Sections:	Core Logged By:
Drive Length:	Attempt #:
Recovery:	Type of Core ☐ Mudmole ☐ Vibracore ☐ Diver Core
% Recovery:	Diameter of Core (inches)
Notes:	

Recovered Length (ft)	Size % Gravel	Size % Sand	Size % Fines	**Classification and Remarks** (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (ft)	PID	Sample	Summary Sketch

Surface Sediment Collection Log

Job: Station:

Job No: Date:

Field Staff: Sample Method:

Contractor: Proposed Coordinates: Lat.

Long.

Water Height

DTM Depth Sounder: _____

DTM Lead Line: _____

Mudline Elevation (datum): calculated after sampling

Tide Measurements

Time: _____

Height: _____

Sample Acceptability Criteria:

1) Overlying water is present
2) Water has low turbidity
3) Sampler is not overfilled
4) Surface is flat
5) Desired penetration depth

Notes: _____

Grab #	Time	Confirmed Coordinates (datum)		Sample Accept (Y/N)	Recovery Depth (in)	Comments: jaws close, good seal, winnowing, overlying water, surface intact, etc
		NAD 83 (N)	NAD 83 (E)			

Sample Description: MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor. Structure descriptions

Sample Depth:

Sample Containers:

Analyses:

Sediment Description Key

Visual Sediment Descriptions consist of the following:

MAJOR CONSTITUENT GROUP NAME. Moisture content, density/consistency, color, major constituent (%), minor constituents (%), plasticity. Amount and shape of minor constituents (e.g., wood, shells). Biota. Sheen, odor (as needed). Structure descriptions (as needed). Use parenthesis to denote interpretation (e.g., asphalt, glass).

Examples:

SILT with SAND (MH) Moist, soft, olive gray, 80% fines, 20% f-sand, medium plasticity, contains fine gravel and anthropogenics (brick and plastic fragments), sulfide odor.

CLAYEY GRAVEL with SAND (GC) Moist, dense, dark brown, 70% f-c gravel, 15% m-sand, 15% low plasticity fines, gravel is subrounded up to 3".

Sediment Description Terminology

MAJOR and minor Group Name			
Gravel	Sand	Silt	Clay
** For Group Name of Major Unit follow flow charts in ASTM D2488. Incorporate use of terms 'Lean, Sandy, Gravelly, Fat, Elastic'*			
** MAJOR is written in all CAPITAL LETTERS (i.e., SILTY SAND), If minor sand/gravel constituents >15% use 'with GRAVEL' or 'with SAND'*			

Moisture Content	
Dry	Little perceptible moisture (upland only), dusty or powdery
Wet	Visible free water
Moist	No visible water (most sediment)

Density/Consistency	
SILT or CLAY	
Consistency:	***Notes:***
Very Soft	Soupy
Soft	Easily penetrated, just starting to be cohesive
Firm	Molded by figure pressure
Hard	Can indent and mold by finger pressure
Very Hard	modeling clay (rolls to a ball)
SAND or GRAVEL	
Consistency:	***Notes:***
Very Loose	Freefall: May occur at the top of a core or grab
Loose	Easy penetration: May occur at the top of a core or grab
Medium Dense	Moderate penetration: Typically down core due to compaction or compression
Dense	Hard Penetration: Bottom of a core, typical to glacial deposits
Very Dense	Refusal: Bottom of a core, typical to glacial deposits

Color and Shading					
Example Colors:	Black			Browns (olive, yellow, red)	Grays (gray, olive, brown)
Shades:	Light	Dark	Very Dark	Mottling: Streaks or spots of a minor color within the larger color unit	

Descriptors* – Sand and Gravel			
Grain size	Sand: fine, medium, coarse	Gravel: fine (0.19-0.75") and coarse (0.75-3")	Cobbles: >3"
Grading	Well graded: many sizes	Poorly graded: homogenous	
Grain color	(black, white, grey, yellow, etc.)	*(*State percentage of fines, gravel,*	
Rounding	(subrounded, subangular, angular, rounded)	*and sand either in text or in columns provided on log.)*	

Plasticity	
Non-plastic, low, medium, high	**For fine-grained soil, describe plasticity of the unit after grain size percentages (...80% fines, 20% sand, low plasticity)* **For coarse grained soil, describe the plasticity of the fines as part of the percentage description (…80% medium sand, 20% low plasticity fines)*

Other Minor Constituents: % volume			
Other Minor Constituents:	Anthropogenics (aggregates, trash)	Organics (wood debris, fresh/decomposed)	Biota (peat, worms, shells, grass, etc.)
Percent:	Call out volume in 5% increments		

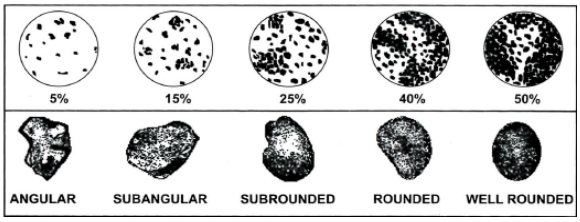
Odor Descriptions		
Hydrocarbon-like	H_2S - like (Hydrogen sulfide - like)	Septic - like
Intensity: slight, moderate, and strong		

Sediment Description Key

Product	
Hydrocarbon Stained	Visible brown or black stains (fine grained)
Hydrocarbon Coated	Visible brown or black coating (coarse grained)
Hydrocarbon Wetted	Visible brown or black hydrocarbon wetting on soil. Hydrocarbon appears as a liquid and is not held by soil grains (pools)
Sheen	
Describe sheen as necessary with percentages (5% increments)	**No odor or sheen observed unless noted*
Visual Description Terminology:	
Rainbow	Multicolored
Metallic	Metallic gray-colored
Florets	Semi-circular and flat (2-D)
Blebs	Semi-circular and spherical (3-D)
Structure and Other Sediment Descriptions	
Blocky	Cohesive soil that can be broken down into smaller lumps
Decomposed	Visible sign of decomposition or discoloration
Fresh	No visible sign of decomposition or discoloration
Gummy	Cohesive, pliable soil with high percentage of clay
Bed	Greater than 1/2" thick
Thin bed	Up to 1/2" thick
Laminated beds	Thin beds (<1/2" thick) lying between or alternating within a greater unit
Stratified beds	Beds (>1/2" thick) lying between or alternating within a greater unit
Layer	A bed or thin bed of minor constituents
Pockets	Semicircular to circular inclusion/deposit
Winnowed	Loss of material that occurred during coring
Anthropogenic	Debris originated from human activity

MAJOR DIVISONS			GROUP SYMBOL	GRAPHIC SYMBOL	TYPICAL DESCRIPTIONS
HIGHLY ORGANIC SOILS			PT		Peat, Humus and Other Highly Organic Soils
COARSE-GRAINED SOILS More than 50% retained on No. 200 (0.075 mm) sieve	GRAVELS More than 50% of coarse fraction retained on No. 4 (4.75 mm) sieve	CLEAN GRAVELS Less than 5% fines	GW		Well-graded Gravels, Gravel-Sand Mixtures, < 5% Fines *
			GP		Poorly-graded Gravels, Gravel-Sand Mixtures, < 5% Fines *
		GRAVELS WITH FINES Greater than 12% fines	GM		Silty Gravels, Gravel-Sand-Silt Mixtures, > 12% Fines *
			GC		Clayey Gravels, Gravel-Sand-Clay Mixtures, > 12% Fines *
	SANDS More than 50% of coarse fraction passing No. 4 (4.75 mm) sieve	CLEAN SANDS Less than 5% fines	SW		Well-graded Sands, Gravelly Sands, < 5% Fines *
			SP		Poorly-graded Sands, Gravelly Sands, < 5% Fines *
		SANDS WITH FINES Greater than 12% fines	SM		Silty Sands, Sand-Silt Mixtures, > 12% Fines *
			SC		Clayey Sands, Sand-Clay Mixtures, > 12% Fines *
FINE-GRAINED SOILS 50% or more passes the No. 200 (0.075 mm) sieve	SILTS AND CLAYS Liquid Limit less than 50	INORGANIC	ML		Inorganic Silts and Very Fine Sands, Rock Flour, Silty Sands of Slight Plasticity
			CL		Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
		ORGANIC	OL		Organic Silts and Organic Silty Clays of Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50	INORGANIC	MH		Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils
			CH		Inorganic Clays of High Plasticity, Fat Clays
		ORGANIC	OH		Organic Clays of High Plasticity

*NOTE: The use of dual group symbols are required if percent fines are between 5 and 12% (e.g. GW-GC).



Chain of Custody Record & Laboratory Analysis Request

Laboratory Name:
Date:
Project Name: Harris Avenue Shipyard PRDI
Project Number:
Project Manager:
Phone Number:
Shipment Method:

Line	Field Sample ID	Collection Date/Time	Matrix	No. of Containers	Test Parameters: PAHs (8270E-SIM)	PCB Aroclors (8082A)	Metals (6020B)	TOC (9060A)	TS (SM2540G)	Grain size (ASTM D422)	Atterberg limits (ASTM D4318)	Bulk Density (ASTM D7263	Specific Gravity (ASTM D854)	Moisture Content (ASTM D2216)	TCLP Metals (1311/6010D/7470A)	MS/MSD				Comments/Preservation
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				

Notes:

Relinquished By:	Company: Anchor QEA, LLC	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time
Relinquished By:	Company:	Received By:	Company:
Signature/Printed Name	Date/Time	Signature/Printed Name	Date/Time

Distribution: A copy will be made for the laboratory and client. The Project file will retain the original.

Investigation-derived Waste Drum Log

Drum Number:	Investigation-derived Waste (IDW) Medium:
Accumulation Start Date:	Manifest Number:
Accumulation End Date:	Manifest Date:
Transport Contractor:	Lab ID Number:
Transport Pick-up Date:	Characterization Date:
Manifest Copy Received from Waste Facility: _____	Date:

Samples placed in Drum	Date of Placement	Comment	Initials

IDW Medium:

Field Deviation Form

Form No. _____

Deviation subject: _____

Project name:

Standard procedure for field collection:

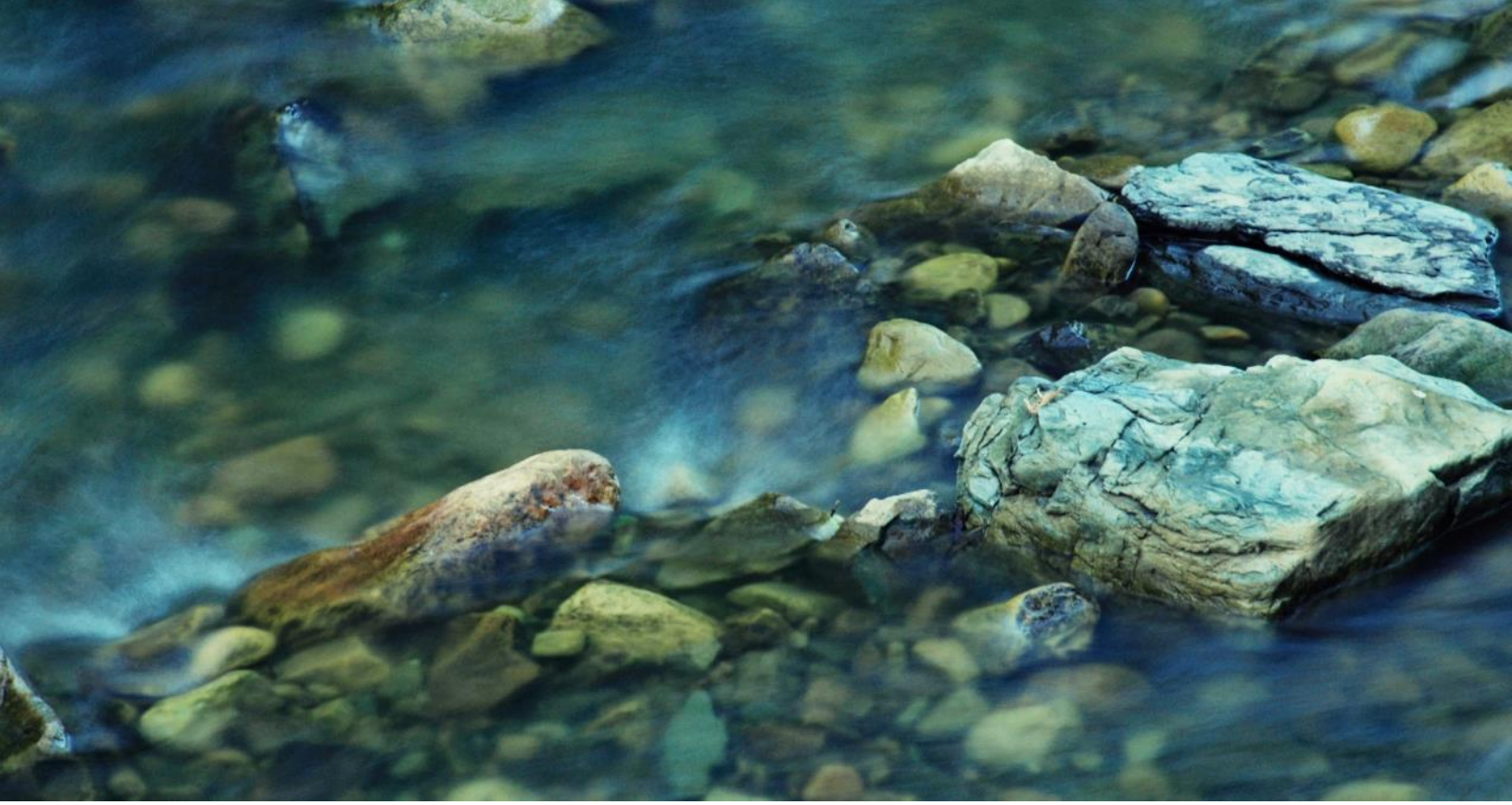
Reason for deviation:

Description of deviation:

Special equipment, materials, or personnel required:

Initiator's Name:	**Date:**
Project Manager:	**Date:**
QA Coordinator:	**Date:**

Attachment C
Quality Assurance Project Plan



October 2021
Harris Avenue Shipyard Cleanup

ANCHOR QEA

PRDI Work Plan Attachment C
Quality Assurance Project Plan

Prepared for Washington State Department of Ecology

October 2021
Harris Avenue Shipyard Cleanup

PRDI Work Plan Attachment C
Quality Assurance Project Plan

Prepared for
Washington State Department of Ecology
Bellingham Field Office
913 Squalicum Way #101
Bellingham, Washington 98225

Prepared by
Anchor QEA, LLC and Aspect Consulting, LLC

Prepared on behalf of
Port of Bellingham
1801 Roeder Avenue
Bellingham, Washington 98227

Project Number: 210007-02.01
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TABLES

ABBREVIATIONS

CAP	Cleanup Action Plan
CCV	continuing calibration verification
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
GC	gas chromatography
MDL	Method Detection Limit
MRL	Method Reporting Limit
MS	matrix spike
MSD	matrix spike duplicate
NFG	National Functional Guidelines
PAH	polycyclic aromatic hydrocarbon
PRDI	Pre-Remedial Design Investigation
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RPD	relative percent difference
SAP	Sampling and Analysis Plan
Site	Harris Avenue Shipyard Site

1 Introduction and Purpose

This *Pre-Remedial Design Investigation Quality Assurance Project Plan* (QAPP) is prepared as Attachment C to the Pre-Remedial Design Investigation (PRDI) Work Plan for the Harris Avenue Shipyard Site (Site) located in Bellingham, Washington. Both upland and in-water portions of the Site are regulated by the cleanup process under the Model Toxics Control Act, Revised Code of Washington 70.105D, and Washington Administrative Code (WAC) 173-340, administered by the Washington State Department of Ecology (Ecology).

In 2021, Ecology authored a *Cleanup Action Plan* (CAP; Ecology 2021), which describes the proposed cleanup action for the Site based on the *Remedial Investigation/Feasibility Study* (Floyd-Snider 2019). Ecology made a preliminary 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.

Analytical quality assurance (QA)/quality control (QC) procedures were developed based on the analytical protocols and QA guidance of the U.S. Environmental Protection Agency's (EPA's) *Test Methods for the Evaluation of Solid Waste: Physical/Chemical Methods* (EPA 1986) and the EPA Contract Laboratory Program National Functional Guidelines (NFG) for Data Review (EPA 2020a, 2020b).

The PRDI Work Plan presents pre-remedial design data gaps and the field investigations that will be used to fill data gaps for remedial design of the upland and in-water areas of the Site. The purpose of this QAPP is to establish the QA/QC objectives and criteria for conducting sampling and analytical activities described in the associated Upland and In-Water Sampling and Analysis Plans (SAPs; Attachments A and B to the PRDI Work Plan). The analytical methods and QA procedures described here will be followed by the Port of Bellingham and its contractors during sample collection and survey activities described in the PRDI Work Plan and the associated SAPs. The objective of this QAPP is to ensure that data of sufficiently high quality are generated to support the project data quality objectives (DQOs).

2 Laboratory Analytical Methods

Chemical analyses will be conducted at Analytical Resources, Inc., an Ecology and National Environmental Laboratory Accreditation Program accredited laboratory. Geotechnical analyses will be conducted by Materials Testing and Consulting. Dredge elutriate test elutriates will be prepared by Anchor QEA's Geochemistry Laboratory.

2.1 Chemical and Physical Analyses

Tables C-1 and C-2 present the proposed analytes, evaluation criteria, analytical methods to be used, and target detection and reporting limits for the evaluation of sediment, soil, groundwater, elutriate, and leachate samples. All sample analyses will be conducted in accordance with methods approved by the Puget Sound Estuary Program (PSEP; 1997) and Ecology, as applicable. Prior to analyses, all samples will be maintained according to appropriate holding times and required temperatures for each analysis.

In completing analyses for this project, the laboratories are expected to meet the following minimum requirements:

- Adhere to the methods referenced and outlined in this QAPP.
- Follow documentation, custody, and sample tracking procedures.
- Notify the Project QA manager of any QA/QC problems in a timely manner.
- Deliver Adobe PDF and electronic data as specified.
- Meet reporting requirements for deliverables.
- Meet turnaround times for deliverables.
- Implement QA/QC procedures, including following DQOs, laboratory QA requirements, and performance evaluation testing requirements.
- Allow laboratory and data audits to be performed, if deemed necessary.

2.2 Bioassay Test Methods

Contingent toxicity testing will be conducted if surface sediment analytical chemistry results exceed Sediment Cleanup Objective levels. Toxicity testing will include three standard bioassays:

- 10-day amphipod mortality test
- 20-day juvenile polychaete growth test
- Larval bivalve or echinoderm development test

Test methods will follow guidance from Puget Sound Estuary Program (PSEP 1995), the Sediment Cleanup User's Manual (Ecology 2019), and Sediment Management Annual Review Meeting updates. Test results will be compared to Sediment Management Standards Biological Effects Criteria Sediment Cleanup Objective/sediment quality standards and cleanup screening levels for Puget Sound marine waters.

3 Quality Assurance/Quality Control Samples

Requirements for QA/QC will include the collection of field QC samples as well as laboratory QC analyses. Laboratory QC analyses are described in detail in Section 3.3. Field and laboratory QA/QC analytical frequencies are provided in Table C-3. The overall DQO for field sampling and laboratory analysis is to produce data of known and acceptable quality to support the project objectives. Laboratory DQOs for precision, accuracy, and completeness are listed in Table C-4.

Results of the QC samples from each sample group will be reviewed by the analyst immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine if control limits have been exceeded. If control limits are exceeded in the sample group, Anchor QEA will be contacted and corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

3.1.1 Field QC Samples

Field duplicate samples will be collected to evaluate the variability attributable to sample homogenization and subsequent sample handling. Field duplicate samples will be collected from the same homogenized material as the original sample, if sufficient sample volume or mass is available, and analyzed as a separate sample. Field duplicate collection frequencies are listed in Table C-3. Field duplicates will be screened against a relative percent difference (RPD) value of 50% when parent and duplicate sample results are greater than five times the reporting limit. Results that are less than five times the reporting limit will be evaluated by the difference between them and screened against a control limit of plus or minus two times the reporting limit for solid matrices and plus or minus the reporting limit for aqueous matrices.

3.2 Data Quality Objectives and Criteria

The DQOs for this program are to provide results of known quality to inform the remedial design. The parameters used to assess data quality are precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity. These parameters are presented in Table C-4 and discussed in greater detail in the following subsections. DQO results will be reviewed by the laboratory analysts, Project QA manager, and data validator. Re-extraction and/or re-analysis may be warranted in some instances for results outside of control limits, as required by the analytical methods and laboratory standard operating procedures. Data will be qualified accordingly by the validator if DQOs described herein and presented in Table C-4 are not met for final data.

3.2.1 Precision

Precision is the ability of an analytical method or instrument to reproduce its own measurement. It is a measure of the variability, or random error, in sample collection, sample handling, and laboratory analyses. ASTM recognizes two levels of precision:

1. *Repeatability* is the random error associated with measurements made by a single test operator on identical aliquots of test material in a laboratory with the same apparatus under constant operating conditions.
2. *Reproducibility* is the random error associated with measurements made by different test operators in different laboratories using the same method but different equipment to analyze identical samples of test material.

In a laboratory, "within-batch" precision is measured using duplicate sample or QC analyses and is expressed as the RPD between the measurements. The "batch-to-batch" precision is determined from the variance observed in the analyses of standard solutions or laboratory control samples from multiple analytical batches.

Field precision will be evaluated by the collection of one field duplicate for every 20 chemistry samples, if sufficient sample volume is available. Field chemistry duplicate precision will be screened against an RPD of 50%. Data qualification based on field homogenization duplicate precision will be at the discretion of the validator.

Precision measurements can be affected by the nearness of a chemical concentration to the Method Detection Limit (MDL), where the percent error (expressed as RPD) increases. Equation 1 is used to express precision.

Equation 1

$$RPD = \frac{(C_1 - C_2)x\ 100\%}{(C_1 + C_2)/2}$$

where:

RPD	=	relative percent difference
C_1	=	larger of the two observed values
C_2	=	smaller of the two observed values

3.2.2 Accuracy

Accuracy is a measure of the closeness of an individual measurement (or an average of multiple measurements) to the true or expected value. Accuracy is determined by calculating the value of

results from analyses of laboratory control samples, standard reference materials, and standard solutions. In addition, matrix spike (MS) samples are also measured, which indicates the accuracy or bias in the actual sample matrix. Accuracy is expressed as percent recovery of the measured value, relative to the true or expected value. If a measurement process produces results that are not the true or expected values, the process is said to be biased. Bias is the systematic error either inherent in a method of analysis (e.g., extraction efficiencies) or caused by an artifact of the measurement system (e.g., contamination). Analytical laboratories use several QC measures to eliminate analytical bias, including systematic analysis of method blanks, laboratory control samples, and independent calibration verification standards. Because bias can be positive or negative, and because several types of bias can occur simultaneously, only the net (or total) bias can be evaluated in a measurement.

Laboratory accuracy will be evaluated using quantitative laboratory control sample, MS, and surrogate spike standard recoveries compared with method or laboratory-specified performance criteria or criteria listed in Table C-4. Accuracy can be expressed as a concentration compared to the true or reference value or as a percent recovery in analyses where spiked samples are analyzed. Equation 2 is used to express accuracy.

Equation 2

$$\%R = 100\% \; x \; (S - U)/Csa$$

where:

$\%R$	=	percent recovery
S	=	measured concentration in the spiked aliquot
U	=	measured concentration in the unspiked aliquot
Csa	=	actual concentration of spike added

Field accuracy will be controlled by adherence to sample collection procedures outlined in the SAPs.

3.2.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an environmental condition. For the Site, the sample locations were selected based on previous site investigations and the list of analytes are the chemicals of concern described in the CAP.

3.2.4 Comparability

Comparability expresses the confidence with which one dataset can be evaluated in relation to another dataset. For this program, comparability of data will be established through the use of

standard collection, processing, and logging procedures; standard analytical methodologies and reporting formats; and common traceable calibration standards and reference materials.

3.2.5 Completeness

Completeness is a measure of the amount of data determined to be valid in proportion to the amount of data collected. Completeness will be calculated as shown in Equation 3:

Equation 3

$$C = \frac{(Number\ of\ acceptable\ data\ points)\ x\ 100}{Total\ number\ of\ data\ points}$$

where:
C = completeness

The DQO for completeness for all components of this project is 95%. Data that have been qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that have been rejected will not be considered valid for the purpose of assessing completeness.

3.2.6 Sensitivity

Sensitivity is a measure of MDLs and Method Reporting Limits (MRLs). In general, the lowest technologically achievable MDLs and reporting limits will be targeted for this project.

The MDL is defined as the minimum concentration at which a given target analyte can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The laboratory MRL is defined as the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. Laboratory MDLs and MRLs will be used to evaluate the sensitivity or applicability of a method prior to its acceptance for this program.

Sample-specific MDLs and MRLs will be reported by the laboratory and will take into account any factors relating to the sample analysis that might decrease or increase these limits (e.g., dilution factor, percent moisture, and analytical mass or volume). If MDLs and MRLs are elevated due to matrix interferences and subsequent dilutions or reductions in sample aliquots, the data will be evaluated by Anchor QEA and the laboratory to determine whether an alternative course of action is required or possible. The sample-specific MDLs and MRLs will be the values stored in the project database.

3.3 Laboratory Quality Control

Laboratory QC procedures, where applicable, include initial and continuing instrument calibrations, standard reference materials, laboratory control samples, matrix replicates, MSs, surrogate spikes (for organic analyses), and method blanks. A summary of the DQOs is provided in Table C-4. QA/QC sample analytical frequencies are provided in Table C-3.

The analyst will review the results of the QC samples from each sample group immediately after a sample group has been analyzed. The QC sample results will then be evaluated to determine whether control limits have been exceeded. If control limits are exceeded in the sample group, the QA manager will be contacted immediately, and corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

3.3.1 Laboratory Instrument Calibration and Frequency

An initial calibration will be performed on each laboratory instrument to be used prior to the start of the project, after each major interruption to the analytical instrument, and when any ongoing calibration does not meet method control criteria. Calibration verification will be analyzed following each initial calibration and will meet method criteria prior to analyses of samples. Continuing calibration verifications (CCVs) will be analyzed at method-required frequencies to track instrument performance. The frequency of CCVs varies with method. For the gas chromatography (GC)/mass spectrometer method (e.g., for PAHs), one CCV will be analyzed every 12 hours. For GC and inorganic methods that use instrumentation, one will be analyzed for every 10 samples analyzed and at the end of each run. If the continuing calibration is out of control, the analysis will be terminated until the source of the control failure is eliminated or reduced to meet control specifications, which may include analyzing a new initial calibration. Any project samples analyzed while the instrument calibration was out of control will be re-analyzed.

Instrument blanks or continuing calibration blanks provide information on the stability of the baseline established. Continuing calibration blanks will be analyzed immediately prior to or immediately following a CCV at the instrument for each type of applicable analysis.

3.3.2 Laboratory Duplicates and Replicates

Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates and replicates are subsamples of the original sample that are prepared and analyzed as separate samples.

3.3.3 Matrix Spikes and Matrix Spike Duplicates

Analyses of MS samples provide information on the extraction efficiency of the method on the sample matrix, as well as any interferences introduced by the sample matrix. By analyzing MS samples in duplicate, information on the precision of the method is also provided. Matrix spike duplicates (MSDs) may be analyzed in place of laboratory duplicates.

3.3.4 Method Blanks

Method blanks are prepared and analyzed in the same manner as project samples to assess possible laboratory contamination at all stages of sample preparation and analysis. The method blank for all analyses must be less than the MRL of any single target analyte. If a laboratory method blank exceeds this criterion for any analyte, and the concentration of the analyte in any of the samples is above detection and less than five times the concentration found in the blank (10 times for common contaminants), analyses must stop and the source of contamination must be eliminated or reduced. Affected samples should be re-prepared and re-analyzed, if possible.

3.3.5 Laboratory Control Samples

Laboratory control samples are analyzed to assess possible laboratory bias at all stages of sample preparation and analyses. The laboratory control sample is a matrix-dependent spiked sample prepared at the time of sample extraction when the sample to be analyzed, the MS, and the method blank are prepared. The laboratory control sample will provide information on the precision of the analytical process and, when analyzed in duplicate, will provide accuracy information as well.

3.4 Bioassay Laboratory Quality Control

If performed, sediment toxicity tests will incorporate standard QA/QC procedures to ensure that the test results are valid. Standard QA/QC procedures include the use of negative controls, positive controls, replicates, reference sediment, and measurements of water quality during testing. Test performance standards, sediment quality standards, and cleanup screening levels are provided in Table C-5.

3.4.1 Negative Controls

The negative control to be used for both sediment toxicity tests will be a clean control, which consists of a clean, inert material and the same seawater used in testing sediment toxicity. For the tests to be used in this study, the negative control will be the amphipod collection site sediment. The negative control for the bivalve larval test will be a seawater control.

3.4.2 Positive Controls

A positive control will be run for each bioassay using the same batch of organisms used in the test. The positive control to be used for the sediment toxicity test will be a toxic control in which a reference toxicant is used to establish the relative sensitivity of the test organism. The positive control for sediment tests is typically conducted with diluent seawater and without sediment.

3.4.3 Replicates

Five replicate chambers for each test sediment, reference sediment, and negative controls treatment will be run for each bioassay. A water quality replicate will also be run for each treatment.

3.4.4 Reference Sediment

Reference sediment will also be included with each bioassay, tested concurrently with test sediments to provide data that can be used to separate toxicant effects from unrelated effects, such as those of sediment grain size. Reference sediment samples will be collected from an area documented to be free from chemical contamination and will represent the range of important natural, physical, and chemical characteristics of the test sediments (i.e., grain size and total organic carbon). For this study, reference sediment samples will be collected from Carr Inlet, Washington (PSEP 1995). All bioassays have performance standards for reference sediments as mentioned above. Failure to meet these standards may result in the requirement to retest.

3.4.5 Water Quality Monitoring

Water quality monitoring will be conducted for the amphipod, larval, and juvenile polychaete bioassays and reference toxicant tests. This consists of daily measurements in each test replicate of salinity, temperature, pH, and dissolved oxygen for the amphipod and larval tests. These measurements will be made every 3 days for the juvenile polychaete bioassay, except for dissolved oxygen, which will be measured daily. Ammonia and sulfides in the overlying water and sediment porewater from a separate beaker will be determined at test initiation and termination for all three tests. Monitoring will be conducted for all test and reference sediments and negative controls (including seawater controls).

3.4.6 Interpretation

Test interpretation consists of endpoint comparisons of test sediments to the measurements observed in the controls and in reference sediments on an absolute percentage basis, as well as statistical comparison between the test and reference endpoints, where appropriate. Test interpretation will follow the guidelines established through the Sediment Management Standards review process.

3.4.7 Bioassay Retesting

If there are issues (e.g., positive or negative control failure) with the bioassay QA/QC tests described previously that result in erroneous findings or failure to meet DQOs, then the bioassay samples will be retested. Any bioassay retests must be fully coordinated with, and approved by Ecology, who will be contacted to handle this coordination.

3.5 Instrument and Equipment Testing, Inspection, and Maintenance Requirements

This section describes procedures for the testing, inspection, and maintenance of field and laboratory equipment.

3.5.1 Field Instruments and Equipment

In accordance with the QA program, Anchor QEA will maintain an inventory of field instruments and equipment. The frequency and types of maintenance performed on this equipment will be based on the manufacturer's recommendations or Anchor QEA's experience with the equipment.

The Anchor QEA field coordinator will be responsible for the preparation, documentation, and implementation of the preventative maintenance program. The equipment maintenance information will be documented in the instrument's calibration log. The frequency of maintenance depends on the type and stability of the equipment, methods used, intended use of the equipment, and manufacturer's recommendations. Detailed information about the calibration process and the frequency of equipment calibration is provided in each manufacturer's instruction manuals.

All maintenance records will be verified prior to each sampling event. The field coordinator will be responsible for verifying that required maintenance has been performed before the equipment is used in the field. Any problems will be noted in the field log book and corrected prior to continuing sampling, observation, and installation operations.

3.5.2 Laboratory Instruments and Equipment

In accordance with the QA program, the laboratory will maintain an inventory of instruments and equipment, and the frequency of maintenance will be based on the manufacturer's recommendations or the laboratory's experience with the equipment.

The laboratory preventative maintenance program, as detailed in the Laboratory QA Plan, is organized to maintain proper instrument and equipment performance and to prevent instrument and equipment failure during use. The program considers instrumentation, equipment, and parts that are subject to wear; deterioration, or other changes in operational characteristics; the availability of spare parts; and the frequency at which maintenance is required. Any equipment that has been

overloaded, has been mishandled, gives suspect results, or has been determined to be defective will be taken out of service, tagged with the discrepancy noted, and stored in a designated area until the equipment has been repaired. After repair, the equipment will be tested to verify that it is in proper operational condition. The client will be promptly notified in writing if defective equipment casts doubt on the validity of analytical data. The client will also be notified immediately regarding any delays due to instrument malfunctions that could affect holding times.

Laboratories will be responsible for the preparation, documentation, and implementation of the preventative maintenance program. Maintenance records will be checked according to the laboratory's internal schedule and recorded by laboratory personnel. The Laboratory QA Manager or designee will be responsible for verifying compliance.

3.5.2.1 Laboratory Instrument and Equipment Calibration

As part of their QC programs, laboratories perform two types of calibrations: Periodic calibration (of, for example, balances, drying ovens, refrigerators, and thermometers) is performed at prescribed intervals. Operational calibrations are performed daily at a specified frequency or prior to analysis (i.e., initial calibrations) according to method requirements. Calibration procedures and frequency are discussed in the Laboratory QA Plan. Calibrations are discussed in the laboratory standard operating procedures for analyses.

The Laboratory QA Manager will be responsible for ensuring that the laboratory instrumentation is calibrated in accordance with specifications. Implementation of the calibration program will be the responsibility of the respective laboratory Group Supervisors. Recognized procedures (EPA, ASTM, or manufacturer's instructions) will be used when available.

Physical standards (i.e., weights or certified thermometers) will be traceable to nationally recognized standards such as the National Institute of Standards and Technology. Chemical reference standards will be National Institute of Standards and Technology standard reference materials or vendor-certified materials traceable to these standards.

The calibration requirements for each method and respective corrective actions will be accessible, either in the laboratory standard operating procedures or in the Laboratory QA Plan for each instrument or analytical method in use. All calibrations will be preserved on electronic media.

4 Assessments and Oversight

Once data are received from the laboratory, several QC procedures will be followed to provide an accurate evaluation of the data quality. Specific procedures will be followed to assess data precision, accuracy, and completeness.

4.1 Compliance Assessments

Laboratory and field performance audits consist of on-site reviews of QA systems and equipment for sampling, calibration, and measurement. Audits will not be conducted as part of this study. However, laboratory audit reports will be made available to the project QA manager upon request.

The laboratory is required to have written procedures addressing internal QA/QC. When these procedures have been submitted, the project QA manager will review them to ensure compliance with this QAPP. The laboratory must ensure that personnel engaged in sampling and analysis tasks have appropriate training.

4.2 Response and Corrective Actions

The project manager, QA manager, and field coordinator will work together to determine actions to be taken in the event of an error, problem, or nonconformance to protocols identified in this QAPP.

4.2.1 Field Activities

The field coordinator will be responsible for correcting equipment malfunctions during the field sampling effort. The QA manager will be responsible for resolving situations identified by the field coordinator that may result in noncompliance with this QAPP. All corrective measures will be immediately documented in the field log book.

4.2.2 Laboratory

The laboratory is required to comply with their standard operating procedures. The laboratory managers will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this QAPP. All laboratory personnel will be responsible for reporting problems that may compromise quality data.

The laboratory managers will be notified if any QC sample grossly exceeds the laboratory in-house control limits. The analyst will identify and correct the anomaly before continuing with the sample analysis. If the anomaly cannot be corrected, the laboratory manager will notify the QA manager. A narrative describing the anomaly, steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, re-analysis, and re-extraction) will be submitted with the data package.

4.3 Reports to Management

QA reports to project management will include verbal status reports, written reports on field sampling activities and laboratory processes, data validation reports, and final project reports. These reports shall be the responsibility of the project manager.

4.4 Documentation and Records

Records will be maintained documenting all activities and data related to site surveys, sample collection, and laboratory analyses. Results of data verification and validation activities will also be documented. Procedures for documentation of these activities are described in this section.

4.4.1 Field Records

Field surveys and sample collection activities will be documented using a custom field application or field collection logs. Additionally, the field coordinator or designee will keep a daily record of significant events, observations, and measurements on a daily log. Entries for each day will begin on a new page. The person recording information must enter the date and time and initial each entry.

In general, sufficient information will be recorded during sampling and surveys to reconstruct the event without relying on the memory of the field personnel.

The daily log will contain the following information, as applicable to the task:

- Project name
- Field personnel on site and time(s) present on site
- Site visitors
- Weather conditions
- Field observations
- Maps and/or drawings
- Sample collection date and time
- Sample collection method and description of activities
- Deviations from the PRDI Work Plan
- Conferences associated with field activities

4.4.2 Analytical Records

The laboratory will retain analytical data records. Additionally, Anchor QEA will retain them in its central project files. For all analyses, the data reporting requirements will include those items necessary to complete data validation, including copies of all raw data. The analytical laboratory will be required, where applicable, to report the following:

Project Narrative. This summary, in the form of a cover letter, will discuss problems, if any, encountered during any aspect of analysis. This summary will discuss, but not be limited to, QC, sample shipment, sample storage, and analytical difficulties. Any problems encountered, actual or perceived, and their resolutions will be documented in as much detail as appropriate.

Chain-of-Custody Records. Legible copies of the Chain-of-Custody forms will be provided as part of the data package. This documentation will include the time of receipt and condition of each sample received by the laboratory. Additional internal tracking of sample custody by the laboratory will also be documented on a sample receipt form. The form must include all sample shipping container temperatures measured at the time of sample receipt.

Sample Results. The data package will summarize the results for each sample analyzed. The summary will include the following information when applicable:

- Field sample identification code and the corresponding laboratory identification code
- Sample matrix
- Date of sample extraction
- Date and time of analysis
- Weight and/or volume used for analysis
- Final dilution volumes or concentration factor for the sample
- Identification of the instrument used for analysis
- MDLs
- MRLs accounting for sample-specific factors (e.g., dilution)
- Analytical results with reporting units identified
- Data qualifiers and their definitions

QA/QC Summaries. This section will contain the results of the laboratory QA/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results. No recovery or blank corrections will be made by the laboratory. The required summaries follow; additional information may be requested:

- **Calibration Data Summary:** This summary will report the concentrations of the initial calibration and daily calibration standards, and the date and time of analysis. The response factor, percent relative standard deviation, percent difference, and retention time for each analyte will be listed, as appropriate. Results for standards to indicate instrument sensitivity will be documented.
- **Internal Standard Area Summary:** The stability of internal standard areas will be reported.
- **Method Blank Analysis:** The method blank analyses associated with each sample and the concentration of all compounds of interest identified in these blanks will be reported.

- **Surrogate Spike Recovery:** This will include all surrogate spike recovery data for organic compounds. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed.
- **Matrix Spike Recovery:** This will report all MS recovery data for organic and metal compounds. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed. The RPD for all duplicate analyses will be included.
- **Matrix Duplicate:** This will include the percent recovery and associated RPD for all MSD analyses.
- **Laboratory Control Sample:** All laboratory control sample recovery data for organic and metal compounds will be reported. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed. The RPD for all duplicate analyses will be included.
- **Relative Retention Time:** This will include a report of the relative retention time of each analyte detected in the samples for both primary and conformational analyses.

Original Data. Legible copies of the original data generated by the laboratory will include the following:

- Sample extraction, preparation, identification of extraction method used, and cleanup logs
- Instrument specifications and analysis logs for all instruments used on days of calibration and analysis
- Calculation worksheets for inorganic analyses
- Reconstructed ion chromatograms for all samples, standards, blanks, calibrations, spikes, replicates, and reference materials
- Original printouts of full scan chromatograms and quantitation reports for all GC and/or GC/mass spectrometry samples, standards, blanks, calibrations, spikes, replicates, and reference materials
- Enhanced spectra of detected compounds with associated best-match spectra for each sample

All instrument data shall be fully restorable at the laboratory from electronic backup. The laboratory will be required to maintain all records relevant to project analyses for a minimum of 5 years. Data validation reports will be maintained in the central project files with the analytical data reports.

4.4.3 Data Reduction

Data reduction is the conversion of raw data to final results. Methods or procedures for data reduction shall be documented. The following procedures will be implemented to verify the accuracy of data reduction:

- Technical staff will document, review, and QC their own work to ensure accuracy.

- Major calculations will be subject to an independent senior technical review to ensure that both the methods and the calculations are correct and consistent with the approved PRDI Work Plan, including approved supplementals to the PRDI Work Plan.
- The project manager will be responsible for ensuring that data reduction is conducted in a manner that produces high quality data via review and approval of concepts, methods, assumptions, and calculations.

5 Data Validation and Usability

Data generated in the field and at the laboratories will be verified and validated according to methods and procedures described in this section.

5.1 Data Review, Validation, and Verification

During the validation process, analytical data will be electronically and/or manually evaluated for method and laboratory QC compliance, and their validity and applicability for program purposes will be determined.

Based on findings of the validation process, data validation qualifiers may be assigned. Validated project data, including qualifiers, will be entered into the project database, thus enabling this information to be retained or retrieved as needed.

5.2 Validation and Verification Methods

Laboratory data will be provided in both PDF and EQuIS electronic format and uploaded to Anchor QEA's project database. Once data are received from the laboratory, a number of QC procedures will be followed to provide an accurate evaluation of data quality.

Stage 2B validations (EPA 2009) will be performed for all testing parameters.

Data quality review will be completed by Anchor QEA (or a subconsultant) in accordance with EPA NFG for Data Review (EPA 2020a, 2020b) by considering the following:

- Data completeness
- Holding times
- Method blanks
- Surrogates
- Detection and reporting limits
- Laboratory control samples
- Replicates
- MS/MSD samples
- Initial and continuing calibrations
- Internal standard area counts
- Standard reference materials

Data will be validated in accordance with the project-specific DQOs (Table C-4), analytical method criteria, and the laboratory's internal performance standards based on its standard operating procedures. The results of the data quality review, including assigning qualifiers in accordance with

the NFG and a tabular summary of qualifiers, will be generated by the database manager and submitted to the QA/QC Manager for final review and confirmation of data validity.

Laboratory data, which will be electronically provided and loaded into Anchor QEA's project database, will undergo a check against the laboratory hard copy data. Data will be validated or reviewed manually, and qualifiers, if assigned, will be entered manually. The accuracy of all manually entered data will be verified by a second party. Data tables and reports will be exported from EQuIS to Excel tables.

Field datasheets or data entries will be checked for completeness and accuracy prior to database entry. Data generated in the field will be documented electronically or on hard copy and provided to the database manager, who is responsible for data entry into the database. Manually entered data will be checked by a second party. Field documentation will be filed in the main project file after data entry and checking are complete.

5.3 Reconciliation with User Requirements

The QA manager will review data at the completion of the task to determine if DQOs have been met.

If data do not meet the project's specifications, the QA manager will review the errors and determine if the problem is due to calibration/maintenance, sampling techniques, or other factors and will suggest corrective action, if appropriate. The problem will be corrected by retraining, revising techniques, or replacing supplies/equipment; if not, the DQOs will be reviewed for feasibility. If specific DQOs are not achievable, the QA manager will recommend appropriate modifications. If matrix interference is suspected to have attributed to the exceedance, adequate laboratory documentation must be presented to demonstrate that instrument performance and/or laboratory technique did not bias the result. In cases where the DQOs have been exceeded and corrective actions did not resolve the outlier, data will be qualified per NFG. In these instances, the usability of data will be determined by the extent of the exceedance.

Rejected data will be assigned an "R" qualifier and will not be used for any purposes. Data qualified with a "J" flag will be used, but the basis for the J-flag will be documented in the data validation report and data uncertainties will be considered during use of the data for project reporting.

6 References

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Ecology, 2021. *Cleanup Action Plan. Harris Avenue Shipyard, Port of Bellingham*. Issued by Washington State Department of Ecology Toxics Cleanup Program, Southwest Regional Office, Olympia, Washington. February 2, 2021.

EPA (U.S. Environmental Protection Agency), 1986. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA-530/SW-846.

EPA, 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. EPA 540-R-08-005. January 2009.

EPA, 2020a. National Functional Guidelines for Organic Superfund Methods Data Review. Office of Superfund Remediation and Technology Innovation. United States Environmental Protection Agency. EPA-540-R-20-005. November 2020.

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PSEP (Puget Sound Estuary Program), 1995. *Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments*. Prepared for the U.S. Environmental Protection Agency, Region 10, Seattle, Washington, and Puget Sound Water Quality Authority, Olympia, Washington, by King County Environmental Lab, Seattle, Washington. 1995.

PSEP, 1997. *Puget Sound Estuary Program: Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound*. Prepared for USEPA Region 10 and the Puget Sound Water Quality Authority. Puget Sound Water Quality Authority, Olympia, Washington.

Tables

Table C-1
Sediment and Soil Analytical Methods, Testing Criteria, and Reporting Limits

Parameter	Method	Protection of Benthic Species and Human Direct Contact		Protection of Seafood Consumption	MDL	MRL
		Intertidal Area	Subtidal Area			
Geotechnical Analyses						
Grain size (%)	ASTM D422	--	--	--	0.1	0.1
Atterberg limits	ASTM D4318	--	--	--		
Bulk density	ASTM D7263	--	--	--		
Specific gravity	ASTM D854	--	--	--		
Moisture content (%)	ASTM D2216	--	--	--		
Conventionals (%)						
Total solids	SM 2540G	--	--	--	0.1	0.1
Total organic carbon	EPA 9060A	--	--	--	0.1	0.1
Metals (mg/kg)						
Arsenic	EPA 6010C	20	13	13	0.470	5.00
Cadmium	EPA 6010C	--	--	0.8	0.034	0.200
Copper	EPA 6010C	390	390	--	0.0660	0.200
Zinc	EPA 6010C	410	410	--	0.210	1.00
PAHs (µg/kg)						
Total LPAH	8270E	--	--	--	--	--
Naphthalene	8270E	--	--	--	5.25	20.0
Acenaphthylene	8270E	--	--	--	4.77	20.0
Acenaphthene	8270E	--	--	--	5.13	20.0
Fluorene	8270E	--	--	--	4.95	20.0
Phenanthrene	8270E	--	--	--	4.69	20.0
Anthracene	8270E	--	--	--	5.93	20.0
2-Methylnaphthalene	8270E	--	--	--	5.67	20.0
Total HPAHs	8270E	--	--	--	--	--
Fluoranthene	8270E	--	1700	--	4.52	20.0
Pyrene	8270E	--	2600	--	5.55	20.0
Benzo(a)anthracene	8270E	--	--	--	5.18	20.0
Chrysene	8270E	--	--	--	5.22	20.0
Total benzo(b,j,k)fluoranthenes	8270E	--	--	--	10.2	40.0
Benzo(a)pyrene	8270E	--	--	--	6.48	20.0
Indeno(1,2,3-cd)pyrene	8270E	--	--	--	5.99	20.0
Dibenz(a,h)anthracene	8270E	--	--	--	6.16	20.0
Benzo(g,h,i)perylene	8270E	--	--	--	5.82	20.0
cPAH TEQ	--	--	--	140	--	--
PCBs (µg/kg)						
Aroclor 1016	8082A	--	--	--	--	--
Aroclor 1221	8082A	--	--	--	--	--
Aroclor 1232	8082A	--	--	--	--	--
Aroclor 1242	8082A	--	--	--	--	--
Aroclor 1248	8082A	--	--	--	--	--
Aroclor 1254	8082A	--	--	--	--	--
Aroclor 1260	8082A	--	--	--	--	--
Total PCBs	--	--	130	33	--	--

Notes:

µg/kg: micrograms per kilogram
ASTM: ASTM International
cPAH: carcinogenic polycyclic aromatic hydrocarbon
EPA: U.S. Environmental Protection Agency
HPAH: high molecular weight PAH
LPAH: low molecular weight PAH
MDL: Method Detection Limit
mg/kg: milligram per kilogram
MRL: Method Reporting Limit
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
TEQ: toxic equivalent

Table C-2
Aqueous Analytical Testing Criteria and Reporting Limits

Parameter	Method	MDL	MRL
Metals (µg/L)			
Arsenic	EPA 6020B	0.037	0.20
Cadmium	EPA 6020B	0.040	0.10
Copper	EPA 6020B	0.35	0.50
Zinc	EPA 6020B	2.92	6.0
Iron	EPA 6020B	0.018	0.036
Manganese	EPA 6020B	0.014	0.500
Groundwater PAHs (µg/L)			
Naphthalene	8270E-SIM	0.00131	0.010
2-Methylnaphthalene	8270E-SIM	0.00102	0.010
1-Methylnaphthalene	8270E-SIM	0.00091	0.010
2-Chloronaphthalene	8270E-SIM	0.00106	0.010
Acenaphthylene	8270E-SIM	0.00185	0.010
Acenaphthene	8270E-SIM	0.00289	0.010
Dibenzofuran	8270E-SIM	0.00152	0.010
Fluorene	8270E-SIM	0.00152	0.010
Phenanthrene	8270E-SIM	0.0013	0.010
Anthracene	8270E-SIM	0.00116	0.010
Carbazole	8270E-SIM	0.00121	0.010
Fluoranthene	8270E-SIM	0.00171	0.010
Pyrene	8270E-SIM	0.00118	0.010
Benzo(a)anthracene	8270E-SIM	0.00075	0.010
Chrysene	8270E-SIM	0.0009	0.010
Benzo(b)fluoranthene	8270E-SIM	0.00046	0.010
Benzo(k)fluoranthene	8270E-SIM	0.00321	0.010
Benzo(j)fluoranthene	8270E-SIM	0.00187	0.010
Benzofluoranthenes, Total	8270E-SIM	0.00356	0.010
Benzo(a)pyrene	8270E-SIM	0.00248	0.010
Indeno(1,2,3-cd)pyrene	8270E-SIM	0.00101	0.010
Dibenzo(a,h)anthracene	8270E-SIM	0.00134	0.010
Benzo(g,h,i)perylene	8270E-SIM	0.00142	0.010
Groundwater Conventionals (mg/L)			
Alkalinity, Total	SM 2320 B-97	1.00	1.00
Nitrate + Nitrite as N	EPA 353.2	0.0100	0.0100
Sulfate	EPA 300.0	0.100	0.100
TCLP Metals (µg/L)			
Arsenic	EPA 6010D	14	250
Barium	EPA 6010D	7.5	15
Cadmium	EPA 6010D	0.6	10
Chromium	EPA 6010D	2.4	25
Copper	EPA 6010D		
Lead	EPA 6010D	6.5	100
Mercury	EPA 7470A	0.007	0.10
Selenium	EPA 6010D	41	250
Silver	EPA 6010D	2.2	15
Zinc	EPA 6010D	8.0	100
DRET Total and Dissolved Metals (µg/L)			
Arsenic	EPA 6010D	14	250
Cadmium	EPA 6010D	0.6	10
Copper	EPA 6010D		
Zinc	EPA 6010D	8.0	100
DRET PAHs (µg/L)			
2-Methylnaphthalene	8270E	0.2	1.0
Acenaphthene	8270E	0.3	1.0
Acenaphthylene	8270E	0.3	1.0
Anthracene	8270E	0.3	1.0

Table C-2
Aqueous Analytical Testing Criteria and Reporting Limits

Parameter	Method	MDL	MRL
Benzo(a)anthracene	8270E	0.3	1.0
Benzo(a)pyrene	8270E	0.3	1.0
Benzo(g,h,i)perylene	8270E	0.4	1.0
Chrysene	8270E	0.4	1.0
Dibenz(a,h)anthracene	8270E	0.4	1.0
Fluoranthene	8270E	0.4	1.0
Fluorene	8270E	0.3	1.0
Indeno(1,2,3-cd)pyrene	8270E	0.4	1.0
Naphthalene	8270E	0.2	1.0
Phenanthrene	8270E	0.4	1.0
Pyrene	8270E	0.4	1.0
Total benzo(b,j,k)fluoranthenes	8270E	0.8	2.0
DRET PCBs (µg/L)			
Aroclor 1016	8082A	0.018	0.10
Aroclor 1221	8082A	0.018	0.10
Aroclor 1232	8082A	0.018	0.10
Aroclor 1242	8082A	0.018	0.10
Aroclor 1248	8082A	0.018	0.10
Aroclor 1254	8082A	0.018	0.10
Aroclor 1260	8082A	0.017	0.10
Total PCBs	--		

Notes:
µg/L: micrograms per liter
DRET: Dredge Elutriate Test
MDL: Method Detection Limit
mg/L: milligrams per liter
MRL: Method Reporting Limit
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
TCLP: toxicity characteristic leaching procedure

Table C-3

Quality Control Analysis Summary for Chemical Testing

Analysis	Field Duplicate	Initial Calibration	Ongoing Calibration	Matrix Duplicates	Matrix Spikes	LCS/SRM[3]	Matrix Spike Duplicates[4]	Method Blanks	Surrogates
Geotech	1 per 20 samples	Daily[1]	NA	NA	NA	NA	NA	NA	NA
Total solids	1 per 20 samples	Daily[1]	NA	1 per 20 samples	NA	NA	NA	NA	NA
Total organic carbon	1 per 20 samples	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
Metals	1 per 20 samples	Daily or each batch	1 per 10 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	NA	1 per 20 samples	NA
PAHs	1 per 20 samples	As needed[2]	Every 12 hours	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample
PCBs	1 per 20 samples	As needed[2]	Every 12 hours	NA	1 per 20 samples	1 per 20 samples	1 per 20 samples	1 per 20 samples	Every sample

Notes:

1. Calibration and certification of drying ovens and weighing scales are conducted bi-annually.
2. Initial calibrations are considered valid until the continuing calibration no longer meets method specifications. At that point, a new initial calibration is analyzed.
3. The Puget Sound SRM will be analyzed in association with the dioxin/furan analyses at a rate of one per project.
4. Matrix spike duplicates may be analyzed in place of matrix duplicates for applicable methods.

NA: not applicable

PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl

LCS: laboratory control sample

SRM: sediment reference material

Table C-4
Data Quality Objectives for Chemical Testing

Parameter	Precision	Accuracy	Completeness
Grain size	± 30% RPD	NA	95%
Total solids	± 20% RPD	NA	95%
Total organic carbon	± 30% RPD	75-125% R	95%
Metals	± 30% RPD	70-130% R	95%
PAHs	± 35% RPD	50-150% R	95%
PCBs	± 35% RPD	50-150% R	95%

Notes:
NA: not applicable
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
R: recovery
RPD: relative percent difference

Table C-5
Biological Effects Criteria

Biological Test	Performance Standards		SCO/SQS	CSL
	Control	Reference		
10-Day Amphipod	$M_c \leq 10\%$	$M_R \leq 25\%$	$M_T > 25\%$ Absolute and M_T vs. M_R SD ($p < 0.05$)	$M_T - M_R \geq 30\%$ and M_T vs. M_R SD ($p < 0.05$)
Larval Growth	$N_c/I \geq 0.70$	$N_R/N_C \geq 0.65$	$N_T / N_R < 0.85$ and N_T vs. N_R SD ($p < 0.10$)	$N_T / N_R < 0.70$ and N_T vs. N_R SD ($p < 0.10$)
20-Day Juvenile Polychaete	$M_c \leq 10\%$ and $MIG_C \geq 0.38$ mg/individual/day (or case by case)	$MIG_R / MIG_C \geq 0.80$	$MIG_T / MIG_{R <} 0.70$ and MIG_T vs. MIG_R SD ($p < 0.05$)	$MIG_T / MIG_{R <} 0.50$ and MIG_T vs. MIG_R SD ($p < 0.05$)

Notes:
Source: Ecology 2019
A: abundance
BLD: blank corrected light decrease
C: control
CSL: cleanup screening level
F: final
I: initial count
M: mortality
MIG: Mean Individual Growth Rate expressed in mg/ind/day Ash Free Dry Weight
ML: mean light output
N: normal survivorship expressed as actual counts
R: reference
SCO: Sediment Cleanup Objective
SD: significantly different
SQS: Sediment Quality Standards
T: test

Attachment D
Inadvertent Discovery Plan

INADVERTENT DISCOVERY PLAN

October 2021

PLAN AND PROCEDURES FOR THE UNANTICIPATED DISCOVERY OF CULTURAL RESOURCES AND HUMAN SKELETAL REMAINS

Project Title: Harris Avenue Shipyard Pre-Remedial Design Investigation
Project Proponent: Port of Bellingham
Project ID Number: FSID: 2922, CSID: 193
County: Whatcom
Address: 201 Harris Avenue, Bellingham, WA
Section, Township, Range: Section 1, Township 37 N, Range 2 E

1. INTRODUCTION

This Inadvertent Discovery Plan (IDP) outlines procedures to perform in the event of discovering cultural resources or human remains, in accordance with Washington State preservation laws. These laws concern historic preservation, archaeology, human remains, and cemeteries.

2. RECOGNIZING CULTURAL RESOURCES

A cultural resource discovery could be prehistoric or historic. Examples include:

a. An accumulation of shell, burned rocks, or other food related materials.
b. Bones or small pieces of bone.
c. An area of charcoal or very dark stained soil with artifacts.
d. Stone tools or waste flakes (i.e., an arrowhead or stone chips).
e. Clusters of tin cans or bottles, logging or agricultural equipment that appears to be older than 50 years.
f. Buried railroad tracks, decking, or other industrial materials.

See cultural resource images in Appendix A.

3. ON-SITE RESPONSIBILITIES

STEP 1: *Stop Work.* If any employee, contractor, or subcontractor believes that he or she has discovered a cultural resource, leave it in place and stop work in the area (about a 100-foot radius). Do not allow vehicles, equipment, and unauthorized personnel to traverse the discovery area. Delineate and secure the area to protect the integrity of the discovery. Upon encountering cultural resources within a boring, discontinue all further work within that boring.

STEP 2: *Notify the Project Manager:* The Project Manager or alternate will make all calls and necessary notifications.

Brian Gouran Cell: (360) 296-2441 Email: Briang@portofbellingham.com	Brian Keenan Cell: (360) 296-2642 Email: Briank@portofbellingham.com

If human skeletal remains are encountered, treat them with dignity and respect at all times. Cover the remains with a tarp or other materials (not soil or rocks) for temporary protection and to shield them from being photographed. **Do not call 911 or speak with the media. Do not take pictures. Follow the procedure described in Section 5.**

4. PROJECT MANAGER RESPONSIBILITIES UPON DISCOVERY OF POTENTIAL CULTURAL RESOURCES

a. *Protect Potential Find*: Ensure no work occurs within the discovery area (expected to be a 30-foot radius around potential find unless otherwise indicated). Delineate and secure the discovery area to protect the integrity of the discovery.
b. *Direct Sampling/Construction Activities Elsewhere*: Direct sampling/construction activities away from the discovery area prior to contacting the concerned parties.
c. *Contact the Department of Ecology*: Maintain regular communications until treatment of the discovery is completed as set forth in this IDP:

Department of Ecology (Ecology) Contacts:

Project Manager John Guenther Office: (360) 255-4381 Cell: (425) 324-1438 Email: jgue461@ecy.wa.gov	Cultural Resources Review Coordinator Lucy McInerney Office: (425) 649-7272 Cell: (425) 410-1400 Email: lucy.mcinerney@ecy.wa.gov

d. *Provide Archaeological Examination*: Ensure that a qualified professional archaeologist examines the find. If the archaeologist determines that the find:
    - Is not archaeological or historical material, or human remains/funerary objects; work may proceed with no further delay.
    - Is archaeological or historical material; contact the Washington Department of Archaeology and Historic Preservation (DAHP) and affected Tribes. See contacts below. Document discoveries as described in Section 6.
    - May be human remains or funerary objects. **Follow the procedure described in Section 5.**
e. *Protect Confirmed Find*: The archaeologist may refine the boundaries of the cultural resource discovery area. Do not work in this designated area until treatment of the discovery is completed, following the procedures set forth in this IDP.

DAHP Contacts:

Allyson Brooks, PhD State Historic Preservation Officer Phone: (360) 586-3066 Email: allyson.brooks@dahp.wa.gov	Rob Whitlam, PhD State Archaeologist Office: (360) 586-3080 Cell: (360) 890-2615 Email: rob.whitlam@dahp.wa.gov
Alternate: Lance Wollwage, PhD Assistant State Archaeologist Office: (360) 586-3536 Cell: (360) 890-2616 Email: lance.wollwage@dahp.wa.gov	
Tribal Contacts: Lena Tso, THPO Lummi Nation Office: (360) 312-2257 Email: lena@lummi-nsn.gov	Scott Schuyler, Cultural Resources Upper Skagit Tribe Office: (360) 854-7009 Email: sschuyler@upperskagit.com
Larry Campbell, THPO Swinomish Tribal Community Office: (360) 466-7314 Email: lcampbell@swinomish.nsn.us	Trevor Delgado, THPO Nooksack Tribe Office: (360) 592-5176 ext. 32234 Email: tdelgado@nooksack-nsn.gov

5. SPECIAL PROCEDURES FOR THE DISCOVERY OF HUMAN SKELETAL REMAINS

If human skeletal remains are encountered, cease all work that may cause further disturbance to the remains, and secure and protect the discovery area. Do not touch, move, or further disturb the remains.

Project Manager: Immediately call the Bellingham Police Department.

Bellingham Police Department (360) 778-8800

The Bellingham Police Department will contact the Medical Examiner, who will determine if the remains are human and whether the discovery site constitutes a crime scene. If the remains constitute a crime scene (forensic), the Medical Examiner will retain jurisdiction. If they do not constitute a crime scene (non-forensic), the Medical Examiner will notify DAHP.

DAHP will have jurisdiction over non-forensic remains until provenance of the remains is established.

Sampling/construction in the discovery area may resume only as directed by the Medical Examiner/law enforcement personnel for forensic remains and by DAHP for non-forensic remains.

6. DOCUMENTATION OF CULTURAL RESOURCES

The Project Manager will ensure the proper documentation and field assessment of any discovered cultural resources by a qualified professional archaeologist in cooperation with all parties: DAHP, Ecology, and affected tribes.

All prehistoric and historic cultural material discovered during sampling will be recorded by a qualified professional archaeologist using standard and approved techniques. Site overviews, features, and artifacts will be photographed; stratigraphic profiles and soil/sediment descriptions will be prepared for minimal subsurface exposures. Discovery locations will be documented on scaled site plans and site location maps. The appropriate DAHP forms will be prepared.

Cultural features, horizons, and artifacts detected in buried sediments may require further evaluation using hand-dug test units. Units may be dug in controlled fashion to expose features, collect samples from undisturbed contexts, or to interpret complex stratigraphy. A test excavation unit or small trench might also be used to determine if an intact occupation surface is present. Test units will be used only when necessary to gather information on the nature, extent, and integrity of subsurface cultural deposits to evaluate the site's significance. Excavations will be conducted using state-of-the-art techniques for controlling provenience, and the chronology of ownership, custody, and location recorded with precision.

Spatial information, depth of excavation levels, natural and cultural stratigraphy, presence or absence of cultural material, and depth to sterile soil, regolith, or bedrock will be recorded for each probe on a standard form. Test excavation units will be recorded on unit-level forms, which include plan maps for each excavated level, and material type, number, and vertical provenience (depth below surface and stratum association where applicable) for all artifacts recovered from the level. A stratigraphic profile will be drawn for at least one wall of each test excavation unit.

Sediments excavated for purposes of cultural resources investigation will be screened through 1/8-inch mesh unless soil conditions warrant 1/4-inch mesh.

All prehistoric and historic artifacts collected from the surface and from probes and excavation units will be analyzed, catalogued, and temporarily curated. Ultimate disposition of cultural materials will be determined in consultation with DAHP, Ecology, and the affected tribes.

If field assessment work exposes human skeletal remains, the process described in Section 5 will be followed.

Within 30 days of concluding field work, the Project Manager will provide a technical report summarizing the work and findings of the professional archaeologist to Ecology, DAHP, and the affected tribes.

7. PROCEEDING WITH WORK

Work outside the designated discovery area may continue while documentation and assessment of the discovery proceeds.

Work inside the discovery area may resume only after treatment of the discovery is completed in accordance with this IDP, and with the concurrence of the Project Manager, DAHP, affected tribes, and Ecology. For forensic human remains, the county examiner and law enforcement personnel must concur with resumption of work.

8. IDP AVAILABILITY AND USE

The IDP must be immediately available on site, be implemented to address any discovery, and be available by request by any party. The IDP must be discussed and reviewed with all personnel performing field work in advance of commencing field work.

APPENDIX A
Cultural Resource Images

Print images in color for accuracy.

Implement the IDP if…

You see chipped stone artifacts.

- Glass-like material
- Angular
- “Unusual” material for area
- “Unusual” shape
- Regularity of flaking
- Variability of size

Implement the IDP if…

You see ground or pecked stone artifacts.

- Striations or scratching
- Unusual or unnatural shapes
- Unusual stone
- Etching
- Perforations
- Pecking
- Regularity in modifications
- Variability of size, function, and complexity

Implement the IDP if…

You see bone or shell artifacts.

- Often pointed if used as a tool
- Often wedge shaped like a “shoehorn”
- Often smooth
- Unusual shape
- Carved

Bone awls from Oregon and bone wedge from California

Implement the IDP if…

You see bone or shell artifacts.

- Often smooth
- Unusual shape
- Perforated
- Variability of size

Tooth pendant and bone pendants from Oregon and Washington

Implement the IDP if…

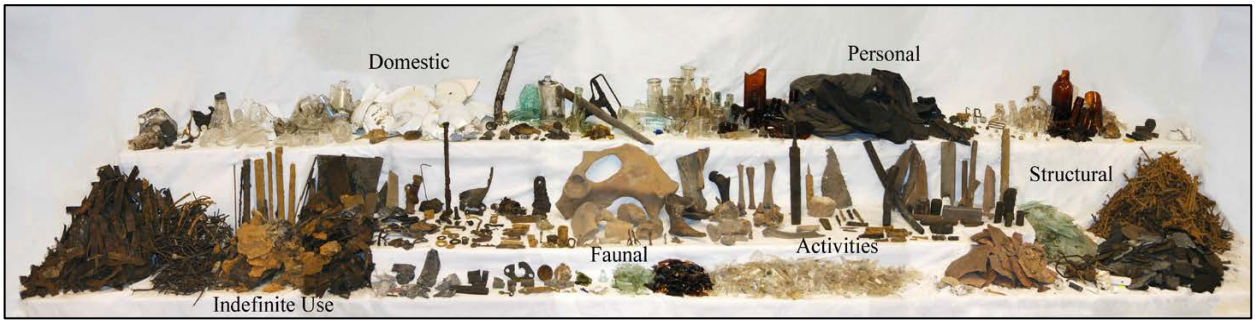
You see fiber or wood artifacts.

- Wet environments needed for preservation
- Variability of size, function, and complexity
- Rare

Artifacts from Mud Bay, Olympia, Washington

Implement the IDP if…

You see historic period artifacts.



Artifacts from Downtown Seattle, Alaskan Way Viaduct (top and bottom) and Unknown Site (middle)

Implement the IDP if…

You see strange, different, or interesting looking dirt or rocks.

- “Unusual” accumulations of rock (especially fire-cracked rock)
- “Unusual” shaped accumulations of rock (e.g., similar to a fire ring)
- Charcoal or charcoal-stained soils
- Oxidized or burned-looking soils
- Accumulations of shell
- Accumulations of bones or artifacts
- Look for the “unusual” or out of place (e.g., rock piles or accumulations in areas with few rocks)
- A layered or “layer cake” appearance
- Associated with black or blackish soil
- Have crushed and compacted shells

Site on Muckleshoot Indian Reservation, near WSDOT ROW along SR 164

Site located within WSDOT ROW near Anacortes Ferry Terminal

Implement the IDP if…

You see historic foundations or buried structures.

45KI924, In WSDOT ROW for SR 99 Tunnel

Attachment E
Upland Health and Safety Plan

PROJECT-SPECIFIC HEALTH AND SAFETY PLAN

Pre-Remedial Design Upland Data Collection Activities, Harris Avenue Shipyard Site

Property Name:	Harris Avenue Shipyard		
Project Number:	210195		
Prepared By:	Steve Germiat	Date:	8/17/21
Reviewed By:	Robert Hanford	Date:	8/17/21

1 INTRODUCTION

This project-specific health and safety plan establishes procedures and practices to protect employees of Aspect Consulting, LLC (Aspect) from potential hazards posed by field activities at the subject site. In this health and safety plan, measures are provided to minimize potential exposure, accidents, and physical injuries that may occur during daily activities and adverse conditions. Contingency arrangements are also provided for emergency situations.

2 EMERGENCY CONTACT INFORMATION

PROPERTY LOCATION	Fairhaven Shipyard 201 Harris Avenue Bellingham, WA 98225
NEAREST HOSPITAL	PeaceHealth St. Joseph Medical Center 2901 Squalicum Parkway Bellingham, WA 98225-1581 (360) 734-5400
EMERGENCY RESPONDERS	Police, Ambulance, Fire **911**
OTHER CONTACTS	Bob Hanford (mobile) .....(206) 276-9256 Steve Germiat (cell) .....(206) 619-6743 Aspect, Seattle Office .....(206) 328-7443 Client Contact, Brian Keenan.....(360) 296-2642
IN EVENT OF EMERGENCY, CALL FOR HELP AS SOON AS POSSIBLE	Give the following information: ✓ **Where You Are:** address, cross streets, or landmarks ✓ **Phone Number** you are calling from ✓ **What Happened:** type of accident, injury ✓ **How Many Persons** need help ✓ **What is Being Done** for the victims ✓ **You Hang Up Last:** let whomever you called hang up first

In case of serious injuries or other emergency, immediately call Bob Hanford, Aspect Corporate Safety Officer, at (206)-276-9256. If no response, call Steve Germiat at (206) 619-6743 or Tim Flynn at (206) 276-5540.

3 PERSONNEL ORGANIZATION AND CHAIN OF COMMAND

The Aspect Project Manager assigns the Site Safety Supervisor and other field personnel for this project, and has ultimate responsibility for developing this project-specific health and safety plan and ensuring it is complied with during project execution. The Aspect Site Safety Supervisor has responsibility and authority for Aspect employees' safety during site activities. Other Aspect personnel on site have the responsibility to comply with this project-specific health and safety plan in coordination with the Site Safety Supervisor.

Aspect Personnel			
Role	**Name**	**Office Phone**	**Mobile/Cell Phone**
Project Manager	Steve Germiat	206-838-5830	206-619-6743
Site Safety Supervisor	Jane Gregg	360.810.3553	906.231.1500
Field Personnel	Jane Gregg	360.810.3553	906.231.1500
Field Personnel	TBD		
Aspect's Subcontractors Working On Site			
APS	Private utility locates	TBD	TBD
Holocene	Sonic drilling contractor	TBD	TBD

Aspect will inform its subcontractors working onsite of potential fire, explosion, health, safety or other hazards associated with planned site activities, and can make available to them this project-specific health and safety plan. However, all subcontractors are solely responsible for **preparation of their own health and safety plan, and for the safety of their employees.**

4 SITE CONTROL PLAN

4.1 Property Description

Property Name:	Harris Ave Shipyard site	
Property Location or Address:	201 Harris Avenue, Bellingham, WA	
Owners/Tenants:	Various retail, restaurant and fitness organizations	
Current Property Use:	Industrial repair	
Past Use of Property (if different):	Shipyard	
Designated Hazardous Waste Site?	Yes	If yes, specify federal, state, or other: MTCA
Industrial Site?	Yes	
Topography:	flat	
Surround Land Use/Nearest Population:	Industrial, commercial	
Drinking Water/Sanitary Facilities:	none	
Site Map:	On site	

4.2 Site Access Control

Describe controls to be used to prevent entry by unauthorized persons:

- Traffic cones, barriers, chain-link fence, and caution tape, as needed.

Describe how exclusion zones and contamination reduction zones will be designated:

- Drilling will be performed in multiple areas of the property.
- The area immediately adjacent to each boring/monitoring well location will be considered an exclusion zone.
- During drilling, Aspect or the subcontractor will mark the limits of the exclusion zone using cones, caution tape, etc.
- During drilling, the contamination reduction zone will be located adjacent to the driller's/excavation contractor's mobile decontamination trailer, and will include steam cleaning equipment for equipment decontamination.
- Aspect field personnel will remain vigilant about preventing unauthorized persons from approaching the exclusion zone.

4.3 Worker Hygiene Practices (Special COVID-19 Virus Prevention Actions)

Along with normal hygiene practices commonly exercised by Aspect employees, workers must practice recommended infection prevention measures to avoid exposure and spreading of the COVID-19 virus. The Center for Disease Control (CDC) indicates that: *"COVID-19 is a respiratory illness that can spread from person to person.."* Therefore, worker hygiene and distancing are critical elements to managing the virus' spread. The following is guidance that was used to develop this section of the HASP.

- Occupational Safety and Health Administration (OSHA) https://www.osha.gov/Publications/OSHA3990.pdf
- Centers for Disease Control (CDC) https://www.cdc.gov/coronavirus/2019-ncov/downloads/community-mitigation-strategy.pdf)
- World Health Organization (WHO) https://www.who.int/emergencies/diseases/novel-coronavirus-2019

Most COVID-19 guidance is geared toward protecting workers in office settings, whereas there is limited guidance for field work settings. Therefore, Aspect has adopted and enhanced the COVID-19 procedures outlined by OSHA under their guidelines for "Low Exposure Risk" work (https://www.osha.gov/Publications/OSHA3990.pdf). OSHA states that:

> *"The Occupational Safety and Health Administration (OSHA) developed this COVID-19 planning guidance based on traditional infection prevention and industrial hygiene practices. It focuses on the need for employers to implement engineering, administrative, and work practice controls and personal protective equipment (PPE), as well as considerations for doing so.*"

OSHA Guidance and Aspect Actions

OSHA outlines three categories of Exposure Risk: High/Very High, Medium and Low. The High/Very High and Medium Exposure Risk situations relate to health worker or large community settings. Aspect personnel will ONLY conduct projects in situations that meet the Low Exposure Risk Category. Guidance and Actions are outlined below.

> ***Low Exposure Risk.*** OSHA states that **"**Lower exposure risk (caution) jobs are those that do not require contact with people known to be, or suspected of being, infected with COVID-19 nor frequent close contact with (i.e., within 6 feet of) the general public. Workers in this category have minimal occupational contact with the public and other coworkers."
>
> ***ACTION.*** Aspect personnel will use the following hygiene practices while working on site to maintain Low Exposure Risk. Note that OSHA indicates for this category, that *"Additional PPE is not recommended for workers in the lower exposure risk group. Workers should continue to use the PPE, if any, that they would ordinarily use for other job tasks."* With this said, Aspect employees will use the following protocols to comply with established social distancing and sanitary hygiene directives.

Distancing Procedures

1. Workers, if working in a team, will take separate vehicles to the job site.
2. Workers will not congregate in groups of more than four other individuals
3. Workers will not be permitted to enter the site if they feel sick or exhibit any symptoms common to cold, flu or COVID-19.
4. A minimum distance of six feet should be maintained from other individuals.
5. No person will eat, drink, chew gum or tobacco in potentially contaminated areas or around other people. Drinking replacement fluids for heat stress control will be permitted only in areas that are free from contamination, except in emergency situations. Lunch should be eaten in a car or away from other individuals.
6. All personnel leaving potentially contaminated areas will wash their hands and face prior to entering any new area; particularly eating areas.

Hygiene Procedures

1. Nitrile gloves will always be worn and changed as often as needed.
2. Frequently touched objects (e.g. outhouse doors, gate lock) will be disinfected at least at the beginning and end of each day when workers are on site.
3. Workers will avoid sharing unsanitized equipment, including phones and laptop screens.
4. Hands should be washed with soap and water, or otherwise sanitized with hand-sanitizer after using the restroom, before and after lunch breaks and after co-handling objects.
5. Smoking is prohibited except in designated areas of the site.

Aspect will continue to monitor CDC guidance for businesses (https://www.cdc.gov/coronavirus/2019-ncov/community/guidance-business-response.html) and mitigation strategies (https://www.cdc.gov/coronavirus/2019-ncov/downloads/community-

mitigation-strategy.pdf) as new information becomes available. This site-specific health and safety plan will be updated accordingly to reflect current information and recommendations.

4.4 Emergency Communications

Aspect workers on site will have a mobile (cell) phone on site, which will be used for communications should an emergency arise. Phone numbers for Aspect site personnel are listed in Section 3: Personnel Organization and Chain of Command.

4.5 Nearest Medical Assistance

FIRST CALL 911. The route from the site to the nearest hospital is shown on the figure attached at the end of this plan.

5 SITE WORK PLAN

Proposed Work Activities On Site:	• Locating underground utilities • Drilling soil borings and potentially well installations • Collecting samples of soil from sonic drill rig • Collecting samples of groundwater from monitoring wells • Collecting water level data from monitoring wells
Objectives of Site Activities:	Filling data gaps with respect to designing the upland cleanup action
Proposed Work Dates:	December 2021 (tentative)
Will On-site Personnel Potentially be Exposed to Hazardous Substances?	The site potentially contains heavy metals (arsenic, copper, zinc) and diesel-range petroleum (with naphthalenes) contamination in soil and groundwater.
Do Personnel Conducting Site Activities have Training in Accordance with WAC 296-843-200?	Yes

6 DECONTAMINATION

Goals	Procedures
To prevent the distribution of contaminants outside the exclusion zone or cross-contamination of samples, the following procedures will be used to decontaminate sample equipment.	• Decontamination process involving Alconox wash, tap water rinse, and deionized water rinse (with air dry). • Dedicated tubing used for groundwater sampling will be disposed of or retained (bagged) for future use, but not decontaminated.
To prevent the distribution of contaminants outside the exclusion zone, unnecessary vehicles will not be allowed inside the exclusion zone. For vehicles required in the exclusion zone (e.g., drill rig, excavator), the following decontamination procedures will be used to prevent contamination from leaving the exclusion zone:	• Steam clean drilling equipment that advances below ground surface.
To minimize or prevent worker exposure to hazardous substances, all personnel working in the exclusion zone and contamination reduction zones will comply with the following decontamination procedures:	• Wash boots and rain gear that have come into contact with soil or groundwater with Alconox/tap water and air dry. • Dispose of disposable personal protective equipment (PPE such as gloves, Tyvek) into Department of Transportation (DOT) approved and appropriately labeled 55-gallon drums. • To prevent distribution of contaminants outside the exclusion zone, do not allow unnecessary vehicles inside the exclusion zone.
Soil cuttings, monitoring well purge water, and decontamination wastewater will be managed in the following manner:	• Place soil cuttings from each location in DOT-approved 55-gallon drums (appropriately labeled) at the sample location for future disposal. • Combine decontamination wastewater and monitoring well purge water from locations with evidence of contamination in DOT-approved 55-gallon drums at the property for future disposal.

7 HAZARD ANALYSIS

The potential hazards and corresponding control measures for planned site work activities are as follows:

Work Activity	Primary Potential Hazards	Control Measures
Rotosonic drilling borings, soil sampling	• Getting hit by drill rig equipment, especially from overhead.	• Stay back from rig whenever possible and stay alert. • Modified Level D PPE (with hard hat, traffic vest, steel-toe boots).
	• Excessive noise.	• Wear hearing protection.
	• Chemical exposure (skin contact, ingestion, inhalation).	• Modified Level D PPE. • Air monitoring.
Well development (potential) and groundwater sampling, hydraulic testing	• Chemical exposure (skin or eye contact, ingestion).	• Modified Level D PPE. • Securely join pump tubing and other connectors.
All	• Getting hit by other trucks or other equipment working on the property.	• Wear traffic vest. • Stay back from roads and stay alert.
	• Hypothermia (seasonally)	• Dress appropriately
	• Heat stress (seasonally)	• Take breaks, seek shade, and increase fluid intake.

Potentially Hazardous Chemicals Known or Suspected at the Property and Permissible Exposure Limits (air)					
Substance	**Medium**	**OHSA PEL**	**OSHA STEL**	**IDLH**	**Carcinogen or Other Hazard**
Diesel- and Oil-Range Petroleum	Soil, GW	1 ppmv	5 ppmv	500 ppmv	T
Naphthalene	Soil, GW	10 ppm	10 ppm	250 ppm	C

Notes:
-- = none established
C = carcinogen
GW = groundwater
IDLH = immediately dangerous to life or health
N/A = not applicable/not available
OHSA = Occupational Safety and Health Administration
T = toxic
PEL = permissible exposure level (8-hour time-weighted average)
STEL = short-term exposure level

Chemicals Known or Suspected On-site (check box)			
Chemical Class	**Known**	**Possible**	**Unlikely**
Corrosive (e.g. sodium hydroxide)			x
Ignitable (if expected, specify)			x
Reactive			x
Volatile		x	
Radioactive			x
Explosive			x
Biological Agent			x
Particulate or Fibers			x

8 PERSONAL PROTECTIVE EQUIPMENT

Based on the hazards identified above, the following personal protective equipment (PPE) will be required for the following field activities. This section specifies both an initial level of protection and a more protective (contingency) level or protection, in the event conditions should change. The contingency defines the PPE that will be available on site.

Work Activity	**Level of Protection**	
	Initial	**Contingency**
Drilling/soil sampling	D	Mod. D
Well development/groundwater sampling	D	Mod. D
Sample handling	D	Mod. D
Other activities (list):		

Each level of protection will incorporate the following equipment (specify type of protective clothing, boots, gloves, respiratory cartridges or other protection, safety glasses, hardhat, and hearing protection):

Level of Protection	**Specific PPE**
Level D	Work clothing, traffic vest, rubber (nitrile) gloves, steel toe and shank boots, safety glasses, hearing protection, and hardhat.
Modified D	Level D plus Tyvek coveralls or rain gear, and neoprene outer gloves.

NOTE: Project personnel are not permitted to deviate from the specified levels of protection without the prior approval of the Site Safety Supervisor.

9 AIR MONITORING

Air monitoring will be conducted for all subsurface explorations (soil borings, monitoring wells, and test pit excavations) to identify potentially hazardous environments and determine reference or background concentrations. Air monitoring can be used to define exclusion zones. Air monitoring can also be conducted to evaluate relative concentrations of volatile organic chemicals in samples.

The following equipment will be used to monitor air quality in the breathing zone during work activities:

Monitoring Instrument	Calibration Frequency	Parameters of Interest	Sampling Frequency
PID (in breathing zone)	Daily	Volatile organic compounds	• At least once per 30 minutes during drilling and soil sampling

Use the following action levels to determine the appropriate level of personal protection to be used during field activities:

Monitoring Instrument	Reading in Breathing Zone	Action	Comments
PID	10 PID units above background for 5 minutes	Confirm with detector tube (*naphthalene*) **or** upgrade to Level C (air-purifying respirator with organic vapor cartridge).	Alternatively, use engineering controls (ventilation) or leave location and return at a later time.
PID	100 PID units above background for 5 minutes	Leave location pending further evaluation by Aspect Corporate Safety Officer.	

10 SAFETY EQUIPMENT

The following safety equipment will be on site during the proposed field activities:

Other Required Items (check items required)	
First aid kit	x
Eyewash (e.g., bottled water)	x
PID	x
Drinking water	x
Fire extinguisher	
Brush fan	
Other:	

11 SPILL CONTAINMENT

Will the proposed field work include the handling of bulk chemicals?	Yes	No X
If yes, describe spill containment provisions for the property:		

12 CONFINED SPACE ENTRY

Will the proposed field work include confined space entry?	Yes	No X
If yes, attach to this plan the confined space entry checklist and permit.		

13 ASPECTTRAINING AND MEDICAL MONITORING

Aspect employees who perform site work are responsible for understanding potential health and safety hazards of the site. All Aspect site workers will have health and safety training for hazardous waste operations, in accordance with WAC 296-843-200. In addition, Aspect requires medical monitoring for all employees potentially exposed to chemical hazards in concentrations in excess of the permissible exposure limit (PEL) for more than 30 days per year, as required under WAC 296-843-210. Employees who use respirators for their work will have a respirator medical evaluation as required under Chapter 296-842-WAC.

14 DISCLAIMER

Aspect Consulting, LLC does not guarantee the health or safety of any person entering these property. Because of the potentially hazardous nature of this property and the activity occurring thereon, it is not possible to discover, evaluate, and provide protection for all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at this property. The health and safety guidelines in this plan were prepared specifically for this site and should not be used on any other property without prior evaluation by trained health and safety personnel.

FIELD SAFETY PLAN CONSENT AGREEMENT

Aspect Consulting Employees

I have reviewed the project specific health and safety plan, dated August 18, 2021 for the Harris Avenue Shipyard upland data collection fieldwork. I understand the purpose of the plan and I consent to adhere to its procedures and guidelines while conducting activities on site that are described in the plan.

Employee Printed Name	Signature	Date

Site Visitors

I have been briefed on the contents of the project-specific health and safety plan. I am responsible for my own health and safety.

Visitor Printed Name and Organization/Company	Signature	Date

FIELD SAFETY MEETING MINUTES

Site Name _____**Project No.** _____

Meeting Location _____

Meeting Date _____ **Time** _____ **Conducted by**_____

Pre-field Work Orientation_____ **Weekly Safety Meeting**_____ **Other**_____

Subject Discussed _____

_____

_____

_____

Site Safety Supervisor Comments _____

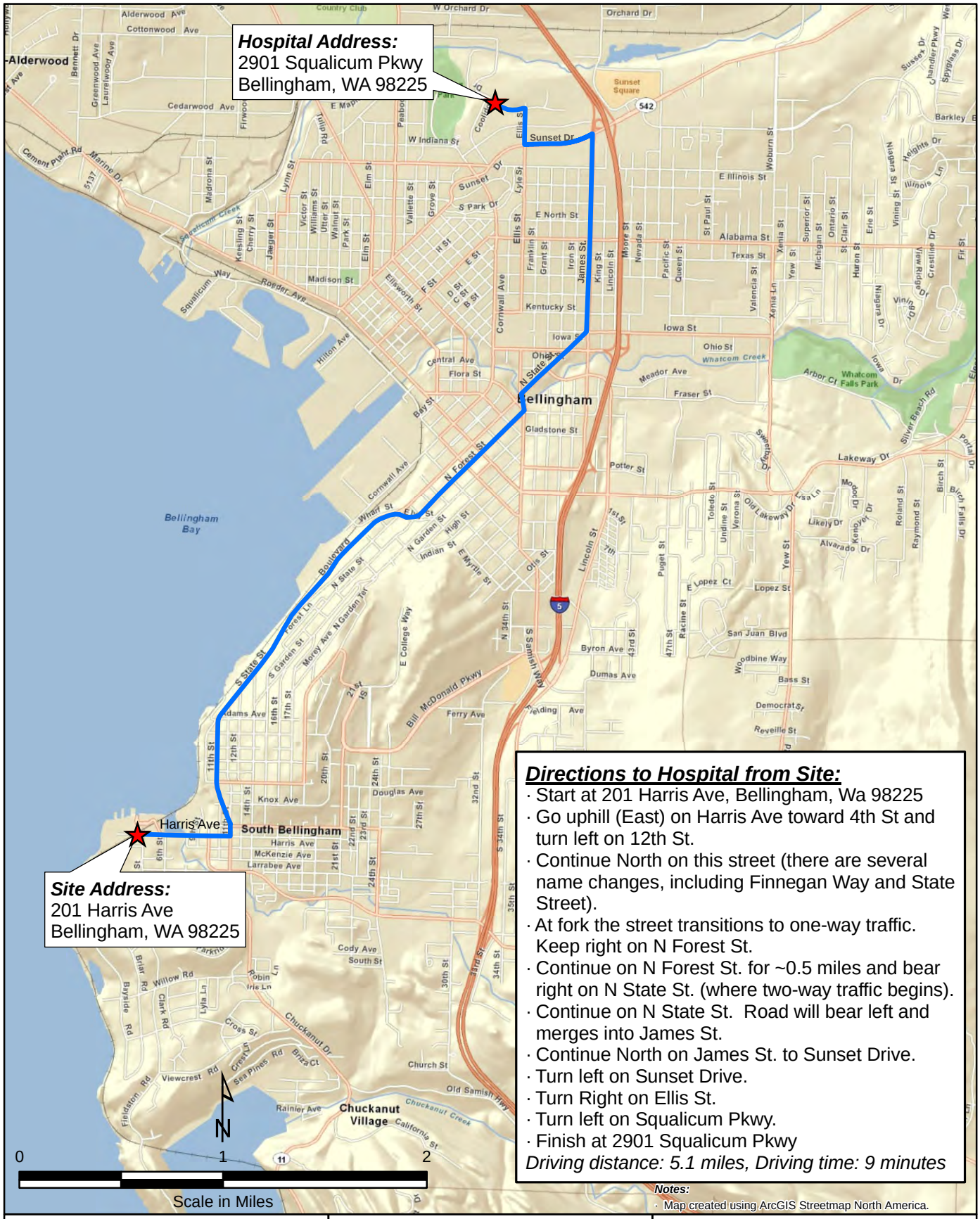
_____

_____

_____

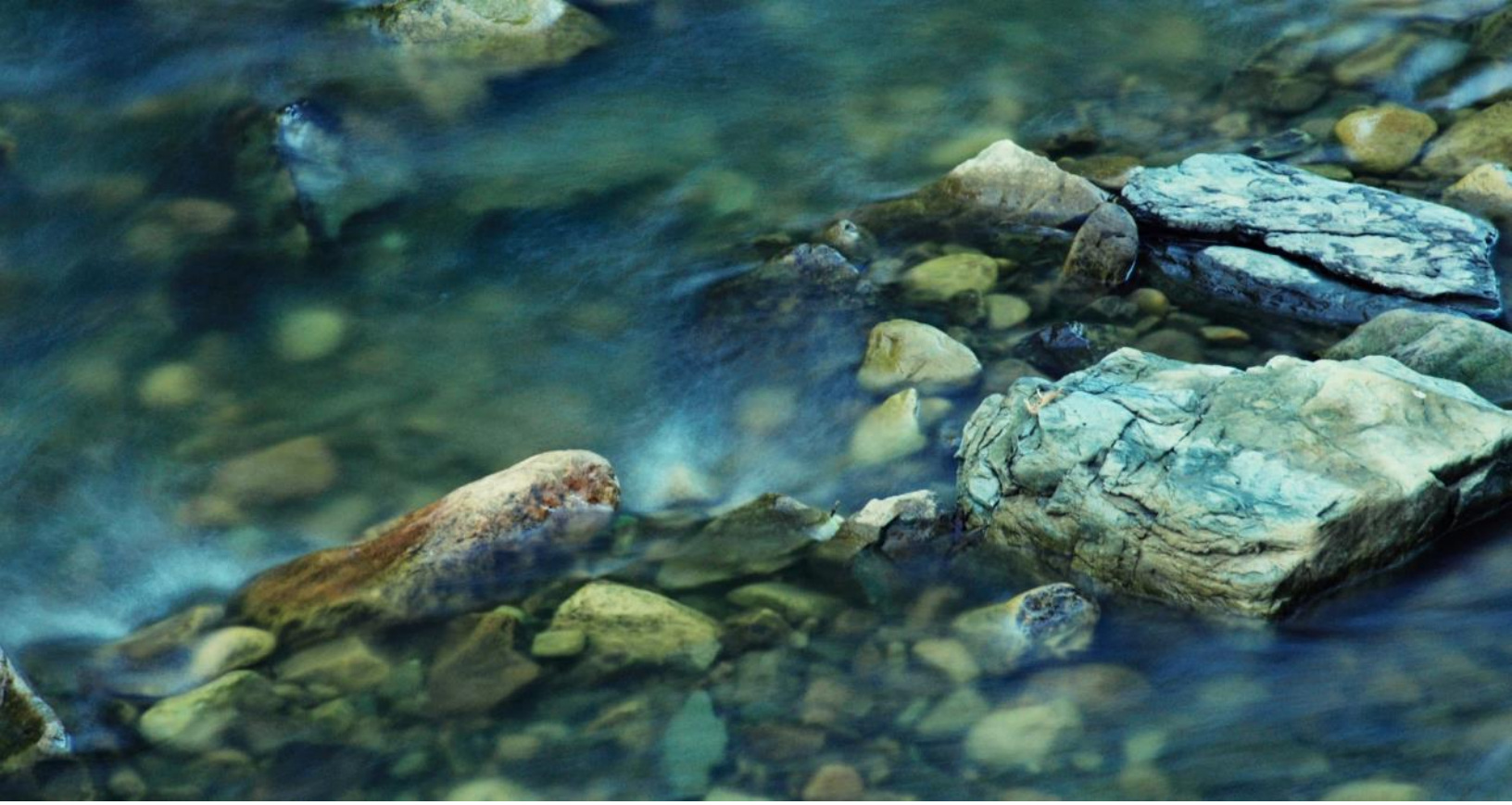
Participants

Printed Name (and company if subcontractor)	Signature



	PRDI Work Plan **Harris Avenue Shipyard, Bellingham, WA**	Route to Hospital Map

Attachment F
In-Water Health and Safety Plan



October 2021
Harris Avenue Shipyard Cleanup

ANCHOR QEA

In-Water Health and Safety Plan

Prepared for Washington State Department of Ecology

PLAYING IT SAFE

Stop Play Record Rewind

October 2021
Harris Avenue Shipyard Cleanup

In-Water Health and Safety Plan

Prepared for
Washington State Department of Ecology
Bellingham Field Office
913 Squalicum Way #101
Bellingham, Washington 98225

Prepared by
Anchor QEA, LLC
1605 Cornwall Avenue
Bellingham, Washington 98225

Prepared on behalf of
Port of Bellingham
1801 Roeder Avenue
Bellingham, Washington 98227

Certification Page

Derek Ormerod	Delaney Peterson
Project Manager	Field Lead
Anchor QEA, LLC	Anchor QEA, LLC
Date: _____	Date: _____

The information in this Health and Safety Plan has been designed for the Work Plan presently contemplated by Anchor QEA, LLC. Therefore, this document may not be appropriate if the work is not performed by or using the methods presently contemplated by Anchor QEA. In addition, as the work is performed, conditions different from those anticipated may be encountered and this document may have to be modified. Therefore, Anchor QEA only intends this plan to address currently anticipated activities and conditions and makes no representations or warranties as to the adequacy of the Health and Safety Plan for all conditions encountered.

Health and Safety Plan Acknowledgement Form

Project Number: 210007-02.01

Project Name: Harris Avenue Shipyard PRDI

My signature below certifies that I have read and understand the policies and procedures specified in this Health and Safety Plan (HASP). For non-Anchor QEA employees, this HASP may include company-specific appendices to this plan developed by entities other than Anchor QEA. Non-affiliated personnel may be required to sign the Liability Waiver following this Acknowledgement Form.

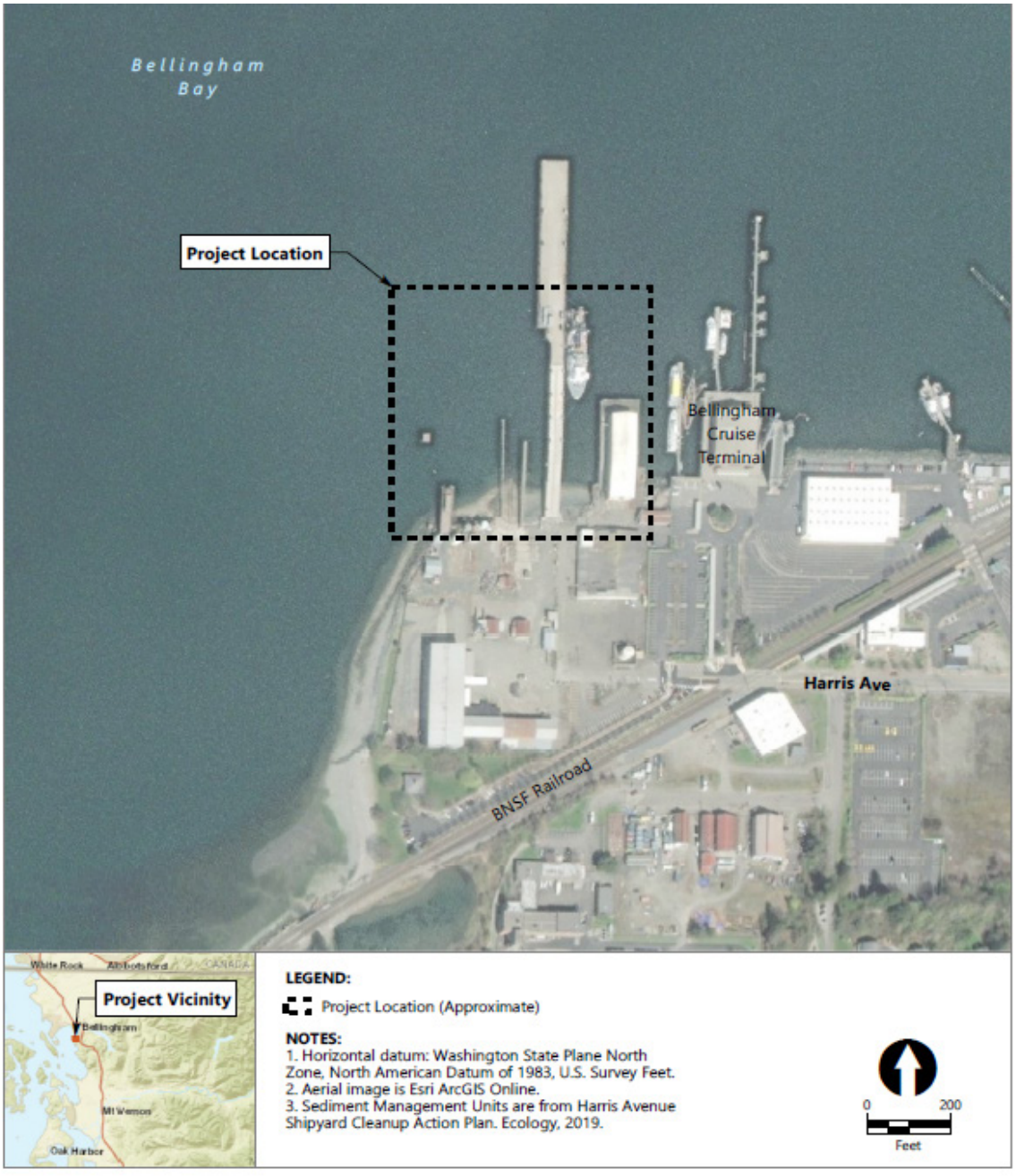
Date	Name (print)	Signature	Company

Date	Name (print)	Signature	Company

Site Emergency Procedures

Site Map

Figure A
General Site Location Overview



Emergency Contact Information

Table A
Site Emergency Form and Emergency Phone Numbers*

Category	Information	
Possible Chemicals of Concern	Arsenic, copper, zinc, 1-methylnaphthalene, total TPH	
Minimum Level of Protection	Modified Level D	
Site(s) Location Address	201 Harris Avenue, Bellingham, WA 98225	
Emergency Phone Numbers		
Ambulance	911	
Fire	911	
Police	911	
Poison Control	(800) 222-1222	
Client Contact	Brian Keenan	Cell: (360) 296-2642
Project Manager (PM)	Derek Ormerod	Office: (360) 715-2721 Cell: (205) 331-1738
Field Lead (FL)	Delaney Peterson	Office: (360) 715-2707 Cell: (206) 919-2845
Corporate Health and Safety Manager (CHSM)	David Templeton	Office: (206) 287-9130 Cell: (206) 910-4279
Health and Safety Program Lead	Tim Shaner	Office: (251) 375-5282 Cell: (251) 281-3386
State Emergency Response System	1 (800) 854-5406	
EPA Emergency Response Team,[1] Region 10	1 (206) 553-1200	

Notes:

* In the event of any emergency, contact the PM and FL.

1. For local resources, please visit: http://www2.epa.gov/emergency-response/emergency-response-my-community. The National Response Center hotline is (800) 424-8802.

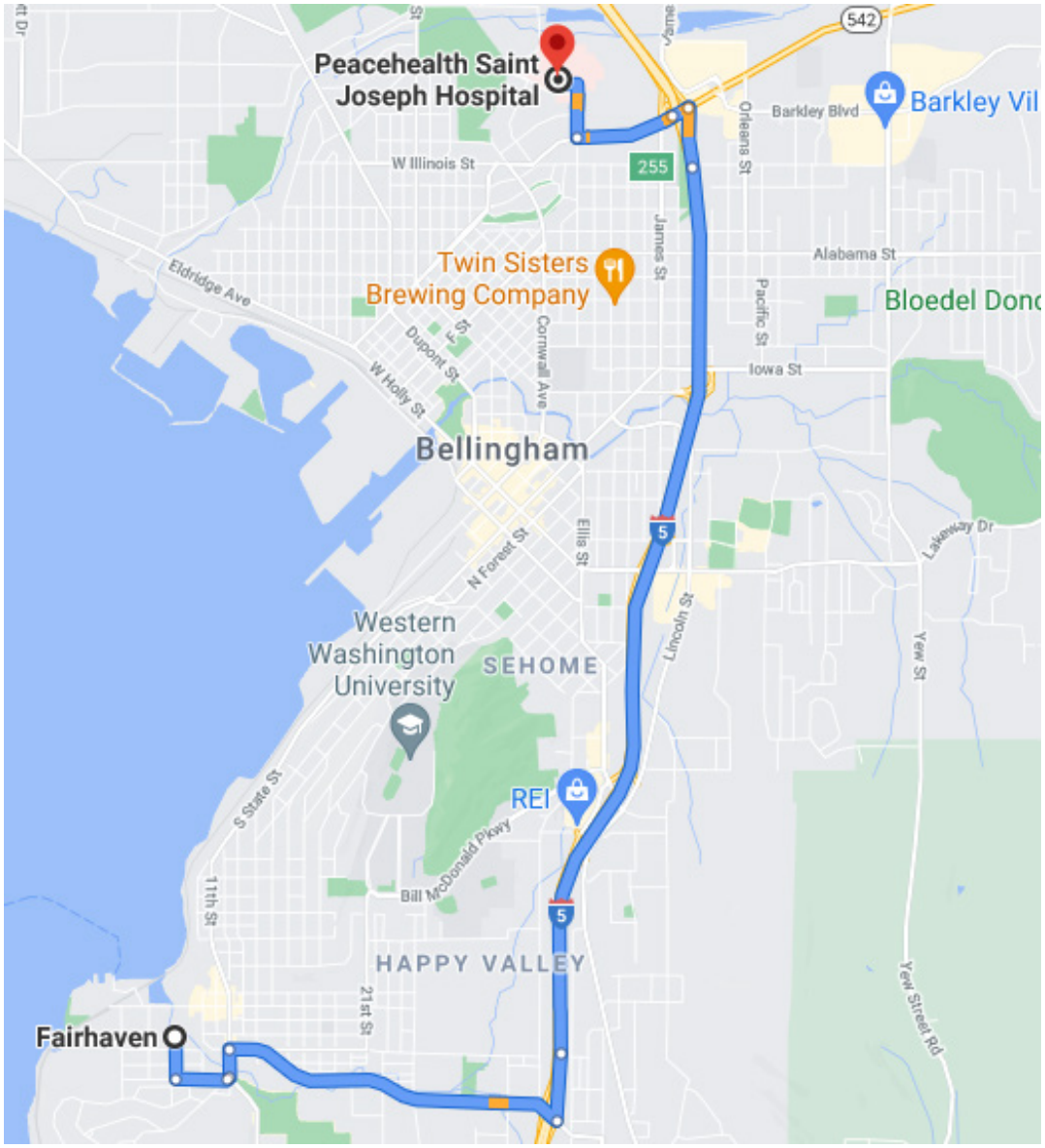
Table B
Hospital Information

Category	Information
Hospital Name	Peace Health St. Joseph Hospital
Address	2901 Squalicum Pkwy
City, State	Bellingham, WA
Phone	1 (360) 734-5400
Emergency Phone	1 (360) 734-5400

Hospital Route Map and Driving Directions

1. Get on I-5 N from Old Fairhaven Pkwy (2.1 miles)
2. Head south on 8th St toward Donovan Ave (0.1 mile)
3. Turn left onto Cowgill Ave (0.2 mile)
4. Turn left onto Hawthorn Rd (92 feet)
5. Turn left onto 12th St (0.1 mile)
6. Turn right onto Old Fairhaven Pkwy (1.4 miles)
7. Turn left to merge onto I-5 N toward Vancouver B.C. (0.3 mile)
8. Follow I-5 N to WA-542 W/E Sunset Dr. Take exit 255 from I-5 N (3.8 miles)
9. Merge onto I-5 N (3.6 miles)
10. Take exit 255 for WA-542 E/Sunset Dr toward Mt Baker (0.2 mile)
11. Follow E Sunset Dr to Ellis St (0.8 mile)
12. Sharp left onto WA-542 W/E Sunset Dr
13. Continue to follow E Sunset Dr (384 feet)
14. Continue straight to stay on E Sunset Dr (0.4 mile)
15. Turn right onto Ellis St
16. Destination will be on the right

Figure B
Hospital Route Map



Care Management—WorkCare Incident Intervention

Anchor QEA has an additional Incident Intervention resource from WorkCare to help answer questions, alleviate uncertainty and stress in a potential injury situation, and maintain the health and safety of our employees. Incident Intervention is an injury and illness management tool that provides employees with 24 hours a day/7 days a week (24/7) immediate telephone access to a member of

WorkCare's clinical staff of nurses and physicians who intervene at the time of a workplace injury or illness. Contact information is provided below:

- **Access WorkCare 24/7 from anywhere using the toll-free number: 1-888-449-7787**

At the time of a workplace injury or illness, the employee, manager, or another employee at the scene notifies WorkCare using the toll-free number listed above. The caller provides information on the type of incident, possible cause, and the scope of the situation. With the details of the incident recorded, an experienced nurse or physician provides the following:

- Responsive evaluation of the incident
- Direction on the appropriate course of action
- Consultation with the employee's treating physician to design a quality care treatment plan that meets the needs of the employee and Anchor QEA

All employees are encouraged to use this service should a workplace injury or illness occur.

Key Safety Personnel

The following people share responsibility for health and safety at the site. See Section 4 of this Health and Safety Plan (HASP) for a description of the role and responsibility of each.

Client Contact: Brian Keenan	Cell: (360) 296-2642
Project Manager (PM): Derek Ormerod	Office: (360) 715-2721 Cell: (206) 331-1738
Field Lead (FL): Delaney Peterson	Office: (360) 715-2707 Cell: (206) 919-2845
Corporate Health and Safety Manager (CHSM): David Templeton	Office: (206) 287-9130 Cell: (206) 910-4279
Health and Safety Program Lead: Tim Shaner	Office: (251) 375-5282 Cell: (251) 281-3386

Personal Incident Response Procedures

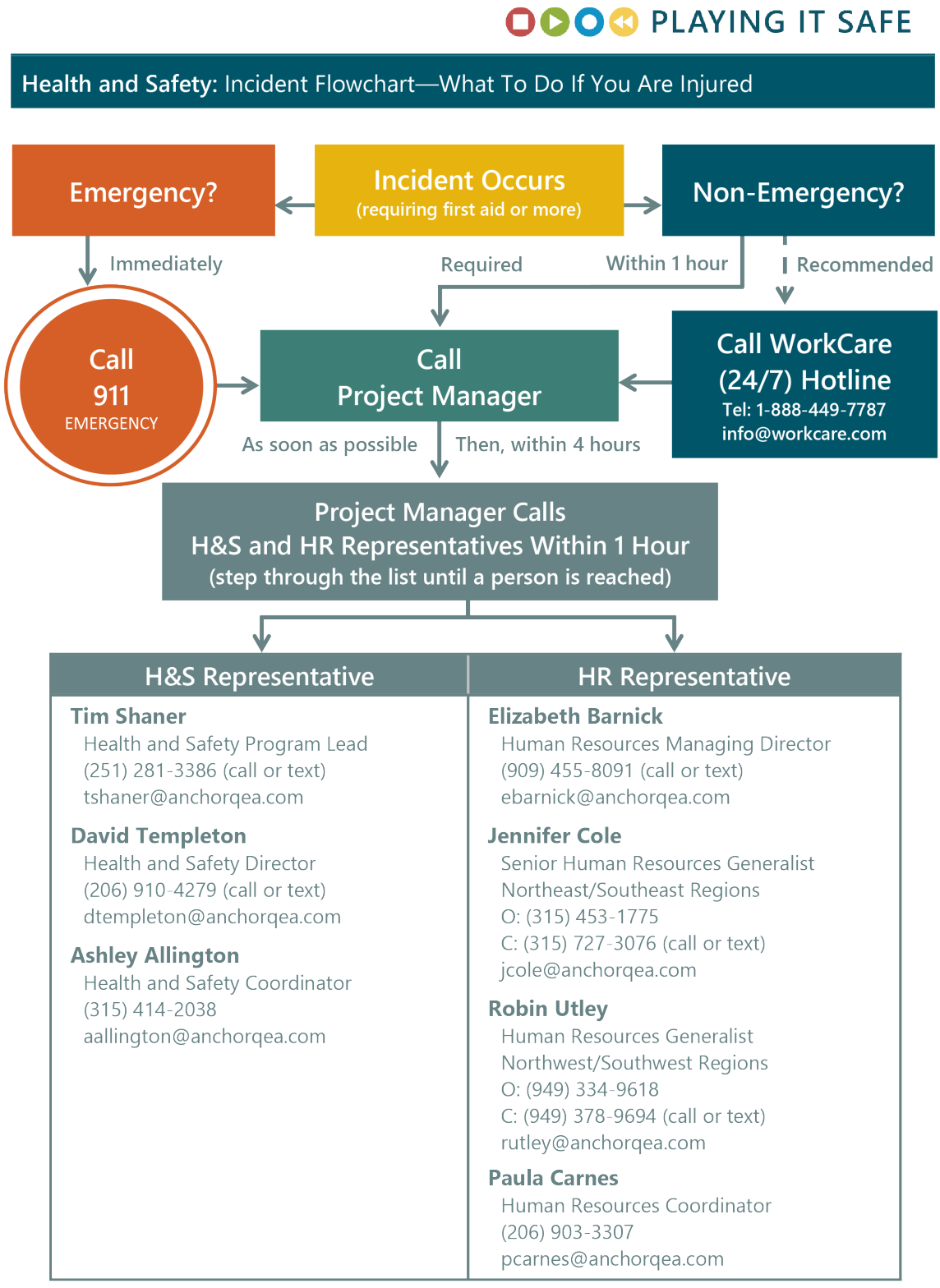
In the event of an emergency, immediate action must be taken by the first person to recognize the event. Use the following steps as a guideline and refer to Figure C:

1. Survey the situation to verify that it is safe for you and the victim. Do not endanger your own life. Do not enter an area to rescue someone who has been overcome unless properly equipped and trained. Verify that all protocols are followed. If applicable, review Safety Data Sheets (SDS) to evaluate response actions for chemical exposures.
2. Call the appropriate emergency number (911, if available) or direct someone else to do this immediately (see Table A). Explain the physical injury, chemical exposure, fire, or release and location of the incident.

3. Have someone retrieve the nearest first aid kit (containing appropriate items for the particular work scope) and Automated External Defibrillator (AED), if available. Note: Only use an AED if you have been properly trained and are currently certified to do so.
4. Decontaminate the victim without delaying life-saving procedures (see Section 8).
5. Administer first aid and cardiopulmonary resuscitation (CPR), if properly trained, until emergency responders arrive.[1]
6. In the event that evacuation is required, the FL must perform a head count to verify that all Anchor QEA personnel are accounted for.
7. Notify the Field Lead (FL) and Project Manager (PM); the PM will notify the client contact. The PM will also contact the Corporate Health and Safety Manager (CHSM). The CHSM will facilitate the incident investigation. All client requirements pertinent to personal incident reporting will also be adhered to.
8. Complete the appropriate incident investigation reports.

[1] Personnel qualified and currently certified in basic first aid or CPR are protected under Good Samaritan policies as long as they only perform the basic tasks that they were taught. Do not perform first aid or CPR tasks if you have not been trained in first aid or CPR.

Figure C
Incident Flowchart



Non-Personal Incident Response Procedures

All incidents including, but not limited to, fire, explosion, property damage, or environmental release will be responded to in accordance with the site-specific HASP. In general, this includes securing the site appropriate to the incident, turning control over to the emergency responders, or securing the site and summoning appropriate remedial personnel or equipment. Anchor QEA will immediately notify the client of any major incident, fire, equipment or property damage, or environmental incident with a preliminary report. A full report will be provided within 72 hours.

Spills and Releases of Hazardous Materials

When required, notify the National Response Center and local state agencies. The following information should be provided to the National Response Center:

- Name and telephone number
- Name and address of incident location
- Time and type of incident
- Name and quantity of materials involved, if known
- Extent of injuries
- Possible hazards to human health or the environment outside the facility

The emergency telephone number for the National Response Center is (800) 424-8802. If hazardous waste is released or produced through control of the incident, verify the following:

- Waste is collected and contained
- Containers of waste are removed or isolated from the immediate site of the emergency
- Treatment or storage of the recovered waste, contaminated soil or surface water, or any other material that results from the incident or its control is provided
- No waste that is incompatible with released material is treated or stored in the facility until cleanup procedures are completed

Verify that all emergency equipment used is decontaminated, recharged, and fit for its intended use before operations are resumed.

Near-Miss Reporting

All near-miss incidents (i.e., those that could have reasonably led to an injury, environmental release, or other incident) must be reported to the FL and PM immediately, so action can be taken to verify that such conditions that led to the near-miss incident are readily corrected to prevent future occurrences.

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ABBREVIATIONS

AED	Automated External Defibrillator
ANSI	American National Standards Institute
APR	Air-Purifying Respirator
ASTM	ASTM International
CFR	Code of Federal Regulations
CHSM	Corporate Health and Safety Manager
COC	chemical of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CPR	cardiopulmonary resuscitation
CRZ	Contamination Reduction Zone
dBA	A-weighted decibel
dB	decibel
EPA	U.S. Environmental Protection Agency
EZ	Exclusion Zone/Hot Zone
FL	Field Lead
GFCI	ground-fault circuit interrupter
HASP	Health and Safety Plan
HAZMAT	Hazardous Materials
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	high-efficiency particulate air
IDLH	immediately dangerous to life or health
JSA	Job Safety Analysis
kV	kilovolt
LPAH	low-molecular-weight polycyclic aromatic hydrocarbon
LO/TO	lockout/tagout
mg/m^3	milligram per cubic meter
MHR	maximum heart rate
NIOSH	National Institute for Occupational Safety and Health
NPL	National Priority List
NRR	Noise Reduction Rating
OSHA	Occupational Safety and Health Act or Administration
OV	organic vapor
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEL	Permissible Exposure Limit
PFD	personal flotation device
PM	Project Manager

PPE	personal protective equipment
ppm	parts per million
REL	Recommended Exposure Limit
RCRA	Resource Conservation and Recovery Act
SDS	Safety Data Sheets
SZ	Support Zone/Clean Zone
TLV	Threshold Limit Value
TWA	time-weighted average
USCG	U.S. Coast Guard
UV	ultraviolet
WBGT	wet bulb globe temperature

1 Introduction

This Health and Safety Plan (HASP) was prepared on behalf of the Port of Bellingham and presents health and safety requirements and procedures that will be followed by Anchor QEA, LLC, personnel and at a minimum by Anchor QEA subcontractors during work activities at the Harris Avenue Shipyard (the Site). This HASP was developed in accordance with Title 29 of the Code of Federal Regulations (CFR), Part 1910.120(b), and will be used in conjunction with Anchor QEA's Corporate Health and Safety Program. See Section 1.1 for HASP modification procedures.

The provisions of this HASP are mandatory for all Anchor QEA personnel assigned to the project. A copy of this HASP must be maintained on site and available for employee review at all times. Anchor QEA subcontractors are also expected to follow the provisions of this HASP unless they have their own HASP that covers their specific activities related to this project. Any subcontractor HASPs must include the requirements set forth in this HASP, at a minimum. All visitors to the work site must also abide by the requirements of this HASP and will attend a pre-work briefing where the contents of this HASP will be presented and discussed.

Personnel assigned to work at the project site will be required to read this plan and must sign the Health and Safety Plan Acknowledgement Form to confirm that they understand and agree to abide by the provisions of this HASP.

Subcontractors are ultimately responsible for the health and safety of their employees. Subcontractors may mandate health and safety protection measures for their employees beyond the minimum requirements specified in this HASP.

The objectives of this HASP are to identify potential physical, chemical, and biological hazards associated with field activities; establish safe working conditions and protective measures to control those hazards; define emergency procedures; and describe the responsibilities, training requirements, and medical monitoring requirements for site personnel.

This HASP prescribes the procedures that must be followed during specific site activities. Significant operational changes that could affect the health and safety of personnel, the community, or the environment will not be made without the prior approval of the Project Manager (PM) and the Corporate Health and Safety Manager (CHSM).

Issuance of this approved HASP documents that the workplace has been evaluated for hazards. A hazard assessment was performed, and the adequacy of the personal protective equipment (PPE) selected was evaluated as required by 29 CFR 1910.132(d)—Personal Protective Equipment, General Requirements (General Industry); 29 CFR 1910.134—Respiratory Protection; 29 CFR 1926.28—Personal Protective Equipment (Construction Industry); and 29 CFR 1926.55—Gases, Vapors, Fumes,

Dusts and Mist, and is duly noted by the signature(s) and date appearing on the certification page of this document.

1.1 Health and Safety Plan Modifications

This HASP will be modified by amendment, if necessary, to address changing field conditions or additional work tasks not already described in this document. Modifications will be proposed by the Field Lead (FL) using the Modification to Health and Safety Plan form included in Appendix A. Modifications will be reviewed by the CHSM or authorized representative and approved by the PM.

2 Site Description and Background Information

2.1 Site Description

The Site is located at 201 Harris Avenue in Bellingham, Washington. The name of the Site, Harris Avenue Shipyard, is intended to include all shipyard and industrial activities that have occurred at 201 Harris Avenue. The Site, as defined by Model Toxics Control Act Chapter 173-340-200 Washington Administrative Code as the location where contamination has come to lie, consists of portions of the upland and aquatic land occupied by Puglia (operated as Fairhaven Shipyard) and portions of the property occupied by All American. The Site consists of 10 total acres, which includes approximately 5 acres of uplands and 5 acres in water, as shown on Figure A. The uplands portion of the Site consists of the properties described previously and the area to the west of 201 Harris Avenue (a narrow strip of land that is part of Fairhaven Marine Park). Puglia is the only operator currently at the Site.

2.2 Site Background Information

The main sources of contamination at the Site are associated with historical shipyard activities. The property has been used as a shipyard on and off since 1915, with multiple owners and operators throughout this time performing vessel storage, construction, maintenance, and repair operations. The primary sources of sediment contamination (consisting of metals [arsenic, cadmium, copper, zinc], carcinogenic polycyclic aromatic hydrocarbons [cPAHs], high molecular weight polycyclic aromatic hydrocarbons [PAHs] [fluoranthene, pyrene], and polychlorinated biphenyls [PCBs]) include the following pathways:

- Overwater and nearshore operations that resulted in spills, leaks, and releases of hazardous materials directly to Site waters and surface sediments
- Impacted groundwater originating from upland areas, traveling through the fill unit (soil) and then discharging to sediments
- Discharges of contaminated materials to sediments from former industrial wastewater or stormwater outfalls
- Discharges by sheet flow of surface contamination generated from upland activities (e.g., sandblasting)
- Erosion and sloughing of contaminated nearshore fill materials onto the intertidal sediment surface (e.g., marine railway area)

Primary sources of soil and groundwater contamination (consisting of metals [arsenic, copper, and zinc], TPH, and low-molecular-weight polycyclic aromatic hydrocarbons [LPAHs; 1-methylnaphthalene]) in the uplands include the following:

- Operations conducted in the marine railway area. This was one of the most heavily used areas of the shipyard and the location where the most extensive contamination has been identified, including contaminants associated with painting and sandblasting.
- Releases of petroleum products (consisting of hydrocarbons and LPAHs) from the former AST systems located south of the Harris Avenue Pier.
- Shipyard operations including painting, sandblasting, handling sandblast grit, and ship repair activities throughout the primary shipyard property.

3 Scope of Work

3.1 Project Scope of Work

This plan addresses health and safety issues associated with the following field tasks:

- Working in and around water
- Operation of research vessel
- Sediment core and grab collection and sample processing

4 Authority and Responsibilities of Key Personnel

This section describes the authority and responsibilities of key Anchor QEA project personnel. The names and contact information for the following key safety personnel are listed in the Site Emergency Procedures section at the beginning of this HASP. Should key site personnel change during the course of the project, a new list will be established and posted immediately at the site. The emergency phone number for the site is **911** and should be used for all medical, fire, and police emergencies.

4.1 Project Manager

The PM provides overall direction for the project. The PM is responsible for ensuring that the project meets the client's objectives in a safe and timely manner. The PM is responsible for providing qualified staff for the project and adequate resources and budget for the health and safety staff to carry out their responsibilities during the field work. The PM will be in regular contact with the FL and CHSM to verify that appropriate health and safety procedures are implemented into each project task.

The PM has authority to direct response operations; the PM assumes total control over project activities but may assign responsibility for aspects of the project to others. In addition, the PM performs the following tasks:

- Overseeing the preparation and organization of background review of the project, the Work Plan, and the field team
- Verifying that the team obtains permission for site access and coordinates activities with appropriate officials
- Briefing the FL and field personnel on specific assignments
- Together with the FL, seeing that health and safety requirements are met
- Consulting with the CHSM regarding unsafe conditions, incidents, or changes in site conditions or the Work Plan

4.2 Field Lead

The FL reports to the PM, has authority to direct response operations, and assumes control over on-site activities. The FL will direct field activities, will coordinate the technical and health and safety components of the field program, and is responsible in general for enforcing this site-specific HASP and Corporate Health and Safety Program requirements. The FL will be the primary point of contact for all field personnel and visitors and has direct responsibility for implementation and administration of this HASP. The FL and any other member of the field team have **STOP WORK AUTHORITY**—the authority to stop or suspend work in the event of an emergency, if conditions arise that pose an unacceptable health and safety risk to the field team or environment, or if conditions arise that warrant modifications to this HASP. It is critical that both the FL and PM

communicate regularly to proactively identify and address any safety-related concerns that may arise. The functions of the FL related to this HASP include, but are not necessarily limited to, the following:

- Conducting and documenting daily safety meetings or designate an alternate FL in his or her absence
- Executing the Work Plan and schedule
- Conducting periodic field health and safety inspections to verify compliance with this HASP
- Overseeing implementation of safety procedures
- Implementing site personnel protection levels
- Enforcing site control measures to help verify that only authorized personnel are allowed on site
- Notifying, when necessary, local public emergency officials (all personnel on site may conduct this task as needed)
- Following up on incident reports to the PM
- Periodically inspecting protective clothing and equipment for adequacy and safety compliance
- Verifying that protective clothing and equipment are properly stored and maintained
- Performing or overseeing air monitoring (if required) in accordance with this HASP
- Maintaining and overseeing operation of monitoring equipment and interpretation of data from the monitoring equipment
- Monitoring site personnel for signs of stress, including heat stress, overexertion, cold exposure, and fatigue
- Requiring participants to use the "buddy" system in performing tasks
- Providing (via implementation of this HASP) emergency procedures, evacuation routes, and telephone numbers for the local hospital, poison control center, fire department, and police department
- Communicating incidents promptly to the PM
- Maintaining communication with the CHSM regarding on-site activities
- If applicable, verifying that decontamination and disposal procedures are followed
- Maintaining the availability of required safety equipment
- Advising appropriate health services and medical personnel of potential exposures
- Notifying emergency response personnel in the event of an emergency and coordinate emergency medical care

The FL will record health-and-safety-related details of the project in the field logbook. At a minimum, each day's entries must include the following information:

- Project name or location
- Names of all on-site personnel

- Level of PPE worn and any other specifics regarding PPE
- Weather conditions
- Type of field work being performed

The FL will have completed the required Occupational Safety and Health Administration (OSHA) 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and annual updates, the 8-hour Supervisor training, medical monitoring clearance, and current first aid and cardiopulmonary resuscitation (CPR) training. Other certifications or training may be stipulated based on client or site requirements.

4.3 Corporate Health and Safety Manager

The CHSM (or designee) will be responsible for managing on-site health and safety activities and will provide support to the PM and FL on health and safety-related issues. The following are specific duties of the CHSM:

- Providing technical input into the design and implementation of this HASP
- Advising on the potential for occupational exposure to project hazards, along with appropriate methods and/or controls to eliminate site hazards
- Verifying that a hazard assessment has been performed and that the adequacy of the PPE selected was evaluated as required by 29 CFR 1910.132(d), 29 CFR 1910.134, 29 CFR 1926.25, and 29 CFR 1926.55, and is duly noted by the signatures and date appearing on the Certification Page of this document
- Consulting with the FL on matters relating to suspending site activities in the event of an emergency
- Verifying that all on-site Anchor QEA personnel and subcontractors have read and signed the HASP Acknowledgement Form
- Verifying that corrective actions resulting from deficiencies identified by audit and observations are implemented and effective

The CHSM or designee will have completed the required OSHA 40-hour HAZWOPER training and annual updates as well as the 8-hour Supervisor training (or a minimum of 5 years of supervisory experience).

4.4 Project Field Team

All project field team members will attend a project-specific meeting conducted by the FL concerning safety issues and project work task review before beginning work on site. All field team members, including subcontractors, must be familiar with and comply with this HASP. The field team has the responsibility to immediately report any potentially unsafe or hazardous conditions to the FL, and all members of the field team have **STOP WORK AUTHORITY**—the authority to stop or

suspend work if conditions arise that pose an unacceptable health and safety risk to the field team or environment, or if conditions arise that warrant modifications to this HASP. It is critical that all field team members proactively communicate with the FL to identify potential unsafe conditions. The field team reports to the FL for on-site activities and is responsible for the following:

- Reviewing and maintaining a working knowledge of this HASP
- Safely completing on-site tasks required to fulfill the Work Plan
- Complying with the HASP
- Attending and participating in daily safety meetings
- Notifying the FL of existing or potential safety conditions at the site
- Reporting all incidents to the FL
- Demonstrating safety and health-conscious conduct

Per OSHA 1910.120(e)(3)(i),[2] newly assigned HAZWOPER 40-hour trained field team members must have at least 3 days of field work supervised by an experienced FL (preferably an individual with HAZWOPER Supervisor training). It is the responsibility of the PM to identify such "short service" personnel and verify that their supervised field experience occurs (or has occurred) and is documented in the project field notes and on the Daily Safety Briefing form (Appendix A).

[2] "General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained experienced supervisor."

5 Project-Specific Requirements

This section provides activity-specific levels of protection and air monitoring requirements to be used on this site based on the Work Plan and the chemicals of concern (COCs).

5.1 Activity-Specific Level of Protection Requirements

Refer to Section 10 for general requirements for PPE. Level D is the minimum acceptable level for most sites. An upgrade to Modified Level D occurs when there is a possibility that contaminated media can come in contact with the skin or work uniform. An upgrade to Level C occurs when there is a potential for exposure to airborne COCs (i.e., if the results of air monitoring reveal that action levels have been exceeded). Hearing protection must be worn when there are high noise levels. Site personnel must maintain proficiency in the use and care of PPE that is to be worn.

Table 5-1 describes the specific means of protection needed for each identified work activity.

5.2 Project Air Monitoring Requirements

Particulates and volatile chemicals are not at high enough levels to require air monitoring of the Site. If conditions change, the PM and Health and Safety Lead will be consulted.

Table 5-1
Project Job Tasks and Required Personal Protective Equipment

Job Tasks		PPE Requirements
• Loading and unloading sample coolers, boat equipment, general non-sampling activities onboard a marine vessel • Operation of sampling equipment but with no anticipated direct contact with sediments or decontamination chemicals	☒	Standard work uniform/coveralls
	☒	Work boots with safety toe conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05
	☒	High-visibility traffic safety vest
	☒	Chemical-resistant clothing <u>check appropriate garments</u>: ☐ One-piece coverall ☐ Hooded one- or two-piece chemical splash suit ☐ Disposable chemical coveralls ☐ Chemical-resistant hood and apron ☒ Bib-style overalls and jacket with hood **Fabric Type**: Tyvek NOTE: Thick rain pants and coveralls may be substituted for coated Tyvek if sediments are not obviously contaminated with PAHs or related petroleum products. Rain slickers cannot be effectively decontaminated of tar/petroleum contamination.
	☐	Disposable inner gloves (latex or equivalent "surgical")
	☐	Disposable chemical-resistant outer gloves **Material Type**: Nitrile
	☒	Chemical-resistant boots with safety toe conforming to ASTM F2412-05/ASTM F2413-05 or disposable boot covers for safety toe/work boots **Material Type**: Rubber or leather
	☐	Puncture-resistant shanks in safety shoes conforming to ASTM F2412-05/ASTM F2413-05
	☐	Metatarsal guards conforming to ASTM F2412-05/ASTM F2413-05
	☐	Sleeves to be duct-taped over gloves and pants to be duct-taped over boots
	☐	Splash-proof safety goggles
	☒	Safety glasses
	☒	Hard hat
	☐	Hard hat with face shield
	☒	Hearing protectors (**REQUIRED** if site noise levels are greater than 85 decibels [dB] based on an 8-hour time-weighted average [TWA]). **Type**: Foam or ear muffs
	☐	Two-way radio communication (intrinsically safe, if explosive atmosphere is a potential)

Job Tasks		PPE Requirements
	☐	Long cotton underwear
	☒	High-visibility, U.S. Coast Guard (USCG)-approved personal flotation device (PFD) (if working on any water vessel or without fall protection within 10 feet of water)
	☐	USCG-approved float coat and bib-overalls (e.g., full two-piece "Mustang" survival suit or similar) or one-piece survival suit if combined air and water temperature is below 90°F
	☐	Half-face Air-Purifying Respirator (APR) (OSHA/NIOSH-approved)
	☐	Full-face APR (OSHA/NIOSH-approved)
	☐	**Type of Cartridges to be Used**: ☐ **OV or** ☐ **OV/HEPA (if samples are dry)**
• Sampling and characterizing sediments from a vessel	☒	Standard work uniform/coveralls
	☒	Work boots with safety toe conforming to ASTM F2412-05/ASTM F2413-05
	☐	High-visibility traffic safety vest
	☐	Chemical-resistant clothing <u>check appropriate garments</u>: ☐ One-piece coverall ☐ Hooded one- or two-piece chemical splash suit ☐ Disposable chemical coveralls ☐ Chemical-resistant hood and apron ☒ Bib-style overalls and jacket with hood **Fabric Type**: Tyvek NOTE: Thick rain pants and coveralls may be substituted for coated Tyvek if sediments are not obviously contaminated with PAHs or related petroleum products. Rain slickers cannot be effectively decontaminated of tar/petroleum contamination.
	☒	Disposable inner gloves (latex or equivalent "surgical")
	☒	Disposable chemical-resistant outer gloves **Material Type**: Nitrile
	☒	Chemical-resistant boots with safety toe and steel shank conforming to ASTM F2412-05/ASTM F2413-05 or disposable boot covers for safety toe/work boots **Material Type**: Rubber or leather
	☐	Puncture-resistant shanks in safety shoes conforming to ASTM F2412-05/ASTM F2413-05
	☐	Metatarsal guards conforming to ASTM F2412-05/ASTM F2413-05
	☐	Sleeves to be duct-taped over gloves and pants to be duct-taped over boots

Job Tasks		PPE Requirements
	☐	Splash-proof safety goggles
	☒	Safety glasses
	☒	Hard hat
	☐	Hard hat with face shield
	☒	Hearing protectors (**REQUIRED** if site noise levels are greater than 85 dB based on an 8-hour TWA). **Type:** Foam or ear muffs
	☐	Two-way radio communication (intrinsically safe, if explosive atmosphere is a potential)
	☐	Long cotton underwear
	☒	High-visibility, USCG-approved PFD (if working on any water vessel or without fall protection within 10 feet of water)
	☐	USCG-approved float coat and bib-overalls (e.g., full two-piece "Mustang" survival suit or similar) or one-piece survival suit if combined air and water temperature is below 90°F
	☐	Half-face APR (OSHA/NIOSH-approved)
	☐	Full-face APR (OSHA/NIOSH-approved)
	☐	**Type of Cartridges to be Used:** ☐ **OV or** ☐ **OV/HEPA (if samples are dry)**

6 Risk Analysis and Control

The following sections discuss the potential health and safety hazards associated with the field tasks described in the Work Plan. Controls of these hazards are addressed through the mechanical and physical control measures, use of PPE, monitoring, training, decontamination, emergency response, and safety procedures.

Significant changes in the Work Plan covered by this HASP must be communicated to the PM and CHSM, and a modification to this HASP must be created as needed (see Section 1.1). Any task conducted beyond those identified in the Work Plan and this HASP must be evaluated using the Job Safety Analysis (JSA) process prior to conducting the work.

6.1 Job Safety Analysis

Anchor QEA work tasks have been evaluated for their hazards and JSA documents have been developed that detail the chemical, physical, and biological hazards associated with these tasks along with the control measures (e.g., engineering controls, administrative controls, and/or PPE) that will be used to conduct them in a safe manner.

The PM and FL are responsible for identifying work tasks and project site conditions that are beyond the previously developed JSA documents and for communicating such information to the CHSM. The CHSM will provide support, as needed, to the PM and the FL, who will have primary responsibility to develop project-specific JSAs.

The contents of the JSA documents shall be communicated to project personnel during the site orientation meeting and during daily safety meetings when conducting work where the specific JSAs are applicable.

JSA documents applicable to this project are located in Appendix B and include the following field tasks:

- Sediment sampling
- General boating activities
- Decontamination activities
- Motor vehicle operation
- Sample and laboratory glassware handling

6.1.1 Augmented Job Safety Analysis Process

If significant work tasks are identified during the course of the project that were not previously addressed in the JSA documentation supplied in Appendix B, then a task-specific JSA document must be developed prior to conducting the work. The PM and FL shall develop this document(s) with input from the CHSM, as needed, and this HASP will be modified to include the JSA document (see

Section 1.1 for HASP modification procedures). Project personnel shall be trained on the contents of the developed task-specific JSA prior to its implementation. Appendix B of this HASP includes a blank JSA form that can be used to create a new task-specific JSA.

6.2 Exposure Routes

Possible routes of exposure to the chemicals potentially encountered on this project include inhalation, dermal contact, and ingestion of dust, mist, gas, vapor, or liquid. Exposure will be minimized by using safe work practices and by wearing the appropriate PPE. A further discussion of PPE requirements is presented in Section 10.

6.2.1 Inhalation

Inhalation of particulates, dust, mist, gas, or vapor during field activities is possible. Whenever possible, work activities will be oriented so that personnel are upwind of the sampling location.

6.2.2 Dermal Contact

Dermal contact with potentially contaminated soil, sediment, or groundwater during field activities is possible. Direct contact will be minimized by using appropriate PPE and decontamination procedures.

6.2.3 Ingestion

Direct ingestion of contaminants can occur by inhaling airborne dust, mist, or vapors, or by swallowing contaminants trapped in the upper respiratory tract. Indirect ingestion can occur by introducing the contaminants into the mouth by way of food, tobacco, fingers, or other carriers. Although ingestion of contaminants can occur, proper hygiene, decontamination, and contamination reduction procedures should reduce the probability of this route of exposure.

6.3 Chemicals of Concern Profile

Table 6-1 provides a summary profile for the COCs for this project. As available, this profile is based on recent site history and site characterization information. For more detailed and specific information, always refer to the Safety Data Sheet (SDS) or equivalent information for the chemical (see Appendix C).

Table 6-1
Chemicals of Concern Profile

Chemical	Exposure Routes	Symptoms	Target Organs	Occupational Exposure Limits	Odor Threshold (ppm)	Lower Explosive Limit (%)	Ionization Potential
Arsenic	Inhalation, ingestion, skin and/or eye contact	Irritation skin, possible dermatitis; respiratory distress; diarrhea; kidney damage; muscle tremor, convulsions; possible gastrointestinal tract, reproductive effects; possible liver damage	Skin, respiratory system, kidneys, central nervous system, liver, gastrointestinal tract, reproductive system	OSHA PEL 0.5 mg/m^3	--	--	--
Cadmium	Inhalation, ingestion	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]	Respiratory system, kidneys, prostate, blood	OSHA PEL 0.005 mg/m3	--	--	--
Copper	Inhalation, ingestion, skin and/or eye contact	Irritation eyes, nose, pharynx; nasal septum perforation; metallic taste; dermatitis; In Animals: lung, liver, kidney damage; anemia	Eyes, skin, respiratory system, liver, kidneys (increased risk with Wilson's disease	NIOSH REL 1 mg/m^3	--	--	--

Chemical	Exposure Routes	Symptoms	Target Organs	Occupational Exposure Limits	Odor Threshold (ppm)	Lower Explosive Limit (%)	Ionization Potential
Zinc	Inhalation	Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function	Respiratory system	NIOSH REL Dust: TWA 5 mg/m^3 Celling 15 mg/m^3 Fume: TWA 5 mg/m^3 Short Term 10 mg/m^3 OSHA PEL Fume: TWA 5 mg/m^3 Total Dust: 15 mg/m^3 Respirable Dust: TWA 5 mg/m^3	--	--	--
Total PCB	Inhalation, skin absorption, ingestion, skin and/or eye contact	Irritation eyes, chloracne; liver damage; reproductive effects; [potential occupational carcinogen]	Skin, eyes, liver, reproductive system	0.001 mg/m^3 TWA	--	--	--
PAHs – as coal tar pitch volatiles. (Includes benzo(a)pyrene, chrysene, phenanthrene, fluoranthene, pyrene, acenaphthene, methylnaphthalenes, and anthracene)	Skin, eye, inhalation, and ingestion hazard	Direct contact or exposure to the vapors may be irritating to the eyes. Direct contact can be highly irritating to the skin and can cause dermatitis. Exposure to high vapor concentrations may cause headaches, nausea, vomiting, and other symptoms. Includes human carcinogens. Exposure to all routes should be carefully controlled to levels as low as possible. Confirmed Animal Carcinogen.	Respiratory system, skin, bladder, kidneys	0.2 mg/m^3 TWA8 0.1 mg/m^3 TWA8 (Cyclohexane-extractable fraction) IDLH / Ca – 80 mg/m^3	-- Varies	--	--

Note:
--: indicates no data available

7 Site Control and Communications

The primary purposes for site controls are to establish the hazardous area perimeter, reduce migration of contaminants into clean areas, and prevent unauthorized access or exposure to hazardous materials by site personnel and the public. Site control is especially important in emergency situations.

7.1 General Site Control Safety Procedures

The following standard safe work practices apply to all Anchor QEA site personnel and subcontractors and shall be discussed in the safety briefing prior to initiating work on the site:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited on site except in designated areas.
- Hands and faces must be washed upon leaving the work area and before eating, drinking, chewing gum or tobacco, and smoking.
- A buddy system will be used. Radio, cell phone, or hand signals will be established to maintain communication.
- During site operations, each worker will consider himself/herself as a safety backup to his/her partner.
- Visual contact will be maintained between buddies on site when performing potentially hazardous duties.
- No personnel will be admitted to the site without the proper safety equipment, training, and (if required) medical monitoring certification.
- All personnel must comply with established safety procedures. Any staff member who does not comply with safety policy as established in this HASP may be subject to corrective action, potentially including but not limited to, being reprimanded or immediately dismissed.
- Proper decontamination procedures must be followed before leaving a contaminated work area.

7.2 Work Area Access Control

If work is performed in public areas, the following precautions shall be taken to protect both the site personnel and the public. Access control to the work area will be accomplished using a combination of the following devices and/or methods:

- Fences and/or barricades
- Traffic control devices and/or use of flaggers
- Caution tape
- Other methods to keep the site secure and provide a visual barrier to help keep unauthorized personnel from entering the site and active work areas

7.3 Hazardous Waste Site Work Control Procedures

To prevent contamination from migrating from personnel and equipment, work areas will be clearly specified as an Exclusion Zone/Hot Zone (EZ), Contamination Reduction Zone (CRZ), or Support Zone/Clean Zone (SZ) prior to beginning operations. Each work area will be clearly identified using signs or physical barriers. At the end of each workday, the site should be secured and/or guarded to prevent unauthorized entry.

The site work zones will be defined as follows:

- **Exclusion Zone/Hot Zone (EZ).** The EZ will be the "hot zone" or contaminated area inside the site perimeter (or sample collection area of boat). The EZ is the defined area where potential respiratory and/or health hazards exist. All personnel entering the EZ must use the required PPE, as set forth in this HASP, and meet the appropriate training and medical clearance. Entry to and exit from this zone will be made through a designated point. Appropriate warning signs to identify the EZ should be posted (e.g., DANGER, AUTHORIZED PERSONNEL ONLY, PROTECTIVE EQUIPMENT REQUIRED BEYOND THIS POINT). Personnel and equipment decontamination must be performed upon exiting the EZ.
- **Contamination Reduction Zone (CRZ).** The CRZ, also known as the "warm zone," is a transitional zone between the EZ and the SZ (also known as the "cold zone" or "clean zone"). The CRZ provides a location for removal and decontamination of PPE and tools leaving the EZ. A separate decontamination area will be established for heavy equipment. All personnel and equipment must exit via the CRZ. If the CRZ is compromised at any time, a new CRZ will be established.
- **Support Zone/Clean Zone (SZ).** This uncontaminated zone will be the area outside the EZ and CRZ and within the geographic perimeters of the site (including boat and processing areas). The SZ is used for support personnel; staging materials; parking vehicles; office, laboratory, and sanitation facilities; and receiving deliveries. Personnel entering this zone may include delivery personnel, visitors, security guards, and others who will not necessarily be permitted in the EZ or CRZ.

A log of all personnel visiting, entering, or working on the site shall be maintained by the FL. No visitor will be allowed in the EZ without showing proof of training and medical certification, per 29 CFR 1910.120(e),(f) (and 29 CFR 1926.1101(k)(9),(m) if appropriate). Visitors will attend a site orientation given by the FL and sign the HASP.

7.4 Site-Specific Work Zone Requirements

This section contains guidelines for maintaining safe conditions when working from a boat, in a roadway, or at an excavation site.

7.4.1 Sediment Sampling Work Zones

This subsection contains guidelines concerning health and safety aboard marine sampling vessels. The vessel captain, onshore coring operator, and the FL will delineate the boundaries of the work zones aboard the vessel and will inform the field team of the arrangement. The purpose of the zones is to limit the migration of sample material out of the zones and to restrict access to active work areas.

Two work zones will be observed aboard the vessel. One will encompass the "moonhole" of the vessel where the samplers will be deployed and recovered. Only the coring team may enter this zone unless assistance is required by other personnel. The second work zone will be a sample processing area on the vessel. The contractor team will deliver sediment core tubes to this zone and open them. Anchor QEA personnel will log and process the sediment cores either on the boat or on shore.

Both the collection and processing areas on the vessel and onshore will have a SZ outside the CRZ to stage clean equipment, don PPE, take rest breaks, or perform any other site activities that do not involve potentially contaminated materials.

7.4.1.1 Vessel Decontamination Area

A station will be set up for decontaminating sample processing equipment and personnel gear such as boots or PPE. The station will have the buckets, brushes, soapy water, rinse water, or wipes necessary to perform decontamination operations. Plastic bags will be provided for expendable and disposable materials. Decontamination fluids will be stored in sealable containers and will be properly disposed of.

7.4.1.2 Access Control

Security and control of access to the sampling vessel and onshore area will be the responsibility of the captain and FL. Additional security measures may be placed into effect by the client, or as required by national security threat levels determined by the federal government. Access to the vessel and onshore areas will only be granted to necessary project personnel and authorized visitors. Any security or access control problems will be reported to the client or appropriate authorities.

7.4.1.3 Safety Equipment

In addition to PPE that will be worn by shipboard personnel, basic emergency and first aid equipment will also be provided. Equipment will include:

- U.S. Coast Guard (USCG)-approved personal flotation devices (PFDs)
- First aid kit adequate for the number of personnel
- Emergency eyewash

Anchor QEA and/or subconsultants will provide this equipment, which must be at the location(s) where field activities are being performed. Equipment will be checked daily to verify its readiness for use.

7.5 Field Communications

Communications between all Anchor QEA employees and subcontractors at the work site can be verbal and/or non-verbal. Verbal communication can be affected by the on-site background noise and various PPE. See Table 7-1 for a list of the types of communication methods and equipment to use, depending on site conditions. Communication equipment must be checked daily to verify proper operation. All project personnel must be initially briefed on the communication methods prior to starting work; communication methods should be reviewed in daily safety meetings.

Table 7-1
Field Communication Methods

Type of Communication	Communication Device	Signal
Emergency notification	On-site Telephone or Cellular Telephone	Initiate phone call using applicable emergency numbers
Emergency notification among site personnel	Two-way Radio	Initiate radio communication with Code Red message
Hailing site personnel for non-emergency	Compressed Air Horn	One long blast, one short blast
Hailing site personnel for emergency evacuation	Compressed Air Horn	Three long, continuous blasts
Hailing site personnel for distress, need help	Visual	Arms waved in circle over head
Hailing site personnel for emergency evacuation	Visual	Arms waved in criss-cross over head
Contaminated air/strong odor	Visual	Hands clutching throat
Break, lunch, end of day	Visual	Two hands together, break apart

8 Decontamination Procedures and Practices

8.1 Minimization of Contamination

The following measures will be observed to prevent or minimize exposure to potentially contaminated materials:

Personnel

- Do not walk through spilled materials.
- Do not handle, touch, or smell sample media directly.
- Make sure PPE has no cuts or tears prior to use.
- Protect and cover any skin injuries.
- Stay upwind of airborne dusts and vapors.
- Do not eat, drink, chew tobacco, or smoke in the work zones.

Sampling Equipment and Vehicles/Vessels

- Use care to avoid getting sampled media on the outside of sample containers.
- If necessary, bag sample containers before filling with sampled media.
- Place clean equipment on a plastic sheet to avoid direct contact with contaminated media.
- Keep contaminated equipment and tools separate from clean equipment and tools.
- Fill sample containers over a plastic tub to contain spillage.
- Clean up spilled material immediately to avoid tracking around the vehicle/vessel.

8.2 Decontamination Equipment

All vehicles, vessels, and equipment that have entered potentially contaminated areas will be visually inspected and, if necessary, decontaminated prior to leaving the area. If the level of vehicle contamination is low, decontamination may be limited to rinsing tires and wheel wells with an appropriate detergent and water. If the vehicle is significantly contaminated, steam cleaning or pressure washing may be required. Tools will be cleaned in the same manner. Rinsate from all decontamination activities will be collected for proper disposal. Decontamination of equipment and tools will take place within the CRZ.

The following supplies will be available to perform decontamination activities:

- Wash and rinse buckets
- Tap water and phosphate-free detergent
- Scrub brushes
- Distilled/deionized water
- Deck pump with pressurized freshwater hose (aboard the vessel)
- Pressure washer/steam cleaner, if appropriate
- Paper towels and plastic garbage bags

8.3 Personnel Decontamination

The FL will verify that all site personnel are familiar with personnel decontamination procedures as listed below. All personnel wearing PPE in a work area (EZ) must undergo decontamination prior to entering the SZ. Personnel will perform the following decontamination procedures:

- Wash and rinse outer gloves and boots in portable buckets to remove gross contamination.
- If suit is heavily soiled, rinse it off.
- Remove outer gloves; inspect and discard if damaged. Leave inner gloves on. Personnel will remove their outer garment and gloves, dispose of them, and properly label container or drum. Personnel will then decontaminate their hard hats and boots with an aqueous solution of detergent or other appropriate cleaning solution. These items then will be hand-carried to the next station. Remove inner gloves.
- Thoroughly wash hands and face before leaving CRZ.
- Sanitize respirators and place in a clean plastic bag.

8.4 Sampling and Processing Equipment Decontamination

To prevent sample cross-contamination, sampling and processing equipment in contact with soil, sediment, or water samples will undergo the following decontamination procedures when work is completed in the CRZ and prior to additional use:

1. Rinse with potable water and wash with scrub brush.
2. Wash with phosphate-free detergent (Alconox).
3. Visually inspect the sampler and repeat the scrub and rinse step, if necessary. If scrubbing and rinsing with Alconox is insufficient to remove visually observable tar-related contamination on equipment, the equipment will be scrubbed and rinsed using hexane (or similar type solution) until all visual signs of contamination are absent.
4. Rinse external sampling equipment with potable water three times prior to use. Rinse homogenizing equipment once with potable water and three times with distilled water prior to and between sample processing.

8.5 Handling of Investigation-Derived Waste

All remaining soil or sediment, fluids used for decontamination of sampling equipment, and sample collection disposable wastes (e.g., gloves, paper towels, foil, or others) will be placed into appropriate containers and staged on site for disposal.

8.5.1 Disposable Personal Protective Equipment

Disposable PPE may include Tyvek suits, inner latex gloves, and respirator cartridges. Dispose of PPE according to the requirements of the client and state and federal agencies.

8.5.2 Non-Disposable Personal Protective Equipment

Non-disposable PPE may include respirators and boots and gloves. When decontaminating respirators, observe the following practices and procedures:

- Wipe out the respirator with a disinfecting pad prior to donning.
- Decontaminate the respirator on site at the close of each day with an approved sanitizing solution.

When decontaminating boots and gloves, observe the following practices and procedures:

- Decontaminate the boots or gloves outside with a solution of detergent and water; rinse with water prior to leaving the site.
- Protect the boots or gloves from exposure by covering with disposable covers such as plastic to minimize required decontamination activities.

8.6 Sanitizing Personal Protective Equipment

Respirators, reusable protective clothing, and other personal articles must be not only decontaminated before being reused, but also sanitized. The insides of masks and clothing become soiled due to exhalation, body oils, and perspiration. Manufacturer's instructions should be used to sanitize respirator masks. If practical, reusable protective clothing should be machine-washed after a thorough decontamination; otherwise, it must be cleaned by hand.

8.7 Emergency Personnel Decontamination

Personnel with medical problems or injuries may also require decontamination. There is the possibility that the decontamination may aggravate or cause more serious health effects. If prompt lifesaving, first aid, and medical treatment are required, decontamination procedures will be omitted. In either case, a member of the site management team will accompany contaminated personnel to the medical facility to advise on matters involving decontamination.

8.8 Containment of Decontamination Fluids

As necessary, spill control measures will be used to contain contaminated runoff that may enter into clean areas. Use plastic sheeting, hay bales, or install a spill control system to prevent spills and contain contaminated water.

8.9 Pressure Washing

The following procedure is required when using high-pressure washing equipment for decontamination purposes:

- Wear modified Level D protection, including a face shield and safety goggles.
- Verify that other personnel are out of the area prior to decontamination.

- Secure the area around the decontamination pad with cones, caution tape, or barricades.
- Verify that safe work practices and precautions are taken to minimize the potential for physical injury from high-pressure water spray. Follow the manufacturer's operating instructions.
- The pressure washer wand must be equipped with a safety release handle.
- Verify that the area is clean after equipment is decontaminated. Barricades, cones, or caution tape must be left in place and secured at all times.

9 Health and Safety Training and Informational Programs

This section describes the health and safety training and informational programs with which Anchor QEA project site personnel must comply. All certifications required in this section are provided in Appendix D and will be kept on internal file.

9.1 Initial Project Site Orientation

Work on all Anchor QEA project sites requires participation in an initial health and safety orientation presented by the PM or FL that will consist of, at a minimum, the following topics:

- A review of the contents of this HASP, including the Work Plan and associated site hazards and control methods and procedures.
- Provisions of this plan are mandatory for all Anchor QEA personnel assigned to the project.
- Anchor QEA subcontractors are also expected to follow the provisions of this plan unless they have their own HASP that covers their specific activities related to this project and includes the minimum requirements of this HASP.
- All visitors to the work site will also be required to abide by the requirements of this plan.
- Personnel assigned to perform work at the project site, working under the provisions of this HASP, will be required to read the plan and must sign the Health and Safety Plan Acknowledgement Form to confirm that they understand and agree to abide by the provisions of this plan. Personnel not directly affiliated with the project (i.e., visitors) may also be required to sign the Liability Waiver.

9.2 Daily Safety Meetings

Daily safety meetings ("tailgate meetings") make accident prevention a top priority for everyone and reinforce awareness of important accident-prevention techniques. The following daily safety meeting procedures and practices are required:

- Daily safety meetings will be held each morning prior to conducting site activities.
- The Daily Safety Briefing form in Appendix A will be used to document each meeting.
- Copies of the completed Daily Safety Briefing forms will be maintained on site during the course of the project.

9.3 End-of-Day Wellness Checks

Similar to the daily safety meetings, field staff will gather at the end of the day to verify group health and wellness and discuss any near misses that occurred that day. The wellness checks will be recorded on that day's Daily Safety Briefing form.

9.4 Hazardous Waste Operations Training

Personnel working on project sites that present a potential exposure to hazardous wastes or other hazardous substances shall be trained in accordance with the requirements of the 29 CFR 1910.120 (HAZWOPER) regulation. Training requirements will consist of the following:

- Field personnel must complete a minimum of 40 hours of hazardous waste activity instruction.
- Field personnel must complete a minimum of 3 days of supervised field instruction.
- Field personnel assigned to the site will also have received 8 hours of refresher training if the time lapse since their previous training has exceeded 1 year.
- On-site managers and supervisors directly responsible for employees engaged in hazardous waste operations will receive an additional 8 hours of supervisory training.
- Field personnel shall be current in first aid/CPR training offered by the American Red Cross or equivalent.
- Other training may be required depending on the task to be performed (e.g., confined space, excavation/trenching, underground storage tank removal, fall protection, respiratory protection, and hazard communication).

9.5 Hazard Communication Program

The purpose of hazard communication (Employee Right-to-Know) is to verify that the hazards of all chemicals located at the field project site are communicated to all Anchor QEA personnel and subcontractors according to 29 CFR 1926.59. Refer to the Anchor QEA Hazard Communication Program document for additional information.

Every container of hazardous materials must be labeled by the manufacturer, who must also provide a SDS upon initial order of the product and upon request thereafter. The actual format may differ from company to company (e.g., National Fire Protection Association, Hazardous Material Information System, or other), but the labels must contain similar types of information. Maintain manufacturer labels if possible. The label may use words or symbols to communicate the following:

- Introduction
- Hazard(s) identification
- Composition/information on ingredients
- First-aid measures
- Fire-fighting measures
- Accidental release response measures
- Handling and storage
- Exposure controls/personal protection
- Physical and chemical properties
- Stability and reactivity properties

- Toxicological properties
- Ecological properties
- Disposal considerations
- Transport considerations
- Regulatory information
- Other information, including at a minimum, label preparation or last revision date

SDS for all chemicals brought onto the site or anticipated to be used on site shall be provided in Appendix C of this HASP. These SDS shall be readily available for reference by site personnel and emergency response personnel.

Hazardous materials received without proper labels shall be set aside and not distributed for use until properly labeled.

If a hazardous chemical is transferred into a portable container (approved safety can), even if for immediate use only, the contents (e.g., acetone or gasoline) of the portable container must be identified.

10 General PPE Requirements

The minimum level of PPE should be selected according to the hazards that may be encountered during site activities in accordance with established U.S. Environmental Protection Agency (EPA) levels of protection (D and C). Only PPE that meets American National Standards Institute (ANSI) standards shall be worn. Site personnel must maintain proficiency in the use and care of PPE. Damaged or defective PPE must be replaced and may not be used. Anchor QEA will provide all necessary PPE for its employees as described in this HASP.

Refer to Section 5 for site-specific job task and level-of-protection requirements.

10.1 Minimum Requirements: Level D Protection

The minimum level of protection on project sites will be Level D protection, which consists of the following equipment:

- Standard work uniform/coveralls
- Work boots with safety toe conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05
- Approved safety glasses or goggles (meets ANSI Z87.1—2010 requirements for eye protection)
- Hard hat (meets ANSI Z89.1—1986 requirements for head protection)
- High-visibility traffic safety vest
- Hearing protection when there are high noise levels

Level D protection will be used only when:

- The atmosphere contains no known hazards
- Work functions preclude splashes, immersions, or the potential for unexpected inhalation of, or contact with, hazardous concentrations of chemicals
- Atmospheric concentrations of contaminants are less than the Permissible Exposure Limit (PEL) and/or Threshold Limit Value (TLV)

10.1.1 Modified Level D Protection Requirements

Depending on the Work Plan and the potential hazards to be encountered, Level D protection shall be modified to include additional protective equipment such as USCG-approved PFDs, face shields/goggles, chemical-resistant clothing, and disposable gloves of varying materials depending on the chemical substances involved. An upgrade to Modified Level D occurs when there is a possibility that contaminated media can contact the skin or work uniform, or if unique, site-specific hazards exist.

Respiratory protection is not anticipated for sediment sampling activities. If field conditions requiring air monitoring are encountered, work will stop until conditions are assessed and this HASP will be modified to include air monitoring procedures in coordination with the PM and Health and Safety Program Lead.

11 General Air Monitoring Requirements

11.1 General Requirements

Air monitoring is not anticipated to be required for sediment sample collection activities.

12 Health and Safety Procedures and Practices

In addition to the task-specific JSAs listed in Section 6.1 and presented in Appendix B, this section lists the health and safety procedures and practices applicable to this project. For additional information, consult with the PM.

12.1 Physical Hazards and Controls

12.1.1 General Site Activities

Observe the following general procedures and practices to prevent physical hazards:

- Legible and understandable precautionary labels shall be affixed prominently to containers of potentially contaminated soil, sediment, water, and clothing.
- No food or beverages shall be present or consumed in areas that have the potential to contain COCs and/or contaminated materials or equipment.
- No tobacco products or cosmetics shall be present or used in areas that have the potential to contain COCs and/or contaminated materials or equipment.
- An emergency eyewash unit shall be located immediately adjacent to employees who handle hazardous or corrosive materials, including decontamination fluids. All operations involving the potential for eye injury or splash must have approved eyewash units locally available capable of delivering at least 0.4 gallons per minute for at least 15 minutes.
- Personnel working within 10 feet of bodies of water shall wear USCG-approved PFDs.
- Certain project sites may have newly finished work (e.g., concrete, paving, framing, habitat reconstruction, or sediment caps) that may be damaged by unnecessary contact, or that could cause dangerous conditions for personnel (e.g., slipping, sinking, or tripping). Personnel working in or around these areas shall communicate with the PM, FL, and client contact as needed to prevent damaging new work or entering dangerous conditions.
- Generally, all on-site activities will be conducted during daylight hours. If work after dusk is planned or becomes necessary due to an emergency, adequate lighting must be provided.
- Hazardous work, such as handling hazardous materials and heavy loads and operating equipment, should not be conducted during severe storms.
- All temporary electrical power must have a ground-fault circuit interrupter (GFCI) as part of its circuit if the circuit is not part of permanent wiring. All equipment must be suitable and approved for the class of hazard present.

12.1.2 Slips, Trips, and Falls

Observe the following procedures and practices to prevent slips, trips, and falls:

- Inspect each work area for slip, trip, and fall potential prior to each work task.

- Slip, trip, and fall hazards identified must be communicated to all personnel. Hazards identified shall be corrected or labeled with warning signs to be avoided.
- All personnel must be aware of their surroundings and maintain constant communication with each other at all times.

12.1.3 Ergonomic Considerations

Certain field tasks may involve workers in fixed positions (e.g., observing subcontractor work) or performing repetitive motions over a period of time (e.g., sediment sample processing). It is important that workers self-monitor for ergonomic fatigue (e.g., soreness, tightness, stiffness, or pain in muscles) and make adjustments to work tasks, body positions, or work areas so that ergonomic stressors are minimized. Suggestions for decreasing the likelihood of ergonomic stress include the following:

- Limit fixed positions. Periodically vary standing and sitting positions, take frequent short walks, and modify observation locations when possible.
- Minimize extreme postures. Conduct work tasks using comfortable postures (particularly if the tasks are repetitive), and use tools or structures to minimize the need to hold or work with materials or access the work area.
- Limit contact stress. Be aware of soft tissue resting on hard surfaces, and limit these occurrences (e.g., use comfortable footwear, and use tools to hold materials).
- Contact the Field Mobilization Team in advance for prolonged field efforts that involve a field trailer. This group can set up field staff with a monitor, mouse, and keyboard so they are not working solely on laptops.
- Take breaks from work tasks, particularly repetitive ones.
- Consider performing stretching exercises before and during work activities, if those tasks are anticipated to be long in duration and/or strenuous.

12.1.4 Corrosive Material Handling Procedures

Corrosive materials include acids and bases. They are extremely corrosive materials with a variety of uses. Acids include hydrochloric, nitric, and sulfuric acids. Bases include sodium hydroxide. Observe the following procedures when working with corrosive materials:

- Wear gloves and eye-splash protection while using acid dispensed from a small dropper bottle during water sampling.
- Wear a full-face APR equipped with combination cartridges (organic vapor/acid gas) as well as Tyvek coveralls and nitrile gloves for large volume applications.
- Have an eyewash bottle and/or portable eyewash station on site.
- Do not add anything into a virgin chemical drum, including unused product.

- Avoid mixing strong acids and bases. Consult the CHSM for task-specific evaluation. If mixing is absolutely necessary, do it slowly. Avoid vapors or fumes that are generated.
- When diluting acids and bases, add the acid or base to water in small quantities and mix cautiously.

12.1.5 Sediment Core Sampling

Sediment samples will be collected using a "Mud Mole" or vibracore sampling equipment operated from a boat. Please see Sections 12.1.18 and 12.1.19 for additional safety information regarding working on or near the water.

All operations involving the use of powered sediment coring rigs will follow generally accepted drilling/coring practices. One person will be assigned the responsibility of Lead Driller/Corer. Additional personnel will assist with equipment as needed. The Lead Driller/Corer will be responsible for operating the drilling/coring rig and ensuring safety.

General rules associated with drilling/coring rig operations will be as follows:

- While drilling, all non-essential personnel shall remain at a distance that is past the radius of any moving parts.
- All operators and team members will be familiar with the rig operations and will have received practical training.
- All personnel will be instructed in the use of the emergency kill switch/shutdown on the drill rig.
- No loose-fitting clothing, jewelry, or free long hair is permitted near the drilling rig or moving machinery parts.
- A first aid kit and fire extinguisher will be available at all times.
- No drilling will occur during impending electrical storms or tornadoes, or when rain, ice, snow, or wind conditions create undue potential hazards.
- Never allow "horsing around" within the vicinity of the drill rig and tool and supply storage areas, even when the drill rig is shut down.

12.1.6 Underground or Overhead Utility Line Contact Prevention

Observe the following underground/overhead utility line contact prevention procedures and practices:

- Prior to conducting work, the PM or FL shall verify that all existing underground or overhead utilities in the work area are located per the state or local mark-out methods and subcontract. Documentation of utility mark-out shall be completed using the Utility Contact Prevention Checklist form (see Appendix A). No excavation work is to be performed until all utility mark-outs are verified.

- The PM or FL shall conduct a site survey to search for signs of other buried or overhead utilities. The results of such surveys shall be documented on the Utility Mark-out documentation form.
- The property owner or facility operator shall be consulted on the issue of underground utilities. As-built drawings shall be reviewed, when available, to verify that underground utility locations are consistent with the utility location mark-outs. All knowledge of past and present utilities must be evaluated prior to conducting work.
- If on-site subsurface utility locations are in question, a private locating service shall be contacted to verify locations. If the investigation calls for boreholes in an area not covered by the municipal One-Call system, then a private utility locate firm shall be contacted to determine the location of other underground utilities.
- The PM shall have documented verbal contact and an agreement with the fiber optic company for all work within 50 feet of any fiber optic cables.
- **Only non-destructive excavation, such as hand digging or hydro excavation, is permitted within 3 feet of underground high voltage, product, or gas lines.** Once the line is exposed, heavy equipment can be used, but must remain at least 3 feet from the exposed line.
- Elevated superstructures (e.g., drill rig, backhoe, scaffolding, ladders, and cranes) shall remain a distance of 10 feet away from utility lines and 20 feet away from power lines. Distance from utility lines may be adjusted by the FL depending on actual voltage of the lines.
- Overhead utility locations shall be marked with warning tape or flags where equipment has the potential for contacting overhead utilities.

Table 12-1 shows the minimum clearances required for energized overhead electrical lines.

Table 12-1
Overhead Utility Clearance Requirements

Minimum Clearance from Energized Overhead Electric Lines	
Nominal System Voltage	**Minimum Required Clearance**
0 to 50 kV	10 feet
51 to 100 kV	12 feet
101 to 200 kV	15 feet
201 to 300 kV	20 feet
301 to 500 kV	25 feet
501 to 750 kV	35 feet
751 to 1,000 kV	45 feet

Notes:
Whenever equipment operations must be performed closer than 20 feet from overhead power lines, the FL must be notified. When clearance to proceed is received from the FL, the electric utility company must be contacted to turn the power off or physically insulate (protect) the lines if the operation must be performed closer to the power line than is allowed in this table. For voltages not listed on this table, add 0.4 inches per kilovolt (kV) to obtain the safe distance between equipment and power lines.

12.1.7 Electric Safety

Observe the following procedures and practices to prevent electric shock:

- General
  - Use only appropriately trained and certified electricians to perform tasks related to electrical equipment. A good rule of thumb is to defer any task that would not normally and reasonably be completed by the average public consumer.
  - Each circuit encountered will be considered live until proven otherwise.
  - Only proper tools will be used to test circuits.
  - No wire will be touched until the circuit is determined to be de-energized.
- Extension Cords
  - All extension cords used on any project will be three-pronged.
  - All extension cords will be in good working order.
  - Each extension cord ground will be tested for continuity on at least a quarterly basis and marked to indicate when the inspection occurred.
  - Each extension cord will be visually inspected before each use.
  - If any extension cord is found in disrepair or fails the continuity test, it will be taken out of service.
  - Any extension cord that does not have the grounding pin will be taken out of service and not used.
  - Extension cords will not be used in place of fixed wiring.
  - Extension cords will not be run through holes in walls, ceilings, or floors.
  - Extension cords will not be attached to the surface of any building.
  - No extension cord will be of the "flat wire" type. Every extension cord will have each individual wire insulated and further protected by an outside cover.
  - Be sure to locate extension cords out of traffic areas or, if this is unavoidable, flag cords and protect workers from tripping over them (i.e., use barricades and tape the cord down).
  - Do not stage extension cords or powered equipment in wet areas, to the degree possible. Elevate cords, connections, and equipment out of puddles.
- Power Tools/Plug and Cord Sets
  - Any cord that is cut in a way that exposes insulation will be removed from service.
  - All tools and plug and cord sets will be tested for continuity.
  - If grounding pins are missing, the plug and cord will be removed from service.
  - Any tool or plug and cord set failing the continuity test will be removed from service.
  - All power tools will have three-pronged plugs unless double insulated.

- Ground-fault Circuit Interrupters
  - Each 120-volt electrical wall receptacle providing power to the job site will be protected by a portable GFCI.
  - Each GFCI will be tested quarterly and marked to indicate when the inspection occurred.
  - Each 120-volt, single-phase, 15- and 20-ampere receptacle outlet, including those on generators, will have an approved GFCI.
  - GFCIs will be located in line as close to the piece of equipment as possible.
- Specific
  - If unsure if a task requires specific electrical training, err on the side of caution and contact the PM and FL prior to proceeding.
  - If subsurface work is to be performed, follow the guidelines in Section 12.1.6 and conduct utility locating prior to work and in accordance with local ordinances.
  - If lock out/tag out (LO/TO) procedures are required (i.e., de-energizing machinery or equipment so work may be performed), the equipment owner must provide LO/TO procedures and training. By default, the equipment owner should perform any LO/TO. If it becomes necessary for Anchor QEA personnel to perform LO/TO tasks, contact the PM and FL prior to doing so.
  - Maintain appropriate distance from overhead utilities (see Table 12-1).
  - If unexpected electrical equipment is encountered (i.e., buried wire) assume it is live, stop work, and contact the PM and FL immediately.
  - If working in enclosed or restricted areas where electrical hazards may be present, contact a licensed electrician or other suitably trained party to provide barriers, shields, or insulating materials to prevent electric shock.
  - If working in areas where electrical hazards are present, verify that conductive clothing and jewelry is replaced with non-conductive clothing, or removed.

12.1.8 General Falls and Ladder Usage

Observe the following general falls and ladder usage procedures and practices:

- Assess work areas for fall hazards. A fall protection system that meets OSHA and ANSI Z3591 standards must be used if work is conducted 6 feet or more above the surface.
- Use ANSI Type 1A rated ladders.
- Verify that ladders are placed so their rungs, cleats, and steps are parallel, level, and uniformly spaced prior to use.
- Make sure ladder rungs are sturdy and free of cracks.
- Use ladders with secure safety feet.
- Pitch ladders at a 1 horizontal to 4 vertical (1H:4V) ratio.
- Secure ladders at the top or have another person at the bottom to help stabilize it.

- Ladders used to access an upper landing surface shall extend at least 3 feet above the upper landing surface.
- Use non-conductive ladders near electrical wires.
- The top rung of a ladder should not be used as a step.
- Do not carry any object or load that could cause a loss of balance or a fall.
- If a ladder is defective, damaged, or in disrepair (i.e., broken or missing rungs, cleats, or steps; broken or split rails; corroded components; or other faulty or defective components), tag the ladder "Do Not Use" and remove it from service until repaired.

12.1.9 Hand and Power Tools

Observe the following procedures and practices when working with hand and power tools:

- Keep hand tools sharp, clean, oiled, dressed, and not abused.
- Worn tools are dangerous. For example, the "teeth" in a pipe wrench can slip if worn smooth, an adjustable wrench will slip if the jaws are sprung, and hammerheads can fly off loose handles.
- Tools subject to impact (e.g., chisels, star drills, and caulking irons) tend to "mushroom." Keep them dressed to avoid flying spalls, and use tool holders.
- Do not force tools beyond their capacity.
- Flying objects can result from operating almost any power tool, so always warn people in the vicinity and use proper eye protection.
- Each power tool should be examined before use for damaged parts, loose fittings, and frayed or cut electric cords. Tag and return defective tools for repairs. Verify that there is adequate lighting, inspect tools for proper lubrication, and relocate tools or material that could "vibrate into trouble."
- Compressed air must be shut off or the electric cord unplugged before making tool adjustments. Air must be "bled down" before replacement or disconnection.
- Proper guards or shields must be installed on all power tools before issue. Do not use improper tools or tools without guards in place.
- Replace all guards before startup. Remove cranks, keys, or wrenches used in service work.

12.1.10 Motor Vehicle Operation

All drivers are required to have a valid driver's license, and all vehicles must have appropriate state vehicle registration and inspection stickers. **Anchor QEA prohibits the use of hand-held wireless devices while driving any vehicle for business use at any time, for personal use during business hours, and as defined by law**. Additionally, site-specific motor vehicle requirements must be followed, if any.

When driving to, from, and within the job site, be aware of potential hazards including:

- Vehicle accidents
- Distractions
- Fatigue
- Weather and road conditions

To mitigate these hazards, observe the following procedures and practices regarding motor vehicle operation:

- Before leaving, inspect fuel and fluid levels and air pressure in tires, and adjust mirrors and seat positions appropriately.
- Wear a seat belt at all times and make sure that clothing will not interfere with driving.
- Plan your travel route and check maps for directions or discuss with colleagues.
- Clean windows and mirrors as needed throughout the trip.
- Wear sunglasses as needed.
- Fill up when the fuel level is low (not near empty).
- Follow a vehicle maintenance schedule to reduce the possibility of a breakdown while driving.
- Stop driving the vehicle, regardless of the speed (e.g., even 5 miles per hour) or location (e.g., a private road), when the potential of being distracted by conversation exists.
- Using hand-held communication devices (e.g., cell phones) while operating any motor vehicle is prohibited.
- Get adequate rest prior to driving.
- Periodically change your seat position, stretch, open the window, or turn on the radio to stay alert.
- Pull over and rest if you are experiencing drowsiness.
- Check road and weather conditions prior to driving.
- Be prepared to adjust your driving plans if conditions change.
- Travel in daylight hours, if possible.
- Give yourself plenty of time to allow for slowdowns due to construction, accidents, or other unforeseen circumstances.
- Use lights at night and lights and wipers during inclement weather.

12.1.11 Boating Operations

The following precautions shall be followed when conducting boating trailer and launch activities:

- Follow the trailer and boat manufacturers' instructions for securing the boat to the trailer.
- Follow the trailer manufacturer's instructions for securing the trailer to the towing vehicle.
- Prohibit site personnel from moving into trailer/vehicle pinch points without advising the vehicle operator.

- Use experienced operators when backing trailers on boat ramps.
- Wear proper work gloves when the possibility of pinching or other injury may be caused by moving or handling large or heavy objects.
- Maintain all equipment in a safe condition.
- Launch boats one at a time to avoid collisions.
- Use a spotter for vehicles backing boats to the launch area.
- Understand and review hand signals.
- Wear boots with non-slip soles when launching boats.
- Wear USCG-approved PFDs when working within 10 feet of the water.
- Keep ropes and lines coiled and stowed to eliminate trip hazards.
- Maintain three-point contact on dock/pier or boat ladders.
- Verify that drain plugs are in place.

The following precautions shall be followed when conducting boating operations:

- Maintain a current boater's license(s) as required.
- Wear USCG-approved PFDs for work activities within 10 feet of the water.
- Obtain and review information regarding dams that may be present in work areas, particularly with regard to "no boating" zones and safety buoys, cables, and warning signage.
- Maintain boat anchorage devices commensurate with anticipated currents, distance to shore, and water depths.
- Provide a floating ring buoy in the immediate boat launch/landing areas with at least 60 feet (18.3 meters) of line for a vessel less than 65 feet (19.8 meters) in length, or 90 feet (27.4 meters) of line for a vessel 65 feet (19.8 meters) or greater in length (see https://www.law.cornell.edu/cfr/text/46/117.70 for more information).
- Step into the center of the boat.
- Keep your weight low when moving on the boat.
- Move slowly and deliberately.
- Steer directly across other boat wakes at a 90-degree angle to avoid capsizing.
- Steer the boat facing forward.
- Watch for floating objects in the water.
- Right-of-way is yielded to vessels on your boat's right, or starboard, and vessels with limited ability to maneuver such as any wind-propelled vessel.

The following precautions shall be followed when working on a boat:

- Observe proper lifting techniques.
- Obey lifting limits (see Section 12.1.23)
- Use mechanical lifting equipment (i.e., pulleys or winches) to move large or awkward loads.
- Wear USCG-approved PFDs for work activities within 10 feet of the water.

The safety-related items listed in Table 12-2 shall be available when conducting boating operations.

Table 12-2
Safety Equipment Specific to In-Water Work

Additional Safety Equipment for Sampling Vessel per U.S. Coast Guard Requirements:	
• Proper vessel registration, numbering, and documentation (registered with state, certificate of vessel registration number displayed, and carrying a valid certificate of number) • USCG-approved personal flotation devices (PFDs; or life jackets) for every person on the sampling vessel (Type I, II, III, or V are required). High-visibility required by Anchor QEA. • Appropriate, non-expired, visual distress devices for day and night use from the following: – Three hand-held red flares (day and night), or – One hand-held red flare and two parachute flares (day and night), or – One hand-held orange smoke signal, two floating orange smoke signals (day), and one electric distress light (night only) • Alternate means of propulsion (oars or paddles) • Dewatering device (pump or bailer) • Properly maintained and inspected USCG-approved fire extinguishers (no fixed system = (2) B-1 or (1) B-2 type extinguishers; fixed system = (1) B-1 type extinguisher) • Proper ventilation of gasoline-powered vessels • Sound-producing device (whistle, bell, or horn) • VHF 2-way radio • Proper navigational light display • Throwable life ring with attached line (any vessel larger than 16 feet is required to carry one Type IV [throwable] PFD)	
Additional USCG Recommended Equipment Includes:	
• Extra visual distress signals • Primary and spare anchor • Heaving line • Fenders • First aid kit • Flashlight • Mirror • Searchlight • Sunburn lotion • Tool kit • Spare fuel	• Boat hook • Spare propeller • Mooring line • Food and water • Binoculars • Spare batteries • Sunglasses • Marine hardware • Extra clothing • Spare parts • Pertinent navigational chart(s) and compass

12.1.12 Working Over or Near Water

12.1.12.1 Personal Flotation Devices

PFDs are not required where employees are continuously protected from the hazard of drowning by railings, nets, safety belts, or other applicable provisions.

Type I, II, III or V USCG-approved, high-visibility PFD shall be provided and properly worn by all personnel in the following circumstances:

- On or within 10 feet of water
- On floating pipelines, pontoons, rafts, or stages
- On structures extending over or next to the water, except where guard rails or safety nets are provided for employees
- Working alone at night where there are drowning hazards, regardless of other safeguards provided
- In skiffs, small boats, or launches, unless in an enclosed cabin or cockpit
- Whenever there is a drowning hazard

The following precautions shall be followed when using PFDs:

- Prior to and after each use, the buoyant work vests or life preservers shall be inspected for defects that would alter their strength or buoyancy. Defective devices or devices with less than 13 pounds buoyancy shall be removed from service.
- All PFDs shall be equipped with reflective tape as specified in 46 CFR 25.25-15.
- Thirty-inch USCG-approved ring buoys with at least 150 feet of 600-pound capacity line shall be provided and readily available for emergency rescue operations. The distance between ring buoys shall not exceed 200 feet.
- PFD lights conforming to 46 CFR 161.012 shall be required whenever there is a potential need for life rings to be used after dark. Onshore installations, at least one life ring, and every third one thereafter, shall have a PFD light attached. PFD lights on life rings are required only in locations where adequate general lighting (e.g., floodlights or light stanchions) is not provided.

12.1.12.2 Cold Water Work

When the combined air and water temperature is below 90°F, field personnel working on or near water shall wear either a float coat and bib overalls (e.g., a full two-piece "Mustang" survival suit or similar) or a one-piece survival suit. Suits or float coats shall be USCG approved. If extremely cold or severe weather conditions are forecast, work activities should be postponed. Work activities will be continually reviewed and adjustments made if wearing a survival suit during work activities potentially poses a hazard due to warm air temperatures, or limited mobility or agility. In addition, proximity of water work to shore and scope/duration/timing of work activities will be considered when stipulating the above requirement. Overall, if water craft will be used during work, or work will be conducted near water, it is imperative that site-specific conditions are considered and evaluated so that proper safeguards and procedures are in place prior to beginning work.

In addition to considering the use of apparel appropriate for anticipated air, weather, and water conditions, field teams shall identify any procedures necessary for cold-water "man-overboard"

scenarios. These procedures should be identified in the site-specific HASP, described in the JSA used for boating activities and, if prudent, practiced before work.

12.1.13 Noise

Excessive noise is hazardous not only because of its potential to damage hearing, but also because of its potential to disrupt communications and instructions. The following procedures and practices shall be followed to prevent noise-related hazards:

- All employees will have access to ear protection with a Noise Reduction Rating of not less than 30.
- Ear protection must be worn in any environment where site personnel must raise their voices to be heard while standing at a distance of 3 feet or less.
- Ear protection must be worn by any personnel observing or operating concrete cutting or sawing equipment, pile driving, or other loud noise-generating activities.

Hearing protection is required for site personnel operating or working near noisy equipment or operations, where the noise level is greater than 85 A-weighted decibels (dBA) (time-weighted average [TWA]), as well as personnel working around heavy equipment. The FL will determine the need and appropriate testing procedures, (i.e., sound level meter and/or dosimeter) for noise measurement.

When needed, a sound level meter will be used to measure noise levels at selected locations in the work area and on the site perimeter. When used, noise monitoring equipment must be calibrated before and after each shift.

If continuous noise levels are found to exceed 85 dBA at any location within the work area, warning signs will be posted. Site personnel and visitors will be notified that hearing protection is required. Appropriate hearing protection (i.e., ear plugs or ear muffs) will be worn whenever personnel or visitors are working in that location. A supply of ear plugs will be maintained on site.

Action levels in Table 12-3 will trigger the use of appropriate hearing protection (plugs or muffs). Hearing protection must be able to attenuate noise below 90 dBA (8-hour TWA). Each hearing protection or device has a Noise Reduction Rating (NRR) assigned by EPA. The calculation for a hearing protection device's effectiveness is as follows:

Equation 1

Noise reading $dBA - (NNR - 7dB) < 90dBA$

where:

dB	=	decibel
dBA	=	A-weighted decibel
NRR	=	Noise Reduction Rating

Table 12-3
Noise Exposure Action Levels

Instrument	Measurement	Action
Type I or Type II Sound Level Meter or Dosimeter	> 80 dBA to 85 dBA	Hearing protection recommended. Limit work duration to 8-hour shifts.
	> 85 dBA to 90 dBA	Hearing protection required. Limit work duration to 8-hour shifts.
	> 90 dBA to 115 dBA	Hearing protection required. Investigate use of engineering controls. Limit work duration to 8-hour shifts.
	> 115 dBA	Stop work. Consult CHSM.

12.1.14 Lifting and Material Handling

Observe the following procedures and practices for lifting and material handling:

- Use leather gloves when handling metal, wire rope, sharp debris, or transporting materials (e.g., wood, piping, or drums).
- The size, shape, and weight of the object to be lifted must first be considered. No individual employee is permitted to lift any object that weighs more than 60 pounds. Multiple employees or mechanical lifting devices are required for objects heavier than the 60-pound limit.
- Plan a lift before doing it. Bend at the knees and lift with the legs; maintain the natural curves of the back; do not use back muscles.
- Check the planned route for clearance.
- Use the buddy system when lifting heavy or awkward objects.
- Do not twist your body while lifting.
- Know the capacity of any handling device (e.g., crane, forklift, chain fall, or come-along) that you intend to use.
- Use tag lines to control loads.
- Verify that your body, material, tools, and equipment are safe from such unexpected movement as falling, slipping, rolling, tripping, bowing, or any other uncontrolled motion.

- Trucks (i.e., flat beds) hauling equipment or materials must not be moved once rigging has been released.
- Chock all material and equipment (such as pipe, drums, tanks, reels, trailers, and wagons) as necessary to prevent rolling.
- Tie down all light, large-surface-area material that might be moved by the wind.
- When working at heights, secure tools, equipment, and wrenches against falling.
- Do not store materials or tools on ducts, lighting fixtures, beam flanges, hung ceilings, or similar elevated locations.
- Fuel-powered tools used inside buildings or enclosures shall be vented and checked for excessive noise.

12.1.15 Fire Control

Observe the following fire control procedures and practices:

- Smoke only in designated areas.
- Keep flammable liquids in closed containers.
- Keep the work site clean; avoid accumulating combustible debris such as paper.
- Obtain and follow property owner hot work safety procedures when welding or performing other activities requiring an open flame.
- Isolate flammable and combustible materials from ignition sources.
- Verify fire safety integrity of equipment installations according to National Electrical Code specifications.

12.1.16 Static Electricity and Transfer of Flammable Liquids

Observe the following procedures and practices regarding static electricity when transferring flammable liquids:

- Electrically bond and ground pumps, transfer vessels, tanks, drums, bailers, and probes when moving flammable liquids.
- Electrically bond and ground vacuum trucks and the tanks they are emptying.
- Do not splash fill containers with flammable liquids.
- Pour flammable liquids slowly and carefully.
- Two fire extinguishers (2A20:BC) must be available, charged, inspected, and readily accessible.

12.1.17 Cleaning Equipment

Observe the following procedures and practices when cleaning equipment:

- Wear appropriate PPE to avoid skin and eye contact with isopropyl alcohol, Alconox, or other cleaning materials.
- Stand upwind to minimize any potential inhalation exposure.

- Dispose of spent cleaning solutions and rinses accordingly.

12.2 Environmental Hazards and Controls

12.2.1 Fatigue Management

Because Anchor QEA personnel may be working during both daytime and nighttime hours several days per week, depending on the activity, it is important that all personnel are aware of the hazards related to fatigue. Fatigue can be defined as an increasing difficulty in performing physical or mental activities. Signs of fatigue may include tiredness, changes in behavior, loss of energy, and reduced ability to concentrate. Fatigued site personnel may have a reduced ability to recognize or avoid risks on the work site, which may lead to an increase in the number and severity of injuries and other incidents. Fatigue can occur at any time when working and may cause safety concerns due to decreased manual dexterity, reaction time, and alertness.

Fatigue results from insufficient rest and sleep between activities. Contributing factors to fatigue may include the following:

- The time of day that work takes place
- The length of time spent at work and in work-related duties
- The type and duration of a work task and the environment (e.g., weather conditions and ambient noise) in which it is performed
- The quantity and quality of rest obtained prior to, during, and after a work period
- Non-work activities
- Individual factors such as sleeping disorders, medications, or emotional state

Personnel suffering from fatigue may exhibit both physical and mental effects, such as the following:

- Slower movements
- Poor coordination
- Slower response time to interaction
- Bloodshot eyes
- Slumped or weary appearance
- Nodding off
- Distractedness or poor concentration
- Inability to complete tasks
- Fixed gaze
- Appearing depressed, irritable, frustrated, or disinterested

Employees are strongly encouraged to get sufficient pre-work rest, maintain sufficient nutritional intake during work (i.e., eat and drink at regular intervals), and communicate with team members and leaders if their level of fatigue elevates.

Use the following procedures to help detect and address fatigue-related issues:

- Periodically observe and query coworkers for signs or symptoms of fatigue.
- Site personnel that express concern over their level of fatigue, or that are observed to be fatigued such that elevated worker risk is evident, will be relieved or have their work tasks adjusted so that they may rest sufficiently.
- Work schedules will consider fatigue factors and optimize continuous periods available for uninterrupted sleep. The employee is responsible for reporting to work properly rested and fit for duty. In case of an emergency or operational difficulties (e.g., limited access due to water levels or boat repairs), work hours may require adjustment.
- Maintain a routine exercise program and regular sleep schedule as much as possible over the course of the work.
- Avoid heavy meals or caffeine and minimize or eliminate the consumption of alcohol and nicotine before sleeping.

12.2.2 Heat Stress

Observe the following general procedures and practices regarding heat stress:

- Increase the number of rest breaks and/or rotate site personnel in shorter work shifts.
- Watch for signs and symptoms of heat stress and fatigue (see Section 12.2.2.1).
- During hot months, plan work for early morning or evening.
- Use ice vests when necessary.
- Rest in cool, dry areas.
- Verify that employees have access to potable drinking water and shade.
- During conditions exceeding 95°F, verify that the following additional procedures are adhered to:
  - Establish effective communication by voice, observation, or electronic means.
  - Observe employees for alertness and signs or symptoms of heat illness.
  - Designate one or more employees on each work site as authorized to call for emergency medical services.
  - Remind employees to drink water throughout the shift.
  - Conduct pre-shift meetings before beginning work to review the high heat procedures, encourage drinking water, and remind employees of their right to take a cool-down rest when necessary.

More details on heat exposure prevention, symptoms, and treatment are provided in Appendix F.

12.2.2.1 Signs, Symptoms, and Treatment

The FL will be trained in heat stress prevention, including the following, prior to supervising employees:

- Procedures to prevent heat illness.

- Procedures to follow when an employee exhibits symptoms consistent with possible heat illness, including emergency response procedures.

The information provided below addresses these training requirements.

Adverse climatic conditions are important considerations in planning and conducting site operations. High ambient temperature can result in health effects ranging from transient heat fatigue, physical discomfort, reduced efficiency, personal illness, and increased accident probability to serious illness or death. Heat stress is of particular concern when chemical protective garments are worn because they prevent evaporative body cooling. Wearing PPE places employees at considerable risk of developing heat stress.

Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of the most common (and potentially serious) illnesses, regular monitoring and other preventive precautions are vital.

Heat Rash. Heat rash can be caused by continuous exposure to hot and humid air and skin abrasion from sweat-soaked clothing, rubber boots, or impermeable waders. The condition is characterized by a localized red skin rash and reduced sweating. Heat rash reduces the ability to tolerate heat. To treat, keep skin hygienically clean and allow it to dry thoroughly after using chemical protective clothing. Take measures to prevent heat rash by changing clothes often to maximize use of dry garments, or taking frequent breaks to allow doffing of equipment and drying of skin.

Heat Cramps. Heat cramps are caused by profuse perspiration with inadequate electrolytic fluid replacement. This often robs the larger muscle groups (stomach and quadriceps) of blood, which can cause painful muscle spasms and pain in the extremities and abdomen. To treat, move the employee to a cool place and give sips of water or an electrolytic drink. Watch for signs of heat exhaustion or heat stroke.

Heat Exhaustion. Heat exhaustion is a mild form of shock caused by increased stress on various organs to meet increased demand to cool the body. Onset is gradual and symptoms should subside within 1 hour. Symptoms include a weak pulse; shallow breathing; pale, cool, moist skin; profuse sweating; dizziness; and fatigue. To treat, move the employee to a cool place and remove as much clothing as possible. Give sips of water or electrolytic solution and fan the person continuously to remove heat by convection. Do not allow the affected person to become chilled. Treat for shock if necessary.

Heat Stroke. Heat stroke is the most severe form of heat stress; the body must be cooled immediately to prevent severe injury and/or death. ***This is a medical emergency!*** Symptoms include red, hot, dry skin; a body temperature of 105°F or higher; no perspiration; nausea; dizziness and

confusion; and a strong, rapid pulse. Because heat stroke is a true medical emergency, transport the individual to a medical facility immediately. Prior to transport, remove as much clothing as possible and wrap the individual in a sheet soaked with water. Fan the individual vigorously while transporting to help reduce body temperature. If available, apply cold packs under the arms, around the neck, or any other place where they can cool large surface blood vessels. If transportation to a medical facility is delayed, reduce body temperature by immersing the individual in a cool-water bath (however, be careful not to over-chill the individual once body temperature is reduced below 102°F). If this is not possible, keep the individual wrapped in a sheet and continuously douse with water and fan.

12.2.2.2 Prevention

The implementation of preventative measures is the most effective way to limit the effects of heat-related illnesses. During periods of high heat, adequate liquids must be provided to replace lost body fluids. Replacement fluids can be a 0.1% saltwater solution, a commercial mix such as Gatorade, or a combination of these with fresh water. The replacement fluid should be kept cool, 50°F to 60°F, and it should be placed close to the work area. Employees must be encouraged to drink more than the amount required to satisfy thirst. Employees should also be encouraged to salt their foods more heavily during hot times of the year.

Cooling devices such as vortex tubes or cooling vests can be worn beneath impermeable clothing. If cooling devices are worn, only physiological monitoring will be used to determine work activity.

All site personnel are to rest when any symptoms of heat stress are noticed. Rest breaks are to be taken in a cool, shaded rest area. Employees shall remove chemical protective garments during rest periods and will not be assigned other tasks.

All employees shall be informed of the importance of adequate rest and proper diet, including the harmful effects of excessive alcohol and caffeine consumption.

12.2.2.3 Monitoring

Heat stress monitoring should be performed when employees are working in environments exceeding 90°F ambient air temperature. If employees are wearing impermeable clothing, this monitoring should begin at 77°F. There are two general types of monitoring that the health and safety representative can designate to be used: wet bulb globe temperature (WBGT), and physiological. The Heat Stress Monitoring Record form (see Appendix A) will be used to record the results of heat stress monitoring.

Note that some states such as Washington and California have specific regulatory standards for protection of employees from heat stress-related injuries.

Wet Bulb Globe Temperature (WBGT). The WBGT index is the simplest and most suitable technique to measure the environmental factors that most nearly correlate with core body temperature and other physiological responses to heat. When WBGT exceeds 25°C (77°F), the work regimen in Table 12-4 should be followed.

Table 12-4
Permissible Heat Exposure Threshold Limit Values

Work/Rest Regimen	Workload		
	Light	Moderate	Heavy
Continuous work	86°F (30.0°C)	80°F (26.7°C)	77°F (25.0°C)
75% work, 25% rest each hour	87°F (30.6°C)	82°F (28.0°C)	78°F (25.9°C)
50% work, 50% rest, each hour	89°F (31.4°C)	85°F (29.4°C)	82°F (27.9°C)
25% work, 75% rest, each hour	90°F (32.2°C)	88°F (31.1°C)	86°F (30.0°C)
These TLVs assume that nearly all acclimated, fully-clothed site personnel with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 100.4°F (38°C).			

(From OSHA Technical Manual, Section III: Chapter 4 - Heat Stress)

The TLVs denoted in Table 12-4 apply to physically fit and acclimatized individuals wearing light, summer clothing. If heavier clothing that impedes sweat or has a higher insulation value is required, the permissible heat exposure TLVs should be adjusted based on the WBGT Correction Factors in Table 12-5.

Table 12-5
Wet Bulb Globe Temperature Correction Factors

Clothing Type	WBGT Correction
Summer lightweight working clothing	0°F (0°C)
Cotton coveralls	-3.6°F (-2°C)
Winter work clothing	-7.2°F (-4°C)
Water barrier, permeable	-10.8°F (-6°C)
Fully encapsulating	-14.4°F (-10°C)

Physiological. Physiological monitoring can be used in lieu of, or in addition to, WBGT. This monitoring can be self-performed once the health and safety representative demonstrates appropriate techniques to affected employees. Because individuals vary in their susceptibility to heat,

this type of monitoring has its advantages. The following two parameters are to be monitored at the beginning of each rest period:

- **Heart Rate:** The maximum heart rate (MHR) is the amount of work (beats) per minute a healthy person's heart can be expected to safely deliver. Each individual will count his/her radial (wrist) pulse for 1 minute as early as possible during each rest period. If the heart rate of any individual exceeds 75% of his/her calculated MHR (MHR = 200 - age) at the beginning of the rest period, then the work cycle will be decreased by one-third. The rest period will remain the same. An individual is not permitted to return to work until his/her sustained heart rate is below 75% of his/her calculated MHR.
- **Temperature:** Each individual will measure his/her temperature with a thermometer for 1 minute as early as possible in the first rest period. If the temperature exceeds 99.6°F at the beginning of the rest period, then the work cycle will be decreased by one-third. The rest period will remain the same. An individual is not permitted to return to work if his/her temperature exceeds 100.4°F.

12.2.2.4 Training

Employees potentially exposed to heat stress conditions will be instructed on the contents of this procedure. This training can be conducted during daily tailgate safety meetings.

12.2.3 Cold Stress

Observe the following procedures and practices regarding cold stress:

- Take breaks in heated shelters when working in extremely cold temperatures.
- Upon entering the shelter, remove the outer layer of clothing and loosen other layers to promote evaporation of perspiration.
- Drink warm liquids to reduce the susceptibility to cold stress.
- Be aware of cold stress symptoms, including shivering, numbness in the extremities, and sluggishness.
- Provide adequate insulating dry clothing to maintain warmth if work is performed in air temperature below 40°F. Wind chill cooling rates and the cooling power of air are critical factors. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.
- If the air temperature is 32°F or less, hands should be protected.
- If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing in use should be impermeable to water. With more severe work under such conditions, the outer layer should be water repellent, and the outer wear should be changed as it becomes wetted. The outer garments should include provisions for easy ventilation in order to prevent wetting of the inner layer by sweat.

- If available clothing does not give adequate protection to prevent cold injury, work should be modified or suspended until adequate clothing is made available, or until weather conditions improve.
- Implement a buddy system in which site personnel are responsible for observing fellow workers for early signs and symptoms of cold stress.

12.2.3.1 Signs, Symptoms, and Treatment

Cold stress can range from frostbite to hypothermia. The signs and symptoms of cold stress are listed below. The appropriate guidelines should be followed if any personnel exhibit these symptoms:

Frostbite. Frostbite is characterized by pain in the extremities and loss of manual dexterity. "Frostnip," or reddening of the tissue, is accompanied by a tingling or loss of sensation in the extremities and continuous shivering.

Hypothermia. Hypothermia is characterized by pain in the extremities and loss of manual dexterity, with severe, uncontrollable shivering, and an inability to maintain the level of activity. Symptoms include excessive fatigue, drowsiness, irritability, or euphoria. Severe hypothermia includes clouded consciousness, low blood pressure, pupil dilation, cessation of shivering, unconsciousness, and possible death.

Move the individual to a warm, dry place. If the individual's clothing is wet, remove it and replace it with dry clothing. Keep the individual warm. Re-warming of the individual should be gradual to avoid stroke symptoms. Dehydration, or the loss of body fluids, may result in a cold injury due to a significant change in blood flow to the extremities. If the individual is conscious and alert, warm sweet liquids should be provided. Coffee and other caffeinated liquids should be avoided because of diuretic and circulatory effects. Extremities affected by frostbite should be gradually warmed up and returned to normal temperature. Moist compresses should be applied; begin with lukewarm compresses and slowly increase the temperature as changes in skin temperature are detected. Keep the individual warm and calm and move them to a medical facility as soon as possible.

12.2.4 Sunlight and Ultraviolet Exposure

Observe the following procedures and practices regarding ultraviolet (UV) exposure:

- Protect against extended exposure to sunlight with shade, long clothing, sunscreen, and high-SPF, broad-spectrum sunscreen applied frequently.
- Plan work to avoid unnecessary UV exposure (see Section 12.2.4.2).
- During peak daylight months, plan work for early morning or evening.
- Many factors affect the hazards associated with UV exposure, including the following:
  - **Time of day:** UV rays are strongest between 10:00 a.m. and 4:00 p.m.

  - **Season of the year:** UV rays are stronger during spring and summer months. This is less of a factor near the equator.
  - **Distance from the equator (latitude):** UV exposure goes down as you get farther from the equator.
  - **Altitude:** More UV rays reach the ground at higher elevations.
  - **Cloud cover**: The effect of clouds can vary. Sometimes cloud cover blocks some UV from the sun and lowers UV exposure, while some types of clouds can reflect UV and increase UV exposure. What is important to know is that UV rays can get through, even on a cloudy day. Consider monitoring the UV index for your work area: http://www2.epa.gov/sunwise/uv-index.
  - **Reflection off surfaces**: UV rays can bounce off surfaces like water, sand, snow, pavement, or grass, leading to an increase in UV exposure.
- Evaluate site-specific factors affecting UV exposure and address work practices as appropriate.

12.2.4.1 Signs, Symptoms, and Treatment

The best way to treat sunburn is to prevent it using the guidelines listed in the preceding bullets and in Section 12.2.4.2. Signs of sunburn include the following:

- Pinkness or redness
- Skin that feels warm or hot to the touch
- Pain, tenderness, or itching
- Swelling
- Small, fluid-filled blisters, which may break
- Headache, fever, chills, and fatigue if the sunburn is severe

If signs of sunburn are noticed, avoid further exposure and immediately implement treatment. If the sunburn is blistering *and* covers 15% or more of the body, seek medical attention.

12.2.4.2 Prevention

UV exposure hazards and their impacts on each worksite should be evaluated to determine the best practices for risk mitigation. The most effective way to prevent skin damage from UV exposure is to protect bare skin from the exposure. This can be accomplished with shade, clothing (e.g., pants, long sleeves, or hats), sunscreen, and sunglasses. Plan work to either create shade or take advantage of natural shade, and avoid peak UV times during the day when possible.

12.2.5 Inclement Weather

Observe the following procedures and practices regarding inclement weather:

- Evaluate the worksite for hazards that may be amplified during inclement weather, such as traction issues, ingress and egress, slope stability, or wind-driven hazards (e.g., dust, debris, or falling trees).
- Stop outdoor work during electrical storms (lightning strikes), hailstorms, high winds, and other extreme weather conditions such as extreme heat or cold.
- Take cover indoors or in a vehicle that will provide adequate protection. In some cases, this may require exiting the worksite, such as during windstorms in areas with overhead hazards (e.g., trees or power lines).
- Listen to local forecasts for warnings about specific weather hazards such as tornadoes, hurricanes, and flash floods.
- Verify that on-site equipment and resources are adequately protected from inclement weather.
- If working in an unfamiliar geographic location, consult with local resources for unique weather hazards.

12.2.6 Insects and Spiders

Observe the following general procedures and practices regarding insects/spiders:

- Tuck pants into socks.
- Wear long sleeves.
- Use insect repellent.
- Avoid contact by always looking ahead to where you will be walking, standing, sitting, leaning, grabbing, lifting, or reaching.
- Check for signs of insect/spider bites, such as redness, swelling, and flu-like symptoms.

The most dangerous spiders to humans in North America are black widows and brown spiders (also known as brown recluse or fiddleback spiders). A guide to identifying these spiders is presented in Table 12-6.

Table 12-6
North American Hazardous Spider Identification Guide

Hazardous Spider Identification Guide	
Black Widow Spider • Abdomen usually shows hourglass marking • Female is 3 to 4 centimeters in diameter • Have been found in well casings and flush-mount covers • Not aggressive, but more likely to bite if guarding eggs • Light, local swelling and reddening are early signs of a bite, followed by intense muscular pain, rigidity of the abdomen and legs, difficulty breathing, and nausea • If bitten, see a physician as soon as possible	
Brown Spiders (aka Brown Recluse or Fiddleback) • Found in the central and southern United States, although in some other areas, as well • 1/4-to-1/2-inch-long body, and size of a silver dollar • Hide in baseboards, ceiling cracks, and undisturbed piles of material • Bite may either go unnoticed or may be followed by a severe localized reaction, including scabbing, necrosis of the affected tissue, and very slow healing • If bitten, see a physician as soon as possible	

12.2.7 Bees and Wasps

Many encounters with bees and wasps occur when nests built in well casings or excavation areas are disturbed. Before opening a well casing, take a few moments to observe whether or not insects are entering or exiting. If they are flying to and from the casing, avoid it if possible. If you must be in an area where disturbing a nest is likely, be sure to wear long pants and a long-sleeved shirt. Stinging insects fly around the top of their target, so if you get into trouble, pull a portion of your shirt over your head and run away.

If you get stung, look for a stinger and, if one is present, remove it as soon as possible. Several over-the-counter products or a simple cold compress can be used to alleviate the pain of the sting. If the sting is followed by severe symptoms, or if it occurs in the neck or the mouth, seek medical attention immediately because swelling could cause suffocation.

If you need to destroy a nest, consult with the PM and project FL first. Commercially available stinging insect control aerosols are very effective, but could potentially contaminate the well. Once the nest is destroyed, fine mesh may be applied over the exit and entry points of a well casing to prevent re-infestation.

12.2.8 Ticks

Ticks in North America can be carriers of several diseases, including Lyme disease, Rocky Mountain spotted fever, and ehrlichiosis.

Limiting exposure to ticks reduces the likelihood of infection when exposed to tick-infested habitats. Measures to prevent tick exposure include the following:

- Remove leaf litter and brush in areas where you will be working prior to tick season.
- Wear light-colored clothing so that ticks are visible.
- Tuck your pant legs into your socks.
- Apply repellents to discourage tick attachment.
- Promptly inspect your body and remove crawling or attached ticks when you leave a tick-infested area.
- Conduct tick checks on buddies upon exiting any suspect area (may be needed multiple times per work day).
- Be aware of seasonal activity; ticks are often most active in the spring.

Observe the following procedures and practices if you are bitten by a tick:

- Use fine-tipped tweezers or shield your fingers with tissue, paper towel, or rubber gloves.
- Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause mouthparts to break off and remain in the skin.
- Do not squeeze, crush, or puncture the body of the tick because its fluids may contain infectious organisms.
- Do not handle the tick with bare hands because infectious agents may enter through mucous membranes or breaks in the skin.
- After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.
- You may wish to save the tick for identification in case you become ill within 2 to 3 weeks. Place the tick in a sealed plastic bag in the freezer, and mark the bag with the date of the bite.

12.2.9 Mosquitoes

Mosquitoes in the United States have been known to carry West Nile virus, Zika virus, St. Louis encephalitis, and dengue fever. Avoid mosquito bites by doing the following:

- Apply insect repellent containing DEET (N,N-diethyl-meta-toluamide) when outdoors. DEET is very effective, but could potentially contaminate samples.
- Read and follow the product directions whenever you use insect repellent.

- Wear long-sleeved clothes and long pants treated with repellent to further reduce your risk, or stay indoors during peak mosquito feeding hours (dusk until dawn).
- Limit the number of places available for mosquitoes to lay their eggs by eliminating standing water sources from around the work area.
- If you need to destroy a nest, consult with the PM and project FL first.
- Check to see if there is an organized mosquito control program near the project site. If no program exists, work with the local government officials to establish a program.

12.2.9.1 Zika Virus

The Zika virus has generated concern starting in 2016 in the southern United States. According to the Centers for Disease Control and Prevention,[3] Zika infection during pregnancy can cause a birth defect of the brain called microcephaly and other severe fetal brain defects. There have also been increased reports of Guillain-Barré syndrome, an uncommon sickness of the nervous system, in areas affected by Zika. The practices listed in the bullets above should be followed to avoid mosquito bites and help prevent contraction of the Zika virus. Symptoms of Zika and treatment options are listed below, should you suspect that you or another employee has been in contact with Zika-infected mosquitoes:

- The most common symptoms of Zika (similar to those of dengue fever) are fever, rash, joint pain, or conjunctivitis (red eyes). Other common symptoms include muscle pain and headache. The incubation period (the time from exposure to symptoms) for Zika virus disease is not known, but is likely to be a few days to a week.
- The illness is usually mild, with symptoms lasting for several days to a week. Severe disease requiring hospitalization is uncommon.
- Call WorkCare or see your healthcare provider if you develop the symptoms described above and have visited an area where Zika is found. If you have recently traveled, tell your healthcare provider when and where you traveled. Your healthcare provider may order blood tests to look for Zika or other similar viruses like dengue fever.

12.2.10 The Public at Large

The community residents around worksites may pose their own specific hazards. These conditions may include the following:

- Unintentional disruption of work
- Benign or malicious trespass
- Criminal intent

[3] https://www.cdc.gov/zika/about/overview.html

Scenarios may include the following:

- Pedestrians, cyclists, or motorists disregarding site boundaries due to distraction or willful disobedience.
- Public use of private site facilities for shelter, relief, and other reasons with no ill-intention.
- Public use of private site facilities for mischievous or criminal activity, such as loitering, vandalism, or theft.
- Encounters with community members who are disgruntled with the project activity.
- Encounters with criminal activities on or near a project site.

If any of the previously mentioned scenarios are anticipated to be likely, take the following precautions as appropriate:

- Verify that the site is adequately marked and barricaded to limit unintentional disruptions of the work by the public.
- Review the site for attractive nuisances (e.g., hazards or conditions that are likely to attract children), and mitigate those.
- Secure all equipment and site facilities to prevent unauthorized access or use.
- Remove valuable items from the site or adequately secure them on site to limit the temptation for potential criminals.
- Have contact information for the client's or owner's public relations office while on site, and direct disgruntled community members to that office. If necessary, vacate the site to relieve the situation and notify the PM or FL.
- Work in pairs when uncertain of the public safety situation at a site. In questionable situations, postpone work as necessary until a plan of action can be developed to verify a safe working environment.

12.2.11 Personal Health and Safety

In addition to hazards associated with chemicals of concern, equipment, operations, or site conditions discussed above, there may be additional personal safety issues to consider at a site, including those related to one or multiple protected classes, such as race, gender, religion, ability, sexual orientation, or gender identity. These conditions may involve the following, perpetrated by the public or those associated with the work:

- Malicious disruption of work
- Harassment, including unwanted comments, gestures, or actions
- Threats of violence, either implied (using derogatory language) or explicit
- Assault

It is critical that the work environment be discussed within the project team to evaluate risks, ways to avoid those risks, and communication protocols. Anchor QEA requires that work be performed in teams.

Specifically, if any of the above are anticipated, take the following precautions as appropriate:

- Alert the PM, FL, CHSM, and Human Resources Department of potential issue(s).
- Formulate a plan of action to verify and maintain a safe working environment prior to field work, which may include the following:
  - Working in pairs and/or within a certain physical distance of other work groups.
  - Coordinated check-ins (calls to or from the office or visual check-ins with other field members).
- Whenever possible, schedule work only within daylight hours (which fluctuate seasonally) or on weekends when questionable scenarios may be less likely.
  - If night work is required, maintain a minimum of two field personnel at all times, and potentially increase the total number of personnel.
  - If working in high-risk areas, discuss the possibility of hiring security if work needs to be performed at night, in low light, or near potentially dangerous areas (e.g., abandoned buildings, public displays of hostility, discrimination, or gang-related activity).
- Maintain a field phone with active GPS and non-locking 911 capability at all times while out in the field.
- If a need arises for a change in field work (e.g., additional sampling or moving to an area that was not planned) or travel plans (e.g., dead battery or flat tire), immediately alert the FL and PM as to the event.

In addition, practice active awareness of your environment. Discuss personal health and safety concerns at the daily tailgate meeting. If you feel unsafe based on the potential behavior of others, immediately bring it up to field team coworkers. If the issue is not resolved to your satisfaction, alert the PM, FL, CHSM, and Human Resources Department to assist in resolving any potential issue(s).

13 Medical Monitoring Program

This section describes the medical monitoring program that Anchor QEA field personnel must comply with when working on sites where there is a potential for exposure to hazardous wastes or other hazardous substances.

13.1 General Requirements

Anchor QEA employees shall be enrolled in a medical monitoring program in compliance with OSHA standards (29 CFR 1910.120(f)) under the following circumstances:

- If they are involved with any of the following operations:
  - *Cleanup operations* required by a governmental body, whether federal, state, local, or other involving hazardous substances that are conducted at uncontrolled hazardous waste sites (including, but not limited to, the EPA's National Priority List [NPL] sites, state priority list sites, sites recommended for the EPA NPL, and initial investigation of government-identified sites that are conducted before the presence or absence of hazardous substances has been ascertained)
  - *Corrective actions* involving cleanup operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA) as amended (42 United States Code 6901 et seq)
  - *Voluntary cleanup operations* at sites recognized by federal, state, local, or other governmental bodies as uncontrolled hazardous waste sites
  - *Operations involving hazardous wastes* that are conducted at treatment, storage, and disposal facilities regulated by 40 CFR 264 and 40 CFR 265 pursuant to RCRA or by agencies under agreement with the EPA to implement RCRA regulations
  - *Emergency response operations* for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard
- And, if they meet the following criteria:
  - Are or may be exposed to hazardous substances or health hazards at or above the established PEL, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more per year
- In addition, employees are required to be enrolled in the medical monitoring program if they meet any of the following conditions:
  - Wear a respirator for 30 days or more per year
  - Are injured, become ill, or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operations
  - Are members of a Hazardous Materials (HAZMAT) team

Anchor QEA employees required to be enrolled in a medical monitoring program under 29 CFR 1910.120(f) shall have medical examinations and consultations made available to them by Anchor QEA on the following schedule:

- Prior to assignment
- At least once every 12 months unless the attending physician believes a longer interval (not greater than biennially) is appropriate
- At termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last 6 months
- As soon as possible upon notification that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the PEL or published exposure levels in an emergency situation
- At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary

The content of medical examinations or consultations made available to employees shall be determined by the attending physician but shall include, at a minimum, a medical and work history with special emphasis on symptoms related to the handling of hazardous substances and health hazards, and to fitness for duty including the ability to wear any required PPE under conditions (i.e., temperature extremes) that may be expected at the work site.

The attending physician shall provide Anchor QEA with a written opinion for each examined employee that contains the following information:

- Whether the employee has any detected medical conditions that would place the employee at an increased risk of impairment of the employee's health from hazardous waste operations work, emergency response, or respirator use
- Any recommended limitations on the employee's assigned work
- A statement that the employee has been informed of the results of the medical examination and any medical conditions that require further examination or treatment

The written opinion obtained by Anchor QEA shall not reveal specific findings or diagnoses unrelated to occupational exposures. Medical monitoring and other employee-related medical records shall be retained for at least the duration of employment plus 30 years.

13.2 Team Self-Monitoring

All personnel will be instructed to look for and inform each other of any deleterious changes in their physical or mental condition during the performance of all field activities. Examples of such changes are as follows:

- Headaches
- Dizziness
- Nausea
- Blurred vision
- Cramps
- Irritation of eyes, skin, or respiratory system
- Skin chafing from damp or wet clothing
- Changes in complexion or skin color
- Changes in apparent motor coordination
- Increased frequency of minor mistakes
- Excessive salivation or changes in papillary response
- Changes in speech ability or speech pattern
- Symptoms of heat stress or heat exhaustion
- Symptoms of hypothermia

If any of these conditions develop, the affected person will be moved from the immediate work location and evaluated. If further assistance is needed, personnel at the local hospital will be notified, and an ambulance will be summoned if the condition is thought to be serious. If the condition is the result of sample collection or processing activities, procedures and/or PPE will be modified to address the problem.

Appendix A
Health and Safety Logs and Forms

EMPLOYEE EXPOSURE/INJURY INCIDENT/SPILL REPORT

EMPLOYEE NAME: _____ **DATE:** _____

PROJECT NAME/NO: _____ **TIME:** _____

TYPE OF OCCURRENCE: ☐ employee exposure ☐ injury incident ☐ spill

SITE NAME AND LOCATION: _____

SITE WEATHER (clear, rain, snow, etc.): _____

NATURE OF ILLNESS/INJURY: _____

SYMPTOMS: _____

ACTION TAKEN: ☐ rest ☐ first aid ☐ medical

TRANSPORTED BY: _____

WITNESSED BY: _____

HOSPITAL NAME: _____ **TREATMENT:** _____

DESCRIBE IN DETAIL HOW THIS EXPOSURE/INJURY INCIDENT/SPILL OCCURRED
(if a spill, list the name of the compounds, quantities, and method of clean-up/containment): _____

_____

_____

_____

_____

_____

WHAT WAS THE PERSON DOING AT THE TIME OF THE ACCIDENT/INCIDENT?: _____

_____

LIST PERSONAL PROTECTIVE EQUIPMENT WORN: _____

_____

WHAT IMMEDIATE ACTION WAS TAKEN TO PREVENT RECURRENCE?: _____

_____

Employee:

Printed Name	Signature	Date

Supervisor:

Printed Name	Signature	Date

Site Safety Representative:

Printed Name	Signature	Date

NOTE: Use additional page(s) if necessary.

ANCHOR QEA

DATE: _____

PROJECT NAME: _____

PROJECT NO: _____

MODIFICATION TO HEALTH AND SAFETY PLAN

MODIFICATION: _____

_____

_____

_____

_____

REASON FOR MODIFICATION: _____

_____

_____

_____

_____

_____

_____

SITE PERSONNEL BRIEFED

NAME: _____ **DATE:** _____

NAME: _____ **DATE:** _____

NAME: _____ **DATE:** _____

NAME: _____ **DATE:** _____

NAME: _____ **DATE:** _____

NAME: _____ **DATE:** _____

NAME: _____ **DATE:** _____

NAME: _____ **DATE:** _____

NAME: _____ **DATE:** _____

NAME: _____ **DATE:** _____

NAME: _____ **DATE:** _____

APPROVALS

FIELD LEAD: _____ _____ _____
Printed Name Signature Date

PROJECT MANAGER: _____ _____ _____
Printed Name Signature Date

Daily Safety Briefing Form

ANCHOR QEA

Date: _____

Project No: _____

Project Name: _____

Person Conducting Meeting: _____ **Health & Safety Officer:** _____ **Project Manager:** _____

TOPICS COVERED: *Highlighted topics are required*

- ☐ Emergency Procedures and Evacuation Route
- ☐ Directions to Hospital
- ☐ HASP Review and Location
- ☐ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/ SDS Location
- ☐ Fire Extinguisher Location
- ☐ Eye Wash Station Location
- ☐ Buddy System
- ☐ Self and Coworker Monitoring
- ☐ Lines of Authority
- ☐ Communication
- ☐ Site Security
- ☐ Vessel Safety Protocols
- ☐ Work Zones
- ☐ Vehicle Safety and Driving/ Road Conditions
- ☐ Equipment Safety and Operation
- ☐ Proper Use of PPE
- ☐ Decontamination Procedures
- ☐ Near Miss Reporting Procedures
- ☐ Lifting Techniques
- ☐ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☐ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking
- ☐ Reviewed Prior Lessons Learned
- ☐ Field Team Medical Conditions for Emergency Purposes (Confidential): _____
- ☐ Other: _____

Weather Conditions: _____

Daily Work Scope: _____

Site-specific Hazards: _____

Safety Comments: _____

Attendees

Printed Name	Signature

End of Day Wellness Check

PLAYING IT SAFE

Utility Contact Prevention Checklist

NOTE: Utility mark-out requirements vary from state to state; consult state authorities before beginning work.

Purpose: This form is intended to help the Field Lead confirm that underground or overhead utilities are identified to the extent practicable and consistent with applicable regulations **PRIOR** to site work.

INVESTIGATIONS MUST NOT OCCUR UNTIL MULTIPLE LINES OF EVIDENCE INDICATE THAT SUBSURFACE OR OVERHEAD UTILITIES ARE NOT PRESENT IN THE WORK AREA

Project Name/No: _____ **Date:** _____

Field Lead: _____ **Project Address:** _____

Project Manager: _____ **Health & Safety Officer:** _____

Emergency Contact Information for One Call: _____

Duration/Summary of Work to be Performed: _____

_____

_____

Consideration	Check		Explanation	Initial
Has the state One Call been contacted?	☐ Yes	☐ No		
Has the property owner or client been contacted for local knowledge of utilities, as applicable?	☐ Yes	☐ No		
Does the property owner or client have specific utility contact prevention procedures and, if so, have they been completed?	☐ Yes	☐ No		
Are any as-built drawings available? If so, do they show any utilities?	☐ Yes	☐ No		
Has a visual inspection of the work area(s) been completed?	☐ Yes	☐ No		
Has the potential presence of in-water utilities been assessed (shore markers, streets dead-ending at water's edge, etc.)	☐ Yes	☐ No		
Is evidence of electrical utilities present? (electric meters on structures, conduits, overhead lines, light poles, etc.)	☐ Yes	☐ No		
Is evidence of water/sewer utilities present? (water meter, hydrants, restrooms, grates in ground, etc.)	☐ Yes	☐ No		
Is evidence of telecommunications utilities present? (fiber optic warning signs, conduits from utility poles, wall-mounted boxes, etc.)	☐ Yes	☐ No		
Is other evidence of utilities present? (unknown ground markings, manholes or valve covers, "Call Before You Dig" signs, linear asphalt or concrete repair characteristics, liner subsidence of ground surface, pin flags or stakes, etc.)	☐ Yes	☐ No		

Utility Contact Prevention Checklist

NOTE: Utility mark-out requirements vary from state to state; consult state authorities before beginning work.

Consideration	Check		Explanation	Initial
Has a private locating service been contacted?	☐ Yes	☐ No		
Were any utilities identified and marked out through a private locating service? If so, duplicate mark-outs on site drawings.	☐ Yes	☐ No		
Are there any fiber optic cables, fuel lines, or high-pressure lines within 50 feet of work locations?	☐ Yes	☐ No		
If fiber optic cables, fuel lines, or high-pressure lines are within 50 feet, has an agreement with the utility owner been established?	☐ Yes	☐ No		
Can a test borehole be advanced by hand digging, probing, post-hole digging, and/or air knifing to 5 feet below ground surface (bgs)?	☐ Yes	☐ No		
If hand digging, probing, post-hole digging, and/or air knifing to 5 feet bgs is not possible, can a non-invasive geophysical investigation be conducted? If not, why?	☐ Yes	☐ No		
Other considerations:				

NOTE: Please fill in second page and attach additional reports, drawings, or other information, as necessary.

Confirmation Number: _____

Contact Name: _____ **Organization:** _____

Contact Date: _____ **Contact Time:** _____

Response: _____

_____

_____

_____

Completed by:

_____ _____ _____

Printed Name Signature Date

Contractor:

_____ _____ _____

Printed Name Signature Date

Appendix B
Job Safety Analysis (JSA) Documents

Job Safety Analysis

Sediment Sampling

Project Name: Harris Avenue Shipyard	**Project Number:** 210007-02.01	**JSA Number:** 001	**Issue Date:** 7/28/2021
Location: 201 Harris Avenue, Bellingham, WA	**Contractor:** Anchor QEA, LLC	**Analysis by:** Sydney Schroeder	**Analysis Date:** 7/28/2021
Work Operation: Sediment sampling	**Superintendent/Competent Person:** Delaney Peterson	**Revised by:** N/A	**Revised Date:** N/A
Required Personal Protective Equipment (PPE): • Modified Level D—Long pants, long sleeves, and/or Tyvek coveralls if handling potentially contaminated media, and steel-toed footwear conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05 • Safety glasses/splash goggles, hard hat, nitrile outer gloves and latex inner gloves, and, if boating, U.S. Coast Guard-approved personal flotation device (PFD; see cold stress section for cold-weather PFD information)		**Reviewed by:** Tim Shaner	**Reviewed Date:** 8/5/2021
		Approved by: Derek Ormerod	**Approved Date:** 8/16/2021

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
If boating		• Follow the Job Safety Analysis (JSA) for boating activities.	
If using glassware		• Follow the JSA for handling glassware.	
Sediment sample retrieval and processing	Injury from hand and power tool operation (e.g., spatula or drill)	• Be aware of sharp edges on hand tools (e.g., spatulas, knives, drill bits, and saw blades). • Be aware of electrical connections and water hazards when working with electric- or battery-operated tools. • Ensure that all tools are working properly; repair or replace defective tools. Repair when unplugged and off. • Keep guards on power tools when not in use.	• Inspect tools to ensure that they are in good working order. • Inspect electrical connections (if applicable). • Inspect tools periodically to ensure dry and clean operation.
	Noise exposure	• Wear hearing protection in high noise environments or when working around heavy machinery or equipment (action level of 85 decibels averaged over an 8-hour day).	• Ensure that hearing protection is available.

Job Safety Analysis

Sediment Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Sediment sample retrieval and processing (continued)	Slips, trips, and falls	• Avoid walking while writing or texting—maintain a heads-up posture. • Be aware of potentially slippery surfaces, including boat decks, riprap, muddy or algae-covered rocks, shoreline plants/seaweed, thick mud, and tripping hazards. Use handrails where available. Wear footwear that has sufficient traction. • Maintain good housekeeping practices. Clean up all spills immediately. • Be aware of weather effects on the work area, including wet and/or frozen ground. • Jumping, running, and horseplay are prohibited. • Be cautious when entering or exiting the vessel, and load/unload items onto/off of the pier or shore once boarded. • Keep all areas clean and free of debris to prevent any trips and falls. • Notify the field team members of any unsafe conditions.	• Routinely inspect work area for unsafe conditions.
	Ingestion of contaminants, or skin or eye contact with contaminants	• Wear appropriate PPE to prevent/reduce exposure. • Contact 911, as necessary; perform CPR if breathing stops. • Move exposed person away from source of contamination, and rinse mouth. If exposure to skin occurs, promptly wash contaminated skin using soap or mild detergent and water. Rinse eyes with large amounts of water. • Follow decontamination procedures as outlined in the Health and Safety Plan (HASP).	• Ensure that decontamination procedures are on hand and are reviewed. • Ensure that PPE and rinsing water are available.
	Muscle strain or injuries from improper lifting	• Use proper lifting techniques or ask for assistance with heavy objects. • If boating, avoid carrying objects directly onto or off the boat; rather, load/unload objects while on the boat to/from the pier/shore.	• Evaluate weight and center of gravity of heavier items prior to lifting or moving.
	Pinch points	• If boating, secure any unsecured objects on deck; they may shift on deck quickly in wave, current, or engine acceleration conditions. • Maintain a safe distance from closing mechanisms and moving parts on sampling gear. • Avoid placing hands or self between boat and dock/piles.	

Job Safety Analysis

Sediment Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Sediment sample retrieval and processing (continued)	Wading	• Be aware of potentially slippery surfaces and tripping hazards such as fallen brush, logs, rocks, and other debris. Wear footwear that has sufficient traction. • Be aware of water depth and potential drop-offs. • Be aware of existing and projected river flows. • Wear hip or chest waders as appropriate for traction and to protect against cold water. • Keep an extra set of dry clothes on hand, including socks. • Use a wading staff for balance and to check for obstructions in murky water. • Always wear a PFD equipped with a whistle, even if water looks shallow or slow; drop-offs occur, and water is often moving faster than it looks. • Waders should fit the person and not be overly baggy. • A wading belt should always be worn (some waders come equipped with one). • Felt and/or studded wading boots should be worn. • When water is deeper than knee deep, walk sideways, at an angle, or shuffle your feet when walking and never cross your feet. • Bottom conditions, water conditions, and flow can change and must be considered when determining safe allowable wading depth. Higher flow conditions will reduce the safe allowable wading depth. • Water should be entered from the bank and only from a boat that is anchored or on the bank. • If a boat is being used, all applicable boating H&S procedures should be followed (e.g., throwable safety buoy/line (throw bag). • When entering the water, depth at entry point should be 1 foot or less and the bottom visible. • Wading should not be conducted if there is overhanging vegetation, logs, or other obstructions that would prevent standing upright while wading. • If the current makes it difficult to hold your position, stop and cease wading. • Deepest water depth acceptable for wading is to an individual's waist. If water depth increases beyond that point, do not proceed into deeper water. Look for an area with shallower water. If shallower water cannot be found, work must be completed from a boat.	• Inspect work area for tripping hazards visible from streambank. • Inspect waders for leaks. • Check depths and flows before wading. • Ensure that change of dry clothes is available if wading in cold weather or cold water conditions. • Inspect PFDs for integrity, particularly the cartridge charge on inflatable PFDs.

Job Safety Analysis

Sediment Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Working outdoors	Heat stress	• Adjust work schedules, as necessary, to avoid the hottest part of the day. • Take rest breaks as warranted. • Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods. • Maintain body fluids at normal levels. • Train workers to recognize the symptoms of heat-related illness.	• Review weather forecast prior to field work. • Monitor workers' physical conditions. • Monitor outside temperature versus worker activity.
	Cold stress	• Provide shelter (enclosed, heated environment) to protect personnel during rest periods. • Educate workers to recognize the symptoms of frostbite and hypothermia. • Use appropriate cold-weather gear, up to and including Mustang-type bib coveralls or jacket/bib combinations. • Consider additional precautions if working near water in cold weather. • Have a dry change of clothing available. • Train workers to recognize the symptoms of cold-related illness.	• Review weather forecast prior to field work. • Monitor workers' physical conditions and PPE. • Monitor outside and water temperature versus worker activity and PPE.
	Rain or snow	• Wear appropriate PPE (rain gear). • Be aware of slip hazards, puddles, and electrical hazards when working in wet conditions. • If extremely cold conditions are forecast, consider additional precautions or postponing work activity.	• Review weather forecast prior to field work. • Inspect PPE daily prior to use. • Routinely inspect work area for deteriorating conditions.
Working outdoors (continued)	Sunshine	• Have sunscreen available for ultraviolet protection. • Have abundant water available to prevent dehydration. • Consider wearing wide-brimmed headwear and light-colored, lightweight, sun-blocking clothing.	• Ensure that sunscreen and water are available.
	Lightning	• Do not begin or continue work until lightning subsides for 30 minutes. Disconnect and do not use or touch electronic equipment. • Immediately head for shore if on the water and lightning is observed. If not able to get to shore, disconnect and do not use or touch the major electronic equipment, including the radio, throughout the duration of the storm.	• Obtain weather forecast and updates as needed.

Job Safety Analysis

Sediment Sampling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Working outdoors (continued)	High winds	• Wear goggles or safety glasses if dust or debris are visible.	• Review weather forecast prior to field work. • Ensure that goggles or safety glasses are available.
	Biological hazards (flora [e.g., poison ivy and poison oak] and fauna [e.g., ticks, bees, spiders, mosquitoes, and snakes])	• Be aware of likely biological hazards in the work area. • Wear appropriate clothing (i.e., hat, long-sleeve shirt, long pants, leather gloves, boots, and Tyvek coveralls, as appropriate), and apply insect repellant. • Wear hand and arm protection when clearing plants or debris from the work area.	• Ensure that insect repellent is available. • Inspect clothing and skin for insects (e.g., ticks) after working in insect-prone areas.

Training Requirements:

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- If boating is involved, and a professional captained vessel is not in use, boat operators must take the appropriate state or provincial boater safety courses.
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Job Safety Analysis

General Boating Activities

Project Name: Harris Avenue Shipyard	**Project Number:** 210007-02.01	**JSA Number:** 002	**Issue Date:** 7/28/2021
Location: 201 Harris Avenue, Bellingham, WA	**Contractor:** Anchor QEA, LLC	**Analysis by:** Sydney Schroeder	**Analysis Date:** 7/28/2021
Work Operation: General boating activities	**Superintendent/Competent Person:** Delaney Peterson	**Revised by:** N/A	**Revised Date:** N/A
Required Personal Protective Equipment (PPE): • U.S. Coast Guard (USCG)-approved personal flotation device (PFD; see cold stress section for cold-weather PFD information)		**Reviewed by:** Tim Shaner	**Reviewed Date:** 8/5/2021
		Approved by: Derek Ormerod	**Approved Date:** 8/16/2021

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Walking on deck	Pinch points	• Secure any unsecured objects on deck; they may shift quickly in wave, current, or engine acceleration conditions. • Maintain a safe distance from closing mechanisms and moving parts, such as on sampling gear. • Avoid placing your hands or yourself between the boat and the dock or piles.	
	Slips, trips, and falls	• Avoid walking while writing or texting—maintain a heads-up posture. • Be aware of potentially slippery surfaces, including boat decks, riprap, muddy or algae-covered rocks, shoreline plants or seaweed, thick mud, and tripping hazards. Use handrails where available. Wear footwear that has sufficient traction. • Maintain good housekeeping practices. Clean up all spills immediately. • Be aware of weather effects on the work area, including wet and/or frozen ground. • Jumping, running, and horseplay are prohibited. • Be cautious when entering or exiting the vessel, and load/unload items onto/off of the pier or shore once boarded. • Keep all areas clean and free of debris to prevent any trips and falls. • Notify the field team members of any unsafe conditions. • Keep rope lines neatly coiled and stowed. Avoid stepping on or over lines.	• Routinely inspect work area for unsafe conditions.
	Exceeding boat capacity	• Keep the number of passengers and equipment as posted on boat placards within limits at all times. If conditions warrant, reduce capacity to maintain boat stability.	• Ensure that field team is aware of limits and adheres accordingly.

Job Safety Analysis

General Boating Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Walking on deck (continued)	Noise exposure	• Wear hearing protection in high noise environments or when working around heavy machinery or equipment (action level of 85 decibels averaged over an 8-hour day).	• Ensure that hearing protection is available.
Working outdoors	Heat stress	• Adjust work schedules, as necessary, to avoid the hottest part of the day. • Take rest breaks as warranted. • Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods. • Maintain body fluids at normal levels. • Train workers to recognize the symptoms of heat-related illness.	• Review weather forecast prior to field work. • Monitor workers' physical conditions. • Monitor outside temperature versus worker activity.
	Cold stress	• Provide shelter (enclosed, heated environment) to protect personnel during rest periods. • Educate workers to recognize the symptoms of frostbite and hypothermia. • If the combined air and water temperature is below 90 degrees Fahrenheit (˚F), wear a USCG-approved float coat, Mustang-type bib coveralls, or one-piece survival suit. • Have a dry change of clothing available. • Train workers to recognize the symptoms of cold-related illness.	• Review weather forecast prior to field work. • Monitor workers' physical conditions and PPE. • Monitor outside and water temperature versus worker activity and PPE.
	Rain or snow	• Wear appropriate PPE (rain gear). • Be aware of slip hazards, puddles, and electrical hazards when working in wet conditions. • If extremely cold conditions are forecast, consider additional precautions or postponing work activity.	• Review weather forecast prior to field work. • Inspect PPE daily prior to use. • Routinely inspect work area for deteriorating conditions.
	Sunshine	• Have sunscreen available for ultraviolet protection. • Have abundant water available to prevent dehydration. • Consider wearing wide-brimmed headwear and light-colored, lightweight, sun-blocking clothing.	• Ensure that sunscreen and water are onboard.
	Fog	• Wait for fog to lift for adequate visibility.	• Review weather forecast prior to field work.

Job Safety Analysis

General Boating Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Working outdoors (continued)	Lightning	• Do not begin or continue work until lightning subsides for at least 30 minutes. Disconnect and do not use or touch electronic equipment. • Immediately head for shore if on the water and lightning is observed. • If not able to get to shore, disconnect and do not use or touch the major electronic equipment, including the radio, throughout the duration of the storm.	• Obtain weather forecast and updates as needed.
	High river flows or high waves	• Be aware of waves and forecasts and recent rainfall in your watershed.	• Have forecast available.
	High winds	• Wear goggles or safety glasses if dust or debris are visible. • Stow or secure loads or equipment that could be moved by wind, particularly when underway.	• Review weather forecast prior to field work. • Ensure that goggles or safety glasses are onboard.
	Biological hazards (e.g., mosquitoes, deer flies, and horse flies)	• Wear appropriate clothing (i.e., hat, long-sleeve shirt, long pants, leather gloves, boots, and Tyvek coveralls, as appropriate), and apply insect repellent.	• Ensure that insect repellent is onboard.
Vessel emergencies	Person overboard	If you witness someone fall overboard: • Yell, "Person overboard!" • Throw a flotation device immediately. • If the engine is running, take it out of gear and swing the stern clear to keep from hitting the person. • Call 911 or USCG as appropriate. • Assign a spotter to keep the person in sight at all times. • Contact nearby vessels for assistance. • Recover the person from the water. If you fall overboard: • Hold your mouth and nose closed and protect your head. • When you reach the surface, look for movement, listen for sounds, and call for help. Use the whistle attached to the PFD and activate the beacon light. • It is only sensible to swim if there is reason to believe you have a chance of reaching your destination. Too much movement in cold water causes hypothermia.	• Ensure that flotation devices are available. • Ensure that team wears PFDs. • Inspect PFDs for integrity, particularly the cartridge charge on inflatable PFDs.

Job Safety Analysis

General Boating Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Vessel emergencies (continued)	Fire, abandon ship	• Be prepared to abandon ship in case of major fire (too large to control with a fire extinguisher), or other emergency. • Only the boat captain can order abandon ship. • Communicate intent to abandon ship to all personnel onboard. • Notify USCG and nearby vessels of intent to abandon ship. • Call 911. • Notify the Project Manager and Field Lead, if time permits. • Be aware of the propeller position before abandoning ship. • Identify a rally point for all personnel. • Know the dangers of hypothermia. • Use the buddy system to support injured personnel.	• Ensure that fire extinguisher is available, current, and in working order. • Review abandon ship procedures with field team prior to work.
Navigation	Boat traffic	• Maintain a safe operating distance from shoreline and other vessels.	• Be aware of on-water surroundings.
Motor vehicle operation and trailering	Boat not secured properly	• Ensure that latches, straps, antennas, and onboard gear are secure. Ensure that motor is up and lights are plugged in for driving. • Follow Job Safety Analysis (JSA) for motor vehicle operation.	• Inspect around entire boat before driving.

Training Requirements:

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- If professional captained vessel is not in use, boat operators must take appropriate state or provincial boater safety courses.
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Job Safety Analysis

Decontamination Activities

Project Name: Harris Avenue Shipyard	**Project Number:** 210007-02.01	**JSA Number:** 003	**Issue Date:** 7/28/2021
Location: 201 Harris Avenue, Bellingham, WA	**Contractor:** Anchor QEA, LLC	**Analysis by:** Sydney Schroeder	**Analysis Date:** 7/28/2021
Work Operation: Decontamination activities	**Superintendent/Competent Person:** Delaney Peterson	**Revised by:**	**Revised Date:**
Required Personal Protective Equipment (PPE): • High-visibility safety vest • Hard hat where overhead hazards and/or heavy equipment are present • U.S. Coast Guard-approved personal flotation device (PFD), if boating (see cold stress section for cold-weather PFD information)		**Reviewed by:** Tim Shaner	**Reviewed Date:** 8/5/2021
		Approved by: Derek Ormerod	**Approved Date:** 8/16/2021

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
If boating		• Follow the Job Safety Analysis (JSA) for boating activities.	
Decontamination area set up	Vehicle, heavy equipment traffic, or boat traffic in work area	• Wear high-visibility safety vest and hard hat PPE. • Be alert when working around heavy equipment and/or other boats, especially if wearing hearing protection.	• Ensure that safety vests are available for staff and visitors.
	Muscle strain or injuries from improper lifting	• Use proper lifting techniques or ask for assistance with heavy objects. • If boating, avoid carrying objects directly onto or off of the boat; rather, load/unload objects while on the boat to/from the pier/shore.	• Evaluate weight and center of gravity of heavier items prior to lifting or moving.
	Biological hazards (flora [e.g., poison ivy, and poison oak] and fauna [e.g., ticks, bees, spiders, mosquitoes, and snakes])	• Be aware of likely biological hazards in the work area. • Wear appropriate clothing (i.e., hat, long-sleeve shirt, long pants, leather gloves, boots, and Tyvek coveralls, as appropriate), and apply insect repellent. • Wear hand and arm protection when clearing plants or debris from the work area.	• Ensure that insect repellent is available. • Inspect clothing and skin for insects (e.g., ticks) after working in insect-prone areas.

Job Safety Analysis

Decontamination Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Decontamination activities	Injury from hand and power tool operation (e.g., spatula or drill)	• Be aware of sharp edges on hand tools (e.g., spatulas, knives, drill bits, and saw blades). • Be aware of electrical connections and water hazards when working with electric- or battery-operated tools. • Ensure that all tools are working properly; repair or replace defective tools. Repair when unplugged and off. • Keep guards on power tools when not in use.	• Inspect tools to ensure that they are in good working order. • Inspect electrical connections (if applicable). • Inspect tools periodically to ensure dry and clean operation.
	Noise exposure	• Wear hearing protection in high noise environments or when working around heavy machinery or equipment (action level of 85 decibels averaged over an 8-hour day).	• Ensure that hearing protection is available.
	Slips, trips, and falls	• Avoid walking while writing or texting—maintain a heads-up posture. • Be aware of potentially slippery surfaces and tripping hazards. Use handrails where available. Wear footwear that has sufficient traction. • Maintain good housekeeping practices. Clean up all spills immediately. • Be aware of weather effects on the work area, including wet and/or frozen ground. • Jumping, running, and horseplay are prohibited. • Keep all areas clean and free of debris to prevent any trips and falls. • Notify the field team members of any unsafe conditions.	• Routinely inspect work area for unsafe conditions.
	Ingestion of contaminants or decontamination fluids, or skin or eye contact with contaminants or decontamination fluids	• Wear appropriate PPE to prevent/reduce exposure. • Contact 911, as necessary; perform CPR if breathing stops. • Move exposed person away from source of contamination, and rinse mouth. If exposure to skin occurs, promptly wash contaminated skin using soap or mild detergent and water. Rinse eyes with large amounts of water. • Follow decontamination procedures as outlined in the Health and Safety Plan (HASP).	• Ensure that decontamination procedures are on hand and are reviewed. • Ensure that PPE and rinsing water are available.
Working outdoors	Heat stress	• Adjust work schedules, as necessary, to avoid the hottest part of the day. • Take rest breaks as warranted. • Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods. • Maintain body fluids at normal levels. • Train workers to recognize the symptoms of heat-related illness.	• Review weather forecast prior to field work. • Monitor workers' physical conditions. • Monitor outside temperature versus worker activity.

Job Safety Analysis

Decontamination Activities

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Working outdoors (continued)	Cold stress	• Provide shelter (enclosed, heated environment) to protect personnel during rest periods. • Educate workers to recognize the symptoms of frostbite and hypothermia. • Use appropriate cold-weather gear, up to and including Mustang-type bib coveralls or jacket/bib combinations. • Consider additional precautions if working near water in cold weather. • Have a dry change of clothing available. • Train workers to recognize the symptoms of cold-related illness.	• Review weather forecast prior to field work. • Monitor workers' physical conditions and PPE. • Monitor outside and water temperature versus worker activity and PPE.
	Rain or snow	• Wear appropriate PPE (rain gear). • Be aware of slip hazards, puddles, and electrical hazards when working in wet conditions. • If extremely cold conditions are forecast, consider additional precautions or postponing work activity.	• Review weather forecast prior to field work. • Inspect PPE daily prior to use. • Routinely inspect work area for deteriorating conditions.
	Sunshine	• Have sunscreen available for ultraviolet protection. • Have abundant water available to prevent dehydration. • Consider wearing wide-brimmed headwear and light-colored, lightweight, sun-blocking clothing.	• Ensure that sunscreen and water are available.
	Lightning	• Do not begin or continue work until lightning subsides for at least 30 minutes. Disconnect and do not use or touch electronic equipment.	• Obtain weather forecast and updates as needed.
	High winds	• Wear goggles or safety glasses if dust or debris are visible.	• Review weather forecast prior to field work. • Ensure that goggles or safety glasses are available.

Decontamination Activities

Training Requirements:

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- If boating is involved, and a professional captained vessel is not in use, boat operators must take the appropriate state or provincial boater safety courses.
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Project Name: Harris Avenue Shipyard	**Project Number:** 210007-02.01	**JSA Number:** 004	**Issue Date:** 7/28/2021
Location: 201 Harris Avenue, Bellingham, WA	**Contractor:** Anchor QEA, LLC	**Analysis by:** David Gillingham	**Analysis Date:** 7/28/2021
Work Operation: Anchor QEA motor vehicle operation	**Superintendent/Competent Person:** Delaney Peterson	**Revised by:**	**Revised Date:**
Required Personal Protective Equipment (PPE): • Wear seat belt at all times • Make sure that clothing will not interfere with driving		**Reviewed by:** Tim Shaner	**Reviewed Date:** 8/5/2021
		Approved by: Derek Ormerod	**Approved Date:** 8/16/2021

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Anchor QEA motor vehicle operation	Unfamiliar with the vehicle	• Allow yourself some time to get familiar with an Anchor QEA vehicle, a rental vehicle, or one not used often. • Test the lights, windshield wipers, hazard lights, horn, parking brake, and other important functions. • Review the dashboard controls, steering radius, and overhead and side clearances. • Allow extra side, front, and back space around the vehicle while driving or parking an unfamiliar vehicle. • Adjust mirrors and the seat while the vehicle is in park. • Drive slowly in confined locations, as in a parking garage, parking lots, or industrial settings. Confirm adequate clearances by sight before turning or backing up in tight or unfamiliar locations. • Use a second person to be a spotter outside the vehicle if needed in tight spaces.	• Inspect fluid levels and air pressure in tires, adjust mirrors and seat positions appropriately, monitor the fuel level, and fill up when the fuel level is low
	Speed and braking	• Fasten and properly adjust the seat belt. • Obey all posted and designated speed limits. • Radar detectors are prohibited in all company-owned, leased, or rented vehicles. • Reduce travel speed during hazardous conditions (e.g., rain, fog, or snow). • Identify whether your vehicle has Anti-Lock Brakes (ABS). If it does, DO NOT pump the brakes to stop when the vehicle has begun to skid. Apply steady pressure to the brakes. If the vehicle does not have ABS, pump the brakes to stop during slippery conditions.	• Seatbelt • Identify designated speed limits • Determine if vehicle has ABS

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Anchor QEA motor vehicle operation (continued)	Distance spacing	• Continually check your rear and side view mirrors. • Use the 3-second rule to keep a safe distance between vehicles. • Increase the 3-second rule as necessary during hazardous travel conditions. • Regularly scan the area you will be entering in the next 10 to 12 seconds. • Always leave yourself an "out" during travel. • When stopping, make sure that you leave enough distance between you and the car in front of you. You should be able to see the rear tires of the vehicle in front when stopped. • Obey the speed limit and traffic regulations. • When at a red light and it turns green, use the "delayed start" technique, by counting to three before you take your foot off the brake. • DO NOT TAILGATE. • Keep headlights (and running lights, if available) on for maximum visibility.	• Seatbelt
	Skids	• If the vehicle has begun to skid out of control, turn the steering wheel in the direction of the skid and re-adjust the wheel, as necessary. • Reduce speed during hazardous travel conditions. • Use 4-wheel drive, if available, when driving vehicles off-road, on steep inclines, or in muddy conditions. • Do not take vehicles off-road if they cannot be operated safely in such conditions.	• Seatbelt
	Blind spots	• Become familiar with any blind spots associated with your vehicle. • Adjust mirrors to give the maximum viewing area. • Use your directional devices to signal all turns and when changing lanes; check rear and side view mirror and glance over your shoulder to check that the lane is clear. • Avoid other driver's blind spots; slow down and let the other vehicle pass. • If parked for an extended period and staying in the vehicle, be sure to inspect the area for changed conditions (e.g., a car that moved in behind you) before leaving.	• Seatbelt • Mirrors
	Backing	• Back into parking spaces upon arrival whenever possible. • Perform a 360-degree walk around the vehicle before backing to identify any new conditions or obstructions. • Use a spotter when backing whenever possible. • Understand hand signals. • Sound the horn prior to backing. • Check the rear and side view mirrors prior to backing. • Back slowly in areas of obstructed vision. • Anticipate others who may be backing out into your pathway and adjust accordingly.	• Seatbelt • Mirrors

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Anchor QEA motor vehicle operation (continued)	Distractions (e.g., cell phones, reading maps or directions, eating)	• Do not engage in distracted driving—focus on operating the vehicle, and on your surroundings (e.g., road conditions and other drivers). • Obey state or local laws regarding cell phone use, at a minimum. • Certain clients prohibit cell phone use regardless of the state you are operating in—know your client's policy. • Use hands-free devices (not hand-held cellular phones) while driving. • Pull over to the side of the road when making a call or checking directions.	• Seatbelt • Hands-free devices connected and ready for use
	Accidents	• In the event of an accident, use the following procedures: – Stop, call for medical assistance, notify police, and complete an accident report and submit it to your supervisor. – Notify the Project Manager (PM) and Field Lead (FL). – Complete the appropriate incident investigation reports. – Contact Sara Weiskotten, Operations Liaison, at (857) 445-4987. – Contact Diana Reynolds, Insurance Liaison, at (302) 236-8403.	• Seatbelt
	Influenced by drugs or alcohol	• NEVER DRIVE UNDER THE INFLUENCE OF DRUGS OR ALCOHOL. • Keep in mind that the person in another vehicle may be under the influence of controlled substances, and be prepared for erratic or sudden driving changes on their part.	• Seatbelt
	Driver attitude	• Do not operate any vehicle when abnormally tired, temporarily disabled (i.e., injured), or under the influence of drugs or alcohol. • Keep an even temper when driving. Do not let the actions of others affect your attitude. • Do not allow yourself to become frustrated, rushed, distracted, or drowsy.	• Seatbelt
	Fatigue	• Stop and rest if fatigued. Exit the road and enter a safe area. Rest until fully refreshed. • Be aware that certain medications (such as cold or allergy medicines) may make you drowsy when driving a vehicle.	• Seatbelt
	Vehicle loading	• DO NOT OVERLOAD the vehicle. • Secure all equipment and supplies within the body of the vehicle using proper tie-downs. • Do not block side view mirrors with the load. • Do not transport U.S. Department of Transportation (DOT)-manifested hazardous materials. • Dispatch all equipment and personnel with proper forms and identification.	• Seatbelt

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Anchor QEA motor vehicle operation (continued)	Equipment failure	• Perform daily inspections of your vehicle. • Maintain vehicle safety equipment (e.g., mirrors, alarms, horns, wipers, lights, and brakes). • Maintain the vehicle (e.g., tire pressure and fluid levels). • Any vehicle with mechanical defects that may endanger the safety of the driver, passengers, or the public shall not be used. • Ensure that appropriate safety equipment is in the vehicle. Safety equipment should include a spare tire, jack, first-aid kit, fire extinguisher, and flashlight. Flares and/or reflective triangles should be available in larger trucks. • Ensure that the proper documentation is in the vehicle. Documentation should include an operations manual for the vehicle, insurance card, vehicle registration, and accident forms.	• Inspect and maintain the vehicle

Training Requirements:

- All drivers are required to have a valid driver's license, and all vehicles must have appropriate state vehicle registration and inspection stickers. The use of hand-held wireless devices is prohibited while driving any vehicle for business use at any time, for personal use during business hours, and as defined by law.
- **If operating a vehicle or vehicle and trailer with a capacity greater than 10,000 pounds, U.S. Department of Transportation regulations may apply. Contact the PM prior to any travel in this configuration.**
- All assigned employees are required to read, familiarize themselves with the contents of this Job Safety Analysis, and sign the signature page before the operation of an Anchor QEA vehicle, and review it with their supervisor during their daily safety meeting.

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Vehicle Operation Job Safety Analysis Acknowledgement Form

The Anchor QEA Motor Vehicle Operation Job Safety Analysis must be read, understood, and signed before the operation of any Anchor QEA vehicle. My signature below certifies that I have read and understand the procedures presented in the Anchor QEA Motor Vehicle Operation Job Safety Analysis and have completed the Smith System Virtual Driving *Distracted Driving* and *Small Vehicle Forward - Five Keys to Safe Driving* training programs.

Date	Name (print)	Signature

Job Safety Analysis

Anchor QEA Motor Vehicle Operation

Date	Name (print)	Signature

Job Safety Analysis

Sample and Laboratory Glassware Handling

Project Name: Harris Avenue	**Project Number:** 210007-02.01	**JSA Number:** 005	**Issue Date:** 7/28/2021
Location: 201 Harris Avenue, Bellingham, WA	**Contractor:** Anchor QEA, LLC	**Analysis by:** Sydney Schroeder	**Analysis Date:** 7/28/2021
Work Operation: Sample and laboratory glassware handling	**Superintendent/Competent Person:** Delaney Peterson	**Revised by:**	**Revised Date:**
Required Personal Protective Equipment (PPE): • Modified Level D—Long pants, long sleeves, and/or Tyvek coveralls if handling potentially contaminated media, and steel-toed footwear conforming to ASTM International (ASTM) F2412-05/ASTM F2413-05 • Depending on activity, the following PPE may also be required: safety glasses/splash goggles, hard hat, nitrile outer gloves and latex inner gloves, and, if boating, U.S. Coast Guard-approved personal flotation device (PFD)		**Reviewed by:** Tim Shaner	**Reviewed Date:** 8/5/2021
		Approved by: Derek Ormerod	**Approved Date:** 8/16/2021

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Transporting and using glassware	Breakage of containers during field activities	• Use appropriately sized tubs or bottle carriers with dividers to prevent bottle-to-bottle contact during transport. • Consider using coated glassware, if practicable. • Carry oversize bottles in tubs or bottle carriers using both hands during transfer to the sampling vessel and whenever the vessel is underway.	• Ensure dividers are sufficient and will remain in place during transport.
	Faulty glassware	• Replace any glassware that is chipped, nicked, or cracked.	• Inspect glassware before use.
	Impact with equipment and other objects	• Use care when loading and unloading sampling equipment. • Minimize the handling of individual containers to the extent possible.	
Filling sample containers	Over-tightening of bottle lids causing breakage	• Avoid use of excessive force to tighten bottle caps (i.e., finger tight). • Secure lids with clear tape to prevent opening during transport.	
	Breakage during sample collection	• Place containers in plastic tubs between aliquots to limit contact with hard surfaces. • Place containers on a stable and non-slip surface during collection. • Use the buddy system as needed to hold bottles during filling.	

Job Safety Analysis

Sample and Laboratory Glassware Handling

Work Activity	Potential Hazards	Preventive or Corrective Measures	Inspection Requirements
Filling sample containers (continued)	Contact with sample preservatives (generally HCL or H_2SO_4 to lower pH to less than 2)	• Wear nitrile gloves and protective eyewear to prevent skin and eye contact if a container is damaged. • Do not open preserved bottles until necessary.	
Packing samples for shipment	Breakage during packing and shipment	• Use bottle wraps, foam sleeves, or bubble wrap to prevent bottle contact in the cooler. • Pack coolers snugly, but do not over pack.	• Ensure glass bottles do not touch to minimize potential breakage during transport.

Training Requirements:

- All personnel working on hazardous waste sites must receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120(e), including, but not limited to initial 40-hour, 8-hour supervisor, and annual 8-hour refresher trainings.
- Medical clearance must be received on an annual basis as required by 29 CFR 1910.120(f).
- All assigned employees are required to familiarize themselves with the contents of this JSA before starting a work activity and review it with their supervisor during their daily safety meeting.

Appendix C
Safety Data Sheets (SDS)

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

Printing date: 31.12.2013 **Revision:** 31.12.2013

1 Identification of the substance/mixture and of the company/undertaking

· **1.1 Product identifier**

· **Trade name: ALCONOX**

· **1.2 Relevant identified uses of the substance or mixture and uses advised against**
No further relevant information available.

· **Application of the substance / the mixture:** Cleaning material/ Detergent

· **1.3 Details of the supplier of the Safety Data Sheet**
· **Manufacturer/Supplier:**
Alconox, Inc.
30 Glenn St., Suite 309
White Plains, NY 10603
Phone: 914-948-4040
· **Further information obtainable from:** Product Safety Department

· **1.4 Emergency telephone number:**
ChemTel Inc.
(800)255-3924, +1 (813)248-0585

2 Hazards identification

· **2.1 Classification of the substance or mixture**
· **Classification according to Regulation (EC) No 1272/2008**


GHS05 corrosion
Eye Dam. 1; H318: Causes serious eye damage.


GHS07
Skin Irrit. 2; H315: Causes skin irritation.

· **Classification according to Directive 67/548/EEC or Directive 1999/45/EC**

Xi; Irritant
R38-41: Irritating to skin. Risk of serious damage to eyes.
· **Information concerning particular hazards for human and environment:**
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.
· **Classification system:**
The classification is according to the latest editions of the EU-lists, and extended by company and literature data.
The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

· **2.2 Label elements**
· **Labelling according to Regulation (EC) No 1272/2008**
The product is classified and labelled according to the CLP regulation.

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Safety Data Sheet
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· **Hazard pictograms**

GHS05

· **Signal word:** Danger

· **Hazard-determining components of labelling:**
sodium dodecylbenzene sulfonate

· **Hazard statements**
H315: Causes skin irritation.
H318: Causes serious eye damage.

· **Precautionary statements**
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P264: Wash thoroughly after handling.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310: Immediately call a POISON CENTER or doctor/physician.
P321: Specific treatment (see on this label).
P362: Take off contaminated clothing and wash before reuse.
P332+P313: If skin irritation occurs: Get medical advice/attention.
P302+P352: IF ON SKIN: Wash with plenty of soap and water.

· **Hazard description:**

· **WHMIS-symbols:**
D2B - Toxic material causing other toxic effects

· **NFPA ratings (scale 0 - 4)**

Health = 1
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**

Health = 1
Fire = 0
Reactivity = 0

· **HMIS Long Term Health Hazard Substances**
None of the ingredients is listed.

· **2.3 Other hazards**

· **Results of PBT and vPvB assessment**

· **PBT:** Not applicable.

· **vPvB:** Not applicable.

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Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), and GHS

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3 Composition/information on ingredients

· **3.2 Mixtures**
· **Description:** Mixture of substances listed below with nonhazardous additions.

· **Dangerous components:**		
CAS: 68081-81-2	sodium dodecylbenzene sulfonate Xn R22; Xi R36	10-25%
	Acute Tox. 4, H302; Eye Irrit. 2, H319	
CAS: 497-19-8 EINECS: 207-838-8 Index number: 011-005-00-2	Sodium Carbonate Xi R36	2,5-10%
	Eye Irrit. 2, H319	
CAS: 7722-88-5 EINECS: 231-767-1	tetrasodium pyrophosphate substance with a Community workplace exposure limit	2,5-10%
CAS: 151-21-3 EINECS: 205-788-1	sodium dodecyl sulphate Xn R21/22; Xi R36/38	2,5-10%
	Acute Tox. 4, H302; Acute Tox. 4, H312; Skin Irrit. 2, H315; Eye Irrit. 2, H319	

· **Additional information:** For the wording of the listed risk phrases refer to section 16.

4 First aid measures

· **4.1 Description of first aid measures**
· **After inhalation:** Supply fresh air; consult doctor in case of complaints.
· **After skin contact:**
Immediately wash with water and soap and rinse thoroughly.
If skin irritation continues, consult a doctor.
· **After eye contact:**
Remove contact lenses if worn.
Rinse opened eye for several minutes under running water. If symptoms persist, consult a doctor.
· **After swallowing:**
Rinse out mouth and then drink plenty of water.
Do not induce vomiting; call for medical help immediately.
· **4.2 Most important symptoms and effects, both acute and delayed**
No further relevant information available.
· **4.3 Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Firefighting measures

· **5.1 Extinguishing media**
· **Suitable extinguishing agents:**
CO2, powder or water spray. Fight larger fires with water spray or alcohol resistant foam.

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· **5.2 Special hazards arising from the substance or mixture:** No further relevant information available.
· **5.3 Advice for firefighters**
· **Protective equipment:**
Wear self-contained respiratory protective device.
Wear fully protective suit.
· **Additional information:** No further relevant information available.

6 Accidental release measures

· **6.1 Personal precautions, protective equipment and emergency procedures**
Product forms slippery surface when combined with water.
· **6.2 Environmental precautions:** Do not allow to enter sewers/ surface or ground water.
· **6.3 Methods and material for containment and cleaning up:**
Pick up mechanically.
Clean the affected area carefully; suitable cleaners are:
Warm water
· **6.4 Reference to other sections**
See Section 7 for information on safe handling.
See Section 8 for information on personal protection equipment.
See Section 13 for disposal information.

7 Handling and storage

· **7.1 Precautions for safe handling**
Prevent formation of dust.
Keep receptacles tightly sealed.
· **Information about fire - and explosion protection:** No special measures required.

· **7.2 Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:** No special requirements.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:** Protect from humidity and water.
· **7.3 Specific end use(s):** No further relevant information available.

8 Exposure controls/personal protection

· **Additional information about design of technical facilities:** No further data; see item 7.

· **8.1 Control parameters**

· **Ingredients with limit values that require monitoring at the workplace:**	
7722-88-5 tetrasodium pyrophosphate	
REL (USA)	5 mg/m³
TLV (USA)	TLV withdrawn
EV (Canada)	5 mg/m³

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· **Additional information:** The lists valid during the making were used as basis.

· **8.2 Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
Keep away from foodstuffs, beverages and feed.
Immediately remove all soiled and contaminated clothing.
Wash hands before breaks and at the end of work.
Avoid contact with the skin.
Avoid contact with the eyes and skin.
· **Respiratory protection:**
Not required under normal conditions of use.
In case of brief exposure or low pollution use respiratory filter device. In case of intensive or longer exposure use self-contained respiratory protective device.
· **Protection of hands:**

Protective gloves

The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation.
· **Material of gloves**
Butyl rubber, BR
Nitrile rubber, NBR
Natural rubber, NR
Neoprene gloves
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material cannot be calculated in advance and has therefore to be checked prior to the application.
· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **Eye protection:**

Safety glasses

· **Body protection:** Protective work clothing

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9 Physical and chemical properties

· **9.1 Information on basic physical and chemical properties**	
· **General Information**	
· **Appearance:**	
Form:	Powder
Colour:	White
· **Odour:**	Odourless
· **Odour threshold:**	Not determined.
· **pH-value (10 g/l) at 20 °C:**	9,5 (- NA for Powder form)
· **Change in condition**	
Melting point/Melting range:	Not Determined.
Boiling point/Boiling range:	Undetermined.
· **Flash point:**	Not applicable.
· **Flammability (solid, gaseous):**	Not determined.
· **Ignition temperature:**	
Decomposition temperature:	Not determined.
· **Self-igniting:**	Product is not self-igniting.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Explosion limits:**	
Lower:	Not determined.
Upper:	Not determined.
· **Vapour pressure:**	Not applicable.
· **Density at 20 °C:**	1,1 g/cm³
· **Relative density**	Not determined.
· **Vapour density**	Not applicable.
· **Evaporation rate**	Not applicable.
· **Solubility in / Miscibility with water:**	Soluble.
· **Partition coefficient (n-octanol/water):**	Not determined.
· **Viscosity:**	
Dynamic:	Not applicable.
Kinematic:	Not applicable.
· **Solvent content:**	
Organic solvents:	0,0 %
Solids content:	100 %
· **9.2 Other information**	No further relevant information available.

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10 Stability and reactivity

· **10.1 Reactivity**
· **10.2 Chemical stability**
· **Thermal decomposition / conditions to be avoided:**
No decomposition if used according to specifications.
· **10.3 Possibility of hazardous reactions**
Reacts with acids.
Reacts with strong alkali.
Reacts with strong oxidizing agents.
· **10.4 Conditions to avoid:** No further relevant information available.
· **10.5 Incompatible materials:** No further relevant information available.
· **10.6 Hazardous decomposition products:**
Carbon monoxide and carbon dioxide
Phosphorus compounds
Sulphur oxides (SOx)

11 Toxicological information

· **11.1 Information on toxicological effects**
· **Acute toxicity:**
· **Primary irritant effect:**
· **On the skin:** Irritant to skin and mucous membranes.
· **On the eye:** Strong irritant with the danger of severe eye injury.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
The product shows the following dangers according to the calculation method of the General EU Classification Guidelines for Preparations as issued in the latest version:
Irritant
Swallowing will lead to a strong caustic effect on mouth and throat and to the danger of perforation of esophagus and stomach.

12 Ecological information

· **12.1 Toxicity**
· **Aquatic toxicity:** No further relevant information available.
· **12.2 Persistence and degradability:** No further relevant information available.
· **12.3 Bioaccumulative potential:** Not worth-mentioning accumulating in organisms
· **12.4 Mobility in soil:** No further relevant information available.
· **Additional ecological information:**
· **General notes:**
Water hazard class 2 (German Regulation) (Self-assessment): hazardous for water.
Do not allow product to reach ground water, water course or sewage system.
Danger to drinking water if even small quantities leak into the ground.
· **12.5 Results of PBT and vPvB assessment**
· **PBT:** Not applicable.

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· **vPvB:** Not applicable.
· **12.6 Other adverse effects:** No further relevant information available.

13 Disposal considerations

· **13.1 Waste treatment methods**
· **Recommendation**
Smaller quantities can be disposed of with household waste.
Small amounts may be diluted with plenty of water and washed away. Dispose of bigger amounts in accordance with Local Authority requirements.
The surfactant used in this product complies with the biodegradability criteria as laid down in Regulation (EC) No. 648/2004 on detergents. Data to support this assertion are held at the disposal of the competent authorities of the Member States and will be made available to them, at their direct request or at the request of a detergent manufacturer.

· **Uncleaned packaging:**
· **Recommendation:** Disposal must be made according to official regulations.
· **Recommended cleansing agents:** Water, if necessary together with cleansing agents.

14 Transport information

· **14.1 UN-Number** · **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **14.2 UN proper shipping name** · **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **14.3 Transport hazard class(es)** · **DOT, ADR, IMDG, IATA, ICAO** · **Class**	Not Regulated
· **14.4 Packing group** · **DOT, ADR, IMDG, IATA, ICAO**	Not Regulated
· **14.5 Environmental hazards:** · **Marine pollutant:**	No
· **14.6 Special precautions for user**	Not applicable.
· **14.7 Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	Not applicable.
· **UN "Model Regulation":**	Not Regulated

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15 Regulatory information

· **15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **United States (USA)**
· **SARA**

· **Section 355 (extremely hazardous substances):**
None of the ingredients is listed.
· **Section 313 (Specific toxic chemical listings):**
None of the ingredients is listed.
· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

· **Proposition 65 (California):**

· **Chemicals known to cause cancer:**
None of the ingredients is listed.
· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients is listed.
· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients is listed.
· **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

· **Carcinogenic Categories**

· **EPA (Environmental Protection Agency)**
None of the ingredients is listed.
· **IARC (International Agency for Research on Cancer)**
None of the ingredients is listed.
· **TLV (Threshold Limit Value established by ACGIH)**
None of the ingredients is listed.
· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.
· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

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· **Canada**

· **Canadian Domestic Substances List (DSL)**	
All ingredients are listed.	
· **Canadian Ingredient Disclosure list (limit 0.1%)**	
None of the ingredients is listed.	
· **Canadian Ingredient Disclosure list (limit 1%)**	
497-19-8	Sodium Carbonate
7722-88-5	tetrasodium pyrophosphate
151-21-3	sodium dodecyl sulphate

· **15.2 Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

This information is based on our present knowledge. However, this shall not constitute a guarantee for any specific product features and shall not establish a legally valid contractual relationship.

· **Relevant phrases**
H302: Harmful if swallowed.
H312: Harmful in contact with skin.
H315: Causes skin irritation.
H319: Causes serious eye irritation.
R21/22: Harmful in contact with skin and if swallowed.
R22: Harmful if swallowed.
R36: Irritating to eyes.
R36/38: Irritating to eyes and skin.

· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road) IMDG: International Maritime Code for Dangerous Goods DOT: US Department of Transportation
IATA: International Air Transport Association
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
WHMIS: Workplace Hazardous Materials Information System (Canada)

Date of Issue:
19 February 2019

SAFETY DATA SHEET

1. Substance and Source Identification

Product Identifier

SRM Number: 3103a
SRM Name: Arsenic (As) Standard Solution
Other Means of Identification: Not applicable.

Recommended Use of This Material and Restrictions of Use

This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of arsenic. A unit of SRM 3103a consists of five 10 mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of arsenic. The solution contains nitric acid at a volume fraction of approximately 10 %, which is equivalent to a concentration (molarity) of approximately 1.6 mol/L.

Company Information

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2300
Gaithersburg, Maryland 20899-2300

Telephone: 301-975-2200
FAX: 301-948-3730
E-mail: SRMMSDS@nist.gov
Website: https://www.nist.gov/srm

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

2. Hazards Identification

Classification

Physical Hazard:	Not classified.	
Health Hazard:	Skin Corrosion/Irritation	Category 1B
	Serious Eye Damage/Irritation	Category 1
	Carcinogenicity	Category 1A

Label Elements

Symbol

Signal Word
DANGER

Hazard Statement(s)

H314	Causes severe skin burns and eye damage.
H350	May cause cancer through inhalation.

Precautionary Statement(s)

P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P260	Do not breathe fumes, mists, vapors, spray.
P264	Wash hands thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P280	Wear protective gloves, protective clothing, eye protection.
P301 + P330 + P331	If swallowed: Rinse mouth. Do NOT induce vomiting.
P303 + P361 + P353	If on skin (or hair): Remove immediately all contaminated clothing. Rinse skin with water.
P304 + P340	If inhaled: Remove person to fresh air and keep comfortable for breathing.

P305 + P351 + P338	If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310	Immediately call a doctor.
P363	Wash contaminated clothing before reuse.
P405	Store locked up.
P501	Dispose of contents and container according to local regulations.

Hazards Not Otherwise Classified: Not applicable.

Ingredients(s) with Unknown Acute Toxicity: Not applicable.

3. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Substance: Nitric Acid/Arsenic Acid Solution

Other Designations:

Nitric acid (aqua fortis; hydrogen nitrate; azotic acid; engraver's acid)
Arsenic acid (Arsenate; Orthoarsenic acid; H_3AsO_4)

NOTE: Arsenic in nitric acid solution forms solvated arsenic acid. The health and physical hazard information provided in this SDS are for nitric and arsenic acid. No physical or chemical data are listed for this solution. The actual effects of the solution may differ from the individual components.

Components are listed in compliance with OSHA's 29 CFR 1910.1200; for the actual values see the Certificate of Analysis.

Hazardous Component(s)	CAS Number	EC Number (EINECS)	Nominal Mass Concentration (%)
Nitric acid	7697-37-2	231-714-2	10
Arsenic Acid	7778-39-4	231-901-9	1.9
Non-Hazardous Component(s)			
Water	7732-18-5	231-791-2	>88

4. FIRST AID MEASURES

Description of First Aid Measures:

Inhalation: If adverse effects occur, remove to uncontaminated area. If not breathing, give artificial respiration or oxygen by qualified personnel. Seek immediate medical attention.

Skin Contact: Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get immediate medical attention. Thoroughly clean and dry contaminated clothing before reuse. Destroy contaminated shoes.

Eye Contact: Immediately flush eyes, including under the eyelids with copious amounts of water for at least 15 minutes. Seek immediate medical attention.

Ingestion: Contact a poison control center immediately for instructions. Do not induce vomiting. Give water to rinse out mouth. Never give liquids to a person with reduced awareness or becoming unconscious. If vomiting occurs, keep head lower than hips to prevent aspiration. If not breathing, give artificial respiration by qualified personnel. Seek immediate medical attention.

Most Important Symptoms/Effects, Acute and Delayed: Acid burns to skin, eyes, and lungs.

Indication of any immediate medical attention and special treatment needed, if necessary: If any of the above symptoms are present, seek immediate medical attention.

5. FIRE FIGHTING MEASURES

Fire and Explosion Hazards: Negligible fire hazard. See Section 9, "Physical and Chemical Properties" for flammability properties.

Extinguishing Media:

Suitable: Use extinguishing media appropriate to the surrounding fire.

Unsuitable: None listed.

Specific Hazards Arising from the Chemical: Thermal decomposition will form oxides of nitrogen and arsine.

Special Protective Equipment and Precautions for Fire-Fighters: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH approved self-contained breathing apparatus (SCBA).

NFPA Ratings (0 = Minimal; 1 = Slight; 2 = Moderate; 3 = Serious; 4 = Severe)

Health = 3 Fire = 0 Reactivity = 0

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment and Emergency Procedures: Immediately contact emergency personnel. Keep unnecessary personnel away. Use suitable protective equipment; see Section 8, "Exposure Controls and Personal Protection".

Methods and Materials for Containment and Clean up: Do not touch spilled material. Notify safety personnel of spills. Absorb with sand or other non-combustible material. Collect spilled material in appropriate container for disposal. Isolate hazard area and deny entry.

7. HANDLING AND STORAGE

Safe Handling Precautions: See Section 8, "Exposure Controls and Personal Protection". Handle glass ampoules with care.

Storage: Store and handle in accordance with all current regulations and standards. Keep separated from incompatible substances (See Section 10, "Stability and Reactivity").

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Exposure Limits:

Component: Nitric acid

NIOSH (REL):	5 mg/m^3 (2 ppm; TWA)
	10 mg/m^3 (4 ppm; STEL)
	65 mg/m^3(25 ppm; IDLH)
ACGIH (TLV):	5 mg/m^3 (2 ppm; TWA)
	10 mg/m^3 (4 ppm; STEL)
OSHA (PEL):	5 mg/m^3 (2 ppm; TWA)

Component: Arsenic acid (as As, related to Arsenic, inorganic compounds)

NIOSH (REL):	0.002 mg/m^3 (15 min, Ceiling)
	5 mg/m^3 (15 min, Ceiling)
ACGIH (TLV):	0.01 mg/m^3 (TWA)
OSHA (PEL):	10 $\mu g/m^3$ (cancer hazard, see 29 CFR 1910.1018, except Arsine as As, TWA)
	5 $\mu g/m^3$ (Action Level)

Engineering Controls: Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

Personal Protection: In accordance with OSHA 29 CFR 1910.132, subpart I, wear appropriate Personal Protective Equipment (PPE) to minimize exposure to this material.

Respiratory Protection: If workplace conditions warrant a respirator, a respiratory protection program that meets OSHA 29CFR 1910.134 must be followed. Refer to NIOSH 42 CFR 84 for applicable certified respirators.

Eye/Face Protection: Wear splash resistant safety goggles with a face shield. An eyewash station should be readily available near areas of use.

Skin and Body Protection: Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. Chemical-resistant gloves should be worn at all times when handling chemicals.

9. PHYSICAL AND CHEMICAL PROPERTIES

NOTE: The physical and chemical data provided are for the pure components. No physical or chemical data are available for this solution. The actual behavior of the solution may differ from the individual components.

Descriptive Properties:	**Nitric acid (10 % of this SRM)**	**Arsenic Acid (1.9 % of this SRM)**
Appearance (physical state, color, etc.):	colorless to yellow liquid	colorless or white solid
Molecular Formula:	HNO_3	H_3AsO_4
Molar Mass (g/mol):	63.01	141.95
Odor:	irritating odor	odorless
Odor threshold:	not available	not available
pH:	1 (1 M)	not available
Evaporation rate:	not available	not available
Melting point/freezing point (ºC):	–42 (–43 ºF)	96 (205 ºF)

Descriptive Properties:	Nitric acid (10 % of this SRM)	Arsenic Acid (1.9 % of this SRM)
Relative Density (g/L) as specific gravity (water = 1):	1.5027 at 25 ºC	2.2
Vapor Pressure (mmHg):	47.9 at 20 ºC	not available
Vapor Density (air = 1):	3.2	not available
Viscosity (cP):	not available	not available
Solubility(ies):	miscible with water and ether	soluble in water, alcohol and glycerol
Partition coefficient (n-octanol/water):	not available	not available
Thermal Stability Properties:		
Autoignition Temperature (ºC):	not applicable	not applicable
Thermal Decomposition (ºC):	not applicable	not available
Initial boiling point and boiling range (ºC):	83 (181 ºF)	not available
Explosive Limits, LEL (Volume %):	not applicable	not available
Explosive Limits, UEL (Volume %):	not applicable	not available
Flash Point (ºC):	not applicable	not available
Flammability (solid, gas):	not applicable	not available

10. STABILITY AND REACTIVITY

Reactivity: Stable at normal temperatures and pressure.

Stability: X Stable _____ Unstable

Possible Hazardous Reactions: None listed.

Conditions to Avoid: Contact with combustible or incompatible materials.

Incompatible Materials: Incompatible with acids, combustible materials, halo carbons, amines, bases, oxidizing materials, metals, halogens, metal salts, metal oxides, reducing agents, peroxides, metal carbide, and cyanides.

Fire/Explosion Information: See Section 5, "Fire Fighting Measures".

Hazardous Decomposition: Thermal decomposition will produce oxides of nitrogen and arsenic.

Hazardous Polymerization: _____ Will Occur X Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Exposure: X Inhalation X Skin X Ingestion

Symptoms Related to the Physical, Chemical and Toxicological Characteristics: Burning pain and severe skin corrosion, eye, lung, and blood damage, and cancer.

Potential Health Effects (Acute, Chronic and Delayed):

Inhalation: Inhalation of nitric acid can damage the mucous membranes and upper respiratory tract. Short term exposure may cause irritation and inflammation of the upper respiratory tract, coughing, choking, sore throat, shortness of breath, headache, dizziness, and nausea. Long term exposure to acid fumes may cause damage to teeth, bronchial irritation, chronic cough, bronchial pneumonia, and gastrointestinal disturbances. Arsenic inorganic compounds may cause foamy sputum.

Skin Contact: Nitric acid can cause severe skin burns. Severity of the damage depends on the concentration and duration of exposure. Effects of acid burns may be delayed. Short term contact with arsenic inorganic compounds can cause irritation and may cause sensitization.

Eye Contact: Nitric acid and arsenic inorganic compounds can cause severe eye irritation, corneal burns, permanent eye damage, or blindness. Severity of the damage depends on the concentration and duration of exposure.

Ingestion: Ingestion of this material is unlikely under normal conditions of use. If ingested, nitric acid can cause severe burns and damage to the gastrointestinal tract. Acute ingestion of low levels of arsenic inorganic compounds can cause tearing, diarrhea, bluish skin color, kidney damage, liver damage, and death. Chronic ingestion may have the same effects and may also cause cancer.

Numerical Measures of Toxicity:

Acute Toxicity: Not classified.

Nitric acid, Rat, Inhalation LC50: 130 mg/m^3 (4 h)

Arsenic acid, Rat, Oral LD50: 48 mg/kg

Skin Corrosion/Irritation: This SRM contains >1 % of nitric acid and it is classified as Category 1B.

Serious Eye Damage/Irritation: This SRM contains >1 % nitric acid and it is classified as Category 1.

Respiratory Sensitization: No data available; not classified.

Skin Sensitization: No data available; not classified.

Germ Cell Mutagenicity: No data available; not classified.

Carcinogenicity: Category 1A.

Listed as a Carcinogen/Potential Carcinogen X Yes ____ No

Nitric acid is not listed by NTP, IARC or OSHA as a carcinogen.

NTP lists Arsenic (inorganic compounds) as known human carcinogen. IARC Monograph 84 (2004) lists arsenic in Group 1 (carcinogenic to humans). OSHA lists inorganic arsenic as a designated carcinogen.

Reproductive Toxicity: Not classified.

Nitric acid, Rat, Oral TDLo: 21 150 mg/kg (pregnant 1 d to 21 d)
Nitric acid, Rat, Oral TDLo: 2345 mg/kg (pregnant 18 d)
Arsenic acid: Rat, Oral TDLo: 120 mg/kg (pregnant 7 to 15 d)

Specific Target Organ Toxicity, Single Exposure: No data available; not classified.

Specific Target Organ Toxicity, Repeated Exposure: No data available; not classified.

Aspiration Hazard: No data available; not classified.

12. ECOLOGICAL INFORMATION

Ecotoxicity Data:

Nitric acid: Starfish (*Asterias rubens*) LC50: 100 mg/L – 300 mg/L (renewal/aerated water, 48 h)
Arsenic acid: Fathead minnow (*Pimephales promelas*) LC50: 25.6 mg/L (96 h)
Bluegill (*Lepomis macrochirus*) LC50: 39 mg/L – 110 mg/L (static, 96 h)
Bluegill (*Lepomis macrochirus*) LC50: 43 mg/L – 59 mg/L (flow-through, 96 h)

Persistence and Degradability: No data available.

Bioaccumulative Potential: No data available.

Mobility in Soil: No data available.

Other Adverse effects: No data available.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: Dispose of waste in accordance with all applicable federal, state, and local regulations.
Nitric acid and arsenic acid subject to disposal regulations: U.S. EPA 40 CFR 262.

Nitric acid Hazardous Waste Numbers: D001, D002.

Arsenic acid Hazardous Waste Numbers: P010, D004. Dispose of in accordance with U.S. EPA 40 CFR 262 for concentrations at or above the Regulatory level (5.0 mg/L).

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA: UN1760, Corrosive liquid, n.o.s. (contains nitric acid), Hazard Class 8, Packing Group II, Excepted Quantities E2.

15. REGULATORY INFORMATION

U.S. Regulations:

CERCLA Sections 102a/103 (40 CFR 302.4): Nitric acid, 1000 lbs (454 kg) RQ;
Arsenic acid, 1 lb (0.454 kg) RQ
SARA Title III Section 302 (40 CFR 355.30): Nitric acid, 1000 lbs (454 kg) TPQ
SARA Title III Section 304 (40 CFR 355.40): Nitric acid, 1000 lbs (454 kg) EPCRA RQ
SARA Title III Section 313 (40 CFR 372.65): Nitric acid, 1 % de minimis concentration;
Arsenic acid, 0.1 % de minimis concentration (related to Arsenic inorganic compounds)
OSHA Process Safety (29 CFR 1910.119): Nitric acid, higher concentrations 500 lbs TQ (≥94.5 % by weight)

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE HEALTH:	Yes.
CHRONIC HEALTH:	Yes.
FIRE:	No.
REACTIVE:	No.
PRESSURE:	No.

State Regulations:

California Proposition 65: WARNING! This product contains a chemical known (arsenic inorganic compounds) to the state of California to cause cancer.

U.S. TSCA Inventory: Nitric acid and arsenic acid are listed.

TSCA 12(b), Export Notification: Not listed.

Canadian Regulations: WHMIS Information is not provided for this material.

16. OTHER INFORMATION

Issue Date: 19 February 2019

Sources: ChemAdvisor, Inc., SDS *Nitric Acid*, 22 September 2015.

ChemAdvisor, Inc., SDS *Arsenic Acid*, 09 December 2015.

CDC; NIOSH; *NIOSH Pocket Guide to Chemical Hazards*; Department of Health and Human Services (DHHS), Centers for Disease Control and Prevention (CDC), National Institute for Safety and Health; *Nitric Acid*, 13 February 2015; available at https://www.cdc.gov/niosh/npg/npgd0447.html (accessed Feb 2019).

Hazardous Substances Data Bank (HSDB), National Library of Medicine's TOXNET system, *Nitric Acid CAS No. 7697-37-2*; available at https://toxnet.nlm.nih.gov (accessed Feb 2019).

Key of Acronyms:

ACGIH	American Conference of Governmental Industrial Hygienists	NRC	Nuclear Regulatory Commission
ALI	Annual Limit on Intake	NTP	National Toxicology Program
CAS	Chemical Abstracts Service	OSHA	Occupational Safety and Health Administration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	PEL	Permissible Exposure Limit
CFR	Code of Federal Regulations	RCRA	Resource Conservation and Recovery Act
DOT	Department of Transportation	REL	Recommended Exposure Limit
EC50	Effective Concentration, 50%	RM	Reference Material
EINECS	European Inventory of Existing Commercial Chemical Substances	RQ	Reportable Quantity
EPCRA	Emergency Planning and Community Right-to-Know Act	RTECS	Registry of Toxic Effects of Chemical Substances
IARC	International Agency for Research on Cancer	SARA	Superfund Amendments and Reauthorization Act
IATA	International Air Transport Association	SCBA	Self-Contained Breathing Apparatus
IDLH	Immediately Dangerous to Life and Health	SRM	Standard Reference Material
LC50	Lethal Concentration, 50 %	STEL	Short Term Exposure Limit
LD50	Lethal Dose, 50 %	TLV	Threshold Limit Value
LEL	Lower Explosive Limit	TPQ	Threshold Planning Quantity
MSDS	Material Safety Data Sheet	TSCA	Toxic Substances Control Act
NFPA	National Fire Protection Association	TWA	Time Weighted Average
NIOSH	National Institute for Occupational Safety and Health	UEL	Upper Explosive Limit
NIST	National Institute of Standards and Technology	WHMIS	Workplace Hazardous Materials Information System
n.o.s.	Not Otherwise Specified		

Disclaimer: Physical and chemical data contained in this SDS are provided only for use in assessing the hazardous nature of the material. The SDS was prepared carefully, using current references; however, NIST does not certify the data in the SDS. The certified values for this material are given in the NIST Certificate of Analysis.

Users of this SRM should ensure that the SDS in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 948-3730; e-mail srmmsds@nist.gov; or via the Internet at https://www.nist.gov/srm.

SAFETY DATA SHEET

Gasoline (All Grades)

HOLLYFRONTIER

Section 1. Identification

Product name : Gasoline (All Grades)

Product code : Not available.

Synonyms : Gasoline, Unleaded Gasoline, Regular Gasoline, Premium Gasoline, Oxyfuel, Reformulated Gasoline

Relevant identified uses of the substance or mixture and uses advised against

Product use : Use in fuel - Industrial use

Area of application : Industrial applications.

Manufacturer : HollyFrontier Refining & Marketing LLC
2828 North Harwood
Suite 1300
Dallas, Texas 75201
USA
Customer Service: (888) 286-8836

Emergency telephone number : CHEMTREC® (800) 424-9300
CCN 201319

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture :

H224	FLAMMABLE LIQUIDS - Category 1
H315	SKIN IRRITATION - Category 2
H319	EYE IRRITATION - Category 2A
H340	GERM CELL MUTAGENICITY - Category 1
H350	CARCINOGENICITY - Category 1B
H361	TOXIC TO REPRODUCTION (Fertility) - Category 2
H361	TOXIC TO REPRODUCTION (Unborn child) - Category 2
H336	SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3
H373	SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (liver) - Category 2
H304	ASPIRATION HAZARD - Category 1

Percentage of the mixture consisting of ingredient(s) of unknown dermal toxicity: 9%
Percentage of the mixture consisting of ingredient(s) of unknown inhalation toxicity: 4%

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements : H224 - Extremely flammable liquid and vapor.
H319 - Causes serious eye irritation.
H315 - Causes skin irritation.
H340 - May cause genetic defects.
H350 - May cause cancer.
H361 - Suspected of damaging fertility or the unborn child.
H304 - May be fatal if swallowed and enters airways.
H336 - May cause drowsiness or dizziness.
H373 - May cause damage to organs through prolonged or repeated exposure. (liver)

Precautionary statements

Prevention : Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear protective gloves. Wear eye or face protection. Wear protective clothing. Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Use only outdoors or in a well-ventilated area. Do not breathe vapor. Wash hands thoroughly after handling.

Response : Get medical attention if you feel unwell. IF exposed or concerned: Get medical attention. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER or physician if you feel unwell. IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting. IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower. IF ON SKIN: Wash with plenty of soap and water. Take off contaminated clothing and wash it before reuse. If skin irritation occurs: Get medical attention. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical attention.

Storage : Store in a well-ventilated place. Keep cool.

Disposal : Dispose of contents and container in accordance with all local, regional, national and international regulations.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Ingredient name	Other names	%	CAS number
Gasoline	-	88 - 100	86290-81-5
ethanol	-	0 - 10	64-17-5
toluene	-	0 - 10	108-88-3
1,2,4-trimethylbenzene	-	0 - 5	95-63-6
benzene	-	0 - 5	71-43-2
n-hexane	-	0 - 3	110-54-3

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Get medical attention. Continue to rinse for at least 15 minutes.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention. If necessary, call a poison center or physician. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Continue to rinse for at least 15 minutes. Get medical attention. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : Aspiration hazard if swallowed. Can enter lungs and cause damage. Do not induce vomiting. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Get medical attention immediately. Call a poison center or physician. Wash out mouth with water. Remove victim to fresh air and keep at rest in a position comfortable for breathing. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Causes serious eye irritation.

Inhalation : Can cause central nervous system (CNS) depression. May cause drowsiness or dizziness.

Skin contact : Causes skin irritation.

Ingestion : Can cause central nervous system (CNS) depression. May be fatal if swallowed and enters airways.

Over-exposure signs/symptoms

Eye contact : pain or irritation; watering; redness

Inhalation : respiratory tract irritation; coughing; nausea or vomiting; headache; drowsiness/ fatigue; dizziness/vertigo; unconsciousness

Skin contact : irritation; redness; dryness; cracking

Ingestion : nausea or vomiting

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled. Epinephrine and other sympathomimetic drugs may initiate cardiac arrhythmias in persons exposed to high concentrations of hydrocarbon solvents.

Specific treatments : No specific treatment.

Protection of medical responders : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use dry chemical, CO_2, water spray (fog) or foam.

Unsuitable extinguishing media : Do not use water jet.

Specific hazards arising from the chemical : Extremely flammable liquid and vapor. Runoff to sewer may create fire or explosion hazard. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapor/gas is heavier than air and will spread along the ground. Vapors may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Avoid breathing vapor or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.

For emergency responders : If specialized clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Absorb with an inert material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.

Large spill : Stop leak if without risk. Move containers from spill area. Use spark-proof tools and explosion-proof equipment. Approach release from upwind. Prevent entry into sewers, waterways, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilled product. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures : Put on appropriate personal protective equipment (see Section 8). Avoid exposure - obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapor or mist. Do not swallow. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Empty containers retain product residue and can be hazardous. Do not reuse container. High pressure skin injections are serious medical emergencies. Injury will not appear serious at first. Within a few hours, tissue will become swollen, discolored and extremely painful.

Advice on general occupational hygiene : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Ingredient name	Exposure limits
Gasoline	**ACGIH TLV (United States, 3/2017).** TWA: 300 ppm 8 hours. TWA: 890 mg/m³ 8 hours. STEL: 500 ppm 15 minutes. STEL: 1480 mg/m³ 15 minutes.
ethanol	**ACGIH TLV (United States, 3/2017).** STEL: 1000 ppm 15 minutes. **NIOSH REL (United States, 10/2016).** TWA: 1000 ppm 10 hours. TWA: 1900 mg/m³ 10 hours. **OSHA PEL (United States, 6/2016).** TWA: 1000 ppm 8 hours. TWA: 1900 mg/m³ 8 hours.
toluene	**OSHA PEL Z2 (United States, 2/2013).** TWA: 200 ppm 8 hours. CEIL: 300 ppm AMP: 500 ppm 10 minutes. **NIOSH REL (United States, 10/2016).** TWA: 100 ppm 10 hours. TWA: 375 mg/m³ 10 hours. STEL: 150 ppm 15 minutes. STEL: 560 mg/m³ 15 minutes. **ACGIH TLV (United States, 3/2017).** TWA: 20 ppm 8 hours.
1,2,4-trimethylbenzene	**ACGIH TLV (United States, 3/2017).** TWA: 25 ppm 8 hours. TWA: 123 mg/m³ 8 hours. **NIOSH REL (United States, 10/2016).** TWA: 25 ppm 10 hours. TWA: 125 mg/m³ 10 hours.
benzene	**ACGIH TLV (United States, 3/2017). Absorbed through skin.** TWA: 0.5 ppm 8 hours. TWA: 1.6 mg/m³ 8 hours. STEL: 2.5 ppm 15 minutes. STEL: 8 mg/m³ 15 minutes. **OSHA PEL Z2 (United States, 2/2013).** TWA: 10 ppm 8 hours. CEIL: 25 ppm AMP: 50 ppm 10 minutes. **NIOSH REL (United States, 10/2016).** TWA: 0.1 ppm 10 hours. STEL: 1 ppm 15 minutes. **OSHA PEL (United States, 6/2016).** TWA: 1 ppm 8 hours. STEL: 5 ppm 15 minutes.
n-hexane	**NIOSH REL (United States, 10/2016).** TWA: 50 ppm 10 hours. TWA: 180 mg/m³ 10 hours. **ACGIH TLV (United States, 3/2017). Absorbed through skin.** TWA: 50 ppm 8 hours. **OSHA PEL (United States, 6/2016).** TWA: 500 ppm 8 hours. TWA: 1800 mg/m³ 8 hours.

Appropriate engineering controls : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapor or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: chemical splash goggles.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product. When there is a risk of ignition from static electricity, wear anti-static protective clothing. For the greatest protection from static discharges, clothing should include anti-static overalls, boots and gloves.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Based on the hazard and potential for exposure, select a respirator that meets the appropriate standard or certification. Respirators must be used according to a respiratory protection program to ensure proper fitting, training, and other important aspects of use.

Section 9. Physical and chemical properties

Appearance

Physical state : Liquid.

Color : Clear to Amber

Odor : Gasoline

Odor threshold : Not available.

pH : Not available.

Melting point : Not available.

Boiling point : 26.667 to 226.67°C (80 to 440°F)

Flash point : -40°C (-40°F)

Evaporation rate : Not available.

Flammability (solid, gas) : Not applicable.

Lower and upper explosive (flammable) limits : Lower: 1.4%
Upper: 7.6%

Vapor pressure : 350-760 mm Hg at 37.8°C (100°F)

Vapor density : 3 to 4 [Air = 1]

Specific gravity : 0.75 [15.5°C (60°F)]

Density : Not available.

Solubility : Negligible

Partition coefficient: n-octanol/water : Not available.

Auto-ignition temperature : >260°C (>500°F)

Decomposition temperature : Not available.

Viscosity : Kinematic (40°C (104°F)): 0.0064 cm^2/s (0.64 cSt)

Flow time (ISO 2431) : Not available.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Under normal conditions of storage and use, hazardous reactions will not occur.
Under normal conditions of storage and use, hazardous polymerization will not occur.

Conditions to avoid : Avoid all possible sources of ignition (spark or flame). Do not pressurize, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow vapor to accumulate in low or confined areas.

Incompatible materials : Reactive or incompatible with the following materials:
oxidizing materials

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Gasoline	LC50 Inhalation Vapor	Rat	>5.2 mg/l	4 hours
	LD50 Dermal	Rabbit	>2000 mg/kg	-
	LD50 Oral	Rat	>5000 mg/kg	-
ethanol	LC50 Inhalation Dusts and mists	Rat	124700 mg/m³	4 hours
	LD50 Oral	Rat	7 g/kg	-

Irritation/Corrosion

Product/ingredient name	Result	Species	Score	Exposure	Observation
ethanol	Eyes - Moderate irritant	Rabbit	-	0.066666667 minutes 100 milligrams	-
	Eyes - Moderate irritant	Rabbit	-	100 microliters	-
	Eyes - Severe irritant	Rabbit	-	500 milligrams	-
	Skin - Mild irritant	Rabbit	-	400 milligrams	-

Sensitization

Product/ingredient name	Route of exposure	Species	Result
Gasoline	skin	Guinea pig	Not sensitizing

Carcinogenicity

Product/ingredient name	OSHA	IARC	NTP
toluene	-	3	-
benzene	+	1	Known to be a human carcinogen.

Specific target organ toxicity (single exposure)

Name	Category	Route of exposure	Target organs
Gasoline	Category 3	Not applicable.	Narcotic effects
ethanol	Category 3	Not applicable.	Respiratory tract irritation and Narcotic effects

Specific target organ toxicity (repeated exposure)

Name	Category	Route of exposure	Target organs
ethanol	Category 2	Not determined	liver

Aspiration hazard

Name	Result
Gasoline	ASPIRATION HAZARD - Category 1

Information on the likely routes of exposure : Routes of entry anticipated: Oral, Dermal, Inhalation.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.

Potential delayed effects : Not available.

Potential chronic health effects

General : May cause damage to organs through prolonged or repeated exposure.

Carcinogenicity : May cause cancer. Risk of cancer depends on duration and level of exposure.

Mutagenicity : May cause genetic defects.

Teratogenicity : Suspected of damaging the unborn child.

Developmental effects : reduced fetal weight; skeletal malformations

Fertility effects : Suspected of damaging fertility.

Numerical measures of toxicity

Acute toxicity estimates

Route	ATE value
Oral Inhalation (vapors)	9768.4 mg/kg 795.6 mg/l

Section 12. Ecological information

Toxicity

Product/ingredient name	Result	Species	Exposure
ethanol	Acute EC50 17.921 mg/l Marine water	Algae - Ulva pertusa	96 hours

Persistence and degradability

Product/ingredient name	Test	Result	Dose	Inoculum
toluene	301C Ready Biodegradability - Modified MITI Test (I)	100 % - 14 days	-	-
benzene	301C Ready Biodegradability - Modified MITI Test (I)	100 % - 14 days	-	-

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
ethanol	-	-	Readily

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Gasoline ethanol	2 to 7 -0.35	10 to 2500 -	high low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

United States - RCRA Toxic hazardous waste "U" List

Ingredient	CAS #	Status	Reference number
Toluene; Benzene, methyl- Benzene (I,T)	108-88-3 71-43-2	Listed Listed	U220 U019

Section 14. Transport information

	DOT Classification	IMDG	IATA
UN number	UN1203	UN1203	UN1203
UN proper shipping name	Gasoline	GASOLINE	Gasoline
Transport hazard class(es)	3 	3 	3 
Packing group	II	II	II
Environmental hazards	No.	No.	Yes. The environmentally hazardous substance mark is not required.

Additional information

DOT Classification : **Reportable quantity** 400 lbs / 181.6 kg [63.965 gal / 242.13 L]. Package sizes shipped in quantities less than the product reportable quantity are not subject to the RQ (reportable quantity) transportation requirements.
Limited quantity Yes.
Packaging instruction Exceptions: 150. Non-bulk: 202. Bulk: 242.
Quantity limitation Passenger aircraft/rail: 5 L. Cargo aircraft: 60 L.
Special provisions 144, 177, B1, B33, IB2, T4

IMDG : **Emergency schedules** F-E, S-E
Special provisions 243

IATA : The environmentally hazardous substance mark may appear if required by other transportation regulations.
Quantity limitation Passenger and Cargo Aircraft: 5 L. Packaging instructions: 353. Cargo Aircraft Only: 60 L. Packaging instructions: 364. Limited Quantities - Passenger Aircraft: 1 L. Packaging instructions: Y341.
Special provisions A100

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Section 15. Regulatory information

U.S. Federal regulations : **United States inventory (TSCA 8b)**: All components are listed or exempted.
Clean Water Act (CWA) 307: toluene; benzene
Clean Water Act (CWA) 311: toluene; benzene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Listed

DEA List II Chemicals (Essential Chemicals) : Listed

SARA 302/304

Composition/information on ingredients

No products were found.

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : FLAMMABLE LIQUIDS - Category 1
SKIN IRRITATION - Category 2
EYE IRRITATION - Category 2A
GERM CELL MUTAGENICITY - Category 1
CARCINOGENICITY - Category 1B
TOXIC TO REPRODUCTION (Fertility) - Category 2
TOXIC TO REPRODUCTION (Unborn child) - Category 2
SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3
SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (liver) - Category 2
ASPIRATION HAZARD - Category 1

Composition/information on ingredients

Name	%	Classification
Gasoline	88 - 100	FLAMMABLE LIQUIDS - Category 1 SKIN IRRITATION - Category 2 GERM CELL MUTAGENICITY - Category 1B CARCINOGENICITY - Category 1B TOXIC TO REPRODUCTION (Fertility) - Category 2 TOXIC TO REPRODUCTION (Unborn child) - Category 2 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3 ASPIRATION HAZARD - Category 1 HNOC - Defatting irritant
ethanol	0 - 10	FLAMMABLE LIQUIDS - Category 2

		SKIN IRRITATION - Category 2 EYE IRRITATION - Category 2A SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (liver) - Category 2 HNOC - Defatting irritant
toluene	0 - 10	FLAMMABLE LIQUIDS - Category 2 ACUTE TOXICITY (oral) - Category 4 SKIN IRRITATION - Category 2 EYE IRRITATION - Category 2A TOXIC TO REPRODUCTION (Unborn child) - Category 2 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 2 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (nervous system) (inhalation) - Category 2 ASPIRATION HAZARD - Category 1 HNOC - Defatting irritant
1,2,4-trimethylbenzene	0 - 5	FLAMMABLE LIQUIDS - Category 3 ACUTE TOXICITY (inhalation) - Category 4 SKIN IRRITATION - Category 2 EYE IRRITATION - Category 2A SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3 ASPIRATION HAZARD - Category 1 HNOC - Defatting irritant
benzene	0 - 5	FLAMMABLE LIQUIDS - Category 2 ACUTE TOXICITY (oral) - Category 4 SKIN IRRITATION - Category 2 EYE IRRITATION - Category 2A GERM CELL MUTAGENICITY - Category 1B CARCINOGENICITY - Category 1A SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) - Category 1 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (haematopoietic system) (oral) - Category 1 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (haematopoietic system) (inhalation) - Category 1 ASPIRATION HAZARD - Category 1
n-hexane	0 - 3	FLAMMABLE LIQUIDS - Category 2 SKIN IRRITATION - Category 2 EYE IRRITATION - Category 2A TOXIC TO REPRODUCTION (Fertility) - Category 2 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Narcotic effects) - Category 3 SPECIFIC TARGET ORGAN TOXICITY (REPEATED EXPOSURE) (nervous system, peripheral nervous system) - Category 2 ASPIRATION HAZARD - Category 1 HNOC - Static-accumulating flammable liquid

SARA 313

	Product name	CAS number	%
Form R - Reporting requirements	toluene 1,2,4-trimethylbenzene benzene n-hexane	108-88-3 95-63-6 71-43-2 110-54-3	0 - 10 0 - 5 0 - 5 0 - 3
Supplier notification	toluene 1,2,4-trimethylbenzene benzene n-hexane	108-88-3 95-63-6 71-43-2 110-54-3	0 - 10 0 - 5 0 - 5 0 - 3

SARA 313 notifications must not be detached from the SDS and any copying and redistribution of the SDS shall include copying and redistribution of the notice attached to copies of the SDS subsequently redistributed.

State regulations

Massachusetts : The following components are listed: TOLUENE; METHYLBENZENE; PSEUDOCUMENE; BENZENE; HEXANE; N-HEXANE; ETHYL ALCOHOL; DENATURED ALCOHOL

New York : The following components are listed: Toluene; Benzene; Hexane

New Jersey : The following components are listed: TOLUENE; BENZENE, METHYL-; PSEUDOCUMENE; 1,2,4-TRIMETHYL BENZENE; BENZENE; n-HEXANE; HEXANE; ETHYL ALCOHOL; ALCOHOL

Pennsylvania : The following components are listed: GASOLINE; BENZENE, METHYL-; PSEUDOCUMENE; BENZENE; BENZOL DILUENT; HEXANE; DENATURED ALCOHOL; ETHANOL

California Prop. 65

⚠ **WARNING**: This product can expose you to Benzene, which is known to the State of California to cause cancer and birth defects or other reproductive harm. This product can expose you to Toluene, which is known to the State of California to cause birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov.

Ingredient name	No significant risk level	Maximum acceptable dosage level
Toluene Benzene	- Yes.	Yes. Yes.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Informed Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Section 16. Other information

National Fire Protection Association (U.S.A.)

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Procedure used to derive the classification

Classification	Justification
Flam. Liq. 1, H224	On basis of test data
Skin Irrit. 2, H315	Calculation method
Eye Irrit. 2A, H319	Calculation method
Muta. 1, H340	Calculation method
Carc. 1B, H350	Expert judgment
Repr. 2, H361 (Fertility)	Calculation method
Repr. 2, H361 (Unborn child)	Calculation method
STOT SE 3, H336	Calculation method
STOT RE 2, H373 (liver)	Expert judgment
Asp. Tox. 1, H304	Calculation method

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Version : 2

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
UN = United Nations

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named manufacturer, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Polycyclic Aromatic Hydrocarbons Standard Mixture

High-Purity Standards

Chemwatch Hazard Alert Code: **4**

Catalogue number: **PAH-HM16C**
Version No: **1.1**
Safety Data Sheet according to OSHA HazCom Standard (2012) requirements

Issue Date: **06/05/2017**
Print Date: **06/05/2017**
S.GHS.USA.EN

SECTION 1 IDENTIFICATION

Product Identifier

Product name	Polycyclic Aromatic Hydrocarbons Standard Mixture
Synonyms	PAH-HM16C
Proper shipping name	Dichloromethane
Other means of identification	PAH-HM16C

Recommended use of the chemical and restrictions on use

Relevant identified uses	Use according to manufacturer's directions.

Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party

Registered company name	High-Purity Standards
Address	PO Box 41727 SC 29423 United States
Telephone	843-767-7900
Fax	843-767-7906
Website	highpuritystandards.com
Email	Not Available

Emergency phone number

Association / Organisation	INFOTRAC
Emergency telephone numbers	1-800-535-5053
Other emergency telephone numbers	1-352-323-3500

SECTION 2 HAZARD(S) IDENTIFICATION

Classification of the substance or mixture

Classification	Carcinogenicity Category 1B, Skin Sensitizer Category 1, Germ cell mutagenicity Category 1B, Reproductive Toxicity Category 1B, Acute Aquatic Hazard Category 1, Chronic Aquatic Hazard Category 1

Label elements

Hazard pictogram(s)	
SIGNAL WORD	**DANGER**

Hazard statement(s)

H350	May cause cancer.
H317	May cause an allergic skin reaction.
H340	May cause genetic defects.
H360	May damage fertility or the unborn child.
H410	Very toxic to aquatic life with long lasting effects.

Continued...

Hazard(s) not otherwise specified

Not Applicable

Precautionary statement(s) Prevention

P201	Obtain special instructions before use.

Precautionary statement(s) Response

P308+P313	IF exposed or concerned: Get medical advice/attention.

Precautionary statement(s) Storage

P405	Store locked up.

Precautionary statement(s) Disposal

P501	Dispose of contents/container in accordance with local regulations.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Substances

See section below for composition of Mixtures

Mixtures

CAS No	%[weight]	Name
75-09-2	balance	methylene chloride
83-32-9	0.2	acenaphthene
208-96-8	0.2	acenaphthylene
120-12-7	0.2	anthracene
56-55-3	0.2	benz[a]anthracene
50-32-8	0.2	benz[a]pyrene
205-99-2	0.2	benzo[b]fluoranthene
191-24-2	0.2	benzo[ghi]perylene
207-08-9	0.2	benzo[k]fluoranthene
218-01-9	0.2	chrysene
53-70-3	0.2	dibenz[a,h]anthracene
206-44-0	0.2	fluoranthene
86-73-7	0.2	fluorene
193-39-5	0.2	indeno[1,2,3-cd]pyrene
91-20-3	0.2	naphthalene
85-01-8	0.2	phenanthrene
129-00-0	0.2	pyrene

SECTION 4 FIRST-AID MEASURES

Description of first aid measures

Eye Contact	If this product comes in contact with the eyes: ▸ Wash out immediately with fresh running water. ▸ Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids. ▸ Seek medical attention without delay; if pain persists or recurs seek medical attention. ▸ Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact	If skin contact occurs: ▸ Immediately remove all contaminated clothing, including footwear. ▸ Flush skin and hair with running water (and soap if available). ▸ Seek medical attention in event of irritation.
Inhalation	▸ If fumes or combustion products are inhaled remove from contaminated area. ▸ Lay patient down. Keep warm and rested. ▸ Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures. ▸ Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary. ▸ Transport to hospital, or doctor.
Ingestion	▸ If swallowed do **NOT** induce vomiting. ▸ If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. ▸ Observe the patient carefully. ▸ Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. ▸ Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink. ▸ Seek medical advice.

Most important symptoms and effects, both acute and delayed

Continued...

See Section 11

Indication of any immediate medical attention and special treatment needed

for naphthalene intoxication: Naphthalene requires hepatic and microsomal activation prior to the production of toxic effects. Liver microsomes catalyse the initial synthesis of the reactive 1,2-epoxide intermediate which is subsequently oxidised to naphthalene dihydrodiol and alpha-naphthol. The 2-naphthoquinones are thought to produce haemolysis, the 1,2-naphthoquinones are thought to be responsible for producing cataracts in rabbits, and the glutathione-adducts of naphthalene-1,2-oxide are probably responsible for pulmonary toxicity. Suggested treatment regime:

- Induce emesis and/or perform gastric lavage with large amounts of warm water where oral poisoning is suspected.
- Instill a saline cathartic such as magnesium or sodium sulfate in water (15 to 30g).
- Demulcents such as milk, egg white, gelatin, or other protein solutions may be useful after the stomach is emptied but oils should be avoided because they promote absorption.
- If eyes/skin contaminated, flush with warm water followed by the application of a bland ointment.
- Severe anaemia, due to haemolysis, may require small repeated blood transfusions, preferably with red cells from a non-sensitive individual.
- Where intravascular haemolysis, with haemoglobinuria occurs, protect the kidneys by promoting a brisk flow of dilute urine with, for example, an osmotic diuretic such as mannitol. It may be useful to alkalinise the urine with small amounts of sodium bicarbonate but many researchers doubt whether this prevents blockage of the renal tubules.
- Use supportive measures in the case of acute renal failure. GOSSELIN, SMITH HODGE: Clinical Toxicology of Commercial Products, 5th Ed.

SECTION 5 FIRE-FIGHTING MEASURES

Extinguishing media

- There is no restriction on the type of extinguisher which may be used.
- Use extinguishing media suitable for surrounding area.

Special hazards arising from the substrate or mixture

Fire Incompatibility	None known.

Special protective equipment and precautions for fire-fighters

Fire Fighting	▸ Alert Fire Brigade and tell them location and nature of hazard. ▸ Wear breathing apparatus plus protective gloves in the event of a fire. ▸ Prevent, by any means available, spillage from entering drains or water courses. ▸ Use fire fighting procedures suitable for surrounding area. ▸ **DO NOT** approach containers suspected to be hot. ▸ Cool fire exposed containers with water spray from a protected location. ▸ If safe to do so, remove containers from path of fire. ▸ Equipment should be thoroughly decontaminated after use.
Fire/Explosion Hazard	▸ Non combustible. ▸ Not considered a significant fire risk, however containers may burn. May emit poisonous fumes.

SECTION 6 ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

See section 8

Environmental precautions

See section 12

Methods and material for containment and cleaning up

Minor Spills	▸ Clean up all spills immediately. ▸ Avoid breathing vapours and contact with skin and eyes. ▸ Control personal contact with the substance, by using protective equipment. ▸ Contain and absorb spill with sand, earth, inert material or vermiculite. ▸ Wipe up. ▸ Place in a suitable, labelled container for waste disposal.
Major Spills	▸ Clear area of personnel and move upwind. ▸ Alert Fire Brigade and tell them location and nature of hazard. ▸ Wear full body protective clothing with breathing apparatus. ▸ Prevent, by all means available, spillage from entering drains or water courses. ▸ Consider evacuation (or protect in place). ▸ No smoking, naked lights or ignition sources. ▸ Increase ventilation. ▸ Stop leak if safe to do so. ▸ Water spray or fog may be used to disperse / absorb vapour. ▸ Contain or absorb spill with sand, earth or vermiculite. ▸ Collect recoverable product into labelled containers for recycling. ▸ Collect solid residues and seal in labelled drums for disposal. ▸ Wash area and prevent runoff into drains. ▸ After clean up operations, decontaminate and launder all protective clothing and equipment before storing and re-using. ▸ If contamination of drains or waterways occurs, advise emergency services.

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 HANDLING AND STORAGE

Precautions for safe handling

Safe handling	▸ Avoid all personal contact, including inhalation. ▸ Wear protective clothing when risk of exposure occurs.

Continued...

	▸ Use in a well-ventilated area. ▸ Prevent concentration in hollows and sumps. ▸ **DO NOT** enter confined spaces until atmosphere has been checked. ▸ **DO NOT** allow material to contact humans, exposed food or food utensils. ▸ Avoid contact with incompatible materials. ▸ When handling, **DO NOT** eat, drink or smoke. ▸ Keep containers securely sealed when not in use. ▸ Avoid physical damage to containers. ▸ Always wash hands with soap and water after handling. ▸ Work clothes should be laundered separately. Launder contaminated clothing before re-use. ▸ Use good occupational work practice. ▸ Observe manufacturer's storage and handling recommendations contained within this SDS. ▸ Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained. ▸ **DO NOT** allow clothing wet with material to stay in contact with skin
Other information	▸ Store in original containers. ▸ Keep containers securely sealed. ▸ Store in a cool, dry, well-ventilated area. ▸ Store away from incompatible materials and foodstuff containers. ▸ Protect containers against physical damage and check regularly for leaks. ▸ Observe manufacturer's storage and handling recommendations contained within this SDS.

Conditions for safe storage, including any incompatibilities

Suitable container	▸ Lined metal can, lined metal pail/ can. ▸ Plastic pail. ▸ Polyliner drum. ▸ Packing as recommended by manufacturer. ▸ Check all containers are clearly labelled and free from leaks. For low viscosity materials ▸ Drums and jerricans must be of the non-removable head type. ▸ Where a can is to be used as an inner package, the can must have a screwed enclosure. For materials with a viscosity of at least 2680 cSt. (23 deg. C) and solids (between 15 C deg. and 40 deg C.): ▸ Removable head packaging; ▸ Cans with friction closures and ▸ low pressure tubes and cartridges may be used. - Where combination packages are used, and the inner packages are of glass, there must be sufficient inert cushioning material in contact with inner and outer packages *. - In addition, where inner packagings are glass and contain liquids of packing group I and II there must be sufficient inert absorbent to absorb any spillage *. - * unless the outer packaging is a close fitting moulded plastic box and the substances are not incompatible with the plastic.
Storage incompatibility	None known

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

OCCUPATIONAL EXPOSURE LIMITS (OEL)

INGREDIENT DATA

Source	Ingredient	Material name	TWA	STEL	Peak	Notes
US OSHA Permissible Exposure Levels (PELs) - Table Z1	methylene chloride	Methylene chloride	50 ppm	Not Available	Not Available	See Table Z-2
US OSHA Permissible Exposure Levels (PELs) - Table Z2	methylene chloride	Methylene Chloride	Not Available	Not Available	Not Available	See 1919.52.
US NIOSH Recommended Exposure Limits (RELs)	methylene chloride	Dichloromethane, Methylene dichloride	Not Available	Not Available	Not Available	Ca See Appendix A
US ACGIH Threshold Limit Values (TLV)	methylene chloride	Dichloromethane	Not Available	Not Available	Not Available	TLV® Basis: COHb-emia; CNS impair; BEI
US ACGIH Threshold Limit Values (TLV)	benz[a]anthracene	Benz[a]anthracene	Not Available	Not Available	Not Available	TLV® Basis: Skin cancer; BEIP
US ACGIH Threshold Limit Values (TLV)	benz[a]pyrene	Benzo[a]pyrene	Not Available	Not Available	Not Available	TLV® Basis: Cancer; BElp
US ACGIH Threshold Limit Values (TLV)	benzo[b]fluoranthene	Benzo[b]fluoranthene	Not Available	Not Available	Not Available	TLV® Basis: Cancer; BElp
US ACGIH Threshold Limit Values (TLV)	chrysene	Chrysene	Not Available	Not Available	Not Available	TLV® Basis: Cancer; BElp
US OSHA Permissible Exposure Levels (PELs) - Table Z1	naphthalene	Naphthalene	50 mg/m3 / 10 ppm	75 mg/m3 / 15 ppm	Not Available	TLV® Basis: URT irr; cataracts; hemolytic anemia
US NIOSH Recommended Exposure Limits (RELs)	naphthalene	Naphthalin, Tar camphor, White tar	50 mg/m3 / 10 ppm	Not Available	Not Available	Not Available
US ACGIH Threshold Limit Values (TLV)	naphthalene	Naphthalene	10 ppm	Not Available	Not Available	Not Available

EMERGENCY LIMITS

Continued...

Ingredient	Material name	TEEL-1	TEEL-2	TEEL-3
methylene chloride	Methylene chloride; (Dichloromethane)	Not Available	Not Available	Not Available
acenaphthene	Acenaphthene	3.6 mg/m3	40 mg/m3	240 mg/m3
acenaphthylene	Acenaphthylene	10 mg/m3	110 mg/m3	660 mg/m3
anthracene	Anthracene	48 mg/m3	530 mg/m3	3,200 mg/m3
benz[a]anthracene	Benzo(a)anthracene	1.2 mg/m3	13 mg/m3	79 mg/m3
benz[a]pyrene	Benzo(a)pyrene; (Coal tar pitch volatiles)	0.6 mg/m3	120 mg/m3	700 mg/m3
benzo[b]fluoranthene	Benz(e)acephenanthrylene; (Benzo(b)fluoroanthene)	0.12 mg/m3	1.3 mg/m3	7.9 mg/m3
benzo[ghi]perylene	Benzo(ghi)perylene	30 mg/m3	330 mg/m3	2,000 mg/m3
chrysene	Chrysene	0.6 mg/m3	12 mg/m3	69 mg/m3
dibenz[a,h]anthracene	Dibenza(a,h)anthracene	0.093 mg/m3	1 mg/m3	2.9 mg/m3
fluoranthene	Fluoranthene	4.1 mg/m3	45 mg/m3	400 mg/m3
fluorene	Fluorene, 9H-	6.6 mg/m3	72 mg/m3	430 mg/m3
indeno[1,2,3-cd]pyrene	Indeno(1,2,3-cd)pyrene	1.2 mg/m3	13 mg/m3	79 mg/m3
naphthalene	Naphthalene	15 ppm	83 ppm	500 ppm
phenanthrene	Phenanthrene	2.1 mg/m3	23 mg/m3	360 mg/m3
pyrene	Pyrene	0.15 mg/m3	1.7 mg/m3	7.5 mg/m3

Ingredient	Original IDLH	Revised IDLH
methylene chloride	10,000 ppm	2,000 ppm
acenaphthene	Not Available	Not Available
acenaphthylene	Not Available	Not Available
anthracene	Not Available	Not Available
benz[a]anthracene	Not Available	Not Available
benz[a]pyrene	Not Available	Not Available
benzo[b]fluoranthene	Not Available	Not Available
benzo[ghi]perylene	Not Available	Not Available
benzo[k]fluoranthene	Not Available	Not Available
chrysene	Not Available	Not Available
dibenz[a,h]anthracene	Not Available	Not Available
fluoranthene	Not Available	Not Available
fluorene	Not Available	Not Available
indeno[1,2,3-cd]pyrene	Not Available	Not Available
naphthalene	500 ppm	250 ppm
phenanthrene	Not Available	Not Available
pyrene	Not Available	Not Available

Exposure controls

Appropriate engineering controls

Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection.
The basic types of engineering controls are:
Process controls which involve changing the way a job activity or process is done to reduce the risk.
Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment. Ventilation can remove or dilute an air contaminant if designed properly. The design of a ventilation system must match the particular process and chemical or contaminant in use.
Employers may need to use multiple types of controls to prevent employee overexposure.

- Employees exposed to confirmed human carcinogens should be authorized to do so by the employer, and work in a regulated area.
- Work should be undertaken in an isolated system such as a "glove-box" . Employees should wash their hands and arms upon completion of the assigned task and before engaging in other activities not associated with the isolated system.
- Within regulated areas, the carcinogen should be stored in sealed containers, or enclosed in a closed system, including piping systems, with any sample ports or openings closed while the carcinogens are contained within.
- Open-vessel systems are prohibited.
- Each operation should be provided with continuous local exhaust ventilation so that air movement is always from ordinary work areas to the operation.
- Exhaust air should not be discharged to regulated areas, non-regulated areas or the external environment unless decontaminated. Clean make-up air should be introduced in sufficient volume to maintain correct operation of the local exhaust system.
- For maintenance and decontamination activities, authorized employees entering the area should be provided with and required to wear clean, impervious garments, including gloves, boots and continuous-air supplied hood. Prior to removing protective garments the employee should undergo decontamination and be required to shower upon removal of the garments and hood.
- Except for outdoor systems, regulated areas should be maintained under negative pressure (with respect to non-regulated areas).
- Local exhaust ventilation requires make-up air be supplied in equal volumes to replaced air.
- Laboratory hoods must be designed and maintained so as to draw air inward at an average linear face velocity of 0.76 m/sec with a minimum of 0.64 m/sec. Design and construction of the fume hood requires that insertion of any portion of the employees body, other than hands and arms, be disallowed.

Personal protection

Continued...

Eye and face protection	▸ Safety glasses with side shields. ▸ Chemical goggles. ▸ Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lenses or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59], [AS/NZS 1336 or national equivalent]
Skin protection	See Hand protection below
Hands/feet protection	▸ Wear chemical protective gloves, e.g. PVC. ▸ Wear safety footwear or safety gumboots, e.g. Rubber **NOTE:** ▸ The material may produce skin sensitisation in predisposed individuals. Care must be taken, when removing gloves and other protective equipment, to avoid all possible skin contact. ▸ Contaminated leather items, such as shoes, belts and watch-bands should be removed and destroyed. The selection of suitable gloves does not only depend on the material, but also on further marks of quality which vary from manufacturer to manufacturer. Where the chemical is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application. The exact break through time for substances has to be obtained from the manufacturer of the protective gloves and has to be observed when making a final choice. Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended. Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include: · frequency and duration of contact, · chemical resistance of glove material, · glove thickness and · dexterity Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739, AS/NZS 2161.1 or national equivalent). · When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended. · When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended. · Some glove polymer types are less affected by movement and this should be taken into account when considering gloves for long-term use. · Contaminated gloves should be replaced. For general applications, gloves with a thickness typically greater than 0.35 mm, are recommended. It should be emphasised that glove thickness is not necessarily a good predictor of glove resistance to a specific chemical, as the permeation efficiency of the glove will be dependent on the exact composition of the glove material. Therefore, glove selection should also be based on consideration of the task requirements and knowledge of breakthrough times. Glove thickness may also vary depending on the glove manufacturer, the glove type and the glove model. Therefore, the manufacturers' technical data should always be taken into account to ensure selection of the most appropriate glove for the task. Note: Depending on the activity being conducted, gloves of varying thickness may be required for specific tasks. For example: · Thinner gloves (down to 0.1 mm or less) may be required where a high degree of manual dexterity is needed. However, these gloves are only likely to give short duration protection and would normally be just for single use applications, then disposed of. · Thicker gloves (up to 3 mm or more) may be required where there is a mechanical (as well as a chemical) risk i.e. where there is abrasion or puncture potential Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.
Body protection	See Other protection below
Other protection	▸ Employees working with confirmed human carcinogens should be provided with, and be required to wear, clean, full body protective clothing (smocks, coveralls, or long-sleeved shirt and pants), shoe covers and gloves prior to entering the regulated area. [AS/NZS ISO 6529:2006 or national equivalent] ▸ Employees engaged in handling operations involving carcinogens should be provided with, and required to wear and use half-face filter-type respirators with filters for dusts, mists and fumes, or air purifying canisters or cartridges. A respirator affording higher levels of protection may be substituted. [AS/NZS 1715 or national equivalent] ▸ Emergency deluge showers and eyewash fountains, supplied with potable water, should be located near, within sight of, and on the same level with locations where direct exposure is likely. ▸ Prior to each exit from an area containing confirmed human carcinogens, employees should be required to remove and leave protective clothing and equipment at the point of exit and at the last exit of the day, to place used clothing and equipment in impervious containers at the point of exit for purposes of decontamination or disposal. The contents of such impervious containers must be identified with suitable labels. For maintenance and decontamination activities, authorized employees entering the area should be provided with and required to wear clean, impervious garments, including gloves, boots and continuous-air supplied hood. ▸ Prior to removing protective garments the employee should undergo decontamination and be required to shower upon removal of the garments and hood.
Thermal hazards	Not Available

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	colorless

Physical state	Liquid	**Relative density (Water = 1)**	Not Available
Odour	Not Available	**Partition coefficient n-octanol / water**	Not Available
Odour threshold	Not Available	**Auto-ignition temperature (°C)**	Not Available
pH (as supplied)	Not Available	**Decomposition temperature**	Not Available
Melting point / freezing point (°C)	Not Available	**Viscosity (cSt)**	Not Available
Initial boiling point and boiling range (°C)	Not Available	**Molecular weight (g/mol)**	Not Available

Continued...

Flash point (°C)	Not Available	**Taste**	Not Available
Evaporation rate	Not Available	**Explosive properties**	Not Available
Flammability	Not Available	**Oxidising properties**	Not Available
Upper Explosive Limit (%)	Not Available	**Surface Tension (dyn/cm or mN/m)**	Not Available
Lower Explosive Limit (%)	Not Available	**Volatile Component (%vol)**	Not Available
Vapour pressure (kPa)	Not Available	**Gas group**	Not Available
Solubility in water (g/L)	Miscible	**pH as a solution (1%)**	Not Available
Vapour density (Air = 1)	Not Available	**VOC g/L**	Not Available

SECTION 10 STABILITY AND REACTIVITY

Reactivity	See section 7
Chemical stability	▸ Unstable in the presence of incompatible materials. ▸ Product is considered stable. ▸ Hazardous polymerisation will not occur.
Possibility of hazardous reactions	See section 7
Conditions to avoid	See section 7
Incompatible materials	See section 7
Hazardous decomposition products	See section 5

SECTION 11 TOXICOLOGICAL INFORMATION

Information on toxicological effects

Inhaled	The material is not thought to produce respiratory irritation (as classified by EC Directives using animal models). Nevertheless inhalation of vapours, fumes or aerosols, especially for prolonged periods, may produce respiratory discomfort and occasionally, distress. Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may be damaging to the health of the individual. Inhalation of naphthalene vapour is linked with headache, loss of appetite, nausea, damage to the eyes and kidneys. According to animal testing, long term exposure may cause excessive weakness and increased salivation, weight loss,difficulty breathing, collapse, and evidence of damage to the skin, liver and lungs.
Ingestion	Accidental ingestion of the material may be damaging to the health of the individual. Ingestion of naphthalene and related compounds may produce abdominal cramps with nausea, vomiting, diarrhoea, headache, profuse sweating, listlessness, confusion, and in severe poisonings, coma with or without convulsions. Irritation of the bladder may also occur, producing urgency, painful urination, and the passage of brown or black urine with or without albumin or casts.
Skin Contact	Skin contact is not thought to have harmful health effects (as classified under EC Directives); the material may still produce health damage following entry through wounds, lesions or abrasions. There is some evidence to suggest that this material can cause inflammation of the skin on contact in some persons. Workers sensitised to naphthalene and related compounds show an inflammation of the skin with scaling and reddening. Some individuals show an allergic reaction. Open cuts, abraded or irritated skin should not be exposed to this material Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.
Eye	Although the liquid is not thought to be an irritant (as classified by EC Directives), direct contact with the eye may produce transient discomfort characterised by tearing or conjunctival redness (as with windburn). Long term exposure to naphthalene has produced clouding of the lens (cataracts) in workers.
Chronic	Inhaling this product is more likely to cause a sensitisation reaction in some persons compared to the general population. Skin contact with the material is more likely to cause a sensitisation reaction in some persons compared to the general population. There is ample evidence that this material can be regarded as being able to cause cancer in humans based on experiments and other information. Based on experiments and other information, there is ample evidence to presume that exposure to this material can cause genetic defects that can be inherited. Ample evidence exists from experimentation that reduced human fertility is directly caused by exposure to the material. Animal testing indicates that inhalation of naphthalene may increase the incidence of respiratory tumours and may aggravate chronic inflammation. Polycyclic aromatic hydrocarbons are found in a number of materials such as coal tar, tobacco smoke, petroleum and air pollution. Some substituted derivatives have been identified as extremely liable to cause cancer, especially that of the lung and genito-urinary tract.

Polycyclic Aromatic Hydrocarbons Standard Mixture	**TOXICITY**	**IRRITATION**
	Not Available	Not Available
methylene chloride	**TOXICITY**	**IRRITATION**
	dermal (rat) LD50: >2000 mg/kg[1]	Eye(rabbit): 162 mg - moderate
	Inhalation (mouse) LC50: 25200 ppm/7hr[2]	Eye(rabbit): 500 mg/24hr - mild
	Oral (rat) LD50: 985 mg/kg[2]	Skin (rabbit): 100mg/24hr-moderate
		Skin (rabbit): 810 mg/24hr-SEVERE
acenaphthene	**TOXICITY**	**IRRITATION**
	Not Available	Not Available

Continued...

acenaphthylene

TOXICITY	IRRITATION
Oral (mouse) LD50: 1760 mg/kg[2]	Not Available

anthracene

TOXICITY	IRRITATION
Oral (mouse) LD50: 4900 mg/kg[2]	Not Available

benz[a]anthracene

TOXICITY	IRRITATION
Not Available	Not Available

benz[a]pyrene

TOXICITY	IRRITATION
Not Available	Skin (mouse): 0.014 mg - mild

benzo[b]fluoranthene

TOXICITY	IRRITATION
Not Available	Not Available

benzo[ghi]perylene

TOXICITY	IRRITATION
Not Available	Not Available

benzo[k]fluoranthene

TOXICITY	IRRITATION
Not Available	Not Available

chrysene

TOXICITY	IRRITATION
Not Available	Not Available

dibenz[a,h]anthracene

TOXICITY	IRRITATION
Not Available	Not Available

fluoranthene

TOXICITY	IRRITATION
Dermal (rabbit) LD50: 3180 mg/kg[2]	Not Available
Oral (rat) LD50: 2000 mg/kgd[2]	

fluorene

TOXICITY	IRRITATION
Not Available	Not Available

indeno[1,2,3-cd]pyrene

TOXICITY	IRRITATION
Not Available	Not Available

naphthalene

TOXICITY	IRRITATION
dermal (rat) LD50: >2500 mg/kg[2]	Eye (rabbit): 100 mg - mild
Oral (rat) LD50: 490 mg/kg[2]	Skin (rabbit):495 mg (open) - mild

phenanthrene

TOXICITY	IRRITATION
Oral (mouse) LD50: 700 mg/kgd[2]	Not Available

pyrene

TOXICITY	IRRITATION
Oral (rat) LD50: 2700 mg/kgd[2]	Skin (rabbit): 500 mg/24h - mild

Legend: *1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2.* Value obtained from manufacturer's SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances*

METHYLENE CHLORIDE

The material may produce moderate eye irritation leading to inflammation.
The material may cause severe skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of

Continued...

	vesicles, scaling and thickening of the skin. Inhalation (human) TCLo: 500 ppm/ 1 y - I Eye(rabbit): 10 mg - mild
ANTHRACENE	Oral (rat) TDLo: 20000 m g/kg/79w -I Skin (mouse): 0.118 mg - mild Equivocal tumorigen by RTECS criteria
BENZ[A]PYRENE	The following information refers to contact allergens as a group and may not be specific to this product. **WARNING:** This substance has been classified by the IARC as Group 1: **CARCINOGENIC TO HUMANS**. Exposure to the material for prolonged periods may cause physical defects in the developing embryo (teratogenesis).
BENZO[B]FLUORANTHENE	Lung, kidney, skin tumors and tumors at site of application recorded.
BENZO[K]FLUORANTHENE	Tumours at site of application.
CHRYSENE	Target organs in include skin (tumours at site of application).
FLUORANTHENE	Equivocal tumorigen bt RTECS criteria. Tumors at site of application recorded.
NAPHTHALENE	The material may be irritating to the eye, with prolonged contact causing inflammation.
PHENANTHRENE	Tumors at site of application. Neoplastic and tumorigenic by RTECS criteria.
PYRENE	Conjunctival irritation, excitement and muscle contraction recorded.
METHYLENE CHLORIDE & DIBENZ[A,H]ANTHRACENE	**WARNING:** This substance has been classified by the IARC as Group 2A: Probably Carcinogenic to Humans.
ACENAPHTHENE & ACENAPHTHYLENE & ANTHRACENE & FLUORANTHENE & PHENANTHRENE & PYRENE	Asthma-like symptoms may continue for months or even years after exposure to the material ends.
ACENAPHTHENE & BENZO[B]FLUORANTHENE & BENZO[GHI]PERYLENE & BENZO[K]FLUORANTHENE & DIBENZ[A,H]ANTHRACENE & INDENO[1,2,3-CD]PYRENE	No significant acute toxicological data identified in literature search.
ACENAPHTHENE & ANTHRACENE & BENZO[GHI]PERYLENE & FLUORANTHENE & FLUORENE & PHENANTHRENE & PYRENE	The substance is classified by IARC as Group 3: **NOT** classifiable as to its carcinogenicity to humans.
ANTHRACENE & BENZ[A]PYRENE & NAPHTHALENE & PYRENE	The material may cause skin irritation after prolonged or repeated exposure and may produce on contact skin redness, swelling, the production of vesicles, scaling and thickening of the skin.
ANTHRACENE & BENZO[B]FLUORANTHENE & BENZO[GHI]PERYLENE & BENZO[K]FLUORANTHENE & CHRYSENE & DIBENZ[A,H]ANTHRACENE & FLUORANTHENE & INDENO[1,2,3-CD]PYRENE & PHENANTHRENE & PYRENE	**NOTE:** Substance has been shown to be mutagenic in at least one assay, or belongs to a family of chemicals producing damage or change to cellular DNA.
BENZ[A]ANTHRACENE & BENZO[B]FLUORANTHENE & BENZO[K]FLUORANTHENE & CHRYSENE & INDENO[1,2,3-CD]PYRENE & NAPHTHALENE	**WARNING:** This substance has been classified by the IARC as Group 2B: Possibly Carcinogenic to Humans.
BENZ[A]ANTHRACENE & BENZ[A]PYRENE & BENZO[B]FLUORANTHENE & BENZO[K]FLUORANTHENE & DIBENZ[A,H]ANTHRACENE & INDENO[1,2,3-CD]PYRENE	Tenth Annual Report on Carcinogens: Substance anticipated to be Carcinogen [*National Toxicology Program: U.S. Dep.*

Acute Toxicity	⊘	**Carcinogenicity**	✔
Skin Irritation/Corrosion	⊘	**Reproductivity**	✔
Serious Eye Damage/Irritation	⊘	**STOT - Single Exposure**	⊘
Respiratory or Skin sensitisation	✔	**STOT - Repeated Exposure**	⊘
Mutagenicity	✔	**Aspiration Hazard**	⊘

Legend: ✘ *– Data available but does not fill the criteria for classification*
✔ *– Data available to make classification*

Continued...

– Data Not Available to make classification

SECTION 12 ECOLOGICAL INFORMATION

Toxicity

Polycyclic Aromatic Hydrocarbons Standard Mixture

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

methylene chloride

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	=13.1mg/L	1
EC50	48	Crustacea	=108.5mg/L	1
EC50	96	Algae or other aquatic plants	161.874mg/L	3
EC50	384	Crustacea	10.334mg/L	3
NOEC	96	Algae or other aquatic plants	56mg/L	4

acenaphthene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.58mg/L	4
EC50	48	Crustacea	1.275mg/L	4
EC50	96	Algae or other aquatic plants	0.5mg/L	1
EC50	384	Crustacea	0.178mg/L	3
NOEC	768	Fish	0.208-0.226mg/L	1

acenaphthylene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.991mg/L	3
EC50	96	Algae or other aquatic plants	1.450mg/L	3
EC50	384	Crustacea	0.249mg/L	3

anthracene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.00127mg/L	4
EC50	48	Crustacea	0.01119096mg/L	4
EC50	72	Algae or other aquatic plants	>0.0078mg/L	2
BCF	48	Fish	1.0mg/L	4
EC50	24	Crustacea	ca.0.0012mg/L	2
NOEC	22	Algae or other aquatic plants	0.0015-0.0017mg/L	2

benz[a]anthracene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.083mg/L	3
EC50	48	Crustacea	0.000958776mg/L	4
EC50	96	Algae or other aquatic plants	0.087mg/L	3
BCF	24	Crustacea	0.006mg/L	4
EC50	48	Crustacea	0.0014815372mg/L	4

benz[a]pyrene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.026mg/L	3
EC50	48	Crustacea	0.0009815248mg/L	4
EC50	72	Algae or other aquatic plants	0.005mg/L	4
BCF	12	Fish	7.51mg/L	4
EC50	48	Crustacea	0.0016249408mg/L	4
NOEC	360	Fish	0.00102mg/L	4

benzo[b]fluoranthene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.026mg/L	3
EC50	96	Algae or other aquatic plants	0.029mg/L	3
EC50	384	Crustacea	0.011mg/L	3

Continued...

benzo[ghi]perylene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.008mg/L	3
EC50	48	Crustacea	0.0001326432mg/L	4
EC50	96	Algae or other aquatic plants	0.010mg/L	3
BCF	24	Crustacea	0.0002mg/L	4
EC50	48	Crustacea	0.0010418018mg/L	4

benzo[k]fluoranthene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
BCF	24	Crustacea	0.0014mg/L	4
NOEC	144	Fish	0.01mg/L	4

chrysene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.083mg/L	3
EC50	96	Algae or other aquatic plants	0.087mg/L	3
BCF	240	Crustacea	0.00136968mg/L	4
EC50	384	Crustacea	0.027mg/L	3
NOEC	2016	Fish	0.116331488mg/L	4

dibenz[a,h]anthracene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.008mg/L	3
EC50	48	Crustacea	0.0005510934mg/L	4
EC50	96	Algae or other aquatic plants	0.010mg/L	3
BCF	6	Crustacea	0.00072mg/L	4
EC50	48	Crustacea	0.001558648mg/L	4
NOEC	144	Fish	0.01mg/L	4

fluoranthene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.0001mg/L	4
EC50	48	Crustacea	0.003984522mg/L	4
EC50	72	Algae or other aquatic plants	0.103mg/L	4
BCF	672	Crustacea	0.125mg/L	4
EC10	144	Crustacea	0.0078mg/L	4
NOEC	744	Crustacea	0.0006mg/L	4

fluorene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.76mg/L	4
EC50	48	Crustacea	0.212mg/L	4
EC50	96	Algae or other aquatic plants	1.346mg/L	3
BCF	576	Crustacea	1.055mg/L	4
EC50	384	Crustacea	0.238mg/L	3
NOEC	336	Crustacea	0.0625mg/L	4

indeno[1,2,3-cd]pyrene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

naphthalene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.213mg/L	4
EC50	48	Crustacea	1.6mg/L	4
EC50	72	Algae or other aquatic plants	ca.0.4mg/L	1
BCF	12	Fish	10.2mg/L	4
EC50	0.05	Crustacea	0.000000085mg/L	4
NOEC	48	Fish	0.012817mg/L	4

phenanthrene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.234mg/L	4

Continued...

	EC50	48	Crustacea	0.117mg/L	4
	EC50	72	Algae or other aquatic plants	0.324mg/L	4
	BCF	24	Algae or other aquatic plants	1mg/L	4
	EC50	96	Fish	0.049mg/L	4
	NOEC	2160	Fish	0.005mg/L	4

pyrene	ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
	LC50	96	Fish	0.249mg/L	3
	EC50	48	Crustacea	0.004327936mg/L	4
	EC50	96	Algae or other aquatic plants	0.256mg/L	3
	BCF	24	Algae or other aquatic plants	0.5mg/L	4
	EC50	24	Crustacea	>=0.003- <=0.03mg/L	2
	NOEC	168	Fish	0.0152mg/L	4

Legend: *Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 3. EPIWIN Suite V3.12 (QSAR) - Aquatic Toxicity Data (Estimated) 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data*

Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
Do NOT allow product to come in contact with surface waters or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment wash-waters.
Wastes resulting from use of the product must be disposed of on site or at approved waste sites.
For naphthalene:
Environmental Fate: Naphthalene may be reach surface water and soil through transportation in water or being carried by air. Most airborne naphthalene is in a vapour form and hence deposition is expected to be slow. A minimal amount of naphthalene emitted to the air is transported to other environmental components mostly by dry deposition. Naphthalene in surface water may volatililize into the atmosphere, depending on environmental condiditons. It remains in solution in water, with only small amounts associated with suspended material and benthic sediments. While naphthalene is readily volatilized from aerated soils, it adheres to soils with a high organic content. Adsorption to aquifer material reduces transportation of naphthalene through groundwater, and the presence of nonionic organic compounds such as tetrachloroethene may enhance sorption to materials that contain low carbon content. Bioconcentration of naphthalene is moderate in aquatic organisms. It is readily metabolized by fish, and invertebrates that are placed in pollutant free water rapidly eliminate any traces of the pollutant. While bioaccumulation in the food chain is unlikely, exposure of cows and chickens to naphthalene could lead to naphthalene being present in milk and eggs. While the data on the transport and partitioning of methylnaphthalenes in the environment is limited, the characteristics of these chemicals are similar to naphthalene, so they are expected to behave in a similar manner to naphthalene in the environment, and produce the same effects on aquatic organisms. Biodegradation of naphthalene occurs relatively quickly in aquatic systems. Methylnaphthalenes are biodegraded under aerobic conditions after adaptation. Degradation rates are highest in water constantly polluted with petroleum. Naphthalene biodegradation rates are higher in sediment than in the water column above it. Methylnaphthalenes biodegrades more slowly. Reported half-lives in sediments were 46 weeks for 1-methylnaphthalene and ranged from 14 to 50 weeks for 2-methylnaphthalene. In soils, the potential for biodegradation is an important factor for biological remediation of soil. Studies on biodegradation of PAHs suggest that adsorption to the organic matter significantly reduces the bioavailability for microorganisms, and thus the biodegradability, of PAHs, including naphthalene. Biodegradation is accomplished through the action of aerobic microorganisms and is reduced in anaerobic soil conditions. Naphthalene biodegrades to carbon dioxide in aerobic soils, with salicylate as an intermediate product. Abiotic degradation of naphthalene seldom occurs in soils. As with naphthalene, 1-Methylnaphthalene is easily volatilised from aerated soil, and the biodegradation half-life averages between 1.7 and 2.2 days.
Ecotoxicity: Acute toxicity data on naphthalene for several fish species (freshwater and marine), show 96h LC50 values range from 1.8 to 7.8 mg/L. Comparable results were obtained with other vertebrates (amphibians). From chronic toxicity tests, a precise NOEL is not clearly determined. A NOEC of 0.12 mg/L was observed in a 40 days test on juvenile pink salmon, but 50% mortality at 0.11 mg/L was calculated for trout fry exposed during hatching.Several data are also available for invertebrates, showing 48h EC50 values ranging from 2.1 to 24 mg/L. While chronic data on freshwater invertebrates and algae are questionable, a 50% photosynthesis reduction was observed at 2.8 mg/L in 4 hours experiments.QSAR prediction models give results consistent with experimental short-term data on fish daphnia and algae.
For Polycyclic Aromatic Hydrocarbons (PAH's):
Environmental Fate: A general rule for biodegradation of PAHs is that parent compounds tend to degrade faster than alkylated analogs. Less is known about the biodegradability of resins and asphaltenes, but the current knowledge suggests these are not very biodegradable and will persist in the environment for a long time. The more hydrophobic a compound, the greater the partitioning to non-aqueous phases.
Atmospheric Fate: PAHs travel through the atmosphere as a gas or attached to dust particles. They are carried by air currents and deposited by dry or wet (rain, dew, etc.) deposition.
Aquatic Fate: When deposited in water PAHs sink to the bottom of lakes and rivers. Some will move though the soil to contaminate groundwater. PAHs are ubiquitous in the marine environment, occurring at their highest environmental concentrations around urban centres. The availability of organic carbon controls, to a large extent, the partitioning behaviour of PAHs in sediment. Mixed microbial populations in sediment/water systems may degrade some PAHs, with degradation progressively decreasing with increasing molecular weight.
Terrestrial Fate: The rate of degradation is dependent on nutrient content and the bacterial community in soil. PAHs in soils undergo a weathering process such that the lighter chain fractions are removed (primarily by volatilization). Heavier fractions bind to soil organic matter and remain behind in the top soil horizon. As the mixture of PAHs age, bioavailability changes as the fraction remaining bind more tightly. In general, the more soluble a PAH, the higher the uptake by plants while the reverse is true for uptake by earthworms and uptake in the gastrointestinal tract of animals.
Ecotoxicity: The primary mode of toxicity for PAHs in soil dwelling terrestrial invertebrates is non-specific non-polar narcosis. The uptake of PAHs by earthworms occurs primarily by direct contact with the soluble phase of soil solution. Microbial degradation of PAHs is a key process in soils. Biodegradation of PAHs may take place over a period of weeks to months. The lipid (fat) phase, of all organisms, contains the highest levels of PAHs. Accumulation of PAHs occurs in all marine organisms, however; there is a wide range in tissue concentrations resulting from variable environmental concentrations, level and time of exposure, and species ability to metabolize these compounds. In fish, bile and liver accumulate the highest levels of PAH and metabolites. In invertebrates, the highest concentrations can be found in the internal organs, such as the liver and pancreas; tissue concentrations appear to follow seasonal cycles which may be related to variations in lipid content or spawning cycles.
DO NOT discharge into sewer or waterways.

Persistence and degradability

Ingredient	Persistence: Water/Soil	Persistence: Air
methylene chloride	LOW (Half-life = 56 days)	HIGH (Half-life = 191 days)
acenaphthene	HIGH (Half-life = 204 days)	LOW (Half-life = 0.37 days)
acenaphthylene	MEDIUM (Half-life = 120 days)	LOW (Half-life = 0.05 days)
anthracene	HIGH (Half-life = 920 days)	LOW (Half-life = 0.21 days)
benz[a]anthracene	HIGH (Half-life = 1360 days)	LOW (Half-life = 0.33 days)
benz[a]pyrene	HIGH (Half-life = 1060 days)	LOW (Half-life = 0.18 days)
benzo[b]fluoranthene	HIGH (Half-life = 1220 days)	LOW (Half-life = 0.6 days)
benzo[ghi]perylene	HIGH (Half-life = 1300 days)	LOW (Half-life = 0.13 days)
benzo[k]fluoranthene	HIGH (Half-life = 4280 days)	LOW (Half-life = 0.46 days)
chrysene	HIGH (Half-life = 2000 days)	LOW (Half-life = 0.33 days)

Continued...

dibenz[a,h]anthracene	HIGH (Half-life = 1880 days)	LOW (Half-life = 0.18 days)
fluoranthene	HIGH (Half-life = 880 days)	LOW (Half-life = 0.84 days)
fluorene	MEDIUM (Half-life = 120 days)	LOW (Half-life = 2.84 days)
indeno[1,2,3-cd]pyrene	HIGH (Half-life = 1460 days)	LOW (Half-life = 0.26 days)
naphthalene	HIGH (Half-life = 258 days)	LOW (Half-life = 1.23 days)
phenanthrene	HIGH (Half-life = 400 days)	LOW (Half-life = 0.84 days)
pyrene	HIGH (Half-life = 3800 days)	LOW (Half-life = 0.33 days)

Bioaccumulative potential

Ingredient	Bioaccumulation
methylene chloride	LOW (BCF = 40)
acenaphthene	LOW (BCF = 387)
acenaphthylene	MEDIUM (BCF = 545)
anthracene	HIGH (BCF = 10500)
benz[a]anthracene	HIGH (LogKOW = 5.76)
benz[a]pyrene	HIGH (LogKOW = 6.13)
benzo[b]fluoranthene	HIGH (LogKOW = 5.78)
benzo[ghi]perylene	HIGH (LogKOW = 6.697)
chrysene	HIGH (LogKOW = 5.81)
dibenz[a,h]anthracene	HIGH (LogKOW = 6.697)
fluoranthene	HIGH (LogKOW = 5.16)
fluorene	MEDIUM (BCF = 830)
naphthalene	HIGH (BCF = 18000)
phenanthrene	MEDIUM (LogKOW = 4.46)
pyrene	HIGH (LogKOW = 4.88)

Mobility in soil

Ingredient	Mobility
methylene chloride	LOW (KOC = 23.74)
acenaphthene	LOW (KOC = 6123)
acenaphthylene	LOW (KOC = 6123)
anthracene	LOW (KOC = 20400)
benz[a]anthracene	LOW (KOC = 231300)
benz[a]pyrene	LOW (KOC = 786800)
benzo[b]fluoranthene	LOW (KOC = 803100)
benzo[ghi]perylene	LOW (KOC = 2676000)
chrysene	LOW (KOC = 236100)
dibenz[a,h]anthracene	LOW (KOC = 2622000)
fluoranthene	LOW (KOC = 70850)
fluorene	LOW (KOC = 11290)
naphthalene	LOW (KOC = 1837)
phenanthrene	LOW (KOC = 20830)
pyrene	LOW (KOC = 69410)

SECTION 13 DISPOSAL CONSIDERATIONS

Waste treatment methods

Product / Packaging disposal	▸ Containers may still present a chemical hazard/ danger when empty. ▸ Return to supplier for reuse/ recycling if possible. Otherwise: ▸ If container can not be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill. ▸ Where possible retain label warnings and SDS and observe all notices pertaining to the product. Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked. A Hierarchy of Controls seems to be common - the user should investigate: ▸ Reduction ▸ Reuse ▸ Recycling ▸ Disposal (if all else fails) This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. If it has been contaminated, it may be possible to reclaim the product by filtration, distillation or some other means. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate.

Continued...

	▸ **DO NOT** allow wash water from cleaning or process equipment to enter drains. ▸ It may be necessary to collect all wash water for treatment before disposal. ▸ In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first. ▸ Where in doubt contact the responsible authority.

SECTION 14 TRANSPORT INFORMATION

Labels Required

	
Marine Pollutant	

Land transport (DOT)

UN number	1593
UN proper shipping name	Dichloromethane
Transport hazard class(es)	Class: 6.1 Subrisk: Not Applicable
Packing group	III
Environmental hazard	Not Applicable
Special precautions for user	Hazard Label: 6.1 Special provisions: IB3, IP8, N36, T7, TP2

Air transport (ICAO-IATA / DGR)

UN number	1593
UN proper shipping name	Dichloromethane
Transport hazard class(es)	ICAO/IATA Class: 6.1 ICAO / IATA Subrisk: Not Applicable ERG Code: 6L
Packing group	III
Environmental hazard	Not Applicable
Special precautions for user	Special provisions: Not Applicable Cargo Only Packing Instructions: 663 Cargo Only Maximum Qty / Pack: 220 L Passenger and Cargo Packing Instructions: 655 Passenger and Cargo Maximum Qty / Pack: 60 L Passenger and Cargo Limited Quantity Packing Instructions: Y642 Passenger and Cargo Limited Maximum Qty / Pack: 2 L

Sea transport (IMDG-Code / GGVSee)

UN number	1593
UN proper shipping name	DICHLOROMETHANE
Transport hazard class(es)	IMDG Class: 6.1 IMDG Subrisk: Not Applicable
Packing group	III
Environmental hazard	Marine Pollutant
Special precautions for user	EMS Number: F-A, S-A Special provisions: Not Applicable Limited Quantities: 5 L

Continued...

Transport in bulk according to Annex II of MARPOL and the IBC code

Not Applicable

SECTION 15 REGULATORY INFORMATION

Safety, health and environmental regulations / legislation specific for the substance or mixture

METHYLENE CHLORIDE(75-09-2) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - Alaska Limits for Air Contaminants
US - California - Proposition 65 - Priority List for the Development of MADLs for Chemicals Causing Reproductive Toxicity
US - California OEHHA/ARB - Acute Reference Exposure Levels and Target Organs (RELs)
US - California OEHHA/ARB - Chronic Reference Exposure Levels and Target Organs (CRELs)
US - California Permissible Exposure Limits for Chemical Contaminants
US - California Proposition 65 - Carcinogens
US - California Proposition 65 - No Significant Risk Levels (NSRLs) for Carcinogens
US - Hawaii Air Contaminant Limits
US - Idaho - Acceptable Maximum Peak Concentrations
US - Idaho - Limits for Air Contaminants
US - Massachusetts - Right To Know Listed Chemicals
US - Michigan Exposure Limits for Air Contaminants
US - Minnesota Permissible Exposure Limits (PELs)
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Carcinogens
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Mutagens
US - Oregon Permissible Exposure Limits (Z-1)
US - Pennsylvania - Hazardous Substance List
US - Rhode Island Hazardous Substance List
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants
US - Washington Permissible exposure limits of air contaminants
US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants
US - Wyoming Toxic and Hazardous Substances Table Z-2 Acceptable ceiling concentration, Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift
US ACGIH Threshold Limit Values (TLV)
US ACGIH Threshold Limit Values (TLV) - Carcinogens
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US National Toxicology Program (NTP) 14th Report Part B.
US NIOSH Recommended Exposure Limits (RELs)
US OSHA Carcinogens Listing
US OSHA Permissible Exposure Levels (PELs) - Table Z1
US OSHA Permissible Exposure Levels (PELs) - Table Z2
US Spacecraft Maximum Allowable Concentrations (SMACs) for Airborne Contaminants
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory
US TSCA New Chemical Exposure Limits (NCEL)

ACENAPHTHENE(83-32-9) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - Massachusetts - Right To Know Listed Chemicals
US - Pennsylvania - Hazardous Substance List
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

ACENAPHTHYLENE(208-96-8) IS FOUND ON THE FOLLOWING REGULATORY LISTS

US - Massachusetts - Right To Know Listed Chemicals
US - Pennsylvania - Hazardous Substance List
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

ANTHRACENE(120-12-7) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - Alaska Limits for Air Contaminants
US - Massachusetts - Right To Know Listed Chemicals
US - Pennsylvania - Hazardous Substance List
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

BENZ[A]ANTHRACENE(56-55-3) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - California - Proposition 65 - Priority List for the Development of MADLs for Chemicals Causing Reproductive Toxicity
US - California Proposition 65 - Carcinogens
US - California Proposition 65 - No Significant Risk Levels (NSRLs) for Carcinogens
US - Massachusetts - Right To Know Listed Chemicals
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Carcinogens
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Mutagens
US - Pennsylvania - Hazardous Substance List
US - Rhode Island Hazardous Substance List
US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values
US ACGIH Threshold Limit Values (TLV)
US ACGIH Threshold Limit Values (TLV) - Carcinogens
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US National Toxicology Program (NTP) 14th Report Part B.
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

BENZ[A]PYRENE(50-32-8) IS FOUND ON THE FOLLOWING REGULATORY LISTS

Continued...

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - Alaska Limits for Air Contaminants
US - California - Proposition 65 - Priority List for the Development of MADLs for Chemicals Causing Reproductive Toxicity
US - California Proposition 65 - Carcinogens
US - California Proposition 65 - No Significant Risk Levels (NSRLs) for Carcinogens
US - Hawaii Air Contaminant Limits
US - Idaho - Limits for Air Contaminants
US - Massachusetts - Right To Know Listed Chemicals
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Carcinogens
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Mutagens
US - Pennsylvania - Hazardous Substance List
US - Rhode Island Hazardous Substance List
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants
US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants
US ACGIH Threshold Limit Values (TLV)
US ACGIH Threshold Limit Values (TLV) - Carcinogens
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US National Toxicology Program (NTP) 14th Report Part B.
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

BENZO[B]FLUORANTHENE(205-99-2) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - California - Proposition 65 - Priority List for the Development of MADLs for Chemicals Causing Reproductive Toxicity
US - California Proposition 65 - Carcinogens
US - California Proposition 65 - No Significant Risk Levels (NSRLs) for Carcinogens
US - Massachusetts - Right To Know Listed Chemicals
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Carcinogens
US - Pennsylvania - Hazardous Substance List
US - Rhode Island Hazardous Substance List
US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values
US ACGIH Threshold Limit Values (TLV)
US ACGIH Threshold Limit Values (TLV) - Carcinogens
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US National Toxicology Program (NTP) 14th Report Part B.

BENZO[GHI]PERYLENE(191-24-2) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - Massachusetts - Right To Know Listed Chemicals
US - Pennsylvania - Hazardous Substance List
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List

BENZO[K]FLUORANTHENE(207-08-9) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - California Proposition 65 - Carcinogens
US - Massachusetts - Right To Know Listed Chemicals
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Carcinogens
US - Pennsylvania - Hazardous Substance List
US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US National Toxicology Program (NTP) 14th Report Part B.
US Priority List for the Development of Proposition 65 Safe Harbor Levels - No Significant Risk Levels (NSRLs) for Carcinogens and Maximum Allowable Dose Levels (MADLs) for Chemicals Causing Reproductive Toxicity

CHRYSENE(218-01-9) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - Alaska Limits for Air Contaminants
US - California - Proposition 65 - Priority List for the Development of MADLs for Chemicals Causing Reproductive Toxicity
US - California Proposition 65 - Carcinogens
US - California Proposition 65 - No Significant Risk Levels (NSRLs) for Carcinogens
US - Hawaii Air Contaminant Limits
US - Idaho - Limits for Air Contaminants
US - Massachusetts - Right To Know Listed Chemicals
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Carcinogens
US - Pennsylvania - Hazardous Substance List
US - Rhode Island Hazardous Substance List
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants
US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants
US ACGIH Threshold Limit Values (TLV)
US ACGIH Threshold Limit Values (TLV) - Carcinogens
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

DIBENZ[A,H]ANTHRACENE(53-70-3) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - California - Proposition 65 - Priority List for the Development of MADLs for Chemicals Causing Reproductive Toxicity
US - California Proposition 65 - Carcinogens
US - California Proposition 65 - No Significant Risk Levels (NSRLs) for Carcinogens
US - Massachusetts - Right To Know Listed Chemicals
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Carcinogens
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Mutagens
US - Pennsylvania - Hazardous Substance List
US - Rhode Island Hazardous Substance List
US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US National Toxicology Program (NTP) 14th Report Part B.
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

Continued...

FLUORANTHENE(206-44-0) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - Massachusetts - Right To Know Listed Chemicals
US - Pennsylvania - Hazardous Substance List
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

FLUORENE(86-73-7) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - Massachusetts - Right To Know Listed Chemicals
US - Pennsylvania - Hazardous Substance List
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

INDENO[1,2,3-CD]PYRENE(193-39-5) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - California Proposition 65 - Carcinogens
US - Massachusetts - Right To Know Listed Chemicals
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Carcinogens
US - Pennsylvania - Hazardous Substance List
US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US National Toxicology Program (NTP) 14th Report Part B.
US Priority List for the Development of Proposition 65 Safe Harbor Levels - No Significant Risk Levels (NSRLs) for Carcinogens and Maximum Allowable Dose Levels (MADLs) for Chemicals Causing Reproductive Toxicity
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

NAPHTHALENE(91-20-3) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - Alaska Limits for Air Contaminants
US - California - Proposition 65 - Priority List for the Development of MADLs for Chemicals Causing Reproductive Toxicity
US - California OEHHA/ARB - Chronic Reference Exposure Levels and Target Organs (CRELs)
US - California Permissible Exposure Limits for Chemical Contaminants
US - California Proposition 65 - Carcinogens
US - California Proposition 65 - No Significant Risk Levels (NSRLs) for Carcinogens
US - Hawaii Air Contaminant Limits
US - Idaho - Limits for Air Contaminants
US - Massachusetts - Right To Know Listed Chemicals
US - Michigan Exposure Limits for Air Contaminants
US - Minnesota Permissible Exposure Limits (PELs)
US - New Jersey Right to Know - Special Health Hazard Substance List (SHHSL): Carcinogens
US - Oregon Permissible Exposure Limits (Z-1)
US - Pennsylvania - Hazardous Substance List
US - Rhode Island Hazardous Substance List
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants
US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants
US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants
US - Washington Permissible exposure limits of air contaminants
US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants
US ACGIH Threshold Limit Values (TLV)
US ACGIH Threshold Limit Values (TLV) - Carcinogens
US ATSDR Minimal Risk Levels for Hazardous Substances (MRLs)
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - List of Hazardous Substances
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US National Toxicology Program (NTP) 14th Report Part B.
US NIOSH Recommended Exposure Limits (RELs)
US OSHA Permissible Exposure Levels (PELs) - Table Z1
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

PHENANTHRENE(85-01-8) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - Alaska Limits for Air Contaminants
US - California OEHHA/ARB - Chronic Reference Exposure Levels and Target Organs (CRELs)
US - California Permissible Exposure Limits for Chemical Contaminants
US - Hawaii Air Contaminant Limits
US - Massachusetts - Right To Know Listed Chemicals
US - Michigan Exposure Limits for Air Contaminants
US - Oregon Permissible Exposure Limits (Z-1)
US - Pennsylvania - Hazardous Substance List
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants
US - Washington Permissible exposure limits of air contaminants
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

PYRENE(129-00-0) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs
US - Alaska Limits for Air Contaminants
US - California OEHHA/ARB - Chronic Reference Exposure Levels and Target Organs (CRELs)
US - California Permissible Exposure Limits for Chemical Contaminants
US - Hawaii Air Contaminant Limits
US - Massachusetts - Right To Know Listed Chemicals
US - Michigan Exposure Limits for Air Contaminants
US - Oregon Permissible Exposure Limits (Z-1)
US - Pennsylvania - Hazardous Substance List
US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants
US - Washington Permissible exposure limits of air contaminants
US - Wyoming Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants
US Clean Air Act - Hazardous Air Pollutants
US CWA (Clean Water Act) - Priority Pollutants
US CWA (Clean Water Act) - Toxic Pollutants
US EPA Carcinogens Listing
US EPCRA Section 313 Chemical List
US SARA Section 302 Extremely Hazardous Substances
US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory

Federal Regulations

Continued...

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SECTION 311/312 HAZARD CATEGORIES

Immediate (acute) health hazard	Yes
Delayed (chronic) health hazard	Yes
Fire hazard	No
Pressure hazard	No
Reactivity hazard	No

US. EPA CERCLA HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES (40 CFR 302.4)

Name	Reportable Quantity in Pounds (lb)	Reportable Quantity in kg
Dichloromethane	1000	454
Acenaphthene	100	45.4
Acenaphthylene	5000	2270
Anthracene	5000	2270
Benz[a]anthracene	10	4.54
Benzo[a]pyrene	1	0.454
Benzo[b]fluoranthene	1	0.454
Benzo[ghi]perylene	5000	2270
Benzo(k)fluoranthene	5000	2270
Chrysene	100	45.4
Dibenz[a,h]anthracene	1	0.454
Fluoranthene	100	45.4
Fluorene	5000	2270
Indeno(1,2,3-cd)pyrene	100	45.4
Naphthalene	100	45.4
Phenanthrene	5000	2270
Pyrene	5000	2270

State Regulations

US. CALIFORNIA PROPOSITION 65

WARNING: This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm

US - CALIFORNIA PREPOSITION 65 - CARCINOGENS & REPRODUCTIVE TOXICITY (CRT): LISTED SUBSTANCE

Dichloromethane (Methylene chloride), Benz[a]anthracene, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Chrysene, Dibenz[a,h]anthracene, Indeno[1,2,3-cd]pyrene, Naphthalene Listed

National Inventory	Status
Australia - AICS	Y
Canada - DSL	N (fluoranthene; benz[a]anthracene; dibenz[a,h]anthracene; indeno[1,2,3-cd]pyrene; benzo[k]fluoranthene; acenaphthylene; benzo[b]fluoranthene; benzo[ghi]perylene)
Canada - NDSL	N (benz[a]pyrene; acenaphthene; pyrene; naphthalene; chrysene; phenanthrene; methylene chloride; fluorene; benzo[k]fluoranthene; benzo[b]fluoranthene; benzo[ghi]perylene; anthracene)
China - IECSC	N (chrysene; indeno[1,2,3-cd]pyrene; benzo[k]fluoranthene; acenaphthylene; benzo[b]fluoranthene; benzo[ghi]perylene)
Europe - EINEC / ELINCS / NLP	Y
Japan - ENCS	N (benz[a]pyrene; pyrene; fluoranthene; chrysene; benz[a]anthracene; phenanthrene; dibenz[a,h]anthracene; indeno[1,2,3-cd]pyrene; benzo[k]fluoranthene; acenaphthylene; benzo[b]fluoranthene; benzo[ghi]perylene)
Korea - KECI	N (fluoranthene; benz[a]anthracene; dibenz[a,h]anthracene; indeno[1,2,3-cd]pyrene; benzo[k]fluoranthene; acenaphthylene; benzo[b]fluoranthene; benzo[ghi]perylene)
New Zealand - NZIoC	Y
Philippines - PICCS	N (fluoranthene; chrysene; benz[a]anthracene; dibenz[a,h]anthracene; indeno[1,2,3-cd]pyrene; benzo[k]fluoranthene; benzo[b]fluoranthene; benzo[ghi]perylene)
USA - TSCA	N (benzo[k]fluoranthene; benzo[b]fluoranthene; benzo[ghi]perylene)
Legend:	*Y = All ingredients are on the inventory* *N = Not determined or one or more ingredients are not on the inventory and are not exempt from listing(see specific ingredients in brackets)*

SECTION 16 OTHER INFORMATION

Other information

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.
The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

Definitions and abbreviations

PC—TWA: Permissible Concentration-Time Weighted Average

Continued...

PC－STEL: Permissible Concentration-Short Term Exposure Limit
IARC: International Agency for Research on Cancer
ACGIH: American Conference of Governmental Industrial Hygienists
STEL: Short Term Exposure Limit
TEEL: Temporary Emergency Exposure Limit。
IDLH: Immediately Dangerous to Life or Health Concentrations
OSF: Odour Safety Factor
NOAEL :No Observed Adverse Effect Level
LOAEL: Lowest Observed Adverse Effect Level
TLV: Threshold Limit Value
LOD: Limit Of Detection
OTV: Odour Threshold Value
BCF: BioConcentration Factors
BEI: Biological Exposure Index

MATERIAL SAFETY DATA SHEET

(POLYCHLORINATED BIPHENYLS)

COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients Name: polychlorinated biphenyls (PCBs)

HAZARD IDENTIFICATION

Reports of Carcinogenicity: YES

HEALTH HAZARDS ACUTE AND CHRONIC

- **Eyes**: Moderately irritating to eye tissues.
- **Skin**: Can be absorbed through intact skin, may cause de-fatting, potential for chloracne.
- **Inhalation**: Possible liver injury.
- **Ingestion**: Slightly toxic; reasonably anticipated to be carcinogenic.

EFFECTS OF OVER-EXPOSURE

Can cause dermatological symptoms; however, these are reversible upon removal of exposure source.

FIRST AID MEASURES

- **Eyes**: Irrigate immediately with copious quantities of running water for at least 15 minutes if liquid or solid PCBs get into them.
- **Skin:** Contaminated clothing should be removed and the skin washed thoroughly with soap and water. Hot PCBs may cause thermal burns.
- **Inhalation**: Remove to fresh air; if skin rash or respiratory irritation persists, consult a physician (if electrical equipment arcs over, PCBs may decompose to produce hydrochloric acid).
- **Ingestion**: Consult a physician. Do not induce vomiting or give any oily laxatives. (If large amounts are ingested, gastric lavage is suggested).

FIRE FIGHTING MEASURES: Flash Point: >141 ^{o}C (285.8 ^{o}F)

EXTINGUISHING MEDIA: PCBs are fire-resistant compounds.

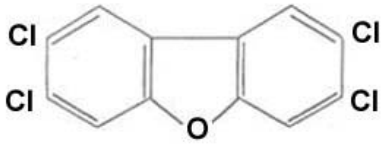
FIRE-FIGHTING PROCEDURES

Standard fire-fighting wearing apparel and self-contained breathing apparatus should be worn when fighting fires that involve possible exposure to chemical combustion products. Fire fighting equipment should be thoroughly cleaned and decontaminated after use.

UNUSUAL FIRE/EXPLOSION HAZARD

If a PCB transformer is involved in a fire-related incident, the owner of the transformer is required to report the incident. Consult and follow appropriate federal, provincial and local regulations.

***Note**: When askarel liquid becomes involved in a fire, toxic by-products of combustion are typically produced including polychlorinated dibenzofurans and polychlorinated dibenzodioxins, both known carcinogens. The structures of these chemical species are as follows:*

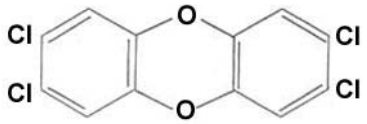


TCDF

$C_{12}H_{8-n}Cl_nO$

$n = 4 - 8$

2,3,7,8-tetrachlorodibenzofuran



TCDD

$C_{12}H_{8-n}Cl_nO_2$

$n = 4 - 8$

2,3,7,8-tetrachloro-dibenzo-p-dioxin

***Note**: 2,3,7,8-tetrachloro-dibenzo-p-dioxin is one of the most potent teratogenic, mutagenic and carcinogenic agents known to man.*

SPILL RELEASE PROCEDURES

Cleanup & disposal of liquid PCBs are strictly regulated by the federal government. Ventilate area. Contain spill/leak. Remove spill by means of absorptive material. Spill clean-up personnel should use proper protective clothing. All wastes and residues containing PCBs should be collected, containerized, marked and disposed of in the manner prescribed by applicable federal, provincial and local laws.

HANDLING AND STORAGE PRECAUTIONS

Care should be taken to prevent entry into the environment through spills, leakage, use, vaporization, or disposal of liquid. Avoid prolonged breathing of vapours or mists. Avoid contact with eyes or prolonged contact with skin. Comply with all federal, provincial and local regulations.

OTHER PRECAUTIONS

Federal regulations require PCBs, PCB items, storage areas, transformer vaults, and transport vehicles to be appropriately labelled.

RESPIRATORY PROTECTION

Use OHSA approved equipment when airborne exposure limits are exceeded. Full facepiece equipment is recommended and, if used, replaces need for face shield and/or chemical splash goggles. The respirator use limitations specified by the manufacturer must be observed.

VENTILATION

Provide natural or mechanical ventilation to control exposure levels below airborne exposure levels.

PROTECTIVE GLOVES: Wear appropriate chemical resistant gloves to prevent skin contact.

EYE PROTECTION: Wear chemical splash goggles and have eye baths available.

OTHER PROTECTIVE EQUIPMENT

Wear appropriate protective clothing. Provide a safety shower at any location where skin contact can occur.

WORK HYGIENIC PRACTICES

Wash thoroughly after handling. Supplemental safety and health : none

PHYSICAL/CHEMICAL PROPERTIES

- **Vapour pressure:** (mm Hg @100 ^{o}F) 0.005 - 0.00006
- **Viscosity:** (CENTISTOKES) 3.6 - 540
- **Stability indicator/materials to avoid:** Yes
- **Stability Condition to Avoid:** PCBs are very stable, fire-resistant compounds.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide, carbon dioxide, hydrogen chloride, phenolics, aldehydes, furans, dioxins

WASTE DISPOSAL METHODS

Consult the applicable PCB regulations prior to any disposal of PCBs or PCB-contaminated items.

SAFETY DATA SHEET

Creation Date 02-Jun-2010 **Revision Date** 18-Jan-2018 **Revision Number** 3

1. Identification

Product Name **Zinc Metal Powder**

Cat No. : **Z5-500; Z46-3**

CAS-No 7440-66-6
Synonyms Zinc Dust (Certified/Technical)

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Substances/mixtures which, in contact with water, emit flammable gases	Category 1
Pyrophoric solids	Category 1
Combustible dust	Yes

Label Elements

Signal Word
Danger

Hazard Statements
May form combustible dust concentrations in air
In contact with water releases flammable gases which may ignite spontaneously
Catches fire spontaneously if exposed to air

Precautionary Statements
Prevention
Keep away from heat/sparks/open flames/hot surfaces. - No smoking
Do not allow contact with air
Wear protective gloves/protective clothing/eye protection/face protection
Keep away from any possible contact with water, because of violent reaction and possible flash fire
Handle under inert gas. Protect from moisture
Skin
Brush off loose particles from skin. Immerse in cool water/wrap with wet bandages
Fire
In case of fire: Use CO2, dry chemical, or foam for extinction
Storage
Store under an inert atmosphere
Store in a dry place. Store in a closed container
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Very toxic to aquatic life with long lasting effects

3. Composition/Information on Ingredients

Component	CAS-No	Weight %
Zinc powder - zinc dust (pyrophoric)	7440-66-6	100

4. First-aid measures

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Get medical attention.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Get medical attention if symptoms occur.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Get medical attention if symptoms occur.

Ingestion Do not induce vomiting. Obtain medical attention.

Most important symptoms and effects No information available.

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Suitable Extinguishing Media Dry sand, clay, approved class D extinguishers.

Unsuitable Extinguishing Media DO NOT USE WATER, Carbon dioxide (CO2), Dry chemical, Foam

Flash Point No information available

Method - No information available

Autoignition Temperature 460 °C / 860 °F

Explosion Limits

Upper	No data available
Lower	No data available
Sensitivity to Mechanical Impact	No information available
Sensitivity to Static Discharge	No information available

Specific Hazards Arising from the Chemical
Flammable. Fine dust dispersed in air may ignite. Pyrophoric: Spontaneously flammable in air. Water reactive. Contact with water liberates extremely flammable gases. Thermal decomposition can lead to release of irritating gases and vapors. Keep product and empty container away from heat and sources of ignition.

Hazardous Combustion Products
Hydrogen
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA

Health	Flammability	Instability	Physical hazards
1	4	3	W

6. Accidental release measures

Personal Precautions Use personal protective equipment. Remove all sources of ignition. Avoid dust formation. Take precautionary measures against static discharges. Do not get in eyes, on skin, or on clothing.

Environmental Precautions Should not be released into the environment. See Section 12 for additional ecological information.

Methods for Containment and Clean Up Remove all sources of ignition. Do not expose spill to water. Sweep up or vacuum up spillage and collect in suitable container for disposal. Use spark-proof tools and explosion-proof equipment. Avoid dust formation.

7. Handling and storage

Handling Use only under a chemical fume hood. Wear personal protective equipment. Avoid dust formation. Avoid contact with skin, eyes and clothing. Avoid ingestion and inhalation. Handle under an inert atmosphere. Do not allow contact with air. Do not allow contact with water. Keep away from open flames, hot surfaces and sources of ignition. Use spark-proof tools and explosion-proof equipment. Take precautionary measures against static discharges.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Store under an inert atmosphere. Keep away from heat and sources of ignition. Keep away from water.

8. Exposure controls / personal protection

Exposure Guidelines This product does not contain any hazardous materials with occupational exposure limitsestablished by the region specific regulatory bodies.

Engineering Measures Use only under a chemical fume hood. Use explosion-proof electrical/ventilating/lighting/equipment. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection	Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.
Skin and body protection	Wear appropriate protective gloves and clothing to prevent skin exposure.
Respiratory Protection	Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Physical State	Solid
Appearance	Light blue
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	419 °C / 786.2 °F
Boiling Point/Range	908 °C / 1666.4 °F
Flash Point	No information available
Evaporation Rate	No information available
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	1 mmHg @ 487 °C
Vapor Density	No information available
Specific Gravity	7.14
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	460 °C / 860 °F
Decomposition Temperature	No information available
Viscosity	No information available
Molecular Formula	Zn
Molecular Weight	65.37

10. Stability and reactivity

Reactive Hazard	Yes
Stability	Water reactive. Moisture sensitive. Air sensitive. Pyrophoric: Spontaneously flammable in air.
Conditions to Avoid	Avoid dust formation. Incompatible products. Exposure to air. Exposure to moist air or water. Keep away from open flames, hot surfaces and sources of ignition.
Incompatible Materials	Strong oxidizing agents, Strong acids, Strong bases, Amines
Hazardous Decomposition Products	Hydrogen
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions	Contact with water liberates extremely flammable gases. Pyrophoric: Spontaneously flammable in air.

11. Toxicological information

Acute Toxicity

Product Information No acute toxicity information is available for this product

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Zinc powder - zinc dust (pyrophoric)	LD50 = 630 mg/kg (Rat)	Not listed	Not listed

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Zinc powder - zinc dust (pyrophoric)	7440-66-6	Not listed	Not listed	Not listed	Not listed	Not listed

Mutagenic Effects No information available

Reproductive Effects No information available.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure None known

STOT - repeated exposure None known

Aspiration hazard No information available

Symptoms / effects,both acute and delayed No information available

Endocrine Disruptor Information No information available

Other Adverse Effects Tumorigenic effects have been reported in experimental animals. See actual entry in RTECS for complete information.

12. Ecological information

Ecotoxicity

This product contains the following substance(s) which are hazardous for the environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Zinc powder - zinc dust (pyrophoric)	EC50: 0.09 - 0.125 mg/L, 72h static (Pseudokirchneriella subcapitata) EC50: 0.11 - 0.271 mg/L, 96h static (Pseudokirchneriella subcapitata)	LC50: 0.211 - 0.269 mg/L, 96h semi-static (Pimephales promelas) LC50: = 2.66 mg/L, 96h static (Pimephales promelas) LC50: = 30 mg/L, 96h (Cyprinus carpio) LC50: = 0.45 mg/L, 96h semi-static (Cyprinus carpio) LC50: = 7.8 mg/L, 96h static (Cyprinus carpio) LC50: = 3.5 mg/L, 96h static (Lepomis macrochirus) LC50: = 0.24 mg/L, 96h flow-through (Oncorhynchus mykiss)	Not listed	EC50: 0.139 - 0.908 mg/L, 48h Static (Daphnia magna)

		LC50: = 0.59 mg/L, 96h semi-static (Oncorhynchus mykiss) LC50: 2.16 - 3.05 mg/L, 96h flow-through (Pimephales promelas) LC50: = 0.41 mg/L, 96h static (Oncorhynchus mykiss)		

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available.

Mobility No information available.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No	UN1436
Proper Shipping Name	ZINC POWDER
Hazard Class	4.3
Subsidiary Hazard Class	4.2
Packing Group	II

TDG

UN-No	UN1436
Proper Shipping Name	ZINC POWDER
Hazard Class	4.3
Subsidiary Hazard Class	4.2
Packing Group	II

IATA

UN-No	UN1436
Proper Shipping Name	ZINC POWDER
Hazard Class	4.3
Subsidiary Hazard Class	4.2
Packing Group	II

IMDG/IMO

UN-No	UN1436
Proper Shipping Name	ZINC POWDER
Hazard Class	4.3
Subsidiary Hazard Class	4.2
Packing Group	II

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Zinc powder - zinc dust (pyrophoric)	X	X	-	231-175-3	-		X	-	X	X	X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance

R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Zinc powder - zinc dust (pyrophoric)	7440-66-6	100	1.0

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Zinc powder - zinc dust (pyrophoric)	-	-	X	X

Clean Air Act Not applicable

OSHA Occupational Safety and Health Administration
Not applicable

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Zinc powder - zinc dust (pyrophoric)	1000 lb	-

California Proposition 65 This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Zinc powder - zinc dust (pyrophoric)	X	X	X	-	X

U.S. Department of Transportation

Reportable Quantity (RQ): N
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By Regulatory Affairs
Thermo Fisher Scientific

Email: EMSDS.RA@thermofisher.com

Creation Date	02-Jun-2010
Revision Date	18-Jan-2018
Print Date	18-Jan-2018
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

SAFETY DATA SHEET

Revision Date 17-Jan-2018 **Revision Number** 3

1. Identification

Product Name **Cadmium**

Cat No. : **C3-500**

CAS-No 7440-43-9
Synonyms No information available

Recommended Use Laboratory chemicals.
Uses advised against Food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Flammable solids	Category 2
Acute oral toxicity	Category 4
Acute dermal toxicity	Category 4
Acute Inhalation Toxicity - Dusts and Mists	Category 2
Germ Cell Mutagenicity	Category 2
Carcinogenicity	Category 1A
Reproductive Toxicity	Category 2
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	
Specific target organ toxicity - (repeated exposure)	Category 1
Target Organs - Kidney, Blood.	
Combustible dust	Yes

Label Elements

Signal Word
Danger

Hazard Statements
Flammable solid
May form combustible dust concentrations in air
Fatal if inhaled
Harmful if swallowed
Harmful in contact with skin
May cause respiratory irritation
Suspected of causing genetic defects
May cause cancer
Suspected of damaging fertility. Suspected of damaging the unborn child
Causes damage to organs through prolonged or repeated exposure

Precautionary Statements
Prevention
Obtain special instructions before use
Do not handle until all safety precautions have been read and understood
Use personal protective equipment as required
Wash face, hands and any exposed skin thoroughly after handling
Do not eat, drink or smoke when using this product
Do not breathe dust/fume/gas/mist/vapors/spray
Use only outdoors or in a well-ventilated area
Ground/bond container and receiving equipment
Use explosion-proof electrical/ventilating/lighting/equipment
Response
IF exposed or concerned: Get medical attention/advice
Inhalation
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing
Immediately call a POISON CENTER or doctor/physician
Skin
IF ON SKIN: Wash with plenty of soap and water
Wash contaminated clothing before reuse
Call a POISON CENTER or doctor/physician if you feel unwell
Ingestion
IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell
Rinse mouth
Fire
Fight fire with normal precautions from a reasonable distance
Evacuate area
Storage
Store locked up
Store in a well-ventilated place. Keep container tightly closed
Disposal
Dispose of contents/container to an approved waste disposal plant
Hazards not otherwise classified (HNOC)
Very toxic to aquatic life with long lasting effects
WARNING. Cancer and Reproductive Harm - https://www.p65warnings.ca.gov/.

3. Composition/Information on Ingredients

Component	CAS-No	Weight %

Cadmium	7440-43-9	100

4. First-aid measures

General Advice Show this safety data sheet to the doctor in attendance. Immediate medical attention is required.

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation Move to fresh air. If not breathing, give artificial respiration. Do not use mouth-to-mouth method if victim ingested or inhaled the substance; give artificial respiration with the aid of a pocket mask equipped with a one-way valve or other proper respiratory medical device. Immediate medical attention is required.

Ingestion Do not induce vomiting. Call a physician or Poison Control Center immediately.

Most important symptoms and effects None reasonably foreseeable. . Kidney disorders: May cause harm to the unborn child: Blood disorders

Notes to Physician Treat symptomatically

5. Fire-fighting measures

Unsuitable Extinguishing Media No information available

Flash Point No information available
Method - No information available

Autoignition Temperature No information available

Explosion Limits
Upper No data available
Lower No data available
Sensitivity to Mechanical Impact No information available
Sensitivity to Static Discharge No information available

Specific Hazards Arising from the Chemical
Thermal decomposition can lead to release of irritating gases and vapors. Fine dust dispersed in air may ignite. Dust can form an explosive mixture in air. Pyrophoric properties of solids and liquids. Do not allow run-off from fire fighting to enter drains or water courses.

Hazardous Combustion Products
Highly toxic fumes
Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear. Thermal decomposition can lead to release of irritating gases and vapors.

NFPA

Health	Flammability	Instability	Physical hazards
4	1	0	N/A

6. Accidental release measures

Personal Precautions Ensure adequate ventilation. Use personal protective equipment. Avoid dust formation. Keep people away from and upwind of spill/leak. Evacuate personnel to safe areas.

Environmental Precautions Do not flush into surface water or sanitary sewer system. Do not allow material to contaminate ground water system. Prevent product from entering drains. Local authorities should be advised if significant spillages cannot be contained.

Methods for Containment and Clean Up Sweep up or vacuum up spillage and collect in suitable container for disposal. Avoid dust formation.

7. Handling and storage

Handling Wear personal protective equipment. Do not get in eyes, on skin, or on clothing. Avoid dust formation. Use only under a chemical fume hood. Do not breathe vapors/dust. Do not ingest.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Store under an inert atmosphere.

8. Exposure controls / personal protection

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH	Mexico OEL (TWA)
Cadmium	TWA: 0.01 mg/m³ TWA: 0.002 mg/m³	Ceiling: 0.3 mg/m³ Ceiling: 0.6 mg/m³ (Vacated) STEL: 0.3 ppm TWA: 0.1 mg/m³ TWA: 0.2 mg/m³ TWA: 5 µg/m³	IDLH: 9 mg/m³	TWA: 0.01 mg/m³ TWA: 0.002 mg/m³

Legend

ACGIH - American Conference of Governmental Industrial Hygienists
OSHA - Occupational Safety and Health Administration
NIOSH IDLH: The National Institute for Occupational Safety and Health Immediately Dangerous to Life or Health

Engineering Measures Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location.

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166.

Skin and body protection Long sleeved clothing.

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced.

Hygiene Measures When using, do not eat, drink or smoke. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product. Keep away from food, drink and animal feeding stuffs.

9. Physical and chemical properties

Physical State	Solid
Appearance	Silver
Odor	Odorless
Odor Threshold	No information available
pH	No information available
Melting Point/Range	321 °C / 609.8 °F

Boiling Point/Range	765 °C / 1409 °F @ 760 mmHg
Flash Point	No information available
Evaporation Rate	Not applicable
Flammability (solid,gas)	No information available
Flammability or explosive limits	
Upper	No data available
Lower	No data available
Vapor Pressure	No information available
Vapor Density	Not applicable
Specific Gravity	8.64 @ 25°C
Solubility	Insoluble in water
Partition coefficient; n-octanol/water	No data available
Autoignition Temperature	No information available
Decomposition Temperature	No information available
Viscosity	Not applicable
Molecular Formula	Cd
Molecular Weight	112.40

10. Stability and reactivity

Reactive Hazard None known, based on information available

Stability Stable under recommended storage conditions. Moisture sensitive. Air sensitive.

Conditions to Avoid Incompatible products. Excess heat. Avoid dust formation. Exposure to air or moisture over prolonged periods.

Incompatible Materials Strong oxidizing agents, Strong acids, Sulfur oxides

Hazardous Decomposition Products Highly toxic fumes

Hazardous Polymerization Hazardous polymerization does not occur.

Hazardous Reactions None under normal processing.

11. Toxicological information

Acute Toxicity

Product Information

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Cadmium	LD50 = 2330 mg/kg (Rat)	Not listed	LC50 = 25 mg/m³ (Rat) 30 min

Toxicologically Synergistic Products No information available

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation No information available

Sensitization No information available

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	CAS-No	IARC	NTP	ACGIH	OSHA	Mexico
Cadmium	7440-43-9	Group 1	Known	A2	X	A2

IARC: (International Agency for Research on Cancer)

NTP: (National Toxicity Program)

IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans
NTP: (National Toxicity Program)

	Known - Known Carcinogen *Reasonably Anticipated - Reasonably Anticipated to be a Human Carcinogen*
ACGIH: (American Conference of Governmental Industrial Hygienists)	*A1 - Known Human Carcinogen* *A2 - Suspected Human Carcinogen* *A3 - Animal Carcinogen* *ACGIH: (American Conference of Governmental Industrial Hygienists)*

Mutagenic Effects Possible risk of irreversible effects

Reproductive Effects Possible risk of impaired fertility. May cause harm to the unborn child.

Developmental Effects No information available.

Teratogenicity No information available.

STOT - single exposure Respiratory system
STOT - repeated exposure Kidney Blood

Aspiration hazard No information available

Symptoms / effects,both acute and delayed Kidney disorders: May cause harm to the unborn child: Blood disorders

Endocrine Disruptor Information No information available

Other Adverse Effects The toxicological properties have not been fully investigated.

12. Ecological information

Ecotoxicity

The product contains following substances which are hazardous for the environment. Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Cadmium	Not listed	LC50: 0.0004 - 0.003 mg/L, 96h (Pimephales promelas) LC50: = 0.016 mg/L, 96h (Oryzias latipes) LC50: = 21.1 mg/L, 96h flow-through (Lepomis macrochirus) LC50: = 0.24 mg/L, 96h static (Cyprinus carpio) LC50: = 4.26 mg/L, 96h semi-static (Cyprinus carpio) LC50: = 0.002 mg/L, 96h (Cyprinus carpio) LC50: = 0.006 mg/L, 96h static (Oncorhynchus mykiss) LC50: = 0.003 mg/L, 96h	Not listed	EC50: = 0.0244 mg/L, 48h Static (Daphnia magna)

		flow-through (Oncorhynchus mykiss)		

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available.

Mobility No information available.

13. Disposal considerations

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. Transport information

DOT

UN-No	UN2930
Proper Shipping Name	TOXIC SOLIDS, FLAMMABLE, ORGANIC, N.O.S.
Proper technical name	Cadmium
Hazard Class	6.1
Subsidiary Hazard Class	4.1
Packing Group	I

TDG

UN-No	UN2930
Proper Shipping Name	TOXIC SOLID, FLAMMABLE, ORGANIC, N.O.S.
Hazard Class	6.1
Subsidiary Hazard Class	4.1
Packing Group	I

IATA

UN-No	UN2930
Proper Shipping Name	TOXIC SOLID, FLAMMABLE, ORGANIC, N.O.S.
Hazard Class	6.1
Subsidiary Hazard Class	4.1
Packing Group	I

IMDG/IMO

UN-No	UN2930
Proper Shipping Name	TOXIC SOLID, FLAMMABLE, ORGANIC, N.O.S.
Hazard Class	6.1
Subsidiary Hazard Class	4.1
Packing Group	I

15. Regulatory information

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	IECSC	KECL
Cadmium	X	X	-	231-152-8	-		X	-	X	X	KE-04397

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule
T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.

Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Cadmium	7440-43-9	100	0.1

SARA 311/312 Hazard Categories See section 2 for more information

CWA (Clean Water Act)

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Cadmium	-	-	X	X

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Cadmium	X		-

OSHA Occupational Safety and Health Administration
Not applicable

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Cadmium	5 µg/m³ TWA 2.5 µg/m³ Action Level	-

CERCLA This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Cadmium	10 lb	-

California Proposition 65 This product contains the following proposition 65 chemicals

Component	CAS-No	California Prop. 65	Prop 65 NSRL	Category
Cadmium	7440-43-9	Carcinogen Developmental Male Reproductive	0.05 µg/day	Developmental Carcinogen

U.S. State Right-to-Know Regulations

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Cadmium	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security
This product does not contain any DHS chemicals.

Other International Regulations

Mexico - Grade No information available

16. Other information

Prepared By	Regulatory Affairs Thermo Fisher Scientific Email: EMSDS.RA@thermofisher.com
Revision Date	17-Jan-2018
Print Date	17-Jan-2018
Revision Summary	This document has been updated to comply with the US OSHA HazCom 2012 Standard replacing the current legislation under 29 CFR 1910.1200 to align with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text

End of SDS

Appendix D
Certifications

Appendix E
COVID-19 Addendum

Field Program COVID-19 Management Plan

Date: _____

Project No: _____

Project Name: _____

In response to the global situation regarding Coronavirus Disease 2019 (COVID-19), Anchor QEA, LLC, has compiled the following guidance to support our ongoing field efforts, whether sediment sampling efforts, wetland delineations, groundwater evaluation, site visits, or construction management. Anchor QEA strongly encourages all staff to be fully vaccinated when they are eligible in the location where they reside. Anchor QEA also requests that, while not required, staff upload a record of their vaccination into the WorkCare screening portal.

This Field Program COVID-19 Management Plan (Plan) is an addendum to the existing project-specific Health and Safety Plan (HASP) for field activities and shall remain a portion of the HASP until superseded by other notification. All personnel who have previously signed acknowledging the HASP must sign off acknowledging this Plan. Acknowledgement of this Plan will be included with future acknowledgements of the overall HASP.

We must keep in mind that our underlying social distancing requirements and responsibilities are the foundation of all our activities. Do not come to work if you are feeling sick, and contact your Manager immediately if you have symptoms consistent with COVID-19, have tested positive for COVID-19, and/or suspect you have been exposed. We also need to be cognizant of changing state and local orders and directives (or removal of restrictions) associated with COVID-19. Specific field efforts will require discussions between the Project Manager, field staff, and client to address availability, travel, and other considerations. If necessary, specific state, local, or project-specific orders and directives can be included with this Plan after review by Health and Safety.

1. Field programs will follow this Field Program COVID-19 Management Plan unless the client, prime contractor, federal, state, or local government establish more restrictive measures, in which case the more restrictive measures will be followed.
2. For projects that do not have an established daily screening, the WorkCare screening portal is to be used.
3. Updated information can be found at the U.S. Centers for Disease Control and Prevention (CDC) website (https://www.cdc.gov/), as well as state and local health agency websites.
4. Staff traveling to certain locations may need to comply with specific testing or vaccination requirements. The company will coordinate with staff as appropriate to meet these requirements, realizing that staff selection for a specific project may be determined by these factors.
5. Nationwide, our community defense is to slow the spread of COVID-19, which may include not traveling between impacted areas and less impacted areas. Therefore, we will evaluate limiting

travel for field work on a case-by-case basis consistent with this community defense approach and following appropriate national, state, and local guidance. We expect that this situation will be fluid as conditions change in the country.

6. Field project schedules, modifications, and regulatory requirements will be discussed with the client representatives.

The objective of this Plan is to provide additional operational guidelines to the team that address the challenges presented by COVID-19 and ensure consistency in our response actions across the project team. These guidelines are consistent with and based on recommendations from the CDC, with multiple links provided throughout. All personnel have Stop Work Authority. If you should have questions or concerns, please direct those to your Field Lead, Staff Manager, or Project Manager.

Some site owners or prime contractors may conduct temperature screening prior to entering a site, which is in accordance with some current guidance. Some site owners or prime contractors may want to record actual temperature readings, test results, or information other than general yes or no questions related to travel, symptoms, vaccination status, etc. If you choose not to participate in the recording of screening information, the site owner or prime contractor may not allow you to access the site. You should immediately contact your Field Lead, Staff Manager, or your Project Manager to discuss alternative work and available options.

The following describes minimum measures to be followed by the project team:

Prior to Coming to the Site

- Travel is allowed.
- Understand the community exposure and travel history of all staff. If a staff member has traveled to an affected country outside the United States or has had close contact with an infected individual within the United States, we require that they be cleared by WorkCare.
  - The following link provides the CDC list of countries with Travel Health Notices in Place: https://wwwnc.cdc.gov/travel/notices
  - The following link provides CDC information on cases within the United States: https://www.cdc.gov/coronavirus/2019-ncov/cases-in-us.html
- If masks (i.e., N 95) are used, they should be used in accordance with OSHA 1910.120, stating, in part, that the user must be fit-tested and in a surveillance program.
- Prior to departing for the site, the Site Safety Officer should obtain enough supply of U.S. Environmental Protection Agency (EPA)-registered disinfectants, wipes, hand sanitizers, and gloves.
- Some projects may require temperature readings prior to entry to a project site. Anchor QEA supports privacy concerns, and if a temperature reading or vaccination status is recorded

(vs. a green light/red light approach based on a temperature threshold) we will take steps to document the confidentiality of that information. However, in some cases Anchor QEA cannot control the procedure nor document confidentiality. In these situations, Anchor QEA staff will need to acknowledge that if they choose to not comply in the future that is their right. If a staff member chooses to not comply, the Project Manager, Regional Lead, and Human Resources should be consulted.

- Some projects may require procedures to document a 14-day look-back period that is absent of symptoms consistent with COVID-19.
- Staff should be self-isolated, as necessary, prior to coming to the site in accordance with current federal, state, and local orders. Any staff member who has been exposed to any household member (including healthcare professionals) exhibiting COVID-19 symptoms or has tested positive for COVID-19 will not report to the site for work unless they have met the guidelines contained in this Plan.
- Exposure to, or close contact with, means being within 6 feet of an individual for 15 minutes or greater in a 24-hour period or being exposed to their cough or sneeze.
- If you meet the criteria listed for Primary or Secondary Exposure, listed below, do not report to work; contact your Manager, contact the Health and Safety representatives, and stay home until the appropriate return to work criteria are met.
- ***Regardless of vaccination status, if staff feel that they are sick or showing symptoms, they are required to stay home and not report to work (office or field).*** They should call their Manager immediately and notify them that they are sick. Showing up to work with symptoms will result in the staff being asked to leave to avoid potentially exposing others to the virus.
- If staff are showing symptoms, they are to contact WorkCare and their healthcare provider for medical advice. If staff feel the need to visit a medical professional, it is recommended that the medical office be contacted first to determine when it is appropriate to visit.
- If staff show any symptoms while on site, they will be asked to leave and not return until they have been cleared by WorkCare. They may be requested submit a physician's note, by WorkCare, releasing them back to work. The exception to this would be if their primary physician recommends more restrictive measures.
  - https://www.cdc.gov/coronavirus/2019-ncov/community/guidance-business-response.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fspecific-groups%2Fguidance-business-response.html

Fully Vaccinated

The CDC defines "fully vaccinated" as greater than or equal to 2 weeks following the final dose in a two-dose series or following the initial dose in a single-dose vaccine.

Anchor QEA will follow CDC and Occupational Safety and Health Administration (OSHA) recommendations regarding fully vaccinated staff being able to forgo the face covering and social distancing requirements both in the office and field. For field work, reference the latest version of this Plan. Fully vaccinated staff must comply with the following guidelines:

- Complete an acknowledgement in Bamboo regarding the updated requirements as well as consent to share with Project Managers, Field Leads, Office Leads, and Staff Managers (who have a need to know) information related to being fully vaccinated if that information has been in accordance with the updated requirements.
- Vaccination information is uploaded into the WorkCare portal. This is to help us meet various state requirements for the employer to determine if the staff member is fully vaccinated.
- Staff who are fully vaccinated, even if information is uploaded to WorkCare, may still use face coverings and follow social distancing if they desire.
- Out of respect, all staff will have face coverings available and fully vaccinated staff will use face coverings if requested by others in close contact situations.
- Fully vaccinated staff are not required to use face coverings or follow social distancing during meetings, meals, or other close contact situations unless requested.
- All staff will still be required to complete the WorkCare daily screening or other project-specific screening.
- All laws, regulations, client requirements, field work requirements, building requirements, and other company requirements apply to all staff (e.g., air travel requirements).
- Fully vaccinated staff that have notified the company may sit together without social distancing or face coverings for meals.
- Food and beverages are allowed to be brought to the project site for sharing, if they are individually packaged.
- Travel is allowed to include sharing vehicles with others who are fully vaccinated.
- Staff must be considerate of others.
- If asymptomatic following close contact with a Primary Exposure, staff do not need to isolate but do need to follow up with WorkCare.

Staff are not required to obtain the vaccination or to notify the company if they have been vaccinated unless they wish to follow the above process. Fully vaccinated staff who have had close contact with a Primary Exposure or who have symptoms consistent with COVID-19 must be cleared to return to work following the processes outlined in the Case Response section below.

Not Fully Vaccinated

The CDC defines "fully vaccinated" as greater than or equal to 2 weeks following the final dose in a two-dose series or following the initial dose in a single-dose vaccine.

Anchor QEA will follow CDC and OSHA recommendations for staff who are not fully vaccinated regarding face covering and social distancing requirements both in the office and field. For field work, reference the latest version of this Plan. Staff who are not fully vaccinated must comply with the following guidelines:

- All staff will still be required to complete the WorkCare daily screening or project-specific screening.
- All laws, regulations, client requirements, field work requirements, building requirements, and other company requirements apply to all staff (e.g., air travel requirements).
- Avoid close contact (i.e., handshakes or other physical contact) and practice social distancing (stay at least 6 feet away from others).
- Meetings are allowed; however, those who are not fully vaccinated must adhere to social distancing requirements.
- If there is a chance that an unvaccinated staff member might have close contact with someone, such as being within 6 feet of an individual for 15 minutes or greater in a 24-hour period, or being exposed to their cough or sneeze, the staff member must wear a face covering in accordance with CDC guidance.
- Common areas (i.e., kitchens, break areas, conference rooms, entryways, restrooms, and copier and printer stations) are to be avoided to the greatest extent possible and social distancing must be observed by those not fully vaccinated.
- The use of communal coffee pots, microwaves, refrigerators, and similar items are allowed.
- Food and beverages are allowed to be brought to the project site for sharing, if they are individually packaged.
- Travel is allowed.
- Travel is preferred to be in individual vehicles.
- Staff should wear cloth face coverings in public settings, in addition to social distancing measures, including travel to the site or office, grocery stores, and picking up to-go food.
- Avoid restaurants if open; use drive-in or take-out services.
- The CDC recommends wearing cloth face coverings in public settings where other social distancing measures are difficult to maintain (e.g., grocery stores and pharmacies) especially in areas of significant community-based transmission.
- Staff must be considerate of others.

Staff are not required to obtain the vaccination or to notify the company if they have been vaccinated unless they wish to follow the process for fully vaccinated staff.

Visitors

- Visitors are allowed but must complete a WorkCare visitor screening or project-specific screening. They additionally must sign an affirmation statement if they wish to forgo the face covering and social distancing requirements.
- Meetings with outside parties should take place virtually, when possible.
- Delivery personnel should not remain in indoor settings for longer than 15 minutes without completing the visitor screening.
- For visitors to forgo the face covering and social distancing requirement, they must attest that they are fully vaccinated when signing in.
- All laws, regulations, client requirements, field work requirements, building requirements, and other company requirements apply to all visitors (e.g., air travel requirements).

On-Site Preventative Measures and Cleaning Requirements

- All staff who work on the site will be required to undergo a site safety orientation (tailgate meeting), which will include information on specific measures to be followed to address efforts to prevent the spread of COVID-19. All field staff are required to vocalize concerns and ensure that protective measures that will slow the spread of COVID-19 are employed.
- Follow the site-specific HASP Personal Protective Equipment (PPE) requirements.
- One step to control spread of the virus at the project job site is focused on hygiene. All staff and management staff will follow CDC guidance regarding hand washing.
  - https://www.cdc.gov/handwashing/index.html
  - Hand wash stations and/or sanitizing wipes/sanitizing gel will be made readily available around the job site and within project office trailers. If these supplies are insufficient, work should be stopped until additional supplies are procured.
- Office trailers will also be cleaned at least twice a day using disinfectant to wipe all surfaces that may be touched by hand including desk and table surfaces. In addition, office trailer personnel (as directed by the Field Lead) will be responsible for multiple daily cleaning of the various field offices and related workspaces.
- Smart phones and radios should be wiped down frequently throughout the day and should not be shared to the greatest extent possible. If these items are shared, they are to be wiped down prior to handing off to another individual or placing in storage for the day.
- Field support areas, boats/vessels, and equipment cabs will be cleaned throughout the day and at every shift change. All "touch" surfaces will be thoroughly wiped clean using a disinfectant.
- Staff should follow published guidance to limit transmission at home and outside of work: https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-prevent-spread.html

- The following links provide a list of U.S. Environmental Protection Agency recommended cleaning products able to kill the virus, as well as some initial guidance with alternatives if supplies run out. ***"Note: Inclusion on this list does not constitute an endorsement by EPA. Additional disinfectants may meet the criteria for use against SARS-CoV-2. EPA will update this list with additional products as needed."***
  - https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2
  - If these products are not available, then either a diluted bleach solution or 70% alcohol solution will work.
  - https://www.cdc.gov/coronavirus/2019-ncov/community/home/cleaning-disinfection.html
- If a staff member becomes ill while on site, they should return to their hotel room or local home, contact their healthcare provider, and follow their guidance. The staff member's Manager should be contacted immediately. Our Health and Safety representatives will follow up with the staff member. If the staff member has a confirmed or presumed case as determined by a healthcare provider, we will follow our procedures as outlined in this document. If the staff member is not able to transport themselves, local emergency responders will be called as per company protocol.

Case Response, and Equipment and Facility Decontamination

According to the CDC, symptoms can appear 2 to 14 days after exposure. Symptoms or combinations of symptoms that may be consistent with COVID-19 include cough, shortness of breath, difficulty breathing, fever (100.4°F [37.8°C] or greater), chills, repeated shaking with chills, muscle pain or body aches, headache, sore throat, congestion or runny nose, nausea or vomiting, diarrhea, or new loss of taste or smell.

If you have symptoms that are consistent with COVID-19 but have not tested positive, regardless of what your primary physician concludes, you are to self-isolate until you have been released to return to work by WorkCare. Immediately contact your Regional Lead and Project Manager. WorkCare may ask you to submit a physician's note releasing you back to work. The exception to this would be if your primary physician recommends more restrictive measures. In this case there is no need to alert or self-isolate any other staff.

Regarding COVID-19 exposures, there are three general scenarios:

- **Primary Exposure:** These are staff who have tested positive for the virus. If you have tested positive for COVID-19, you must be in self-isolation and an effort will be made to contact those people you had direct contact with in the last 14 days. You must not return to the work site until you have been released to return by WorkCare. The exception to this would be if your primary physician recommends more restrictive measures.

- **Secondary Exposure:** These are staff who, within the last 14 days, have had direct contact with someone who has tested positive for COVID-19. You must self-isolate until released by WorkCare to return. You are encouraged to seek medical care. If you start to have symptoms or test positive, follow the appropriate guidance for Primary Exposure noted above.
- **Tertiary Exposure:** These are staff who have had direct contact with someone that meets Secondary Exposure criteria or have been in the same general area. In this scenario, there is no requirement to isolate; however, the staff should self-monitor for the development of symptoms.

In the event there is a documented case of a staff member becoming infected with COVID-19 (Primary Exposure) the field management team will take immediate action as follows:

- The staff member should immediately self-isolate until they have been released to return by WorkCare.
- Notify the Project Manager, Human Resources, and Regional Lead immediately.
- The staff member's work steps will be traced back 14 days to identify work areas the individual may have contacted. All identified areas will be isolated and marked off limits to all site personnel, until a decontamination process can be implemented.
- All identified areas will be disinfected by qualified individuals following CDC guidelines.
- Staff who came in direct contact with the individual will be notified. The Regional Lead will work with the Project Manager and Human Resources to notify the Anchor QEA staff who were identified.
- The Project Manager, in coordination with the client, will notify subcontractors and vendors on the site who had direct contact with the individual.
- The Project Manager should notify the client immediately and inform them of our backup staffing plan as well as our notification plan.
- Confidentiality for the staff member should be maintained.

If a staff member, within the last 14 days, has had direct contact with someone diagnosed with COVID-19 (Secondary Exposure), the field management team will take immediate action as follows:

- Send staff home immediately and have them coordinate with WorkCare for their return.
- Let the Regional Lead and Project Manager know immediately.
- Continue cleaning of common touch areas with recommended disinfectants.
- If staff tests positive, this becomes a Primary Exposure scenario, and that guidance should then be followed.

Situations where a staff member may have had Tertiary Exposure are more difficult to manage. This involves having direct contact with someone who has had Secondary Exposure. In the event of Tertiary Exposure, the field management team will take immediate action as follows:

- Let the Regional Lead and Project Manager know immediately.
- No further notifications are necessary with this scenario.
- Continue cleaning of common touch areas with recommended disinfectants.
- This becomes a Secondary Exposure scenario if the acquaintance is confirmed to be infected, and that guidance should then be followed.

When staff are in self-isolation, their Manager or designee will follow up with them two times per week.

General Measures / Guidance

- Staff must follow the same prevention guidelines off site, which includes travel, hotel, and other activities, in order to address potential exposures outside the workplace.
- Travel, whether by train or plane, will be reviewed on a case-by-case basis. Mass transit should be avoided where social distancing is difficult.
- The virus may live on a variety of surfaces for some period of time; closely follow the cleaner/disinfectant contact time. Avoid combining products that are incompatible and may create toxic byproducts.
- When at hotels, disinfect your own room with EPA-registered cleaners or alternatives, and use the NO HOUSEKEEPING sign to minimize the people coming into your room.
- Catch coughs and sneezes with a disposable tissue, etc. and throw away, then wash hands. If tissues are not available, direct coughs and sneezes into elbow.
- Avoid touching your own mouth, nose, or eyes.
- Hand washing stations with soap and water will be available at all restroom facilities. Frequent hand washing is recommended throughout the day. Washing hands thoroughly for a minimum of 20 seconds with soap and water is one of the most effective ways to prevent the spread of germs. Personnel should wash their hands regularly, before and after going to the bathroom, before and after eating, and after coughing, sneezing, or blowing their nose.
- If soap and water are not available, use hand sanitizer with a minimum of 60% alcohol content.
- Anchor QEA will provide staff with face coverings that can be used for field projects and staff may also use their own face covering if they choose.
- Some projects, municipalities, counties, and states may implement additional requirements for the use of face coverings, gloves, or other items. Those requirements should be followed.

- Time spent in large groups in enclosed spaces will be avoided. Potential alternatives could include phone conferences or holding meetings outside (i.e., field crew safety meetings). Field activities, whether inside or outside, should be planned to minimize staff density in that location.
- Avoid use of shared beverage containers (e.g., coffee pots, water coolers) or food setups (e.g., pizza, buffets). For instance, bring an individual water bottle.
- Work requiring several or more staff will need to be evaluated and a determination will need to be made on how the work can be done safely with a few staff, if at all. If the work cannot be conducted safely, then it may have to be rescheduled for a later time.
- Disinfecting wipes will be located throughout the site for wiping down hard surfaces as required. Alternatives, such as bleach/water solutions, may be used in addition to or in place of disinfecting wipes.
- The frequency and scope of the cleaning program for project facilities (office trailers, bathrooms, other buildings, and work areas) will be reviewed and increased, as necessary.
- Areas where staff eat should be a focus of cleaning efforts.
- Field team equipment operators, vessel operators, and vehicle drivers (whether Anchor QEA equipment or subconsultant equipment) will be provided with disinfecting wipes to clean the enclosed spaces daily. Emphasis should be on hard surfaces that are commonly touched (steering wheel, door handles, levers, buttons).
- Alternates for critical job functions should be available.
- All staff will have their own PPE and will not share with others. Respirators and PPE will be cleaned/disinfected when doffing, along with a thorough arm, hand, and face washing when exiting.
- All staff need to be vigilant regarding potential exposure and transmission of COVID-19. Avoiding any complications related to this outbreak will be a team effort as much as any safety or production concerns related to the project.

COVID-19 Management Plan Acknowledgement

Project Number: _____

Project Name: _____

My signature below certifies that I have read and understand the policies and procedures specified in this Field Program COVID-19 Management Plan.

Date	Name (print)	Signature	Company

Appendix F
Heat Exposure Work Plan

Field Program Heat Exposure Management Plan

Date: _____

Project No: _____

Project Name: _____

This Field Program Heat Exposure Management Plan (Plan) is an addendum to the existing project-specific Health and Safety Plan (HASP) for field activities. All personnel who have previously signed acknowledging the HASP must sign off acknowledging this Plan. Acknowledgement of this Plan will be included with future acknowledgements of the overall HASP. This Plan is intended to be used primarily from May to September of each year; however, depending on temperatures it may also be needed during other months.

Heat-related illnesses can happen if workplace activities in a hot environment overwhelm the body's ability to cool itself. This becomes more likely if any of the risk factors are present. Examples include working in a hot environment without adequate access to water for rehydration, working in protective gear that does not allow air circulation across the skin, or working where the humidity is too high for sweat to evaporate.

This Plan should be applied for anyone working outdoors more than 15 minutes in any 60-minute period in heat index temperatures:

- As low as 52°F when wearing clothing that is non-breathable or provides a vapor barrier like rain gear, chemical resistant suits, or Level A suits
- Starting at 77°F when wearing double layer woven clothing like sweatshirts, coveralls, and jackets on top of other clothes
- At 80°F when wearing any other type of clothing like typical shirts and pants

Some individuals are more susceptible to heat stress than others—for example, individuals who are not acclimatized or who come to work dehydrated.

Prevention Measures

The field team shares responsibility for safety at the work site. This includes watching out for yourself and others because heat illness can become a life-threatening condition quickly if unnoticed or ignored. Speak up if you notice anything that could be unsafe or result in someone getting hurt or sick.

Set up the Work Site for Shade

Before work begins, the Field Lead will assess shade options for the work site. Shade such as trees, walls, or structures like a portable canopy can be used. Fans can help if the air temperature does not go above 95°F, but if air-conditioned spaces are available, like cabs, they can be used to cool individuals off. The Field Lead is responsible to ensure that equipment is available, functional,

transported, and set up properly. The shade area must either be open to the air or provide mechanical ventilation for cooling.

The amount of shade present must be at least enough to accommodate the number of staff on recovery or rest periods, so that they can sit in a normal posture fully in the shade. The shade must be located as close as practical to the areas where staff are working. Shade present during meal periods must be large enough to accommodate the number of staff on the meal period that remain on site. If shade cannot be provided due to safety or feasibility concerns, alternative cooling measures must be implemented.

Schedule Work to Reduce Heat Exposure

The Field Lead, in coordination with the Project Manager, will consider changes to shift timing to avoid working during the hottest period of the day. This could include starting earlier, working in the evening, or splitting the day with a break during the hottest part of the day.

Stay Hydrated

Do not wait to be thirsty to drink water, and do not drink it all at once. In fact, it is best to start drinking water before work. Drink small amounts often throughout the day to stay hydrated. Additional water breaks are allowed during hot days. Potable water should be cool (66ºF to 77ºF) or cold (35ºF to 65ºF). During moderate activity, in moderately hot conditions, staff should drink about 8 ounces of liquid every 15 to 20 minutes.

Sports drinks low in sugar are okay but should not completely replace water. Avoid drinks with caffeine and high sugar content like sodas because they will not hydrate you.

There should be enough water to allow each staff member to drink at least a quart of water each hour. (Drink at least 1 cup every 15 to 20 minutes.)

The Field Lead will ensure that water is available to staff and that it is consumed on a regular basis.

Encourage staff to eat regular meals and snacks because these provide enough salt and electrolytes to replace those lost through sweating if enough water is consumed.

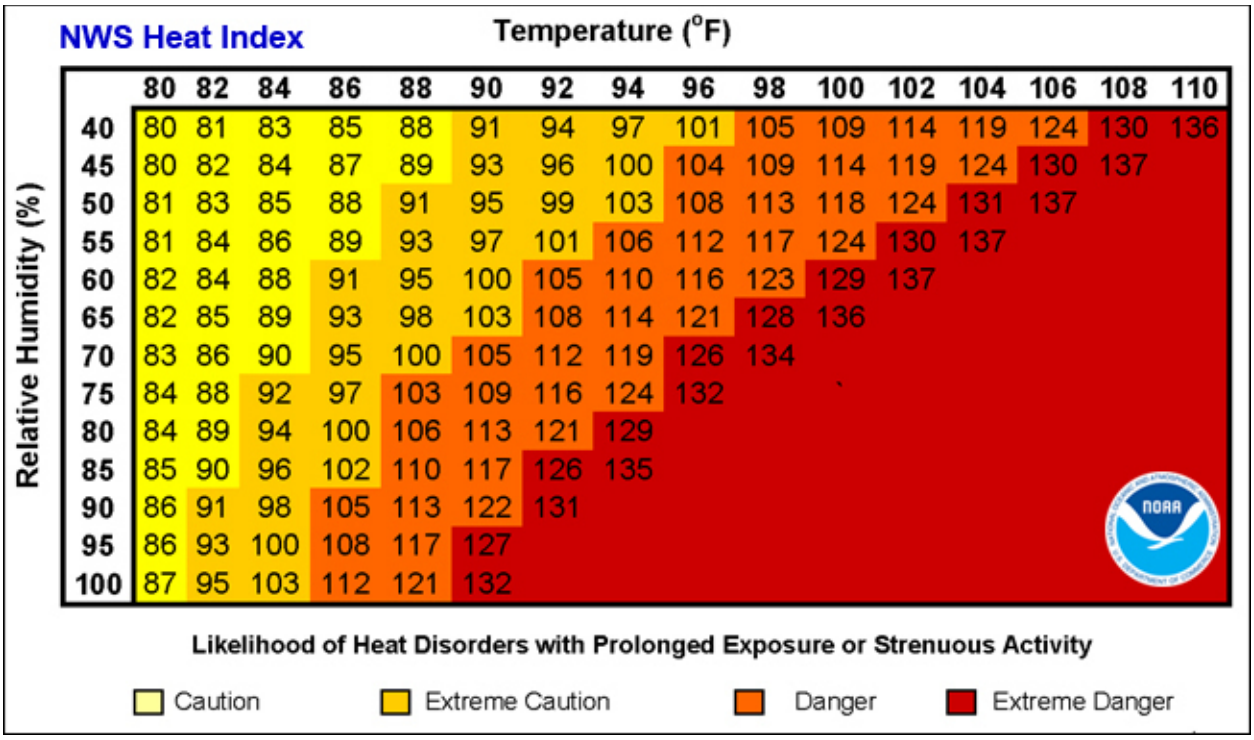
Allow Time to Adjust to Heat (Acclimatization)

It takes about 2 weeks to fully adjust to hot working conditions. This adjustment is lost if you are away from the hot conditions for a week or more. Acclimatization is especially critical for heavy work in hot temperatures.

Start with light physical work and/or short durations of work time, and slowly increase each day. Increase by 20% (of the total shift) each day for non-acclimatized staff.

Training

Each year, staff who may encounter the working conditions listed above will be provided with safety training on the dangers of outdoor heat exposure, the steps we take to protect them, and actions they must follow to prevent heat-related illness. This information will additionally be covered in tailgate meetings at the project site.



Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Source: https://www.weather.gov/images/safety/heatindexchart-650.jpg

High Heat Practices

The following additional high heat practices must be implemented when the ambient heat index exceeds 90°F:

- Ensure that effective communication by voice, observation, or electronic means is maintained so that staff at the work site can contact a Supervisor when necessary. An electronic device, such as a mobile phone or text messaging device, may be used for this purpose only if reception in the area is reliable.
- Ensure that staff are observed for alertness and signs and symptoms of heat illness and monitored to determine whether medical attention is necessary by implementing one or more of the following:
  - Establish regular communication with staff working alone, such as by radio, mobile phone, or other alternative means.

  - Create a mandatory buddy system.
  - Implement other equally effective means of observation or communication.
- The Field Lead must designate and equip one or more staff on the work site as authorized to call for emergency medical services and must allow other staff to call for emergency services when designated staff are not immediately available (such a practice supplements existing requirements to ensure that emergency medical care is immediately available in all workplaces).
- The Field Lead must ensure that each staff member takes a minimum 10-minute preventative cool-down rest period in the shade at least every 2 hours, regardless of the overall length of the shift.

Responding to Heat-Related Illness

Let a Supervisor or someone nearby know if you or a coworker are experiencing any signs or symptoms of heat-related illness and take immediate action to ensure things do not get dangerously worse.

- Time is critical. Get the individual away from the hot area into a cool shaded area. Quick action increases the chances for a full recovery.
- Let the individual rest and drink cool water.
- Remove any PPE as appropriate.
- Use ice packs or cooling towels as appropriate and available.
- Never leave an individual who is experiencing heat-related problems alone; things could get worse.
- If the individual is a lone worker, an Anchor QEA representative will stay on the line with the individual. Also, in the case of a lone worker, emergency services will be called to the location of the individual unless an Anchor QEA representative or representative of another company can quickly arrive at the location.
- If the individual does not respond quickly, call emergency medical services.
- Follow the steps in the main HASP document for notifying emergency services to include directions to the site.
- If the individual is in a remote or non-developed area with unidentified roads, you may need to have someone meet emergency services at the closest point to guide them to the victim's location.
- Notify Health and Safety.

If the individual receives medical attention, a written authorization must be obtained from the provider indicating that the individual can get back to work and whether there are any restrictions or limitations.

Risk Factors

The following are environmental risk factors for heat illness:

- Air temperature above 90°F
- Relative humidity above 40%
- Radiant heat from the sun and other sources
- Conductive heat sources such as dark-colored work surfaces
- Lack of air movement
- Physical effort needed for the work
- Use of nonbreathable protective clothing and other Personal Protective Equipment (PPE)

The following are personal risk factors for heat illness:

- Lack of acclimation to warmer temperatures
- Poor general health
- Dehydration
- Alcohol consumption
- Caffeine consumption
- Previous heat-related illness
- Use of prescription medications that affect the body's water retention or other physiological responses to heat such as beta blockers, diuretics, antihistamines, tranquilizers, and antipsychotics

Heat-Related Illnesses

Heat Rash

Heat rash is the most common health problem in hot work environments. It is caused by sweating and looks like a red cluster of pimples or small blisters. Heat rash usually appears on parts of the body that overlap or rub other parts of the body, such as in the groin area, under the arms or breasts, and in knee or elbow creases. If an individual has symptoms of heat rash, provide a cooler, less humid work environment, if possible. Advise the individual to keep the area dry and not to use ointments and creams that make the skin warm or moist, which can make the rash worse.

Heat Exhaustion

Heat exhaustion can best be prevented by being aware of one's physical limits in a hazardous environment on hot, humid days. The most important factor is to drink enough clear fluids (especially water, not alcohol or caffeine) to replace fluids lost to perspiration. Signs and symptoms of heat exhaustion typically include the following:

- Profuse sweating

- Weakness and fatigue
- Nausea and vomiting
- Muscle cramps (associated with dehydration)
- Headache
- Light-headedness or fainting (fainting or loss of consciousness is potentially serious and should be treated as a medical emergency)

When you recognize heat exhaustion symptoms in an individual, you must intervene; stop the activity, and move the individual to a cooler environment. Cooling off and rehydrating with water (or electrolyte-replacing sports drinks) is the cornerstone of treatment for heat exhaustion. If the individual resumes work before their core temperature returns to normal levels, symptoms may quickly return.

If there is no intervention and the body's temperature regulation fails, heat exhaustion can rapidly progress to heat stroke, a life-threatening condition!

Heat Stroke

Heat stroke requires an immediate emergency medical response. The individual may stop sweating, become confused or lethargic, and may even have a seizure! The internal body temperature may exceed 106°F. Signs and symptoms of heat stroke typically include the following:

- Absence of sweating
- Dry skin
- Agitation or strange behavior
- Dizziness, disorientation, or lethargy
- Seizures or signs that mimic those of a heart attack

Ensure that emergency responders are summoned immediately if heat stroke is suspected. While waiting for emergency responders to arrive, cool the individual; move the individual to an air-conditioned environment or a cool, shady area, and help the individual remove any unnecessary clothing. Do not leave the individual unattended. Heat stroke requires immediate medical attention to prevent permanent damage to the brain and other vital organs that can result in death.

Responsibilities

Staff need to be aware of the following:

- How heat can make them sick, and how to recognize the common signs and symptoms of heat-related illness in themselves and coworkers. The four most common conditions are heat rash, heat cramps, heat exhaustion, and heat stroke.

- The environmental factors that increase risk for heat-related illness such as higher temperatures, humidity, sunlight (working under direct sunlight makes it feel about 15 degrees hotter), additional sources of heat like powered equipment and asphalt, no wind, level of physical activity, and wearing of PPE or layers of clothing
- Personal factors that may increase susceptibility to heat-related illness including age, not being acclimatized, having medical conditions such as hormonal and heart issues and diabetes, dehydration, and use of substances that can affect the body's response to heat like drugs, alcohol, caffeine, nicotine, and medications
- The importance of removing heat-retaining PPE such as non-breathable chemical resistant clothing during all breaks to allow the body to cool down
- How to stay well hydrated by drinking small quantities of water or other acceptable beverages frequently throughout the day
- The importance of acclimatization (to get used to the conditions). It takes about 5 days to start and 2 weeks to be fully acclimated
- How to immediately report signs or symptoms of heat-related illness they experience or observe in coworkers, and how to immediately respond to prevent the situation from becoming a medical emergency. How to identify and what to do during a heat-related medical emergency (e.g., potential heat stroke)

Supervisors need to know the following (in addition to what is detailed for staff above):

- The procedures to follow to implement the heat-related illness prevention plan, including the acclimatization schedule, how to keep track of environmental conditions throughout the day, when to increase the number of breaks or stop work early, checking that staff are accessing shade and water (especially for mobile operations), encouraging them to stay hydrated, and communicating with lone workers to ensure they are safe. The free OSHA-NIOSH Heat Safety Tool app could be helpful: https://www.cdc.gov/niosh/topics/heatstress/heatapp.html
- When to provide PPE like cooling vests and gel-filled bandanas
- What the Supervisor needs to do if an individual shows signs and symptoms of possible heat-related illness, including appropriate emergency response procedures and how to transport any affected staff to a medical service provider

Sources

https://osha.oregon.gov/OSHAPubs/pubform/heat-sample-program.pdf

https://www.lni.wa.gov/safety-health/_docs/HRIAPPAddendum.doc

Heat Exposure Management Plan Acknowledgement

Project Number: _____

Project Name: _____

My signature below certifies that I have read and understand the policies and procedures specified in this Field Program Heat Exposure Management Plan.

Date	Name (print)	Signature	Company

Responsibility is taken, not given. Take responsibility for safety.