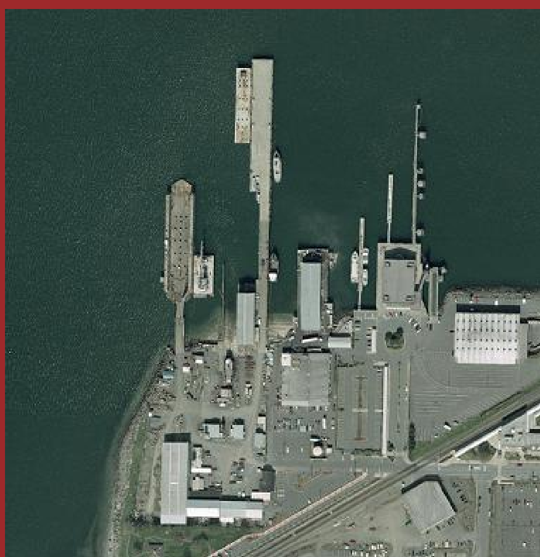

Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

FINAL

January 19, 2011

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Harris Avenue Shipyard

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January 19, 2011

FINAL

Table of Contents

List of Tables

List of Figures

List of Appendices

List of Abbreviations and Acronyms

Acronym/ Abbreviation	Definition
All American	All American Marine, Inc.
ALS	ALS Laboratory
AO	Agreed Order
AOC	Areas of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
ARI	Analytical Resources, Inc.
AST	Aboveground storage tank
Bay	Bellingham Bay
BBS	Bellingham Bay Shipyards
bgs	Below ground surface
BMP	Best Management Practice
BSL	Bioaccumulation screening level
BTEX	Benzene, toluene, ethylbenzene, xylene
COC	Contaminant of concern
CSM	Conceptual Site Model
CUL	Cleanup level
CWA	Clean Water Act
CY	Cubic yards
DAHP	Washington State Department of Archaeology and Historic Preservation
DCA	Disproportionate cost analysis
DMMP	Dredged Material Management Plan
DNR	Department of Natural Resources
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management
HASP	Health and Safety Plan
HRA	Historical Research Associates
MCI	Maritime Contractors, Inc.
MCUL	Minimum Cleanup Level
MLLW	Mean Lower Low Water
MTCA	Model Toxics Control Act

Acronym/ Abbreviation	Definition
NPDES	National Pollutant Discharge Elimination System
PAF	Pacific American Fisheries
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PMA	Port Management Agreement
Port	Port of Bellingham
POTW	Publicly-owned treatment works
ppm	Parts per million
PSDDA	Puget Sound Dredged Disposal Analysis
Puglia	Puglia Engineering
RAO	Remedial Action Objective
RCW	Revised Code of Washington
RI/FS	Remedial Investigation/Feasibility Study
SAP/QAPP	Sampling and Analysis Plan and Quality Assurance Project Plan
SEDQUAL	Sediment Data Management and Analysis Tool
SEPA	State Environmental Policy Act
SMS	Sediment Management Standards
SVOC	Semivolatile organic compound
TBT	Tributyltin
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
VCP	Voluntary Cleanup Program
VOC	Volatile organic compound
WAC	Washington Administrative Code

1.0 Introduction

1.1 BACKGROUND AND OVERVIEW

This document presents the Site-Wide Remedial Investigation/Feasibility Study (Draft Site-Wide RI/FS) Work Plan for the Harris Avenue Shipyard Site (Site) in Bellingham Bay, an active shipyard located in Bellingham, Washington (Figure 1.1). The Site is one of twelve sediment cleanup sites around Bellingham Bay (the Bay) coordinated by the Bellingham Bay Demonstration Pilot Project. The Site was identified as high priority by the Washington State Department of Ecology (Ecology) in 2000 in a comprehensive strategy developed in cooperation with the Bellingham Bay Demonstration Pilot Team[1].

The Port of Bellingham (Port) and Ecology entered into an initial Agreed Order (AO) No. DE-03TCPBE-5670 in August 2003. The AO described the requirement to complete a final RI/FS for site sediments, pursuant to Washington Administrative Code (WAC) 173-340-350 and WAC 173-204-560.[2] On behalf of the Port, RETEC completed a draft RI/FS for marine sediments in May 2004, which was then amended in January 2006. The RI/FS was conducted under Ecology's direction, consistent with the Washington State Model Toxics Control Act (MTCA) and the Sediment Management Standards (SMS). Work Plan development for the Sediment RI/FS and some sampling was initially done under the Voluntary Cleanup Program (VCP) while negotiations proceeded towards finalizing the initial AO.

In October 2007, Ecology and the Port agreed to expand the scope of work performed at the Harris Avenue Shipyard to provide a Site-Wide RI/FS. This decision was in large part a natural progression, informed by the collection of information regarding source control at the shipyard and review of the draft sediment-focused work products.

A new AO (No. 7342) was signed between Ecology and the Port in March 2010 that governs completion of the upland and sediment remedial investigations and feasibility studies as one, site-wide process. The new AO was issued pursuant to the MTCA Revised Code of Washington (RCW) 70.105D.050(1) and supersedes AO No. DE-03TCPBE-5670. This Final Site-Wide RI/FS Work Plan was prepared as a formal deliverable as specified in Exhibit B Scope of Work in the new AO.

The objective of the Site-Wide RI/FS is to conduct a comprehensive site-wide evaluation, including the upland and in-water properties. This will involve completing a full characterization of soil, groundwater, and sediment quality; determining the compliance status of upland soil and groundwater; and evaluating potential upland-sediment contaminant migration pathways. Remedial actions for upland soil and groundwater will be evaluated and coordinated with updated sediment remedial actions to define site-wide remedial alternatives. Site-wide remedial alternatives will be evaluated against MTCA and SMS criteria and a preferred cleanup alternative will be identified.

[1] The Bellingham Bay Demonstration Pilot Team is a partnership of 14 federal, tribal, state, and local agencies that have developed a cooperative approach to expedite sediment cleanup, source control, and habitat restoration for sediment cleanup sites around the Bay.

[2] The upland portions of the Site were not included in the initial AO or addressed in the Sediment RI/FS.

1.2 WORK PLAN PURPOSE AND ORGANIZATION

The purpose of this Site-Wide RI/FS Work Plan is to document the scope and detail the approach for completing the Site-Wide RI/FS, which is intended to develop and evaluate remedial alternatives that consider both upland and in-water areas of the Site.

The following activities are involved in the development and finalization of the Site-Wide RI/FS Work Plan:

- Review of all existing site documentation, the Sediment RI/FS, and related Ecology communication.
- Coordination with Ecology to understand Ecology's concerns and expectations for the Site-Wide RI/FS.
- Coordination with shipyard tenants to understand tenant operational constraints, objectives for continued use and potential future facility development, and to evaluate the source control status.
- Production of draft versions of the RI/FS Work Plan for Ecology, Stakeholder, and public review.
- Preparation of formal response to Ecology comments and preparation of the Final RI/FS Work Plan.

This RI/FS Work Plan complies with MTCA requirements and includes background regarding the Sediment RI/FS, existing information regarding the uplands, and objectives for expansion to a Site-Wide RI/FS. The remainder of the RI/FS Work Plan is organized as follows:

- **Section 2.0—Site Description:** Provides information on the location, ownership, land use, and physical setting of the facility.
- **Section 3.0—Regulatory Framework:** Presents the current regulatory framework and updated AO and MTCA requirements for the Site, as well as cleanup standards and other applicable or relevant and appropriate requirements (ARARs).
- **Section 4.0—Previous Investigations and Evaluations:** Presents previous uplands and sediment investigations that have occurred at the Site in chronological order.
- **Section 5.0—Site-Wide RI/FS Objectives:** Describes the comprehensive site-wide evaluation, preliminary remedial action objectives, site characterization, and source control requirements.
- **Section 6.0—Conceptual Model and Data Gaps:** Presents the preliminary site Conceptual Model, contaminants of concern (COCs), and exposure pathways, areas of concern (AOCs), and identified data gaps.
- **Section 7.0—Proposed Supplementary Site Investigation:** Details supplemental data that will be collected to fill data gaps in sediment, soil, and groundwater and additional project plans including the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) and Health and Safety Plan (HASP).
- **Section 8.0—Source Control Evaluation:** Details the current source control status and source control evaluation tasks to be performed as part of the RI/FS process.
- **Section 9.0—Additional RI/FS Studies:** Summarizes additional studies to be completed during the RI/FS phase of the work and following implementation of this Final RI/FS Work Plan. Additional studies to be completed include evaluation to

human health and ecological risk, and consideration of additional sediment sampling to support sediment disposal suitability studies.

- **Section 10.0—Site-Wide RI/FS Preparation Methodology:** Defines the specific tasks of the RI/FS that will be completed, the report outline per Ecology for Bellingham Bay, schedule, and public and stakeholder involvement.
- **Section 11.0—Project Team and Responsibilities:** Describes technical consultants and Ecology's responsibilities for analysis and authorship of the RI/FS.
- **Section 12.0—References:** Presents the sources cited in this Final RI/FS Work Plan.

2.0 Site Description

2.1 LOCATION, CURRENT SITE OWNERSHIP, AND SITE HISTORY

2.1.1 Location

Figure 2.1 shows the location of the Harris Avenue Shipyard on Post Point, within an industrial area of Bellingham, Washington. The site address is 102 Harris Avenue and it consists of approximately 7 acres of upland and over-water operational area. The property is bounded on the north and west sides by Bellingham Bay and on the south by Bellingham Marine Park and the Burlington Northern Rail lines.

Industrial properties, owned by the Port, are present to the east and southeast of the Site. The properties to the east include the Bellingham Cruise Terminal, operated by the Port as the southern terminus for the Alaska State ferry, and the former Arrowac Fisheries building, now leased by Puglia Engineering.

2.1.2 Current Site Ownership

Current site activity is confined to two active upland and offshore lease areas (as shown on Figure 2.1) currently occupied by Puglia Engineering (Puglia) and All American Marine, Inc. (All American).

The Puglia lease area is operated as Fairhaven Shipyards and is subdivided into three parcels, identified as Parcel A, Parcel B, and Parcel C, based on Port leasehold maps dated August 31, 2006. Parcel A is primarily an offshore lease parcel composed of land owned by the State of Washington (but managed by the Port) and includes both aquatic lands and lands of historic harbor infill above the high waterline that are located between the inner and outer harbor lines. Parcel B is located to the south of Parcel A and is an upland lease parcel that has been owned by the Port since 1966 and was previously leased by Bellingham Bay Shipyards (BBS). Parcel C is an upland lease parcel owned by the Port and is located at the southeastern corner of the Site.

The All American lease area is located in the southwestern corner of the Site in between the three Puglia lease parcels and is composed of land owned by the Port and land owned by the State of Washington located water-ward of the inner harbor line. All American conducts all manufacturing operations within the lease area inside the Fabrication and Maintenance Building and currently does not conduct fabrication or repair activities near the shoreline area over-water or in-water. The interior portion of the facility is used only for the construction of aluminum passenger vessels. The exterior portion of the property is used for employee parking and the storage of aluminum on wood pallets. A limited quantity of used paints and oil consisting of two storage drums are currently stored in a small covered shed located in the northwest corner of the property outside of the fabrication and maintenance building. All materials are currently stored in secondary containment in the storage shed. Once vessel fabrication activities are completed at the All American facility, the vessels are placed on a trailer and launched at the shipyard for testing before product delivery. All refueling of vessels occurs at the nearby Ferry Terminal facility.

An executed Port Management Agreement (PMA) in 1995 with Washington Department of Natural Resources (DNR) granted primary property-management authority to the Port for multiple harbor-area parcels that were previously managed by DNR. These Port parcels include Parcels 5, 6, and 9 as shown on Figure 2.1.

Puglia lease Parcel A includes portions of Port Parcels 6 and 9 that were formerly leased by the Port from DNR prior to execution of the PMA. The Port, in turn, sublets Parcel A to Puglia for existing operation of the Shipyard. Additionally, the northwestern portion of the All American lease area includes a portion of Port Parcel 6, which comprises lands of historic harbor infill above the high waterline. The Port currently sublets this portion of Port Parcel 6 to All American for operation of their fabrication and maintenance facility. As a result of the PMA, the Port currently manages these multiple harbor-area parcels for the State of Washington, including the aquatic and historic infill lands of Port Parcel A and the All American lease area.

As shown on Figure 2.1, the aquatic lands located immediately to the west of the All American lease area comprise Port Parcel 5, which is also now managed by the Port as part of the Port's PMA with DNR.

No shipyard operations are currently being performed by Puglia or All American within the Port Parcel 5 area and no previous tenants have leased this area from the Port. However, historic ship building activities are documented to have occurred in the Port Parcel 5 area during the 1940s. The Port Parcel 5 lease area was investigated as part of the Draft Sediments RI/FS effort documented by RETEC in 2004 and results of the investigation do not indicate exceedances of cleanup criteria in this area (RETEC 2004).

2.1.3 Bellingham Bay Demonstration Pilot Project

A Bellingham Bay Comprehensive Strategy (Comprehensive Strategy) has been developed by an interagency consortium known as the Bellingham Bay Demonstration Pilot (Pilot). The Pilot brought together a partnership of agencies, tribes, local government, and businesses known collectively as the Pilot Work Group, to develop a cooperative approach to expedite source control, sediment cleanup, and associated habitat restoration in Bellingham Bay.

As part of the approach, the Pilot Work Group developed a strategy that considered contaminated sediments, sources of pollution, habitat restoration, and in-water and shoreline land use from a bay-wide perspective. The strategy integrated this information to identify priority issues requiring action in the near-term and to provide long-term guidance to decision-makers. The Comprehensive Strategy was finalized with a Final Environmental Impact Statement in October 2000 prepared under the State Environmental Policy Act (SEPA).

The Site is located within the study area of the Bellingham Bay Comprehensive Strategy. The cleanup of the shipyard is identified as a high-priority near-term action.

2.1.4 Site History

The Site has been used by various entities for industrial purposes since the early 1900s. Shipyard activity began at the property in 1915 with Pacific American Fisheries (PAF). In May 1915, PAF leased the property from the State of Washington and then purchased it in 1916. After the purchase, PAF used the shipyard facilities to construct wooden fishing boats and cannery operations were conducted to the east of the shipyard at the present Arrowac Fisheries and Alaska Ferry Terminal properties.

In 1937, significant filling of the shoreline in west and north portions of the Site was performed, expanding the uplands by approximately four acres. Nearly all of the site property has been utilized at some point in the past for shipbuilding or repair. Maps from the Port's archive files and reports of historical investigations at the Site indicate that shipway structures occupied the western and northern sides of the property in the 1940s. From 1942 to 1945, PAF subleased the property to the Northwestern Shipbuilding Company.

During the 1930s and 1940s, an aboveground storage tank (AST) for ship fuel was located near the main dock and operated by Union Oil (a.k.a. Unocal). The bunker fuel tank had a reported capacity of 100,000 gallons and was removed in the late 1940s or early 1950s.

During World War II, PAF constructed wooden ships for use during the war. Salvaging of Liberty Ships was reportedly conducted in the post-war era on the north side of the Site (in the existing Parcel A).

In 1966, the PAF property, including the shipyard, was purchased by the Port. Since purchase of the land by the Port, the property has been leased by several different companies for use as a shipyard. Based on Port lease files and review of the RETEC investigation and sediments RI/FS reports, the following dates summarize the recent history of shipyard tenants and activities:

- 1968: Post Point Marine leases the property and changes their company name to Post Point Industries in June 1970.
- 1971: Associated Venture Capital purchases Post Point Industries and changes their company name to Fairhaven Shipyard.
- 1971: Weldit Corporation purchases Fairhaven Shipyard and changes their company name to Fairhaven Industries, Inc.
- 1982: Dry Dock No. 2 is replaced with the existing dry dock structure. Records indicate that approximately 25,000 cubic yards (CY) of sediment were dredged under an U.S. Army Corps of Engineers permit in 1982 to accommodate the existing dry dock structure. These sediments were generally removed from the southern end of the existing dry dock and were disposed at an authorized open-water disposal site.
- 1985: Maritime Contractors, Inc. (MCI), acquires the existing Weldit lease. MCI establishes a new lease agreement with the Port in 1986.
- 1998: MCI terminates operations and sells company assets to BBS, who initiates a new lease agreement with the Port.
- 2002: Puglia and All American enter into leases with the Port, dividing the property into two separate operations.

2.2 CURRENT UPLAND AND OVER-WATER USE

The Site is currently zoned for water-dependent industrial use. The majority of the PAF buildings have been removed from the Site with the exception of the main office building and the pier building. The former joiner shop was used for a variety of activities including painting and caulking. The shipyard site operates on a pier, dry dock, marine railway, and various mobile and floating cranes in addition to using upland support service shops such as a machine shop, electrical shop, steel fabrication and mechanical shop, valve shop, sandblast shed and paint shop, and water treatment building.

An extensive network of utilities exists at the shipyard, including storm drains, sanitary sewer, natural gas, water, and electrical. A stormwater outfall located at the Site was plugged between

1994 and 1997, but was then extended with a diffuser and reactivated for discharge. Catch basins draining to this outfall were shared between the two site tenants. In 2004, stormwater drainage at the shipyard was reconfigured such that primary industrial areas of the Site are now collected for discharge to the City's publicly-owned treatment works (POTW).

Puglia Engineering currently provides dry-docking and mooring capabilities and other support services for vessels. The marine railway, located in the middle of the north side of the Site, was formerly connected to a series of sidetracks where boats were stored during work activities. The marine railway, sidetracks, and former joiner shop currently remain one of the most heavily used portions of upland property for existing shipyard operations. The sidetracks area is currently used for sandblasting and other maintenance and repair operations even though the sidetracks are no longer connected to the main marine railway line.

Current over-water shipyard activities are generally confined to the marine railway, dry dock, and pier areas on the north side of the Site.

All American uses two upland trailers for offices and a large upland warehouse (Fabrication and Maintenance Building) for vessel manufacturing activities. The Fabrication and Maintenance Building is located in the southwestern portion of the yard and was constructed in the 1970s. The building has a concrete slab and footing foundation. All American also shares part of the Machine Shop building with Puglia for storage. All of the All American manufacturing activities are performed inside the Fabrication and Maintenance Building. As summarized in Section 2.1.2, All American does not perform fabrication or repair activities outside or on the shoreline area of their lease parcel.

2.2.1 Existing Permits

A sewer outfall from the City of Bellingham POTW is located offshore to the southwest of the Site. Puglia has an active National Pollution Discharge Elimination System (NPDES) permit to regulate facility stormwater discharge. The outfall is regulated under a current NPDES permit (No. WA-003134-8). The current NPDES permit was revised specifying that stormwater will be transferred to sanitary sewers with the exception of a major storm event. Because All American's fabrication is conducted indoors, Ecology does not require All American to have a stormwater discharge permit. All American and Puglia are small quantity generators of dangerous waste in Washington State and subject to requirements for waste profiling, storage, and disposal under Ecology.

2.2.2 Potential Infrastructure Upgrades

The Main Pier was originally constructed in the 1950s and a concrete extension was built at the northern end of the pier in 1996. Since becoming tenants at the Site, Puglia has repaired and maintained the Main Pier, including installation of new timber decking, secured steel plates over decking, and repair/replacement of transverse diagonal bracers. Currently, the inner portion of the timber pile-supported Main Pier is not in favorable condition and will require structural upgrades or replacement in the future. Should funding become available, the inner portion of the primary pier may be removed and replaced with fewer pilings. Should this work occur, formal consultation with the Endangered Species Act Section 7 would be required for these types of construction-related activities.

The Site-Wide RI/FS, sediment cleanup, and potential infrastructure improvement projects will need to be carefully coordinated as necessary. Should infrastructure improvement projects be initiated prior to completion of remedial actions at the Site, interim remedial actions may be considered and will need to be coordinated with Ecology.

Puglia has recently permitted use of an additional vessel (the Faithful Servant) for dry docking operations at the shipyard. The submersible vessel was purchased by Puglia in summer 2009 and permitting efforts were recently completed. The vessel has been mobilized to the Site and is currently moored at the northeast end of the Main Pier. Source control requirements associated with operation of the Faithful Servant are documented in the permits and will be evaluated as part of the Site-Wide RI/FS process. No interim actions were required as part of mobilization and operational use of the Faithful Servant at the Site.

2.3 PHYSICAL SETTING

This section describes the physical setting that is specific to the Site, including geology, hydrogeology, marine environment, sea-level rise, substrate types present near the shoreline, and historical and archaeological cultural resources.

The shipyard property is low and flat, with an elevation less than 20 feet above the Mean Lower Low Water (MLLW) datum. The shoreline is armored with riprap and there are concrete block bulkheads on the north side of the property. Most of the upland area is covered with gravel; however, there is some asphalt and concrete in the area of the painting booths near the marine railway structure as a result of recent stormwater management site upgrades. The shoreline slopes are generally steep and reinforced with armor material (riprap and bulkheads) to approximate elevation 0 feet MLLW.

Mudline elevations in the aquatic site area range from approximate elevations 0 to -45 feet MLLW. Over-water site feature structures include the Main Pier, which houses the loft and pier shops, several smaller docks, one dry dock, and the marine railway area as shown on Figure 2.1. The marine railway extends approximately 200 feet to the north from the shoreline, is timber pile-supported, and is generally elevated above the mudline except on the upland portion of the Site.

2.3.1 Upland Geology

Based on test pits and soil borings advanced throughout the site area during the Phase 2 sampling, the soil beneath the surficial ground cover (either pavement or gravel) consists of anthropogenic gravelly to sandy fill soils, ranging in thickness up to 7 feet and include wood, brick, metal, and other material. The fill material is predominantly sand with gravel and shell fragments, likely originating as dredged sediments taken from the western and northern areas of the facility in the 1930s. Underlying native soil consists of fine to coarse grained sand with gravel throughout most of the Site. However, in the central portion of the Site, native sands were reported to be similar to glacial outwash deposits.

2.3.2 Hydrogeology

Based on monitoring well data collected during the sampling conducted in 1998, groundwater is observed within sandy soils at depths from 8 to 11 feet below ground surface (bgs). Shallow groundwater appears to be unconfined and flows toward the Bay. Groundwater elevations fluctuate with tidal amplitude in all five monitoring wells previously installed at the Site. In general, the highest tidal influence is closest to the shoreline. Higher tidal influence in certain wells (e.g., MW-4) suggests that either a utility corridor or another unknown type of hydraulic connectivity between the well and the shoreline may be present.

2.3.3 Marine Setting

For the majority of the main shipyard and Parcel 5 area, sediment surface elevations slope away from the shoreline (at approximate elevation 0 feet MLLW) to bottom elevations ranging from -30 to -35 feet MLLW. Slope grades in these areas range from 3H:1V at the steepest to as shallow as 12H:1V with shallow slopes generally located at the north end of the Site. Some eel grass beds are present in a shallow offshore area at the southern end of Parcel 5.

For the purpose of the Site-Wide RI/FS and based on information provided by Ecology, an estimate of potential sea-level rise in Bellingham Bay over the next 100 years is approximately 2.4 feet above current mean sea level, with a low probability of a very high potential sea level rise of 50 inches (provided in a January 2008 report by University of Washington and Ecology). While marine facilities typically are designed to operate at current sea level conditions, sea-level rise will be considered during the RI/FS process.

The sediment bathymetry contours around the existing dry dock are irregular compared to the general shipyard area. As documented in the investigation reports prepared by RETEC and in Port files, dredging was completed in 1982 in the area of the southern footprint of the existing dry dock to achieve required water depths to accommodate the structure. The footprint of this dredging event is still evident in the most current bathymetry data.

General sediment stratigraphy at the Site consists of a mixture of silt and sand to an approximate depth of 5 feet below mudline. The underlying layer consists mainly of sand and gravel and provides a firm bottom beneath the upper recent sediment deposits. Gravelly material is also observed near the sediment surface in the previously dredged area at the existing dry dock and Main Pier. Silty sediment is observed in the southern portion of Parcel 5, within the vicinity of the eel grass beds.

Anthropogenic debris is observed within the main shipyard area, with the greatest abundance of debris located in the area immediately east of the pier building. In this area, metal cable, rope, shovels, and cobbles are prevalent. The presence of a debris pile, approximately 4-feet high and 6-feet in diameter, has also been identified in the area underneath the main pier beneath the loft and pier shops. The debris pile appears to consist of concrete or other material with a calcified coating.

2.3.4 Cultural Resources (Historical and Archaeological)

Bellingham Bay shoreline areas are sensitive for historical and archaeological cultural resources as the Lummi Tribe lived around the mouth of the Nooksack River, along Whatcom Creek, and on the San Juan Islands for thousands of years. However, there are some indications that the proposed Supplemental Site Investigation presented in Section 7.0 is unlikely to encounter historical and archaeological cultural resources. Available information from the Port and the RETEC Phase 2 report indicates that the former shoreline has been modified several times (RETEC 1998a). In 1930, the western side of the Site was extensively filled to expand the upland area for Shipyard activities. The fill deposits have significantly changed the location of the shoreline, moving it approximately 100 feet up to 800 feet north and west from the former shoreline. Fill in this area was reportedly placed to a depth of 15 feet and is comprised of sand but also included gravel and shell fragments. The presence of shell may indicate that dredged sediment was used as part of the fill material. Figure 2.2 shows the original shoreline in the 1891 Harbor Line Commission map overlaid with the current shoreline area.

Archaeological sites are known to be located in the vicinity of the Shipyard and a cultural resource specialist, Historical Research Associates (HRA), has been retained to assist with historical research for the duration of the project. An HRA archaeologist will conduct an archaeological and additional historic records search at the Washington State Department of Archaeology and Historic Preservation (DAHP) in Olympia, Washington prior to the start of the proposed Supplemental Site Investigation to identify known archaeological resources within the vicinity of the Shipyard.

HRA staff will conduct an online records search using the DAHP Washington Information System for Architectural and Archaeological Records Data (WISAARD). WISAARD contains cultural resource survey reports, archaeological site records, cemetery records, and Historic Property Inventory (HPI) forms. Additionally, HRA will search WISAARD for National Register of Historic Places (NRHP) and Washington Heritage Register (WHR) eligible and listed properties in the vicinity of the project. The statewide predictive model layer in the database will be reviewed for probability estimates for identifying cultural resources, and to aid in recommendations for subsequent cultural resources work. HRA staff will, as necessary, examine documents held in the in-house library, as well as sources at the University of Washington Libraries and the Seattle Public Library. Information obtained from these repositories will help to establish the context for potential resources in the vicinity, including previous archaeological work that may not be archived at the DAHP. HRA will also conduct historic map searches, to identify historic-period shoreline positions, and potential ethnographic Native American and historic Euro-American cultural resources in the vicinity of the project.

As part of the background research, HRA will make one field visit, to examine the project area, if needed to verify the conclusions of the literature search.

Based on results of the research ground disturbing activities may be monitored by an HRA archaeologist. However, it is not anticipated that an archaeologist will be present throughout the duration of the Supplemental Site Investigation. The planned ground disturbing activities (well installation, soil borings, hand augers) will produce minimal ground disturbance. The proposed explorations will be limited to the fill soils overlaying the historical tidal flats, within medium or low probability zones for archaeological artifacts. In the event that an archaeologist is not present during all ground disturbing activities, the following procedures will be implemented to address the possibility of encountering cultural artifacts:

- The soils in the borings will be logged by a geologist, with attention paid to looking for evidence of non-soil materials.
- If apparent archaeological artifacts are encountered, the Port will be notified immediately. The Port will notify Ecology, DAHP, the Lummi Nation, and Nooksack Tribe, and will invite the parties to attend an on-site inspection with a professional archaeologist contracted by the Port. The archaeologist will document the discovery in a report submitted to DAHP so that they may control access to information regarding potential sensitive-site locations, in accordance with Chapter 27.53 RCW; the report will be referenced, but not included, in the Site RI/FS report.
- In the event of an inadvertent discovery of potential human remains, work will be immediately halted in the discovery area, and the apparent remains will be covered and secured against further disturbance. The City of Bellingham Police Department and Whatcom County Medical Examiner would be immediately contacted, along with DAHP and authorized Tribal representatives. A treatment plan would be developed by a professional archaeologist at HRA in accordance with applicable state law.

HRA will prepare a brief Technical Report, summarizing the results of map and literature background research. HRA will also provide recommendations for archaeological monitoring at the Shipyard prior to commencing the Supplemental Site Investigation activities. This report will reflect professional standards for format and content as expressed in the guidelines prepared by DAHP. A separate cultural resources monitoring report would be included as an appendix to the Site-Wide RI/FS to allow for the appendix to be redacted from parties that should not have knowledge of sensitive-site location information.

Additionally, the Native American Graves Protection and Repatriation Act, the Archaeological Resources Protection Act, and the National Historic Preservation Act have been added as location-specific ARARs for this project and are discussed in Section 3.0 and Appendix A.

3.0 Regulatory Framework

3.1 REGULATORY FRAMEWORK

In April 1994, Ecology ranked the Site a “2” out of “5” (1 being the highest priority) on the MTCA list of suspected and confirmed contaminated sites. The Site was listed on the MTCA Hazardous Sites List. The high ranking was reportedly due to presumed ecological risks associated with metals and polychlorinated biphenyls (PCBs) detected in sediments during the Ecology sampling event in 1993.

The Site-Wide RI/FS will be completed under MTCA WAC 173-340. Under MTCA, an RI/FS (WAC 173-340-350) is required once a site is prioritized for remedial action. The Site-Wide RI/FS will focus on collecting, developing, and evaluating enough information to select a cleanup action under WAC 173-340-360 through 390. Investigation of in-water areas and sediments will be completed under the SMS (WAC 173-204).

3.2 AGREED ORDER AND MODEL TOXICS CONTROL ACT REQUIREMENTS

The Port’s obligations under the initial AO (No. DE-03TCPBE-5670) signed in August 2003 included the determination by Ecology that the Port, as the performing party, must conduct an RI/FS for site sediments to develop and evaluate cleanup action alternatives to enable final cleanup actions to be selected for the Site. According to the former AO, the Sediment RI/FS was to be performed in accordance with WAC 173-340, 173-340-350, and WAC 173-204-560 to achieve the remedial action objectives (RAOs). It was also determined that a final SAP, in accordance with WAC 173-340-350 and SMS WAC 173-204-560 requirements for sediments, be submitted to Ecology within 30 days of the effective date of the former AO. The Final SAP, Supplemental Bioassay Testing, completed by RETEC was included as Exhibit C to the former AO. All chemical and biological data collected was ordered to be submitted to Ecology in Sediment Data Management and Analysis Tool (SEDQUAL) data format. During the performance of the former AO, the Port submitted quarterly progress reports to Ecology summarizing work to be performed during the period and other anticipated work to be completed.

Based on the agreement with Ecology to expand the RI/FS for site sediments to also include upland areas, the former AO between Ecology and the Port was terminated and a new AO was signed in March 2010to document the Port’s commitment to complete a Site-Wide RI/FS.

3.3 ARARS, SCREENING LEVELS, AND CLEANUP STANDARDS

Compliance with ARARs is a MTCA threshold requirement, and must be met by all proposed remedial alternatives. Under WAC 173-340-350 and WAC 173-340-170, the term “applicable requirements” refers to regulatory cleanup standards, standards of control, and other environmental requirements, criteria, or limitations established under state or federal law that specifically address a COC, remedial action, location, or other circumstance at the Site. The relevant and appropriate requirements are regulatory requirements or guidance that do not apply to the Site under law, but have been determined to be appropriate for use by Ecology.

ARARs are often categorized as chemical-specific, location-specific, or action-specific. Chemical-specific ARARs include regulatory cleanup levels (CULs) for the relevant COCs. Location-specific ARARs include any regulations or guidance relevant to a specific location at the Site. Action-specific ARARs include regulations or guidance governing any activities proposed to remediate the Site. Preliminary project-, location-, and chemical-specific ARARs that may be directly relevant to the development and evaluation of remedial alternatives are included in Appendix A.

The primary cleanup regulations that apply to this Site are MTCA and SMS. Site screening levels will be based on MTCA and SMS sediment quality standards, as presented in Table 3.1 and 3.2, and other ARARs to ensure protectiveness of sediment and water quality. Site-specific cleanup standards will be developed and established during the RI/FS in conjunction with Ecology, the Port, and other site stakeholders and responsible parties.

The following section of the Site-Wide RI/FS Work Plan presents a summary of information gained from previous investigations at the property. In this summary, existing chemical data collected from the Site is compared to published MTCA and SMS criteria as screening levels to develop an initial understanding of environmental compliance status.

4.0 Summary of Prior Investigations

4.1 SEDIMENT AND UPLANDS INVESTIGATIONS AND ACTIONS

This section provides a summary of environmental investigations and actions that have been completed at the Site to date. Investigations have been completed in the uplands and sediments since approximately 1993 and have been documented in several reports prepared by Ecology, GeoEngineers, and RETEC. Data from the previous investigations are summarized below and relevant data tables from historical site investigations are included in Appendix B.

4.1.1 Pre-1998 Sampling and Ecology Inspections

Limited sampling of upland soil and sediment was performed prior to the initial work by RETEC beginning in 1998 as described in the following paragraphs.

In March 1993, Ecology completed a Solid and Hazardous Waste Inspection and noted sandblast grits and stained soil near the sandblast shed, former joiner shop, marine railway, and sidetracks areas. Sediment samples collected from the main shipyard area exceeded SMS sediment quality standards for one or more analytes. Phenol and PCBs were reported in exceedances of SMS criteria. Arsenic, copper, lead, and zinc were also reported in exceedance of the SMS criteria. Tributyltin (TBT) was detected in three samples (Cubbage 1993).

In 1993, MCI, a former tenant, excavated an unknown amount of petroleum-contaminated soil from the marine railway area as an improvement action for stormwater control at the Site. Petroleum-contaminated soil from the marine railway was excavated as part of improvements to stormwater control at the shipyard. Soil was tested and designated non-hazardous, petroleum-contaminated soil. During the same time period, MCI was cited as the defendant in a Citizen lawsuit under the Clean Water Act (CWA) for violation of stormwater permit conditions.

In June 1996, GeoEngineers collected three sediment samples along the under-pier area of the Main Pier as part of the pier-extension project (GeoEngineers 1996). All samples were in compliance with the SMS sediment criteria. The sampling excluded analyses for organotins.

4.1.2 RETEC Phase 2 Sampling of Sediments, August 1998

In 1998, Environmental Site Assessment Phase 2 sampling was performed in both upland and sediment areas of the Site to provide baseline information relative to a change in the leasehold at the property. The objective of the Phase 2 sediment sampling was to provide initial sediment characterization. Two primary areas were sampled, the Parcel 5 area and the marine shipyard area. RETEC completed a site survey, diver video survey, and grab sampling at 23 locations using a hydraulic Van Veen sampler. Primary grab samples were analyzed for metals and PCBs, and secondary analyses were completed for semivolatile organic compounds (SVOCs) and organotins. SMS exceedances were reported in samples collected east of the pier shops under the northern portion of the large dry dock. Samples were also collected from Parcel 5 area west of the Site; however, no SMS sediment quality standards or minimum cleanup level (MCUL) exceedances were reported in those samples. Grab samples were collected around areas of debris. Five samples were analyzed for SVOCs. Eight grab samples were analyzed for organotins in porewater.

In addition to the grab samples, cores were advanced using a vibracore sampler at four locations in areas of known contamination to delineate vertical extent. Core samples were analyzed for metals, total organic carbon (TOC) and PCBs, with logs noting the presence of anthropogenic debris (RETEC 1998a).

4.1.3 RETEC Phase 2 Sampling of Soil and Groundwater, September 1998

In 1998, Environmental Site Assessment Phase 2 sampling was performed in both upland and sediment areas of the Site to provide baseline information relative to a change in the leasehold at the property. As part of the Phase 2 upland sampling completed in September 1998, RETEC installed five monitoring wells to define hydrogeologic properties at the facility including depth to groundwater, tidal influence on groundwater elevations, and hydraulic conductivity. Gasoline- and diesel-range hydrocarbons were detected in groundwater from a well located downgradient of the former AST at concentrations exceeding MTCA Method A CULs for total petroleum hydrocarbons (TPH) in groundwater. Petroleum hydrocarbons were also detected in subsurface soil samples collected during the installation of this well. TPH was also detected in groundwater samples from two other wells but at concentrations less than the MTCA Method A CUL. Volatile organic compounds (VOCs) were generally not detected in any groundwater sample with the exception of benzene, toluene, ethylbenzene, xylene (BTEX) and alkylbenzenes, and acetone in the well downgradient from the former AST, which was reported to be attributable to petroleum contamination. Dissolved metals were detected in several samples from monitoring wells. Concentrations of metals generally reflected natural background concentrations. Groundwater samples were reportedly very turbid as monitoring wells were not sampled using a low-flow sampling protocol.

Soil sampling confirmed that metals, petroleum hydrocarbons, and polycyclic aromatic hydrocarbon (PAH) compounds are present in subsurface soil at concentrations exceeding MTCA Method A CULs and, in some samples, greater than Method C industrial CULs. Elevated concentrations of metals in shallow soils were attributable to sandblast grit and included anthropogenic debris. Petroleum hydrocarbons were detected at several locations, with the highest concentration located in the northern area of the Site, including the former Union Oil AST area, the marine railway area, and the northwestern corner uplands area. In the area of the former Union Oil AST and former joiner shop, PAH compounds are thought to be related to the hydrocarbon contamination in that area. Contamination in the area of the former joiner shop is reported to be derived from coal tars or treated-wood debris generated during shipbuilding activity prior to its demolition (RETEC 1998b).

4.2 RETEC WORKING DRAFT SEDIMENTS RI/FS, MAY 2004 (AMENDED JANUARY 2006)

The RETEC working Draft Sediments RI/FS (RETEC 2004) was completed for Ecology review in May 2004 and later amended in January 2006 (RETEC 2006) to include the findings of a supplemental sediment source control evaluation that was conducted in 2005, as described in Section 4.2.2. The supplemental source control evaluation addressed the intertidal sediments and adjacent upland marine railway area of the Site.

The updated working Draft Sediments RI/FS document was prepared for Ecology review; however, the public review process for this report has not been completed, and the document was not formally approved by Ecology. All data collected during preparation of the working Draft Sediment RI/FS and supplementary sampling events will be evaluated in the Site-Wide RI/FS for development of the proposed site-wide remedial alternatives.

The working Draft Sediments RI/FS and supplemental sampling results concluded that the extent of surface and subsurface sediment contamination at the Site had been accurately delineated and sediment remediation unit boundaries were proposed as part of the remedial alternatives. The total volume of contaminated sediment was estimated at approximately 19,300 CY, including provisions for a 1-foot overdredge allowance. Remedial technologies and cleanup alternatives were evaluated (at that time) consistent with MTCA and SMS criteria. The preferred remedial alternative presented in the draft document included dredging in accessible areas with Puget Sound Dredged Disposal Analysis (PSDDA) open-water or upland disposal, capping in inaccessible areas (underpier areas and the marine railway), and beneficial reuse of dredged material, as applicable. The revised preferred alternative in 2006 also proposed limited removal of exposed intertidal sediments in the marine railway area.

Principal investigation tasks involved the collection of additional chemical data in the underpier area, dry dock, and other areas with inadequate data to determine compliance with SMS criteria. Confirmatory biological testing on surface sediment was conducted in areas that exceeded SMS criteria for samples collected in 2000. Bioassay testing was not completed in areas where PCB concentrations exceeded the PCB site-specific CUL of 6.0 parts per million (ppm) TOC, but were less than the SMS PCB criteria of 12 ppm TOC. The bioassay testing is summarized below in Section 4.2.1. Human health and ecological risk assessments for PCBs were also conducted at the Site. The evaluation concluded that the proposed PCB CUL would not adversely affect ecological receptors.

Core samples were also collected to define the depth and thickness of contaminated sediments at the Site. Sediment deposition patterns were assessed using radioisotope profiles of cesium-137 (Cs-137). Physical parameters (grain size, specific gravity, compressibility, etc.) were also analyzed to support the engineering analysis of the alternatives.

Additional core samples were collected in February 2004 as part of an effort to characterize sediment suitability for disposal at an open-water disposal site. This program was completed in accordance with the PSDDA program and the Dredged Material Management Plan (DMMP). Regulatory agencies provided preliminary approval for disposal of approximately 12,000 CY of dredged sediment from the Site at an open-water disposal location in July 2006 and this disposal option was incorporated into the preferred remedial alternative recommended in the working Draft Sediments RI/FS. Due to the data recency determination for this Site, this PSDDA preliminary approval was valid only until February 2006 and would need to be renegotiated with the regulatory agencies if the open-water sediment disposal option were to be carried forward during development of the Site-Wide RI/FS.

4.2.1 RETEC Supplemental Bioassay Testing, 2003

The initial RI/FS bioassay testing conducted in 2000 experienced quality control and holding time issues. The amphipod and juvenile polychaete tests were performed on sediment from two sample locations. Sediment was collected from an additional three sample locations for repeated larval tests. Therefore, supplemental bioassay sediment toxicity tests at different sample locations located around the northern and western boundary of the Site were conducted to assess the survival of the amphipod *Ampelisca abdita,* the juvenile polychaete worm *Neanthes arenaceodentata*, and the larval development of the mussel *Mytilus galloprovincialis* during the fall 2003. Quality control failures required a second round of sediment collection and bioassay testing conducted in later 2003 and early 2004. Porewater was centrifuged and analyzed for interstitial ammonia and total sulfides.

In initial bioassay tests, two of the sampling locations exhibited significantly decreased survival of *A. abdita* compared to the control. No adverse effects were observed in the juvenile polychaetes *N. arenaceodentata* growth or survival or in larval development of

M. galloprovincialis in any sample relative to the control. Initial SMS sediment quality standards and MCUL biological criteria failure were attributable to quality control failures; however, following a second round of sediment collection and additional bioassay testing, all 2003 bioassay testing locations passed SMS biological effects criteria.

4.2.2 RETEC Uplands Source Control Sampling, August 2005

The RETEC working Draft Sediments RI/FS was completed for Ecology review in 2006 and incorporated results of supplemental uplands source control sampling performed in August 2005. As part of this investigation, soil samples were collected from borings located adjacent to the marine railway area—a known area of contamination with elevated metals and TPH. In addition to upland soils, intertidal sediments and capped sediments in the marine railway area were analyzed for site contaminants. Groundwater collected from a well located upgradient of the nearshore area was analyzed for total and dissolved metals, diesel- and motor oil range hydrocarbons, PAHs, and PCBs. Intertidal and upland soil samples were analyzed for VOCs, PCBs, SVOCs, TBT, metals, TPH including diesel- and motor oil range hydrocarbons and gasoline, and TOC. The well located upgradient of the nearshore area had no detections for PAHs, PCBs, or hydrocarbons. Dissolved metals were not detected or were much less than the applicable CULs.

Petroleum hydrocarbons were detected in sediment beneath the capped marine railway area and in adjacent uplands near the former Union Oil AST. Concentrations of diesel-range TPH below the cap were up to 6,300 mg/kg (at 2 to 4 feet). Gasoline-range hydrocarbons were detected (up to 310 mg/kg). Several PAHs, including low molecular weight PAHs (up to 454 mg/kg) and high molecular weight PAHs (up to 3,172 mg/kg), exceeded SMS sediment quality standards.

An upland soil sample between the marine railway area and the former AST contained petroleum hydrocarbons, PAHs, and low-level gasoline-range hydrocarbons contamination that appear to increase in concentration with depth, which was consistent with previous RETEC investigations.

Heavy metals including copper (up to 2,620 mg/kg), lead (up to 942 mg/kg), zinc (up to 3,960 mg/kg), mercury (up to 26.2 mg/kg), arsenic (up to 340 mg/kg), and cadmium (up to 7.2 mg/kg) were all detected at concentrations exceeding SMS sediment quality standard values under the capped portion of the marine railway and intertidal sediments. All metal concentrations were less than the SMS sediment quality standard values in the upper and lower intertidal sediment samples. Uplands samples had elevated detections of copper, mercury, and zinc, which was consistent with previous Ecology and RETEC investigations and are thought to be due to the presence of sandblast grit.

TBT analytical results were compared to the former PSDDA program screening level of 0.073 mg/kg. TBT was detected under marine railway area pavement (up to 6.2 mg/kg) and in both intertidal samples (up to 3 mg/kg). TBT is believed to be localized in this area.

SVOCs were not detected at concentrations greater than SMS values in two intertidal sediment samples. PCBs were not detected in intertidal sediment samples but were detected in two shallow upland samples (up to 37 mg/kg total PCBs). VOCs were not detected at concentrations greater than CULs in any sample in the intertidal and uplands area. RETEC indicated that VOCs do not appear to be significant contaminants for the Site.

5.0 Site-Wide RI/FS Objectives

In October 2007, Ecology and the Port agreed to expand the scope of work performed at the Harris Avenue Shipyard to provide a Site-Wide RI/FS. The Site-Wide RI/FS and associated documents will be prepared under the new AO signed by Ecology and the Port in March 2010. This decision was a natural progression from the initial working Draft Sediments RI/FS, informed by the collection of information regarding source control at the shipyard and review of the draft sediment-focused work products.

The objective of the Site-Wide RI/FS is to conduct a comprehensive site-wide evaluation including the upland and in-water properties and define a preferred remedial action for the full Site that will achieve MTCA and SMS compliance under current and anticipated land uses. The RI/FS work will be designed to meet the following objectives:

- Define Remedial Action Objectives, ARARs, and CULs appropriate to the Site.
- Complete a full characterization of soil, groundwater, and sediment quality; determine the compliance status of upland soil and groundwater; and evaluate potential upland-sediment contaminant migration pathways.
- Evaluate remedial actions for upland soil and groundwater; coordinate upland remedial actions with updated sediment remedial actions to define site-wide remedial alternatives; and evaluate site-wide remedial alternatives to recommend a preferred site-wide alternative.
- Define source control actions that must be implemented prior to site cleanup to protect against recontamination.
- Examine the adequacy of the current NPDES permit to determine if the existing best management practices (BMPs) are sufficient to protect the remediated sediments, and to consider if it is necessary to require sediment quality monitoring due to the discharge from the shipyard operations.

These Site-Wide RI/FS objectives are described further in this section.

5.1 PRELIMINARY REMEDIAL ACTION OBJECTIVES

The Site-Wide RI/FS will define RAOs for the Site as a mechanism for meeting the scoping requirements of the MTCA Cleanup Regulations (Chapter 173-340 WAC). RAOs define the objectives that must be met by the remedy to ensure substantive compliance with ARARs. RAOs are simple statements of what the remedy needs to accomplish in order to address concerns defined in the Conceptual Site Model (CSM). RAOs are used to facilitate development and evaluation of remedial alternatives.

Preliminary RAOs for the Harris Avenue Shipyard Site include the following:

- Remediate upland soil and groundwater to protect human health from exposure to hazardous substances via direct contact and indoor air vapor inhalation.
- Remediate and monitor marine sediments to meet MTCA and SMS requirements protective of benthic toxicity and bioaccumulative risk.
- Control upland-to-sediment contaminant migration pathways so that surface sediment quality meets MTCA and SMS requirements.

Additional Site-Wide RI/FS remedial action considerations include the following:

- Evaluate shipyard source control measures that will need to be implemented during the remedial action and will be protective of both aquatic (e.g., salmonids) and aquatic-dependent species (piscivorous species such as marbled murrelets).
- Develop long-term monitoring approaches that can be implemented following completion of site remediation.
- Select remedial actions that can be implemented and effectively maintained within the active shipyard environment. Minimize shipyard business disturbances during remedial action implementation and avoid impacts to navigational use at and near the Site.
- Consider aquatic habitat and optimize the preferred alternative to protect and enhance aquatic habitat features, where possible, given active shipyard use.

5.2 COMPLETE SITE CHARACTERIZATION

Complete site characterization will enable a comprehensive understanding of the nature and extent of contamination, and development of updated conceptual site model including a full understanding of upland-to-sediment contaminant migration pathways. The complete site characterization will allow definition of COCs, and identification of areas of concern relative to cleanup standards.

Additional data will be gathered to further characterize upland soil and groundwater and in-water sediment conditions as necessary to fill existing data gaps. The proposed Supplemental Site Investigation is described in further detail in Section 7.0.

5.3 DEFINE AND EVALUATE SITE-WIDE MTCA REMEDIAL ACTIONS

5.3.1 Upland Model Toxics Control Act Compliance

The Site-Wide RI/FS will define upland remedial alternatives for soil and groundwater that will meet MTCA requirements, and can be implemented and maintained in the context of the active shipyard. This will include evaluation of direct contact risks to workers, evaluation of soil to groundwater leaching concerns, and evaluation of groundwater threats to adjacent surface waters and sediment.

Upland remedial actions that are frequently necessary at similar sites include capping exposed contaminated soil to prevent exposure at levels harmful to site workers, removing areas of soil contamination that could leach contaminants to groundwater at unacceptable levels, and monitoring of groundwater to ensure that dissolved contaminants are not entering surface waters at levels of concern.

5.3.2 Upland to Sediment Pathways

The Site-Wide RI/FS will evaluate upland-to-sediment contaminant transport pathways. These pathways include groundwater migration and soil erosion. The RI/FS work must evaluate the potential concern relative to groundwater contaminant migration to both sediment and surface water endpoints.

Soil erosion and sloughing will be evaluated in the bank and intertidal areas where soil can be washed to the sediment surface at levels of concern. Bank area material will be evaluated based on sediment cleanup criteria and evaluated based on physical stability.

5.3.3 Update Sediment RI/FS

The Site-Wide RI/FS will incorporate all data from the working Draft Sediments RI/FS and then develop and present site-wide remedial alternatives. Remedial alternatives presented in the working Draft Sediments RI/FS will be adjusted as appropriate based on findings of the site-wide characterization and updated land-use considerations. The Site-Wide RI/FS will confirm if “remediation unit” boundaries are appropriate and adjust them as necessary. The Site-Wide RI/FS will also confirm if previously proposed site CULs are consistent with those being implemented at other Bellingham Bay sites.

The Site-Wide RI/FS will review the 2006 working Draft Sediments RI/FS disposal options and the prior PSDDA suitability decision, given current suitability criteria policy discussions. Disposal options will include upland landfilling, open-water disposal, and evaluation of upland beneficial reuse opportunities that may be present given existing development and cleanup actions planned in Bellingham Bay.

5.3.4 Define and Evaluate Site-Wide Remedial Alternatives

The Site-Wide RI/FS will define and evaluate comprehensive site-wide remedial alternatives for upland and sediment remediation. Evaluation and screening methodologies will follow MTCA guidance and are further defined in Section 10.0.

All alternatives defined will achieve MTCA threshold criteria, and will be evaluated based on the other MTCA requirements and disproportionate cost analysis (DCA). In the DCA, each alternative will be evaluated against the most permanent alternative to identify the alternative that is “permanent to the maximum extent practicable” for both the upland and sediment remediation areas. The DCA will be developed consistent with Ecology expectations for weighting as developed for the Whatcom Waterway site.

5.4 DEFINE SOURCE CONTROL REQUIREMENTS

The Site-Wide RI/FS will evaluate the potential for marine sediments to become recontaminated at levels of concern following implementation of the remedial action. Recontamination as a result of shipyard operations will be considered. Recommendations will be made for control or elimination of potential sources of recontamination. Recontamination potential will be evaluated based on sediment cleanup criteria and COCs. Additional source control evaluation details are provided in Section 8.0.

5.5 ADDRESS CURRENT AND FUTURE LAND USE

The Site-Wide RI/FS will define and evaluate remedial alternatives in the context of active shipyard operations and area navigation. The Site-Wide RI/FS work will include coordination with shipyard tenants and Port personnel to confirm current operations and infrastructure and to determine any planned changes in operations and/or facilities that should be factored into the document.

In addition, the Site-Wide RI/FS will consider aquatic habitat protection and restoration opportunities, and incorporation of habitat restoration into the proposed site-wide alternatives as appropriate.

6.0 Conceptual Site Model and Data Gaps

6.1 PRELIMINARY CONCEPTUAL SITE MODEL, COCS, AND EXPOSURE PATHWAYS

This Final Site-Wide RI/FS Work Plan presents a CSM based on the physical conditions at the Site, findings from the RETEC Working Draft Sediments RI/FS and other site investigations, potential sources of sediment contamination, and contaminant transport and exposure pathways. Development of a preliminary CSM is a tool that assists in identifying data gaps and making decisions about site-wide remedial actions. A depiction of the preliminary CSM is shown on Figure 6.1.

The upland soil beneath the surficial ground cover (either pavement or gravel) consists of gravelly to sandy fill soils, ranging in thickness up to 7 feet and containing anthropogenic debris including wood, brick, metal, and sandblast grit. The fill material likely originated as dredged sediments taken from the western and northern areas of the facility in the 1930s. Underlying the fill is native soil consisting of fine to coarse grained sand with gravel. However, in the central portion of the Site, native sands were reported to be similar to glacial outwash deposits (RETEC 1998b).

Groundwater is first observed within sandy soils at depths from 8 to 11 feet bgs. Shallow groundwater appears to be unconfined and flows toward Bellingham Bay, which is the natural point of discharge. Groundwater elevations fluctuate with tidal amplitude. The highest tidal influence is found closest to the shoreline. Higher tidal influence in one nearshore monitoring well suggests that either a utility corridor or other unknown type of hydraulic connectivity between the well and the shoreline may be present (RETEC 1998b).

The primary targeted COCs for upland soils are metals (arsenic, copper, and lead) as well as diesel- to oil-range petroleum hydrocarbons. Site groundwater in places is impacted primarily by TPH and potentially by dissolved arsenic.

The primary targeted COCs for sediments include PCBs, heavy metals (arsenic, cadmium, lead, mercury, and zinc), phthalates, and PAHs. SMS chemical criteria exceedances have also been detected for some miscellaneous SVOCs, including benzyl alcohol and 2,4-dimethylphenol. TBT at levels of concern is believed to be localized in the marine railway area. Existing analytical data do not suggest the presence of LNAPL along the shoreline area and LNAPL has not been reported in the existing wells, nor have oil seeps been reported near the shoreline.

The marine railway area is one of the most heavily used areas in uplands shipyard operations and is the location where the most contamination has been identified. Other areas of concern include the former joiner shop along the northern and western areas of the Site where paint and other debris may have accumulated, the former location of the Union Oil AST located near the main dock, and the paint shop and sandblast shed.

There are a number of potentially relevant pathways for contaminant transport from these upland sources to sediments. The transport pathways that may have resulted in historic sediment contamination include the following:

- Former shipyard over-water operations that resulted in spills, leaks, and releases of waste materials directly to site waters and sediments.

- Impacted groundwater originating from upland areas, traveling through the fill unit and then discharging through the sediments.
- Discharge of contaminated materials to the Site from industrial wastewater and/or stormwater outfalls.
- Discharge by sheet flow of surface contamination generated from former shipyard upland activities (e.g., sandblasting).
- Erosion and sloughing of contaminated nearshore fill materials onto the sediment surface (e.g., marine railway area).

The primary exposure pathway and receptors for the COCs in upland soil is direct contact by workers to contaminated soil. The vapor pathway will be evaluated as part of the Supplemental Site Investigation.

In sediments, the primary receptors of potential ecological concern are benthic biota (invertebrates) residing in and on top of sediments, resident and migratory fish (vertebrates), seabirds, waterfowl, and marine mammals, representing higher trophic-level species.

Bioassay testing was performed as part of the 2006 RETEC Working Draft Sediments RI/FS and was incorporated into the extent of the evaluated remedial alternatives. Initial SMS sediment quality standards and MCUL biological criteria failure were attributable to quality control failures; however, following a second round of sediment collection and additional bioassay testing, all 2003 bioassay testing locations passed SMS biological effects criteria.

The Site sediment areas are located in a commercial and industrial area. Additionally, the shoreline access is limited due to the placement of riprap and asphalt cover, further limiting any opportunity for human direct dermal contact to the sediments. However, the primary potential exposure pathway for humans is the ingestion of impacted fish or shellfish. The Working Draft Sediments RI/FS included an evaluation of human health risks associated with PCBs. A bioaccumulation screening level (BSL) was developed for PCBs and further evaluated to ensure that it was also protective of ecological receptors. The human health evaluation included subsistence fish and shellfish gathering as well as incorporating the findings of tissue sampling that had been performed within Bellingham Bay, including samples collected at the Marine Park adjacent to the shipyard. The results of the ecological receptor evaluation concluded that the proposed PCB BSL of 6.0 ppm TOC was protective of shorebirds and marine mammals in the Bay and would not adversely affect ecological receptors. The current applicability of the BSL will be assessed and updated as part of the Site-Wide RI/FS process as summarized in Section 9.1.

The Site-Wide RI/FS report will present a revised CSM that identifies all potential transport pathways and receptors following collection of additional data proposed as part of this Final RI/FS Work Plan. Additional data collected as part of the proposed upland and sediment investigation are described in the SAP/QAPP (refer to Appendix C) and will be evaluated as part of development of this Site-Wide CSM.

6.2 DATA GAPS

Past investigations have described general site conditions in a manner that is sufficient to develop a preliminary upland and sediment CSM, as described above. However, several significant data gaps have been identified and need to be addressed as part of development of the Site-Wide CSM. Filling these data gaps will allow for development of a comprehensive Site-Wide CSM that will serve as the basis for identification and evaluation of upland and sediment remedial alternatives to be presented in the Site-Wide RI/FS report.

Data gaps in the nature and extent of potential contamination within the upland, bank, and intertidal areas of the Site have been identified and are presented below.

6.2.1 Upland Soil and Groundwater

The following specific data gaps have been identified relative to upland soil and groundwater. These data gaps are more fully described in Section 7.0, along with recommendations for the Supplementary Site Investigation:

- Extent and depth of known COCs identified in fill historically placed along the length of the northern shoreline and marine railway areas.
- Presence of additional soil and groundwater COCs (not previously analyzed) along the northern shoreline and marine railway area.
- Additional soil and groundwater data to further delineate known areas of historical (pre-Port ownership) and current contamination, including the marine railway area, paint shop, sandblast shed, and the former Union Oil AST.
- Data along the northern shoreline area to assess potential groundwater-surface water interface impacts.
- Data along the northern shoreline and upland area to assess LNAPL accumulation and potential for a vapor pathway.
- Hydrogeological data to support sediment recontamination modeling (i.e., hydraulic conductivity, flow pathways, tidal influence).

6.2.2 Bank, Intertidal, and Nearshore Sediment

The following specific data gaps have been identified in the exposed bank and intertidal sediment areas. These data gaps are more fully described in Section 7.2, along with recommendations for the Supplementary Site Investigation.

- Nature and extent of potential contamination in the intertidal area around the perimeter of the Site. Data in this area would assist in defining the nature and extent of contamination and potential upland to sediment contaminant transport pathways, which are necessary to finalize the Site-Wide CSM. Data from the intertidal area will assist in defining continuity between the upland and in-water remedies.
- Contingency evaluation of nearshore sediment samples following evaluation of bank and intertidal data. Following analysis of the bank and intertidal area data, collection of nearshore surface sediment samples may be necessary to fully document upland to sediment pathways and complete the CSM.

The proposed bank, intertidal, nearshore area sample location, as well as rationale and methods that would be used for collection of these additional samples, are presented in Section 7.3.

6.2.3 Offshore Sediment

Offshore sediment quality was thoroughly investigated by RETEC in the working Draft Sediments RI/FS (RETEC 2006); however, during the design phase of the sediment remedial action, additional data may be collected for the following purposes:

- To finalize specific limits of selected remedial technologies.
- To support final chemical modeling for sediment cap design.
- To confirm current surface sediment concentrations with recent data.
- To support suitability decisions for specific disposal options.

At this time, no additional sediment sampling is being proposed for these purposes. The Site-Wide RI/FS document will make appropriate assumptions regarding these issues, and the need for collection of additional sediment samples will be evaluated during the design phase of the project, when it can be informed by the proposed remedial action.

7.0 Proposed Supplemental Site Investigation

The objective of the Supplemental Site Investigation is to characterize upland site conditions, address the upland and sediment data gaps presented in Section 6.2, and better define the Site-Wide CSM. The proposed approach to the investigation to address data gaps identified in the uplands will include soil and groundwater sample collection and analysis, and installation of additional groundwater monitoring wells. Additional soil and groundwater samples will be collected to better assess groundwater conditions and further delineate the extent of contamination as identified in the CSM.

The proposed approach to address data gaps identified in the marine sediments will include collection of bank/intertidal hand auger samples. The bank/intertidal sediment data will be used to evaluate the potential uplands and shoreline transport pathways to sediments as well as site source control, and provide COC information that will be used for potential groundwater and sediment modeling.

Pending the analytical results of the bank/intertidal sediment samples, a contingency diver-assisted surface sediment sample collection effort may be conducted to further delineate uplands and shoreline transport pathways to sediment, and to complete the Site-Wide CSM.

7.1 SOIL AND GROUNDWATER

Based on previously collected soil and groundwater data, contamination (metals and TPH) is primarily located along the northern shoreline, marine railway and side tracks, and upland source areas including the former Union Oil AST, paint shop, and sandblast shed (former joiner shop) as presented in Figures 7.1 and 7.2. The proposed supplemental investigation within the upland and bank/intertidal areas is presented on Figure 7.3.

The major study elements will include completion of the following activities to address data gaps identified in Section 6.2.1. Specific details of the Supplemental Site Investigation in the contamination areas are further discussed below in Sections 7.1.1 through 7.1.4.

Soil Boring Advancement

Eighteen soil borings will initially be advanced in the upland area to primarily define the extent and depth of known COCs identified in historical fill placed along the length of the northern shoreline and marine railway areas. Proposed boring locations were determined based on interpretation and evaluation of existing analytical data as well as recorded field conditions and site access. Boring locations are proposed with the assumption that there may be additional step-out borings completed, to define an area of contamination once initial field observations are available.

Monitoring Well Installation

Five new monitoring wells will be installed in the upland area of the shipyard to further delineate known areas of contamination and to expand the network of wells for a 72-hour tidal study. Proposed monitoring well locations were determined based on interpretation and evaluation of previous groundwater analytical data as well as recorded field conditions. The proposed locations may be subject to relocation based on field conditions and site access.

LNAPL Assessment

The shoreline area will be assessed for the presence and thickness of LNAPL accumulation during soil boring advancement and well installation. If LNAPL is observed during completion of soil borings, up to two representative petroleum-saturated zone soil cores will be sent to PTS Laboratory for digital UV imaging to verify field test observations and to assist in the identification of hydrocarbon zones.

Soil gas sampling may be completed if significant indications of LNAPL are observed during field drilling activities to assess if there is a vapor risk. If LNAPL is encountered, Ecology will be notified and Floyd|Snider will collect up to two soil gas samples in a pre-evacuated Summa canister for analysis. Further detail on LNAPL assessment techniques and soil gas sample collection is summarized in the SAP/QAPP (Appendix C).

Tidal Study

Water levels will be continually monitored for 72 hours, as part of a tidal study, to assess tidal fluctuation in shallow wells and overall flow direction. The proposed tidal study will use the Serfes method of reducing data to successfully determine tidally-influenced groundwater gradient information using all installed shallow monitoring wells. Floyd|Snider has reviewed previous data reports to determine if the shallow aquifer was tidally-influenced. Based on the RETEC Phase 2 Sampling of Soil and Groundwater (1998b), a preliminary 18-hour tidal study was completed at five monitoring well locations to determine the extent of tidal influence on groundwater elevations. It was determined that shallow groundwater elevations fluctuate with significant tidal amplitude in all five monitoring wells previously installed at the Site. The proposed use of eight wells, as part of the Supplemental Site Investigation, will enable a more rigorous determination of tidal influence on groundwater flow to be made.

7.1.1 Northern Shoreline Area

In general, the northern shoreline area encompasses the waterfront area from the pier to the eastern property line, and north of the inner harbor line. Metals and petroleum-hydrocarbon contamination was previously identified along the shoreline area between the loft and pier shops to the east beyond the dry dock. The full extent of TPH and metals contamination has not been determined and soil and groundwater conditions have not been established along the shoreline area.

Formerly installed Monitoring Wells MW-1 and MW-2 are no longer accessible in this area. These well locations have been proposed for re-installation in the northern shoreline area to assess the groundwater to surface water interface and to address data gaps.

Approximately nine soil borings (FS-01 through FS-09) will be advanced along the northern shoreline area as shown in Figure 7.3. A minimum of five new monitoring wells (MW-01A, MW-02A, and MW-06 through MW-08) are proposed to be installed along the northern shoreline. Two of the five wells will be replacement wells for MW-1 and MW-2. Further detail on the field sampling techniques, field screening and chemical analyses is included in the SAP/QAPP (Appendix C).

With the installation of five new groundwater wells, a network total of eight wells will be in place for future monitoring along the northern shoreline, with three located upgradient. The five new wells and three existing wells will be sampled for site COCs (according to the sampling plan and analytical program presented in Appendix C) following installation and development. Upgradient wells (MW-3, MW-4, and MW-5) will be sampled for baseline groundwater data. A second sampling event will be completed 3 to 6 months following completion of initial sampling in order to confirm the presence and concentration of COCs. With the current schedule, it is anticipated that groundwater sampling should be conducted during the wet season in early 2011. Floyd|Snider will attempt to target a rain event that produces greater than 0.5 inches of rainfall. It is also anticipated that the second sampling event will be completed during the dry season. Groundwater sampling will occur during low tide for both sampling events.

Appropriate field screening of groundwater samples will occur at the time of low-flow sampling including temperature, pH, dissolved oxygen, conductivity, salinity, and turbidity as specified in the SAP/QAPP (Appendix C).

7.1.2 Marine Railway and Side Tracks Area

The marine railway and side tracks area is located in between the Main Pier and the finger pier. The marine railway is also connected to upland side tracks where boats can be stored during work activities. This is one of the most heavily used areas for upland activities. Shipbuilding and launching activities were conducted in this area during the 1940s and currently this area is used for sandblasting.

Previous sampling completed by MCI and Hart Crowser confirmed the presence of oily soil in the marine railway area. Contamination was reported to be related to winch chain oiling and dripping. A test pit location located in between the Union Oil AST and marine railway area confirmed that there are two probable source areas. Sandblast grit and stained soil were observed in this area. Contamination was present in soil samples collected at depth during the installation of MW-2 and in a test pit location located to the south of MW-2. Diesel fuel was detected in soil at 13,000 mg/kg and motor oil at 8,000 mg/kg in MW-2. Gasoline was detected at 240 mg/kg. Diesel-range hydrocarbons were detected in MW-2 at concentrations less than the MTCA Method A cleanup level.

A minimum of two soil borings (FS-10 and FS-11) will be advanced in the marine railway area to address the data gaps described in Section 6.2.1. Soil and groundwater samples will be collected and analyzed for site COCs as described in Appendix C. As mentioned in Section 7.1.1, a replacement monitoring well (MW-02A) will be installed for MW-2 along the northern shoreline area to address the remaining data gaps described in Section 6.2.1.

7.1.3 Former Union Oil AST

The former Union Oil AST was previously located in the eastern portion of the Site. The tank contained approximately 100,000 gallons of bunker oil. The AST was present during the 1930s and 1940s but was later removed. As summarized in Section 4.1.3, elevated concentrations of diesel and motor oil were detected in samples collected at this location in exceedance of the MTCA Method A CUL for diesel and motor oil petroleum. Petroleum contamination was observed in soil from MW-1 and test pits locations.

Approximately four soil borings (FS-12 through FS-15) will be advanced around the former Union Oil AST to determine the extent of contamination in soil and groundwater. Soil and grab groundwater samples will be collected and analyzed for the site COCs as described in Appendix C to address upland data gaps and to assist in estimating the volume of contaminated soil and subsequent identification of possible remedial alternatives.

7.1.4 Paint Shop and Sandblast Shed (former Joiner Shop)

The paint shop and sandblast shed are located in the upland portion of the Site to the south of the marine railway area. The joiner shop was formerly located in the area of the current paint shop and sandblast shed. This area, along with the marine railway area, was one of the most heavily used areas for upland activities and was used for painting and caulking as well as shipbuilding activities. Sandblast grit and stained soil have been observed in this area.

Anthropogenic debris and sandblast grit have been observed in test pit locations south of the paint shop and sandblast shed. Arsenic was detected at 750 mg/kg, in exceedance of the MTCA Method C CUL in one test pit location. A monitoring well was installed at a previous boring location located to the north of the paint shop and sandblast shed. Metals were detected similar to background concentrations. Diesel-range hydrocarbons were detected at 0.73 mg/L, slightly less than the MTCA Method A CUL.

Approximately three soil borings (FS-16 through FS-18) will be advanced in the upland area around the paint shop and sandblast shed to address upland data gaps. Soil samples will be collected and analyzed for the site COCs as described in Appendix C to characterize lateral and vertical extent of contamination and to identify the presence of sandblast grit and anthropogenic debris. Grab groundwater samples will be collected to assist in determining extent of groundwater impacts.

7.2 BANK/INTERTIDAL AND NEARSHORE MARINE SEDIMENT

The 2006 RETEC Draft Sediments RI/FS presents detailed documentation of sediment cleanup criteria exceedances focused on PCBs, metals, SVOCs, and results of biological testing. Figures 7.4 through 7.6 provide summary documentation of these cleanup criteria exceedances for all previous sediment investigations completed at the Site.

Based on interpretation of these sediment cleanup criteria exceedances, Figure 7.7 presents the proposed Supplemental Site Investigation sample locations for the bank/intertidal and marine areas of the Site on the 2006 RETEC Working Draft Sediments RI/FS.

The proposed Supplemental Site Investigation within the bank/intertidal area and nearshore marine sediments will include collection of eight bank/intertidal surface sediment samples and a contingency effort of up to four nearshore marine surface sediment samples as described below. All proposed sediment samples will be analyzed for the site COCs described in Appendix C.

Gasoline-range hydrocarbon analyses will not be performed on sediment samples as there are no SMS criteria for gasoline. The data collected at the shipyard to date do not indicate an ongoing source of gasoline-range hydrocarbons from the upland areas; however, since they will be analyzed for in the uplands, the sediment diesel-range hydrocarbon chromatographs will be reviewed for the presence of gasoline-range hydrocarbons.

Additionally, review of previous copper data within the sediment area of the shipyard indicates that the area near locations where samples failed biological toxicity testing were adequately bounded by surface sediment concentrations of copper that are less than the SMS screening level. Given the data distribution, additional copper contamination delineation in the sediments will not be completed to support development of the Site-Wide RI/FS. Sampling and analyses procedures are described in detail in the RI/FS SAP/QAPP (Appendix C).

Goals of the proposed Supplemental Site Investigation within the bank/intertidal area and nearshore marine sediments are to adequately characterize the nature and extent of potential contamination within the bank/intertidal and nearshore marine areas of the Site.

7.2.1 Bank/Intertidal Surface Sediment Sampling

Bank/intertidal sediment samples will be collected using a hand auger at the locations shown on Figure 7.7. Shoreline riprap will be rolled back as possible to collect the surface 0 to 12 cm of underlying sediment. The lineal extent of the intertidal/bank sample collection is based on the adjacent uplands presumed extent of TPH and metals contamination. A total of eight intertidal/bank sediment samples (HA-1 through HA-8) are proposed, six of which are located within the extent of presumed contamination associated with the adjacent upland Area. To account for a potential wider extent of uplands and intertidal/bank contamination, two sediment samples (HA-1 and HA-8) that are located just outside of the presumed extent of contamination in the adjacent uplands area will be collected and archived for later analysis if necessary.

7.2.2 Nearshore Marine Surface Sediment Contingency Sampling

The nearshore marine surface sediment contingency samples will be collected pending evaluation of analytical results of the bank/intertidal surface sediment samples described above in Section 7.2.1. Based on analytical results contingency surface sediment samples may be collected at four locations (SG-1 through SG-4) as shown on Figure 7.7. If exceedances of screening levels are observed in the bank/intertidal sediment samples, collection and analyses of these nearshore contingency surface sediment samples will be coordinated with Ecology following receipt of the intertidal/bank analytical data. The additional data collection may be necessary to complete the evaluation of upland to sediment transport pathways and to complete the Site-Wide CSM.

Nearshore contingency surface sediment samples (as necessary) will consist of sediment collected from the depth interval of 0 to 12 cm below mudline, and will be collected using a 7-inch diver-assisted hand corer that is then brought to the surface for sample processing. Collection and analysis of all nearshore contingency surface sediment samples will be completed as part of a separate investigation program following completion of the other upland and bank/intertidal investigations and data evaluation.

7.3 SUPPLEMENTAL INVESTIGATION PROJECT PLANS

A combined SAP/QAPP and a Health and Safety Plan (HASP), consistent with WAC 173-340-820, have been completed as part of this Final RI/FS Work Plan. The SAP/QAPP provides guidance for the Supplemental Site Investigation by defining in detail the sampling and data-gathering activities and methods to be used to meet the objectives of the investigation. Figure 7.8 presents an overview of the Site-Wide Supplemental Site Investigation for the uplands, bank/intertidal, and nearshore sediment areas of the Site.

The QAPP portion of the document provides a framework for how environmental data will be collected and analyzed to achieve specific project objectives, and describes the procedures that will be implemented to obtain data of known and adequate quality. The elements of a QAPP that reflect the Ecology requirements for such a document are presented here. The use of each element will vary depending upon the project being undertaken and the experience of the staff involved. The elements of a QAPP include project management, study design, measurement and data acquisition, assessment and oversight, and data validation and usability. The SAP/QAPP is included in Appendix C.

The HASP was completed for all site work that complies with the standards prescribed by the Occupational Safety and Health Act (OSHA) and the Washington Industrial Safety and Health Act (WISHA). The purpose of the HASP is to establish protection standards and mandatory safe practices and procedures for all personnel involved with investigation activities including soil boring and monitoring well installation, well development, soil, sediment, groundwater sample collection, and a tidal study at the Shipyard. The HASP is included in Appendix D.

8.0 Source Control Evaluation

8.1 SOURCE CONTROL STATUS

As part of the Site-Wide RI/FS process, Floyd|Snider will evaluate tenant operations to confirm that physical and operational controls are in place to prevent ongoing pollution that could recontaminate completed remedial actions. Source control documentation and recommendations will be incorporated into the Site-Wide RI/FS document.

Significant improvements have been made in recent years at the shipyard for purposes of pollution prevention and source control. This work has included reconstruction of the Fairhaven Shipyard stormwater management system such that stormwater from primary industrial yard areas is now pumped to holding tanks, where it is then discharged to the municipal wastewater treatment facility. In all but the largest storms, these areas no longer discharge to open water.

Stormwater management systems and operational procedures will be reviewed with Puglia and All American as well as additional source control measures associated with operation of the Faithful Servant at the Site.

8.2 SOURCE CONTROL EVALUATION TASKS TO BE PERFORMED

Source control evaluation tasks to be performed during the Site-Wide RI/FS process will be well communicated with the tenants and address tenant operational constraints and objectives for continued use and potential future facility development. Specific tasks are anticipated to include the following:

- Meetings, site tours, and follow up as necessary with Puglia and All American, to evaluate and document the status of pollution prevention measures to protect soil, groundwater, marine sediments, and surface water from recontamination at levels of concern:
  - Understand and document current stormwater management, NPDES permit status and recent upgrades, and operational requirements.
  - Evaluate that all shipyard stormwater is collected, treated, and re-routed to the sanitary sewer for treatment and discharge.
  - Further evaluation of stormwater inputs and abandoned outfalls (from 1994–1997).
  - Evaluate operational BMPs and effectiveness.
  - Evaluate marine railroad area for BMPs and protections related to runoff, infiltration, and air deposition.
  - Identify potential for recontamination of sediment or upland remedies. As appropriate, identify opportunities for BMP upgrades or other recommended additional source control actions.
  - Communicate findings and discuss compliance strategy with Port and tenants to reach consensus on recommendations to be incorporated into the Site-Wide RI/FS document. Meetings with Ecology to discuss operation of the Faithful Servant relative to permit requirements.

Based on the results of the source control investigation, the Port will coordinate with Ecology to determine if additional sampling and analysis of stormwater that may be discharged to

Bellingham Bay from the shipyard is necessary, and assess if any additional source control activities will be completed.

9.0 Additional RI/FS Studies

Additional comments to the proposed Draft RI/FS Work Plan were provided by Ecology (and the Bellingham Bay Action Team) in June 2010. These comments focused on the need for additional sediment characterization and completion of supplemental human health and ecological risk assessment evaluations. Several meetings were held between the Port and Ecology between June and December 2010 to discuss these comments and Floyd|Snider prepared the following documents to address the issues raised by the comments:

- Harris Avenue Shipyard RI/FS Work Plan Response to Comments Dated June 23, 2010.
- Harris Avenue Shipyard RI/FS Work Plan Summary of December 6, 2010 Ecology Meeting and Approach for Development of Final RI/FS Work Plan.

In December 2010, Ecology provided approval for the approach to address the June 2010 Ecology comments. A summary of planned additional evaluations regarding sediment characterization and human health and ecological risk assessment is presented in the sections below. Details regarding the responses to Ecology comments and approach for development of this Final RI/FS Work Plan document are included in the two above-mentioned Floyd|Snider memoranda, which are included in Appendix E.

9.1 ADDITIONAL SEDIMENT DATA COLLECTION

2010 Ecology comments requested that additional sediment data be collected to delineate the nature and extent of dioxin/furan contamination in surface and subsurface sediments and to better define the limits of copper and TBT sediment contamination in surface sediments.

Ecology comments indicated that while dioxins are not assumed to have originated from past or current operations at the Harris Avenue Shipyard Site, they may be comingled with other contaminants and would then become a COC. Additionally, Ecology commented that analysis of subsurface dioxin/furan samples is important not only to dredge disposal decisions, but is also necessary to ensure that the post-dredge sediment surface will comply with cleanup standards for all contaminants including dioxin/furans.

The Port and Ecology met on December 6, 2010 and developed the following approach to address this comment:

- The remediation boundary at the Site will be determined by other site-generated COCs.
- Dioxin/furans are assumed to be present throughout the area (as they are an area-wide contaminant throughout Bellingham Bay and Puget Sound), and will need to be characterized before the final selection of a cleanup approach for the Site.
- Dioxin/furan characterization in sediment is expensive, and would be most cost-effective if it can be carefully targeted to the locations that have the most relevance to cleanup decision making.

Based on these considerations, the Port and Ecology agree that targeted dioxin/furan sediment sampling will be conducted following Ecology review of the Draft Site-Wide RI/FS, and before preparation of the Final RI/FS. Dioxin/furan sampling will be focused on those locations determined by the Port and Ecology to be most appropriate to assist in the final determination and refinement of a preferred remedial alternative for the Site. The targeted dioxin/furan sediment sampling results will be documented in a technical memorandum that will be included in the Final RI/FS document.

The Port and Ecology also reviewed previous sediment sample data for distribution of copper and TBT contamination in surface and subsurface sediments, and determined that the existing dataset is sufficient for the purposes of the RI/FS and no additional sediment sampling is necessary at this time.

Additional details regarding these comments can be found in the Ecology comment response and technical approach memoranda (Appendix E).

9.2 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

Ecology comments provided in June 2010 identified the need to revisit human health and ecological risk assessment efforts that were completed during production of the Working Draft Sediments RI/FS, as part of development of the Site-Wide RI/FS. These comments were provided as a request to update existing work with more current protocols that have been put in place for risk assessment work in Bellingham Bay.

Per the December 6, 2010 meeting, the Port and Ecology agreed to revise the existing human health risk assessment for the Site and recalculate the site-specific sediment biological screening level (BSL) for PCB contamination using updated input parameters and process described in the October 2010 technical memorandum (Appendix E). The updated input parameters will be consistent with those used at the Whatcom Waterway Site for human health risk assessment regarding mercury contamination. Following recalculation of the site-specific BSL, the new BSL will be checked with the ecological risk assessment results to ensure that is also protective of ecological receptors at the Harris Avenue Shipyard Site.

The Port will also present the non-benthic ecological risk assessment completed as part of the existing Working Draft Sediments RI/FS per the process described in the October 2010 technical memorandum (Appendix E). This ecological risk assessment is anticipated to meet Ecology's requirement to address ecological risk at the Harris Avenue Shipyard Site.

These presentations of revised human health risk assessment and existing site-specific ecological risk assessment will be completed during the development of the Draft Site-Wide RI/FS report and following implementation of this Final RI/FS Work Plan data collection effort. Completion of additional risk assessment work for other potential COCs will not be completed during development of the Draft Site-Wide RI/FS Report. The need for completion of additional human health or ecological risk assessment work will be coordinated with Ecology following collection and analysis of sediment samples for dioxin/furan analysis, as necessary.

10.0 Site-Wide RI/FS Preparation Methodology

10.1 SITE-WIDE RI/FS TASKS

This section summarizes the tasks to be completed for the development of the Site-Wide RI/FS, and describes the methodology for Site-Wide RI/FS report preparation.

10.1.1 Remedial Investigation Tasks

Primary RI tasks include conducting the Supplemental Site Investigation, defining overall COCs and cleanup standards for the Site, documenting the nature and extent of contamination and overall compliance status, and updating the CSM to reflect site-wide comprehensive information. In addition, the RI work will document source control status.

As discussed in Section 7.0, Floyd|Snider will complete a Supplemental Site Investigation to fill upland and sediment data gaps.

The Site-Wide RI/FS will evaluate upland-to-sediment contaminate transport pathways. These pathways include groundwater migration and soil erosion. To evaluate the groundwater migration pathway, two-dimensional groundwater transport modeling will be used to evaluate potential concern relative to groundwater contaminant migration to both sediment and surface water endpoints.

Soil erosion and sloughing will be evaluated in the bank and intertidal areas where soil can be washed to the sediment surface at levels of concern. Bank area material will be evaluated based on sediment cleanup criteria and evaluated based on physical stability.

The preliminary CSM developed from previous site investigations and chemical data will be refined throughout the Site-Wide RI/FS process as additional data are collected and comprehensive site conditions are better defined. The CSM will include a comprehensive understanding of contaminants and sources, the nature and extent of contamination, fate and transport processes, and exposure pathways and receptors.

All chemical data from the Supplemental Site Investigation will be submitted in Ecology's Environmental Information Management (EIM) format. Previous chemical data submitted in the EIM format to date include the following:

- Groundwater Compliance Monitoring Data (5/30/91–8/30/06).
- Supplemental Site Investigation (Sediment Toxicity Assessment, 7/24/2003).
- Supplemental Sediment Investigation (Sediment Toxicity Assessment, 11/6/03).
- PSDDA Investigation (2/24/04).
- Working Draft Sediment RI/FS Intertidal Data (8/17/05).

The RI work concludes with an understanding of site conditions necessary for the Site-Wide Feasibility Study (FS) to define detailed remedial action objectives and remedial alternatives.

10.1.2 Feasibility Study Tasks

The FS will define cleanup requirements: site CULs and detailed RAOs. To support the definition of RAOs, the FS will define site units that can be characterized by specific physical and contaminant conditions. Remedial technologies will be identified and screened to determine applicability to the individual site units.

A reasonable number of remedial alternatives will be defined for the Site. All alternatives will meet MTCA threshold criteria, and will vary to cover the full range of cleanup technologies that could be used to meet the RAOs.

The Site-Wide FS will review and evaluate the 2006 RETEC Working Draft Sediments RI/FS remedial alternatives for informational purposes only, and new remedial alternatives will be developed based on all data collected on the Site and consider future site upgrades. The updated Site-Wide RI/FS will confirm that remediation unit boundaries are appropriate and adjust them as necessary. The document will also confirm the consistency of established CULs with recent regional decisions.

The Site-Wide FS will review the 2006 RETEC Working Draft Sediments RI/FS disposal options and the prior PSDDA suitability decision, given current suitability criteria policy discussions. Disposal options will include upland landfilling, open-water disposal, and evaluation of upland beneficial reuse opportunities that may be present given existing development and cleanup actions planned in Bellingham Bay.

The Site-Wide FS will define and evaluate comprehensive site-wide remedial alternatives for upland and sediment remediation. Initially, remedial technologies will be screened and then packaged into alternatives for consideration. Alternative definition will include definition of the actions to be taken; development of Site-Wide RI/FS-level cost estimates for remedial alternatives, which includes an update of 2006 sediment area cost estimates; and a description of land use, navigation, and habitat considerations.

Alternatives will be evaluated using criteria in MTCA and SMS. All alternatives defined will achieve MTCA threshold requirements, and will be evaluated against other MTCA and SMS requirements including the requirement that the selected alternative uses “permanent solutions to the maximum extent practicable.” A DCA will be conducted for the upland and sediment site areas and used to identify the alternative that uses “permanent solutions to the maximum extent practicable.” The DCA will be developed consistent with Ecology’s approach for the Whatcom Waterway site.

Evaluation of alternatives will result in selection of a site-wide preferred alternative that meets MTCA and SMS requirements.

10.2 SITE-WIDE RI/FS REPORT PREPARATION

Draft Site-Wide RI/FS report versions will be submitted to the Port, tenants, Ecology, and other stakeholders for review after completion of the Supplemental Site Investigation and data reporting. Chemical data will be submitted to Ecology in SEDQUAL and EIM formats. A more detailed schedule is provided below in Section 10.3.

Ecology has developed a draft annotated outline to assist with the preparation of RI/FS reports prepared for sediment and shoreline sites in Bellingham Bay. Ecology’s goal is to develop uniform guidance for all cleanup projects in Bellingham Bay and to strengthen consistency and ease of stakeholder and public review. The Site-Wide RI/FS report for the Site will follow the annotated outline as presented in Appendix F.

Based on site-specific variation, it is anticipated that deviations from the Ecology outline may occur. For the Site, the primary variation from the Ecology outline will be reference to the previous RI/FS completed for the site sediments. The RETEC 2006 Working Draft Sediments RI/FS will be referenced as an appendix to the Site-Wide RI/FS (RETEC 2006). The Site-Wide RI/FS will include evaluation of all data collected from previous investigations and the Supplementary Site Investigation, and a revised Site-Wide FS will be prepared for presentation to Ecology and the public.

10.3 SCHEDULE

The following schedule is anticipated for development of the Site-Wide RI/FS and is consistent with the schedule presented in the new AO:

Document	Date
Draft RI/FS Work Plan, SAP/QAPP, and HASP	60 days from effective date of the AO
Final RI/FS Work Plan, SAP/QAPP, and HASP incorporating Ecology's comments	60 days from receipt of Ecology's final comments on Draft RI/FS Work Plan, SAP/QAPP, and HASP
Supplemental Site Investigation and Draft Data Report	360 days from Ecology's approval of the Final RI/FS Work Plan, SAP/QAPP, and HASP documents
Final Data Report incorporating Ecology's comments	60 days after receipt of Ecology's final comments on the Draft Data Report
Draft Site-Wide RI/FS Report	180 days from Ecology approval of the Final Data Report
Draft Site-Wide RI/FS Report for Public Review Incorporating Ecology's comments	120 days from receipt of Ecology's final comments on the Draft RI/FS Report
Final Site-Wide RI/FS Report incorporating Ecology's comments	90 days from the close of public comment period or receipt of Ecology's comments in the event Ecology determines that changes are necessary due to public comment
Draft Cleanup Action Plan	90 days from Ecology approval of the Final RI/FS Report

11.0 Project Team and Responsibilities

11.1 WASHINGTON STATE DEPARTMENT OF ECOLOGY

Ecology is responsible for coordination and decision-making for the project, and reviewing and approving the RI/FS documents. Ms. Mary O'Herron is the Site Project Manager for Ecology and is responsible for implementation of the AO and development of the RI/FS. Ecology will review all work plans and reports for the Site-Wide RI/FS and will determine if all requirements of the AO have been met.

Ecology will have lead responsibility for all public involvement activities during the RI/FS process. Ms. Katie Skipper is the Communications Manager for Ecology and will be responsible for public relations and outreach in coordination with the Port during the project, which may include participation at public meetings, project fact sheets, and direct community involvement.

11.2 PORT OF BELLINGHAM

The Port's responsibilities include overall project direction and oversight, site access, tenant coordination, and all tasks to support the planning and performance of the work. The Port is the performing party under the AO and the upland land owner. Mr. Mike Stoner is the Port's Environmental Director for the project.

11.3 THE FLOYD|SNIDER TEAM

Floyd|Snider is the Port's technical consultant responsible for project planning, technical analysis, authorship, and Ecology coordination to produce the RI/FS in a manner consistent with the AO and Ecology requirements. Ms. Kate Snider, PE, is the Floyd|Snider Project Manager.

AMEC Geomatrix will work as subcontractor to Floyd|Snider providing assistance as necessary with nearshore aquatic habitat, evaluation of potential habitat restoration opportunities, and marine sediment investigation technologies. Mr. Cliff Whitmus is the primary contact for AMEC Geomatrix.

KPFF Consulting Engineers will work as a subcontractor to Floyd|Snider as necessary for civil/structural consultation related to design and cost estimating of conceptual remedial alternatives, to the extent that they may include alteration of applicable site infrastructure. Mr. Don Oates, PE, will be the primary contact for KPFF services on the project.

Historical Research Associates, Inc. (HRA) will provide cultural resource observation during drilling and exploration in nearshore areas if required during the project. Mr. Brent Hicks is the Cultural Resources Division Manager at HRA and will provide cultural oversight on the project.

11.4 ALS LABORATORY AND ANALYTICAL RESOURCES, INC.

ALS Laboratory (ALS) located in Everett, WA is the laboratory that will conduct chemical testing of soil, groundwater, and sediment samples. PCB and TBT analyses will be conducted by Analytical Resources Inc. (ARI), as a subcontractor to ALS. ALS and ARI will be responsible for calculating method detection limits for each COC and meeting laboratory QC requirements as specified in the SAP/QAPP.

12.0 References

Cubbage, Jim. 1993. Unpublished Memorandum to Ms. Lucy Pebles at the Washington State Department of Ecology re: The Results of Sediment Sampling Performed at the MCI Site in 1993.

GeoEngineers. 1996. *Sediment Sampling Report for the Proposed MCI Pier Extension Project*. Prepared for the Port of Bellingham.

RETEC. 1998a. *Phase 2 Sampling of Bellingham Bay Sediments at Harris Avenue Shipyard*, *Bellingham, Washington*. Prepared for Port of Bellingham. August.

———. 1998b. *Phase 2 Sampling of Soil and Groundwater at the Harris Avenue Shipyard*. Prepared for Port of Bellingham. September.

———. 2004. *Sediments Remedial Investigation and Feasibility Study*. Prepared for Port of Bellingham. December.

———. 2006. *Sediments Remedial Investigation and Feasibility Study (Replacement Pages)*. Prepared for Port of Bellingham. January.

Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Tables

FINAL

Table 3.1
MTCA and SMS Site Screening Levels for Sediment and Soil

Constituent	SMS Criteria: SQS (mg/kg)	SMS Criteria: CSL[1] (mg/kg)	MTCA Method A for Industrial Land Use (mg/kg)	MTCA Method C for Industrial Land Use Non-carcinogenic (mg/kg)
Gasoline-range Hydrocarbons (NWTPH-Gx)				
Gasoline-range (with detectable benzene)	NV	NV	30	NV
Gasoline-range (with no detectable benzene)	NV	NV	100	NV
Diesel-range Hydrocarbons (NWTPH-Dx)				
Diesel-range	NV	NV	2,000	NV
Heavy Oils	NV	NV	2,000	NV
Mineral Oils	NV	NV	4,000	NV
Metals				
Arsenic	57	93	20	NV
Copper	390	390	NV	1.3e+05
Lead	450	530	1,000	NV
Mercury	0.41	0.59	2	NV
Zinc	410	960	NV	1.1e+06
Tributyltin	NV[2]	NV	NV	NV
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	16	57	NV	2.1e+05
Fluorene	23	79	NV	1.4e+05
Phenanthrene	100	480	NV	NV
Anthracene	220	1,200	NV	1.1e+06
Fluoranthene	160	1,200	NV	1.4e+05
Chrysene	110	460	NV	NV
Total Benzofluoranthene	230	450	NV	NV
Total LPAH	370	780	NV	NV
Total HPAH	960	5,300	NV	NV

Note:
1 The CSL is reported in mg/kg organic carbon.
2 No regulatory level for bulk TBT exists under SMS or CSL; however, the PSDDA screening level of 73 µg/kg is frequently used as a conservative screening-level for potential biological effects.

Abbreviations:
CSL Cleanup Screening Level.
HPAH High Molecular Weight Polycyclic Aromatic Hydrocarbons.
LPAH Low Molecular Weight Polycyclic Aromatic Hydrocarbons.
MTCA Model Toxics Control Act.
NV No value available.
PSDDA Puget Sound Dredged Disposal Program
SMS Sediment Management Standards.
SQS Sediment Quality Standards.

Table 3.2
MTCA Site Screening Levels for Groundwater

Constituent	MTCA Method A for Industrial Land Use (µg/L)	MTCA Method B for Industrial Land Use Non-carcinogenic (µg/L)
Gasoline-range Hydrocarbons (NWTPH-Gx)		
Gasoline-range (with detectable benzene)	800	NV
Gasoline-range (with no detectable benzene)	1,000	NV
Diesel-range Hydrocarbons (NWTPH-Dx)		
Diesel-range	500	NV
Heavy Oil	500	NV
Mineral Oil	1,000	NV
Metals		
Arsenic	5	4.8
Copper	NV	590
Lead	15	NV
Mercury	2	4.8
Zinc	NV	4,800
Polycyclic Aromatic Hydrocarbons		
Acenapththene	NV	960
Fluorene	NV	640
Phenanthrene	NV	NV
Anthracene	NV	4,800
Fluoranthrene	NV	640
Chrysene	NV	NV

Abbreviations:
CSL Cleanup Screening Level.
HPAH High Molecular Weight Polycyclic Aromatic Hydrocarbons.
LPAH Low Molecular Weight Polycyclic Aromatic Hydrocarbons.
MTCA Model Toxics Control Act.
NV No value available.

Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Figures

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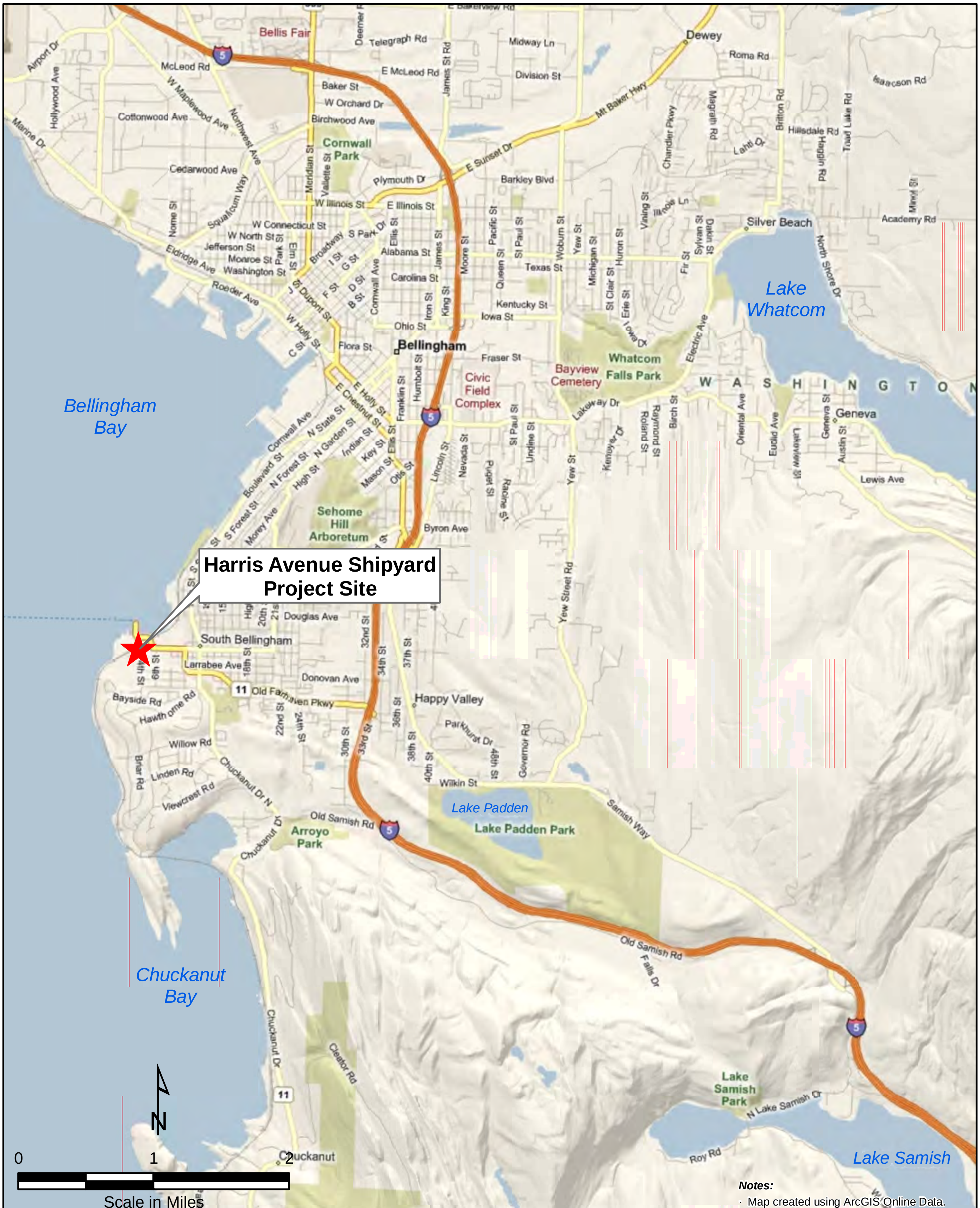
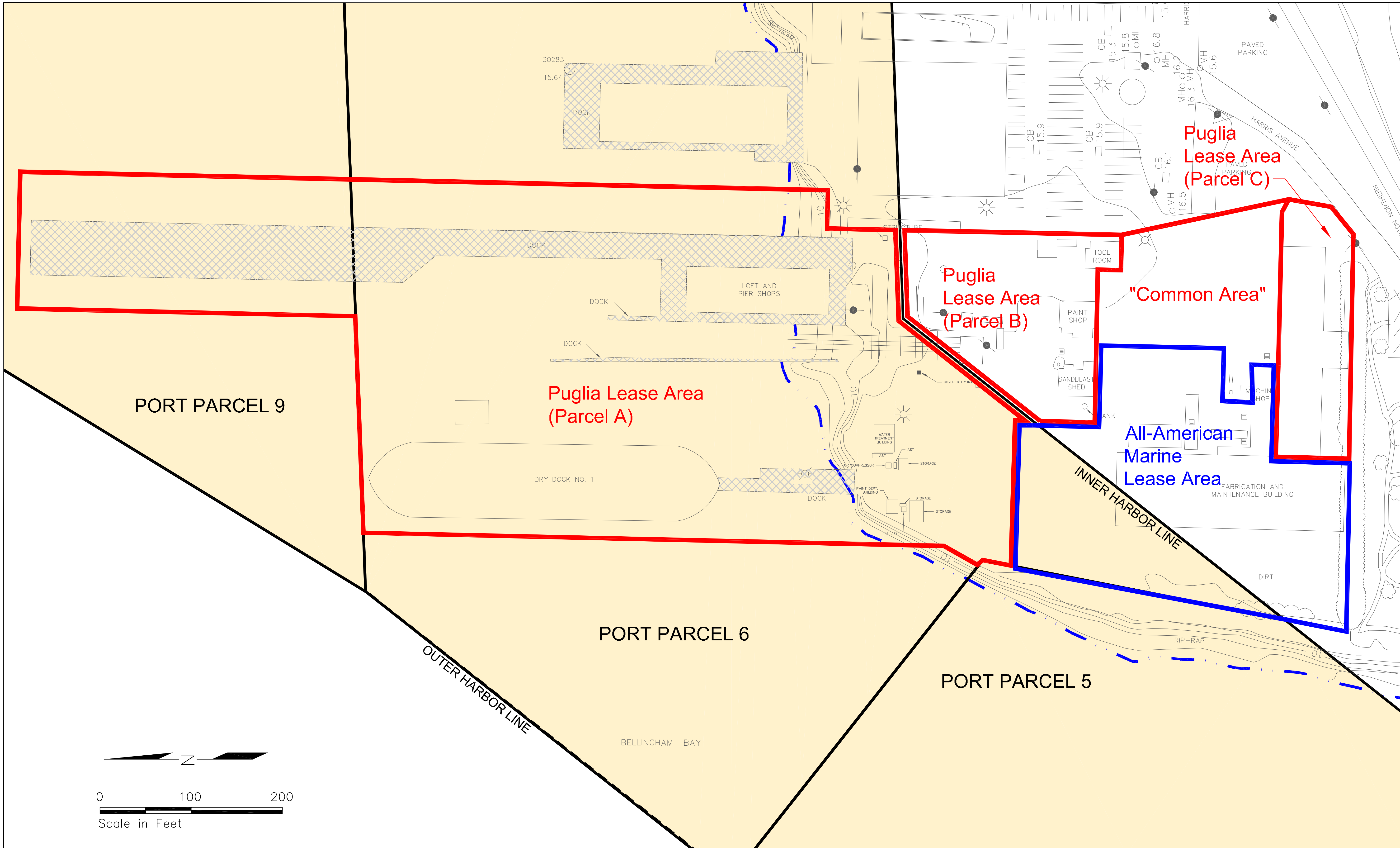


FLOYD | SNIDER strategy ▪ science ▪ engineering	**RI/FS Work Plan Harris Avenue Shipyard Bellingham, Washington**	Figure 1.1 Vicinity Map



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RI/FS Work Plan
Harris Avenue Shipyard
Bellingham, Washington

Figure 2.1
Shipyard Site Location Map and Parcel Boundaries

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DATE: 1/10/2011 9:59 AM

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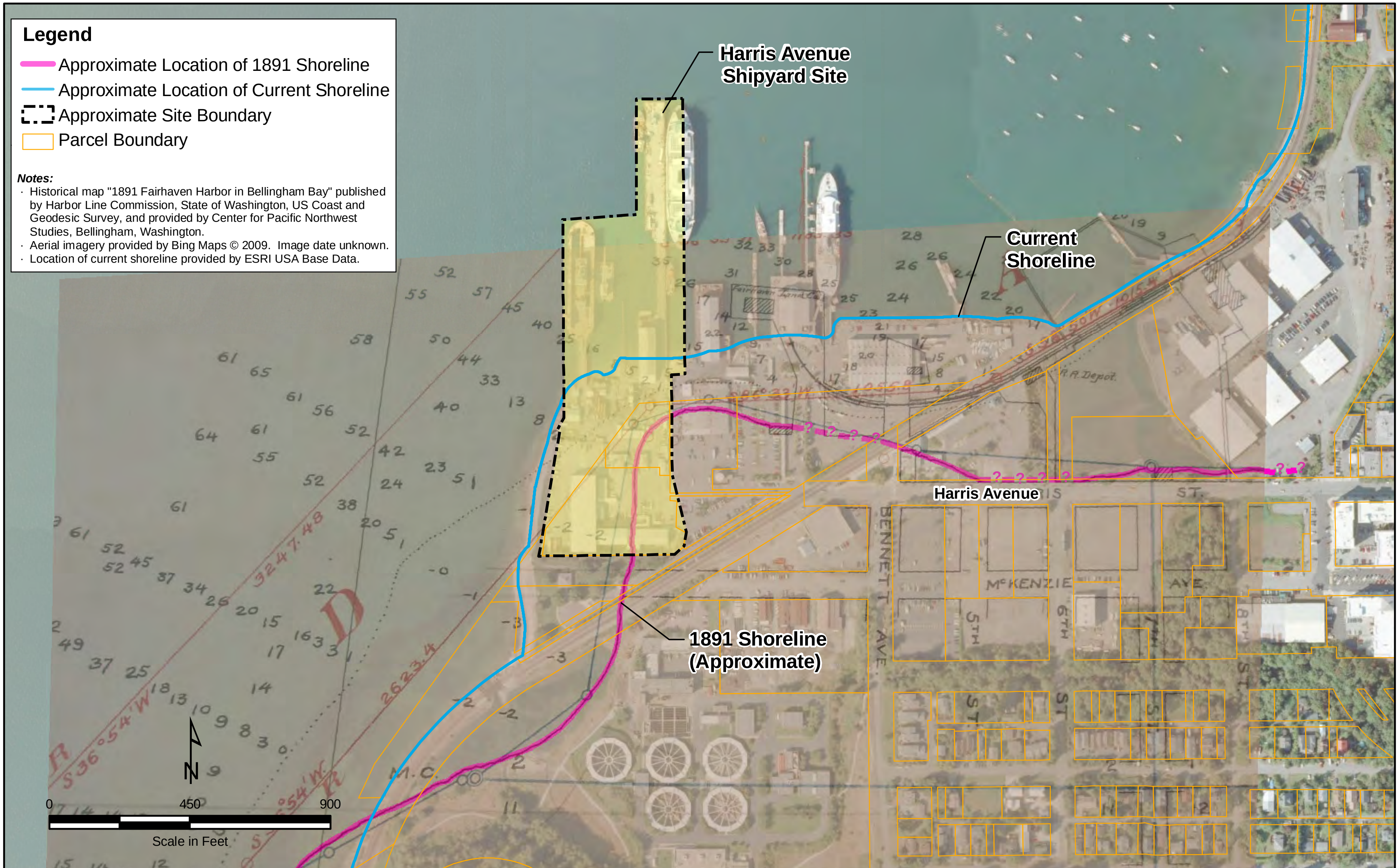

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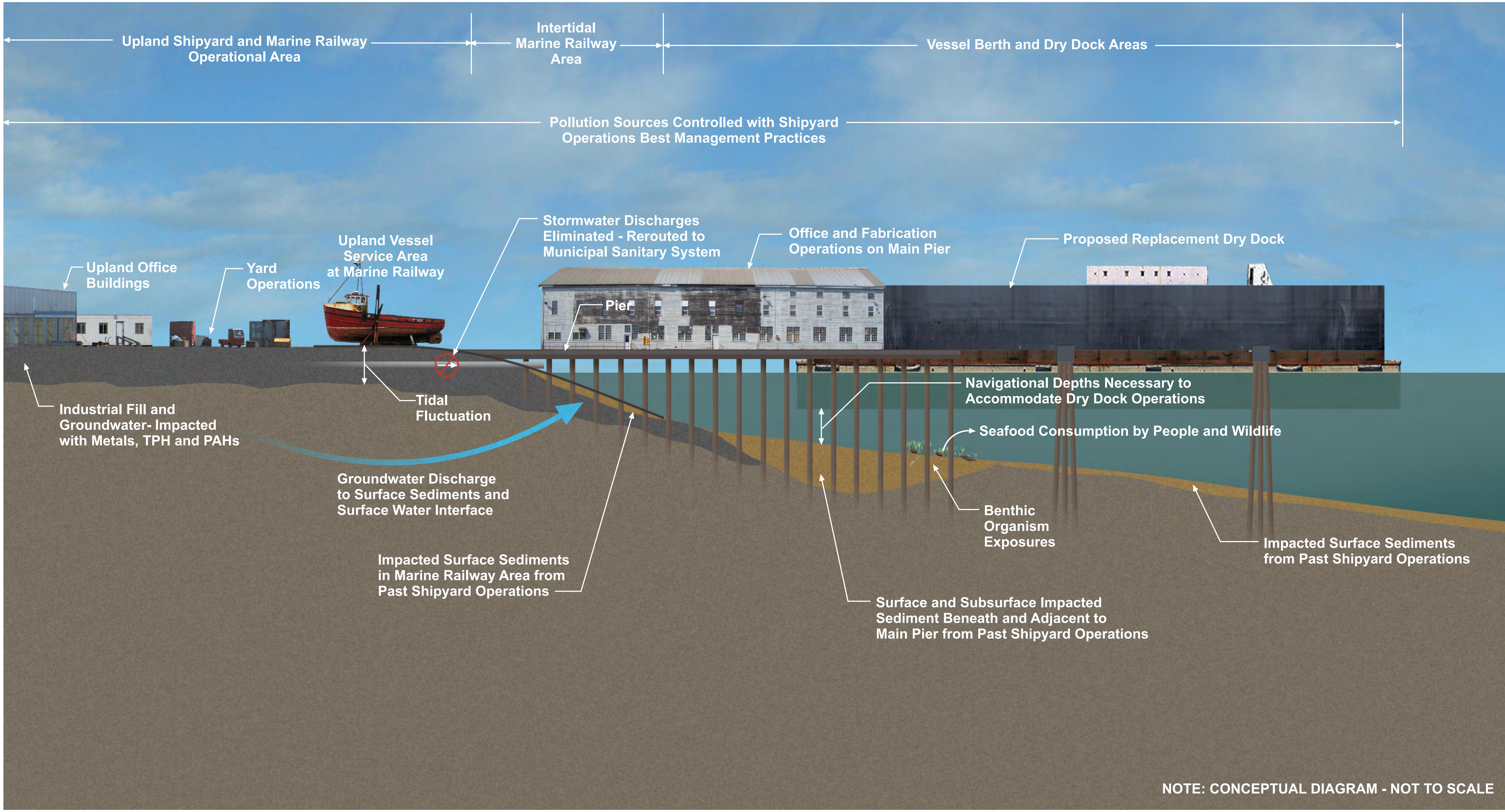
RI/FS Work Plan
Harris Avenue Shipyard
Bellingham, Washington

Figure 2.2
1891 Harbor Line Commission Map
over Bing Maps Imagery

F:\projects\POB-HARRIS\GIS\MXD\Figure 2.2 (Historical 1891 Shoreline Location).mxd
Date: 1/19/2011 11:23 AM

FINAL January 19, 2011



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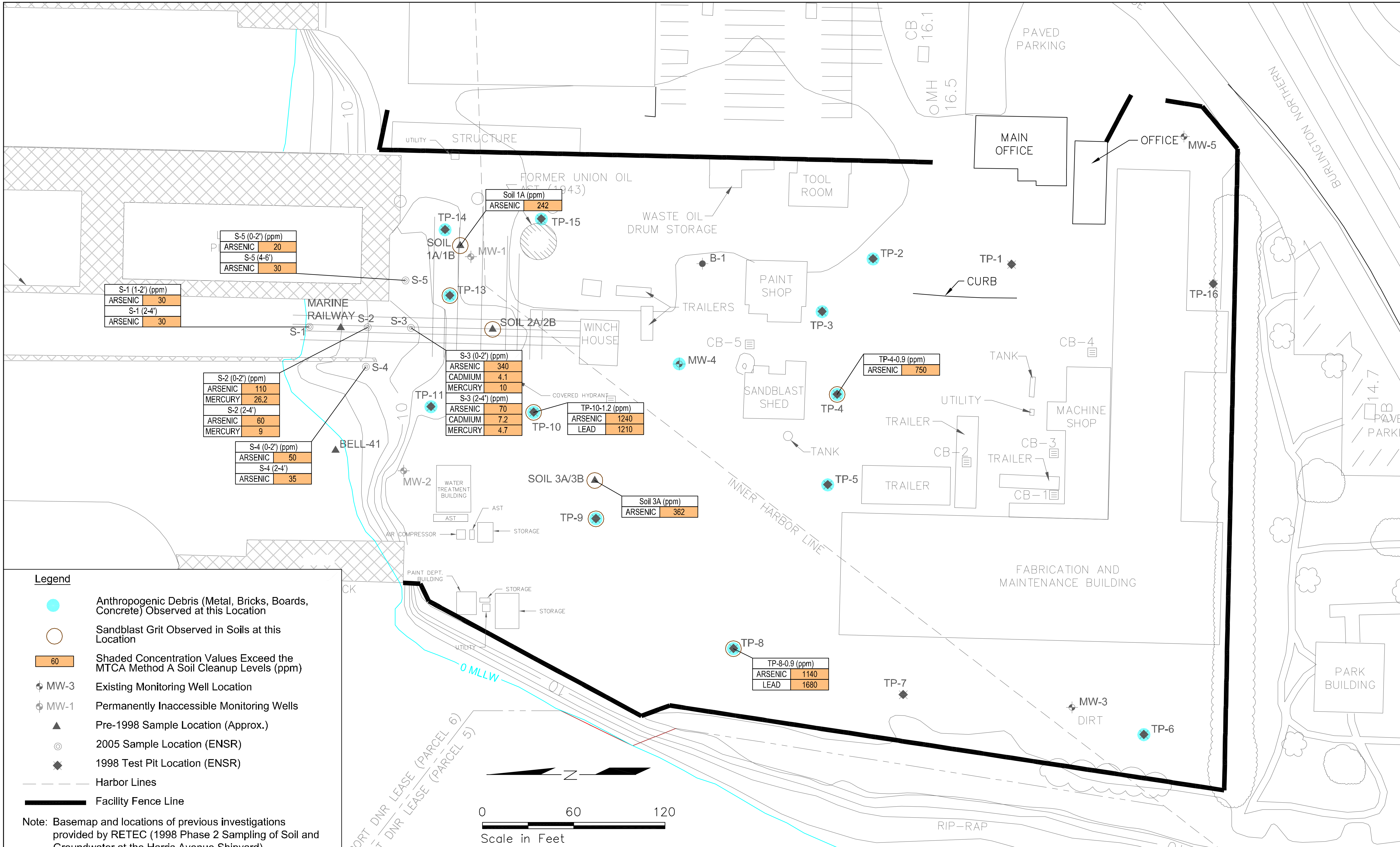
RI/FS Work Plan
Harris Avenue Shipyard
Bellingham, Washington

Figure 6.1
Preliminary Conceptual Site Model

g:projects/clients/floydsnider/harrisavenue/Figure 6.1.cdr

FINAL January 19, 2011



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RI/FS Work Plan
Harris Avenue Shipyard
Bellingham, Washington

Figure 7.1
Existing Heavy Metals MTCA Method A Exceedances in Upland Soil

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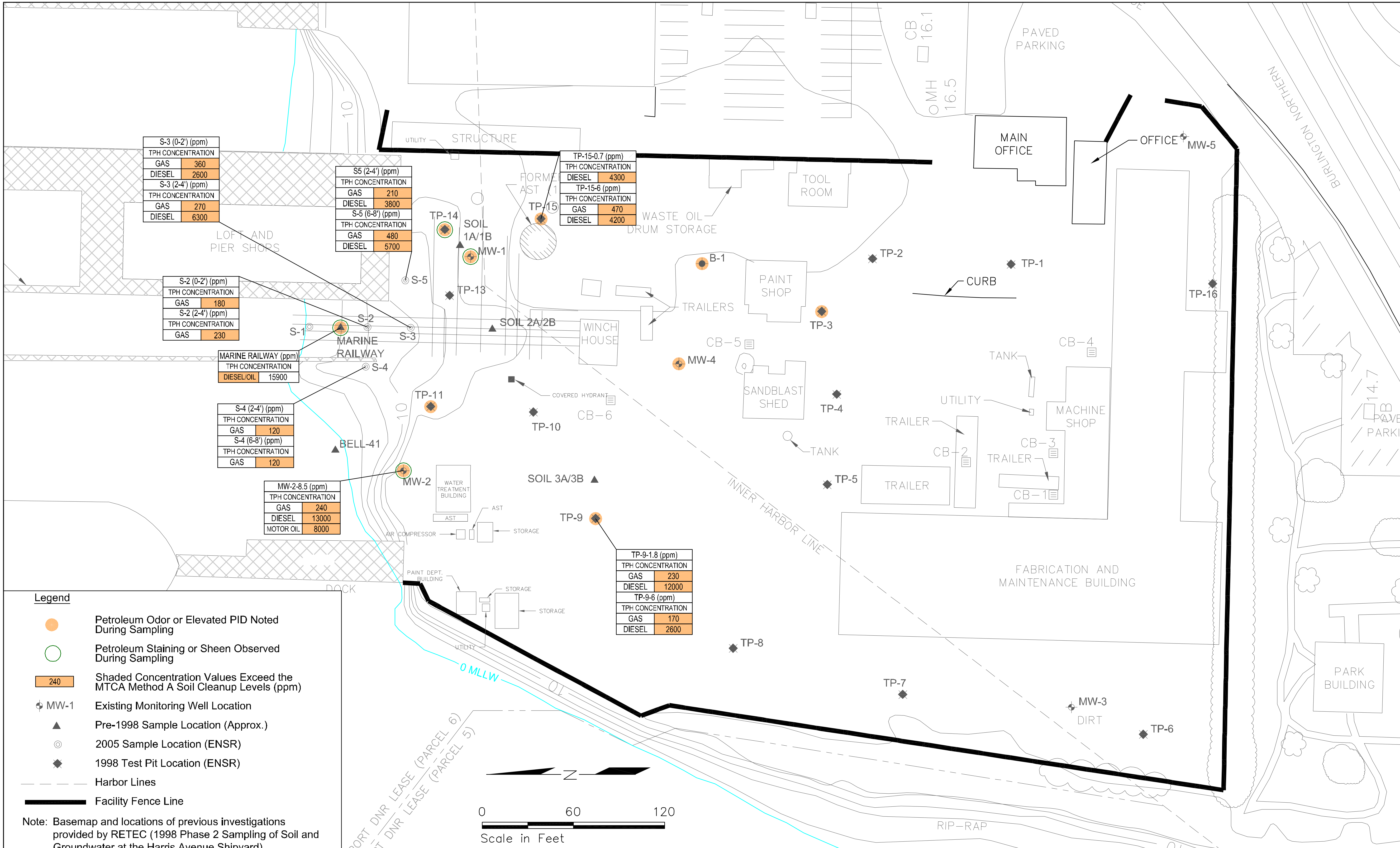
DATE: 1/18/2011 12:20 PM

FINAL January 19, 2011



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Harris Avenue Shipyard
Bellingham, Washington

Figure 7.2
Existing TPH MTCA Method A Exceedances in Upland Soil

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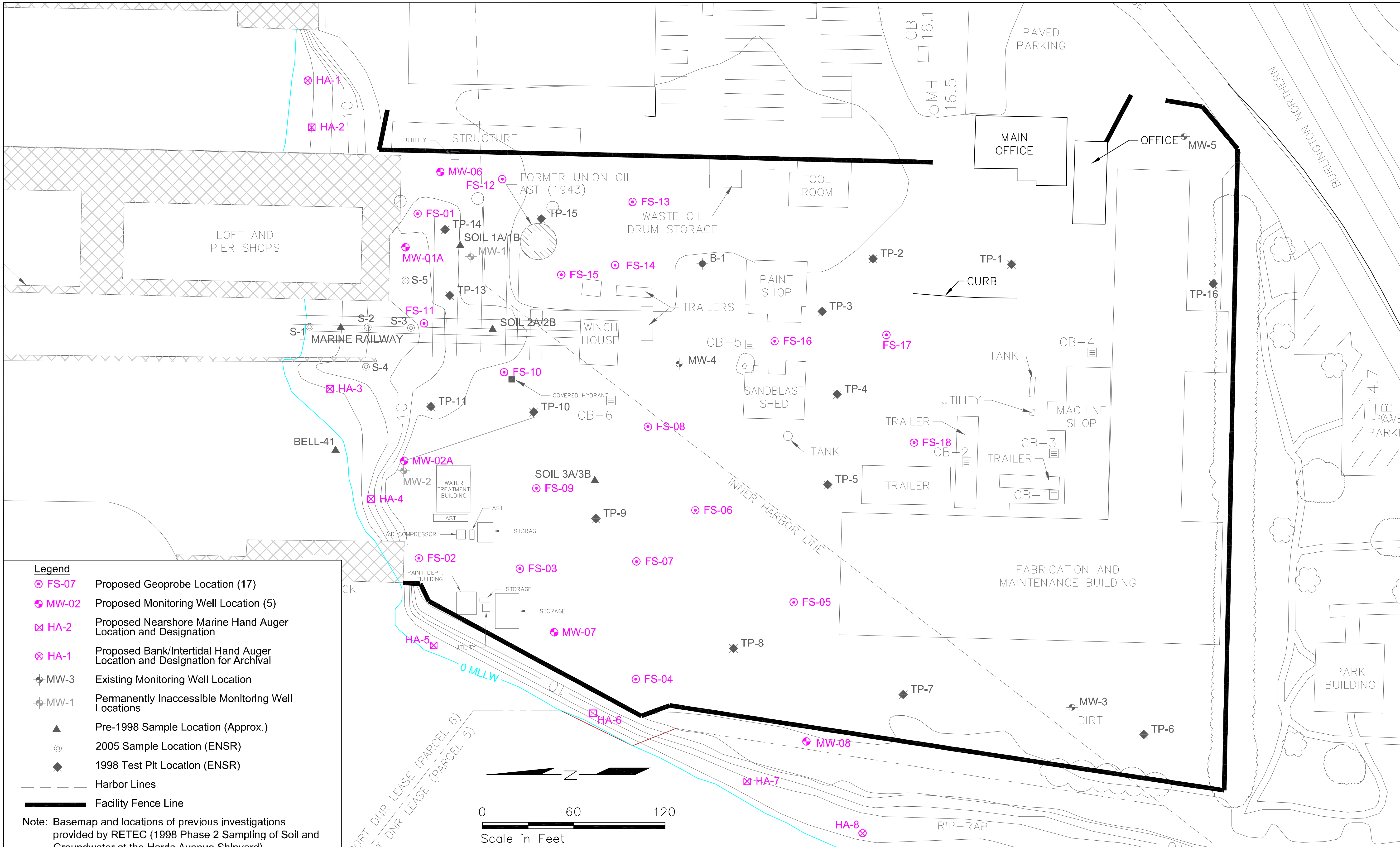

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RI/FS Work Plan
Harris Avenue Shipyard
Bellingham, Washington

Figure 7.3
Proposed Uplands Supplemental Site Investigation

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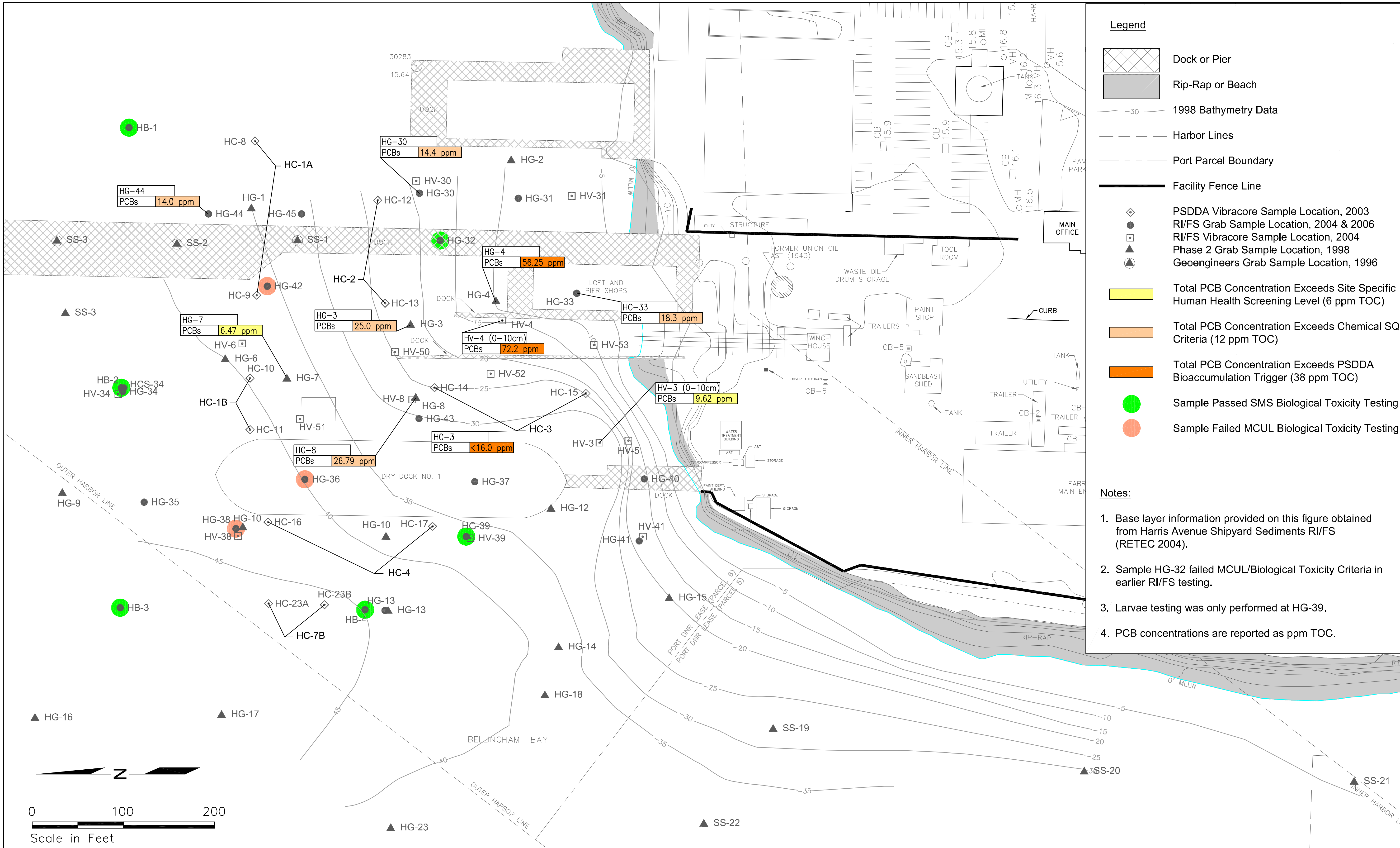
DATE: 1/18/2011 1:59 PM

FINAL January 19, 2011



Notes:

1. Base layer information provided on this figure obtained from Harris Avenue Shipyard Sediments RI/FS (RETEC 2004).
2. Sample HG-32 failed MCUL/Biological Toxicity Criteria in earlier RI/FS testing.
3. Larvae testing was only performed at HG-39.
4. PCB concentrations are reported as ppm TOC.

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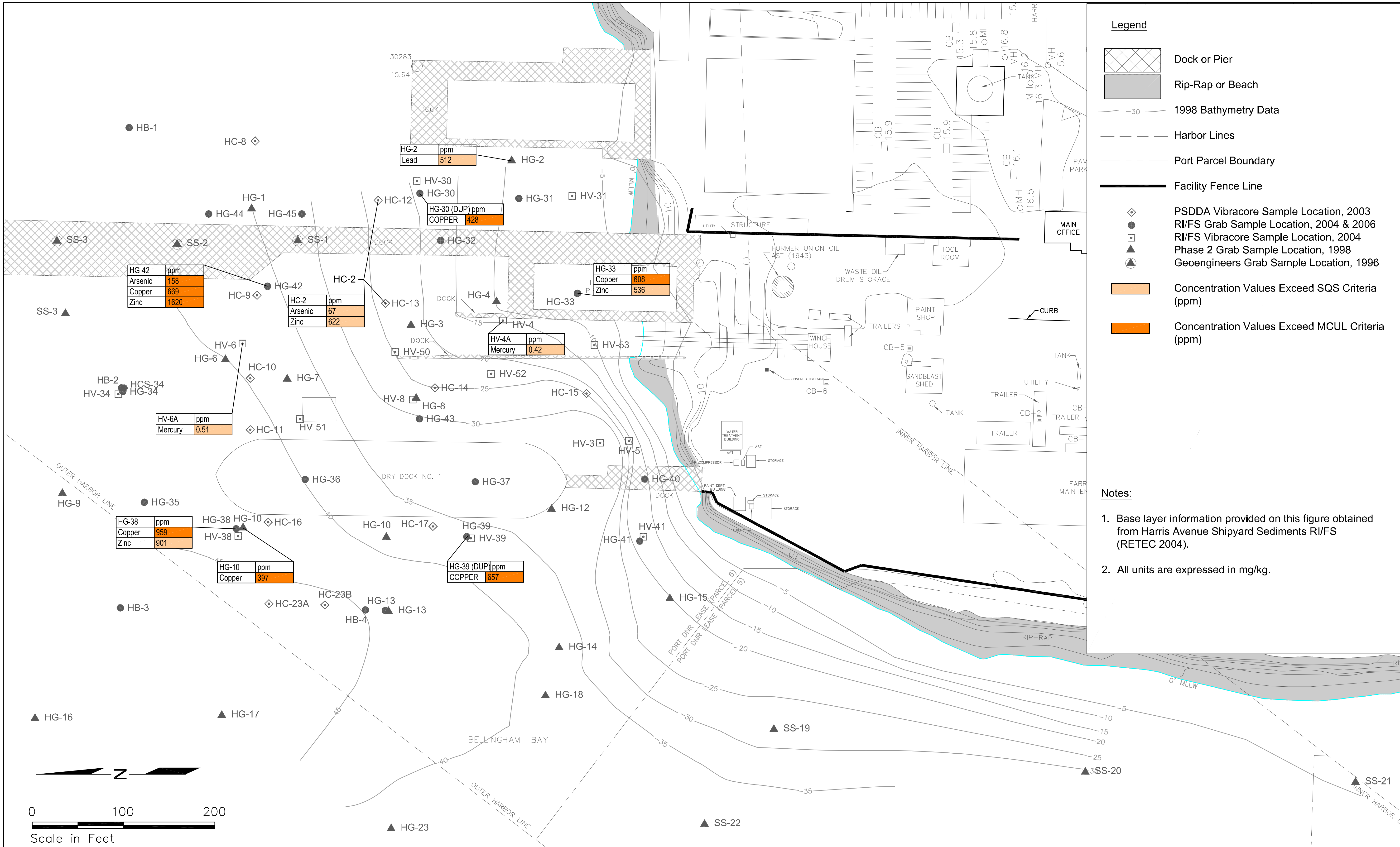
RI/FS Work Plan
Harris Avenue Shipyard
Bellingham, Washington

Figure 7.4
Surface Sediment PCB Cleanup Criteria Exceedences and Biological Testing Results

DWG NAME: G:\project\Clients\Floyd and Snider\Harris Avenue\Harris021.dwg
DATE: 1/10/2011 9:58 AM

FINAL January 19, 2011



Notes:

1. Base layer information provided on this figure obtained from Harris Avenue Shipyard Sediments RI/FS (RETEC 2004).
2. All units are expressed in mg/kg.

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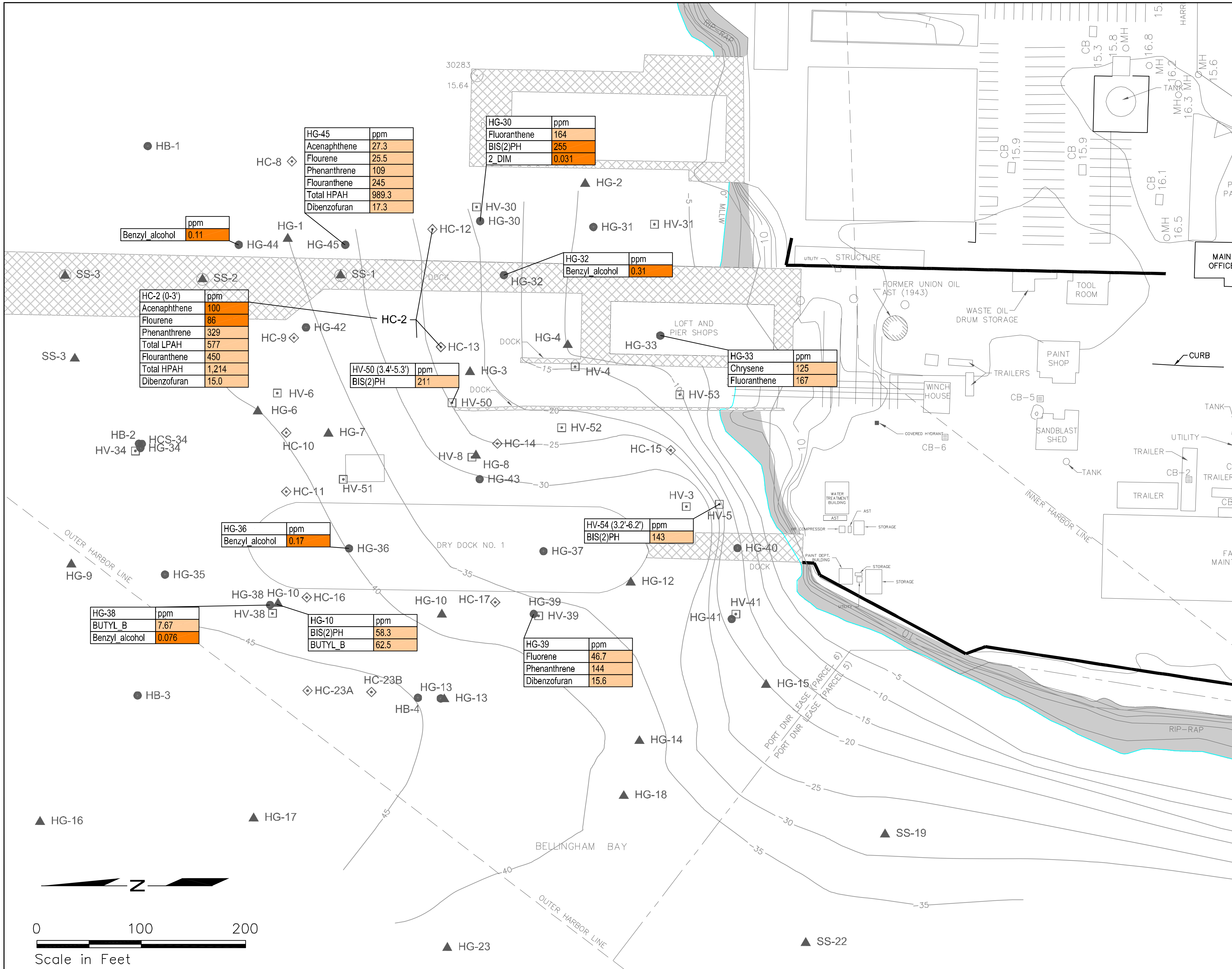
RI/FS Work Plan
Harris Avenue Shipyard
Bellingham, Washington

Figure 7.5
SMS Metal Exceedances in Surface Sediments

DWG NAME: G:\project\Clients\Floyd and Snider\Harris Avenue\Harris017.dwg
DATE: 1/10/2011 9:52 AM

FINAL January 19, 2011



Legend

- Dock or Pier
- Rip-Rap or Beach
- 1998 Bathymetry Data
- Harbor Lines
- Port Parcel Boundary
- Facility Fence Line
- PSDDA Vibracore Sample Location, 2003
- RI/FS Grab Sample Location, 2004 & 2006
- RI/FS Vibracore Sample Location, 2004
- Phase 2 Grab Sample Location, 1998
- Geoengineers Grab Sample Location, 1996
- Concentration Values Exceed SQS Criteria (ppm)
- Concentration Values Exceed MCUL Criteria (ppm)

ABBREVIATIONS:

BIS(2)PH = bis(2-Ethylhexyl)phthalate
2_DIM = 2,4-Dimethylphenol
BUTYL_B = Butylbenzylphthalate

Notes:

1. Base layer information provided on this figure obtained from Harris Avenue Shipyard Sediments RI/FS (RETEC 2004).
2. bis(2-Ethylhexyl)phthalate concentrations at HV-50 and HV-54 were not considered exceedances based on low TOC values and comparison with Apparent Effects Threshhold values.

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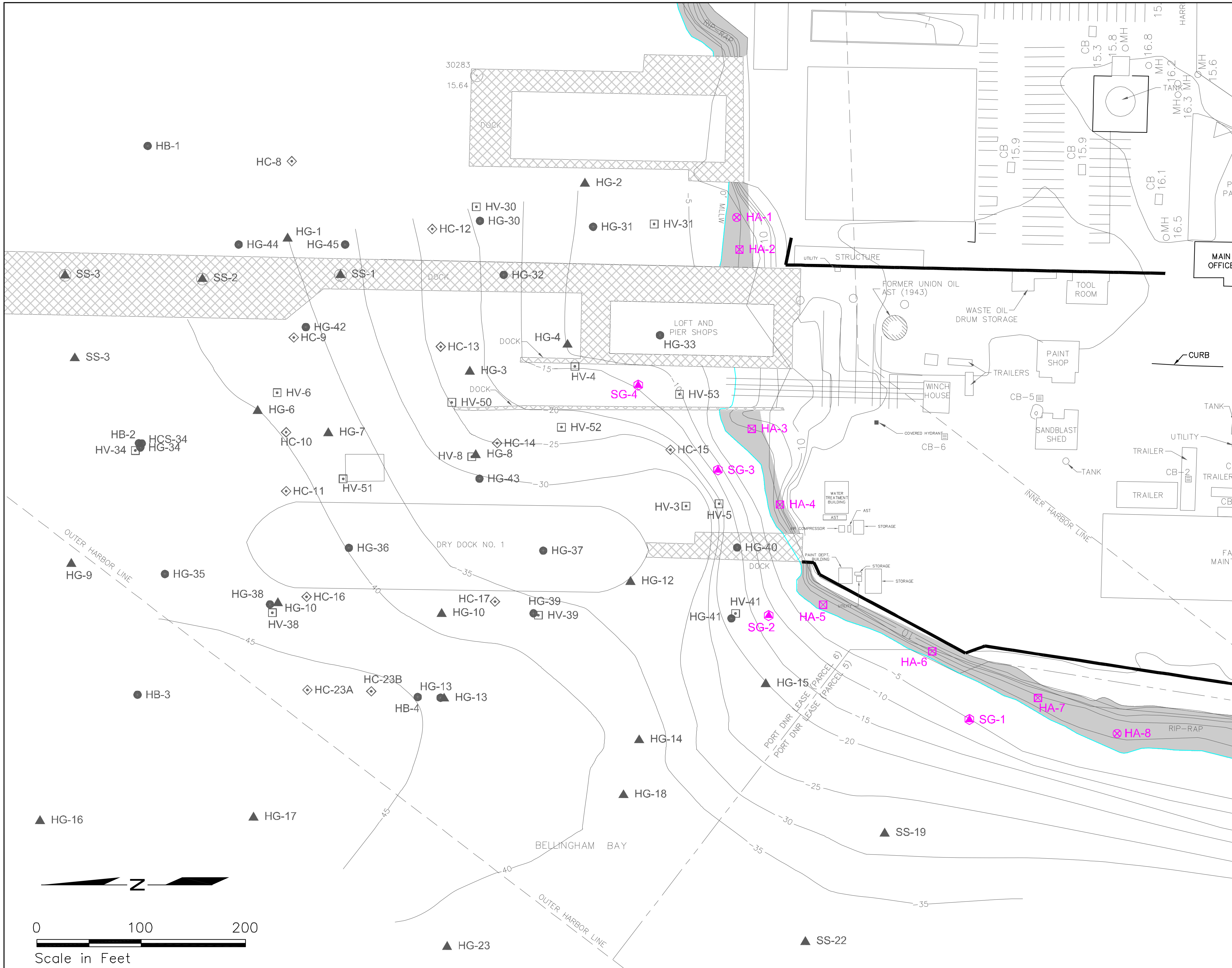
RI/FS Work Plan
Harris Avenue Shipyard
Bellingham, Washington

Figure 7.6
SMS SVOC Exceedances in Sediments

DWG NAME: G:\project\Clients\Floyd and Snider\Harris Avenue\Harris018.dwg
DATE: 1/10/2011 9:53 AM

FINAL January 19, 2011



Legend

Dock or Pier	
Rip-Rap or Beach	
—30—	1998 Bathymetry Data
	Harbor Lines
	Port Parcel Boundary
	Facility Fence Line
◇	PSDDA Vibracore Sample Location, 2003
●	RI/FS Grab Sample Location, 2004 & 2006
⊡	RI/FS Vibracore Sample Location, 2004
▲	Phase 2 Grab Sample Location, 1998
⊛	Geoengineers Grab Sample Location, 1996
SG-1	Proposed Nearshore Marine Contingency Grab Location and Designation
HA-2	Proposed Bank/Intertial Hand Auger Location and Designation
HA-1	Proposed Bank/Intertidal Hand Auger Location and Designation for Archival

Notes:

1. Base layer information provided on this figure obtained from Harris Avenue Shipyard Sediments RI/FS (RETEC 2004).
2. Preferred remedial action proposal will be re-evaluated in the Site-Wide RI/FS Report.

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RI/FS Work Plan
Harris Avenue Shipyard
Bellingham, Washington

Figure 7.7
Proposed Bank/Intertidal and Nearshore Contingency Supplemental Site Investigation

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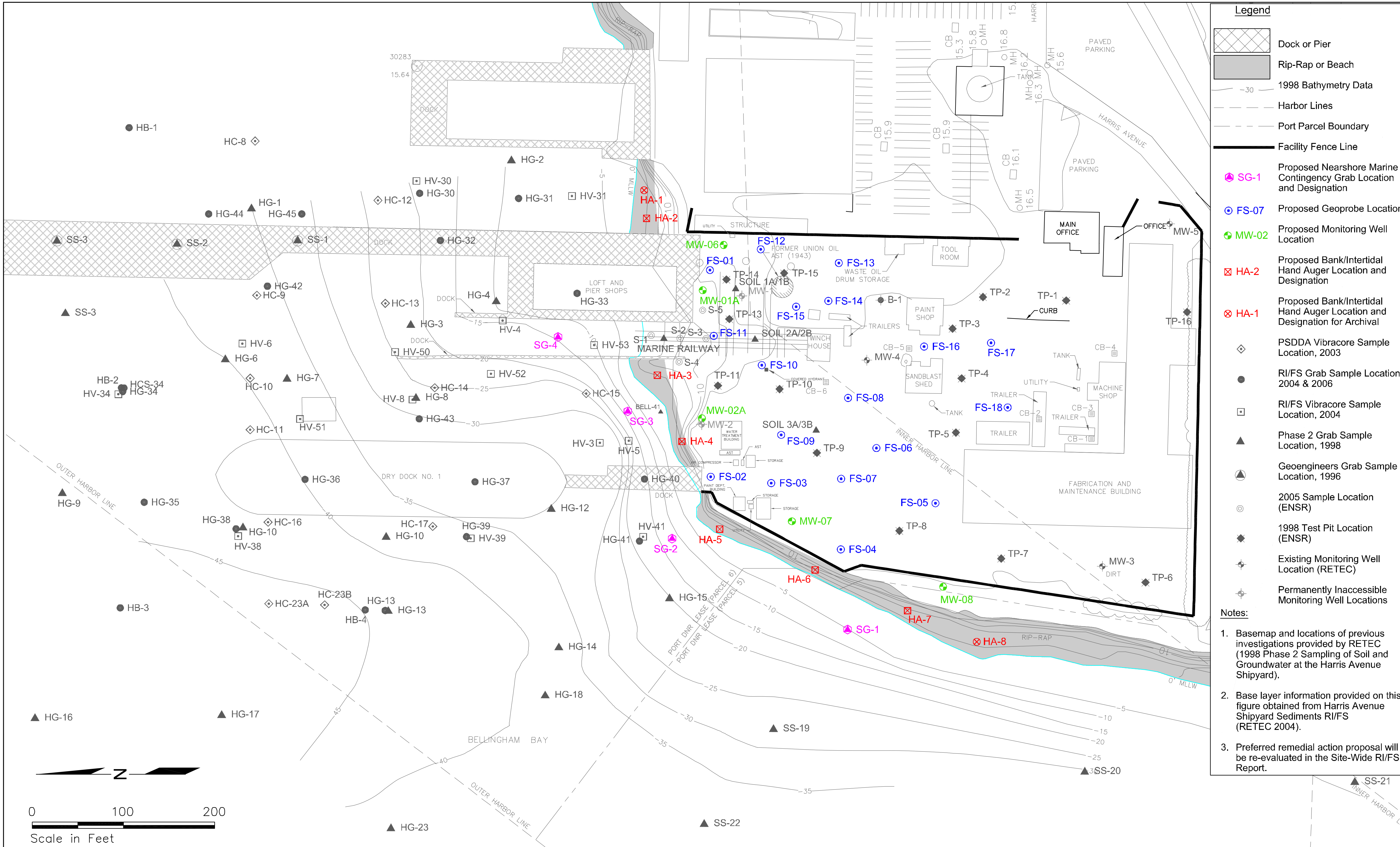
DATE: 1/18/2011 12:09 PM

FINAL January 19, 2011



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RI/FS Work Plan
Harris Avenue Shipyard
Bellingham, Washington

Figure 7.8
Proposed Supplemental Site-Wide Investigation Overview

DWG NAME: G:\project\Clients\Floyd and Snider\Harris Avenue\Harris020.dwg
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Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Appendix A Preliminary ARARs

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Potential Location-specific ARARs for Harris Avenue Shipyard RI/FS

Standard, Requirement, or Limitation	Description	Applicability
Shoreline, Wetlands and Other Critical Areas		
Washington Shoreline Management Act (RCW 90.58; WAC 173-14)	The Washington Shoreline Management Act, authorized under the federal Coastal Zone management Act, establishes requirements for substantial development occurring within the waters of the State of Washington or within 200 feet of a shoreline.	Substantive requirements are applicable. MTCA remedial actions are exempt from the procedural requirements of this law, but must comply with the substantive requirements.
Coastal Zone Management Act (16 USC 1451 et seq.)	Requires action to conserve endangered species within critical habitats on which endangered species depend and includes consultation with the Department of Interior.	Applicable, implemented through Washington State Shoreline Master Program.
Executive Order 11990, Protection of Wetlands (40 CFR 6, Appendix A)	Executive Order 11990 Section 7 requires measures to minimize the destruction, loss, or degradation of wetlands. Requires no net loss of remaining wetlands.	Only applicable if alternatives impact wetlands.
Flood Plain Management 40 CFR 6, Appendix A: 10 CFR 1022 and FEMA requirements	In 100-year flood plains, actions must be taken to reduce the risk of flood loss, minimize the impact of floods on human safety, and restore and preserve the natural beneficial values of flood plains.	The Site is not located within a designated floodplain, therefore floodplain requirements are not applicable.
Washington Floodplain Management Plan RCW 68.16; WAC 173-158	An advisory standard pertaining to wetlands management that suggests local governments, with technical assistance from Ecology, institute a program that can identify and map critical wetland areas located within base floodplains.	

Standard, Requirement, or Limitation	Description	Applicability
In-Water		
Washington Department of Fish and Wildlife Regulations regarding Construction Projects in State Waters (RCW 77.55; WAC 220-100 (SEPA) and 110 (HPA))	Regulates habitat protection for fish and wildlife for construction projects in State waters. Requires SEPA review and Hydraulic Project Approval permits. Although cleanup actions under MTCA and CERCLA are exempt from procedural requirements, the substantive requirements must still be met.	Substantive requirements are applicable. MTCA remedial actions are exempt from the procedural requirements of this law, but must comply with the substantive requirements
Washington State Hydraulics Projects Approval (RCW 77.55, WAC 220-110)	This statute and its implementing regulations apply to any work conducted within the designated shoreline that changes the natural flow or bed of the water body (and therefore has the potential to affect fish habitat). The requirements include bank protections and prohibited work times based on life stages of endangered or threatened fish species.	
Rivers and Harbors Act (33 USC 403; 40 CFR 320, 322, 323)	This act prohibits unauthorized activities that obstruct or alter a navigable waterway. Section 10 applies to all structures or work below the mean high water mark of navigable tidal waters and the ordinary high water mark of navigable fresh waters. Actions in wetlands within these limits are subject to Section 10 provisions. US Army Corps of Engineers (Corps) permits are needed for the alteration or the modification of the course, condition, location, or capacity of a navigable water of the United States.	Bellingham Bay is a navigable water, any alternatives involving in-water work will require compliance with Rivers and Harbors Act.

Standard, Requirement, or Limitation	Description	Applicability
Protection of Habitat		
Endangered Species Act (ESA) (16 USC 1531 et seq.; 50 CFR Part 200; 50 CFR Part 402)	Section 7 of ESA requires that federal agencies consult with Natural Resources Trustees if listed threatened or endangered species are present in or near the project area, before making any decisions that may affect these species.	Listed species are documented to occur in Bellingham Bay, therefore agency consultation and compliance with ESA are required.
Washington Department of Fish and Wildlife Regulations regarding Salmon and Steelhead recovery and management (RCW 77.85 and 110; WAC 220-47 and 48) Fish and Wildlife Coordination Act 40 CFR 6.302; 16 USC 661-666	Regulates habitat protection for fish and wildlife habitat management and mitigation policies. Requires consultation when activities modify any stream or other water body adequate for protection of fish and wildlife resources.	
Magnuson-Stevens Act (16 USC § 1801 et seq.)	The Magnuson-Stevens Act (MSA) governs marine fisheries management in the United States. The MSA mandates the identification of essential fish habitat for federally managed species and development of measures to conserve and enhance the habitat necessary for the fish life cycles.	
Tribal and Cultural Resources		
Native American Graves Protection and Repatriation Act (25 USC 3001 through 3113; 43 CFR Part 10) and Washington's Indian Graves and Records Law (RCW 27.44)	These statutes prohibit the destruction or removal of Native American cultural items and require written notification of inadvertent discovery to the appropriate agencies and Native American tribe. These programs are applicable to the remedial action if cultural items are found. The activities must cease in the area of the discovery; a reasonable effort must be made to protect the items discovered; and notice must be provided.	Due to the Site's industrial history and extensive infilling, Native American protections are likely not an issue, however, the National Historic Preservation Act is applicable.

Standard, Requirement, or Limitation	Description	Applicability
Tribal and Cultural Resources (continued)		
Archaeological Resources Protection Act (16 USC 470aa et seq.; 43 CFR part 7)	This program sets forth requirements that are triggered when archaeological resources are discovered. These requirements only apply if archaeological items are discovered during implementation of the selected remedy.	Due to the Site's industrial history and extensive infilling, Native American protections are likely not an issue, however, the National Historic Preservation Act is applicable.
National Historic Preservation Act (NHPA) (16 USC 470 et seq.; 36 CFR parts 60, 63, and 800)	This program sets forth a national policy of historic preservation and provides a process that must be followed to ensure that impacts of actions on archaeological, historic, and other cultural resources are protected.	
Other Regulations to be Considered		
Treaty of Point Elliott (12 Stat. 927) Treaty of Medicine Creek (10 Stat. 1132)	Treaties protect the rights of recognized native American Tribes, including property rights, water rights, and fish/shellfish harvesting rights.	To Be Considered. Tribal Consultation—Facilitation of tribal consultation with Ecology under the Governor's Proclamation/Millennium Agreement/Centennial Accord and Ecology's Centennial Accord Implementation Plan.
State Aquatic Lands Management Laws (RCW 79.105 through 79.140; WAC 332-30)	Sediment Management on state-owned lands must comply with state regulations and rules for management of state-owned aquatic lands.	To Be Considered. The majority of sediment cleanup actions will occur on State Owned Aquatic Lands.

Abbreviations:

ARAR	Applicable or Relevant and Appropriate Requirement.
CERCLA	Comprehensive Environmental Response Compensation and Liability Act.
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act.
MTCA	Model Toxics Control Act.
RI/FS	Remedial Investigation/Feasibility Study.
SEPA	State Environmental Policy Act.

Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Appendix B
Data Tables from Previous Environmental Reports

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Data Tables from Previous Environmental Reports

Per the request of the Washington State Department of Ecology, data tables from previous environmental reports are included in the RI/FS Work Plan to provide a comprehensive tabulation of analytical data from previous upland and sediment investigations at the shipyard. The data tables are incorporated from the RETEC Draft Sediments RI/FS dated January 5, 2006, the RETEC Phase 2 Sampling of Soil and Groundwater at the Harris Avenue Shipyard dated September 21, 1998, and the RETEC Phase 2 Sampling of Bellingham Bay Sediments at the Harris Avenue Shipyard dated August 6, 1998.

List of Tables

RETEC Draft Sediments RI/FS, January 5, 2006

RETEC Phase 2 Sampling of Soil and Groundwater at Harris Avenue Shipyard, September 21, 1998

RETEC Phase 2 Sampling of Bellingham Bay Sediments at the Harris Avenue Shipyard, August 6, 1998

Appendix B: Analytical Data Tables from RETEC Draft Sediments RI/FS, January 5, 2006

Table 2-1 Summary of Historical Analytical Data

			Pier Samples (GeoEngineers)			Surface Sediment Chemistry Data for the Parcel 5 Area					
	SMS Criteria		SS-1	SS-2	SS-3	HG-19A		HG-20A		HG-21A	
Parameter	SQS	MCUL	1996	1996	1996	3/23/1998		3/23/1998		3/23/1998	
Conventionals											
Total Solids (%)	NV	NV	**53.9**	**48.8**	**58.5**	**37.7**		**21.1**		**73.9**	
Total Preserved Solids (%)	NV	NV	**NA**	**NA**	**NA**	NA		NA		NA	
Total Organic Carbon (%)	NV	NV	**3.5**	**2.8**	**2.4**	**2.2**		**3.9**		**0.72**	
N-Ammonia	NV	NV	**NA**	**NA**	**NA**	NA		NA		NA	
Sulfide	NV	NV	**NA**	**NA**	**NA**	NA		NA		NA	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	NA	NA	NA	<7 J		<10 J		<3 J	
Arsenic	57	93	**17**	**10**	**8.5**	**14**		**10**		**3**	
Cadmium	5.1	6.7	**0.63**	**0.51**	**0.32**	**0.9**		**1.2**		<0.1	
Chromium	260	270	**31**	**71**	**48**	**75.8**		**74**		**28.6**	
Copper	390	390	**190**	**120**	**33**	**136**		**99.4**		**15.2**	
Lead	450	530	**38**	**80**	**34**	**29**		**23**		**7**	
Mercury	0.41	0.59	**0.23**	**0.254**	**0.285**	**0.31 J**		**0.18 J**		**0.04 J**	
Nickel	NV	NV	NA	NA	NA	**85**		**80**		**16.8**	
Silver	6.1	6.1	**0.19**	**0.16**	< 0.08	**0.5**		<0.8		<0.2	
Zinc	410	960	**330**	**120**	**70**	**150**		**128**		**28.3**	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA	NA	NA	NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA	NA	NA	NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA	NA	NA	NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA	NA	NA	NA		NA		NA	
Tributyl Tin Ion	0.073*		NA	NA	NA	NA		NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*		*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA	NA	NA	NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA	NA	NA	NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA	NA	NA	NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA	NA	NA	NA		NA		NA	
Tributyl Tin Ion	0.05**		NA	NA	NA	NA		NA		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	< 0.8	< 1.2	< 1.1	**0.069**	**3.14**	**0.04**	**1.03**	<0.02	<2.78
Acenaphthene	16	57	**1.1**	< 1.2	< 1.1	**0.073**	**3.32**	**0.038**	**0.97**	<0.02	<2.78
Acenaphthylene	66	66	< 0.8	< 1.2	< 1.1	**0.057**	**2.59**	<0.034	<0.87	<0.02	<2.78
Anthracene	220	1,200	**2.5**	**2.3**	**1.4**	**0.2**	**9.09**	**0.25**	**6.41**	<0.02	<2.78
Fluorene	23	79	**1.1**	< 1.2	< 1.1	**0.09**	**4.09**	**0.08**	**2.05**	<0.02	<2.78
Naphthalene	99	170	**1**	< 1.2	< 1.1	**0.21**	**9.55**	**0.1**	**2.56**	<0.02	<2.78
Phenanthrene	100	480	**6**	**7.5**	**5**	**0.59**	**26.82**	**0.39**	**10.00**	<0.02	<2.78
Total LPAHs	**370**	**780**	**11.7**	**9.8**	**6.4**	**1.289**	**58.59**	**0.898**	**23.03**	<0.02	<2.78
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	**4.9**	**4.6**	**4.1**	**0.45**	**20.45**	**0.31**	**7.95**	**0.02**	**2.78**
Benzo(a)pyrene	99	210	**4**	**3.6**	**4.2**	**0.42**	**19.09**	**0.26**	**6.67**	<0.02	<2.78
Benzo(b)fluoranthene	230	450	**4.2**	**4.0**	**4.0**	**0.48**	**21.82**	**0.29**	**7.44**	<0.02	<2.78
Benzo(g,h,i)perylene	31	78	**2.4**	**2.2**	**2.7**	**0.19**	**8.64**	**0.11**	**2.82**	<0.02	<2.78
Benzo(k)fluoranthene	230	450	**4.2**	**4.0**	**4.0**	**0.44**	**20.00**	**0.25**	**6.41**	<0.02	<2.78
Chrysene	110	460	**7.7**	**7.9**	**5.4**	**0.67**	**30.45**	**0.46**	**11.79**	**0.026**	**3.61**
Dibenz(a,h)anthracene	12	33	< 0.8	< 1.2	< 1.1	**0.097**	**4.41**	**0.052**	**1.33**	<0.02	<2.78
Fluoranthene	160	1,200	**11**	**11**	**6.7**	**1**	**45.45**	**0.78**	**20.00**	**0.042**	**5.83**
Indeno(1,2,3-cd)pyrene	34	88	**2.5**	**2.4**	**2.7**	**0.22**	**10.00**	**0.13**	**3.33**	<0.02	<2.78
Pyrene	1,000	1,400	**9.4**	**9.3**	**7.9**	**1.2**	**54.55**	**0.84**	**21.54**	**0.043**	**5.97**
Total HPAHs	**960**	**5,300**	**50.2**	**48.9**	**41.6**	**5.167**	**234.86**	**3.482**	**89.28**	**0.131**	**18.19**
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	**9.7**	**12**	**1.4**	**0.46**	**20.91**	**0.18**	**4.62**	<0.02	<2.78
Butylbenzylphthalate	4.9	64	< 0.8	< 1.2	< 1.1	<0.02	<0.91	<0.034	<0.87	<0.02	<2.78
Diethylphthalate	61	110	< 0.8	< 1.2	< 1.1	<0.02	<0.91	<0.034	<0.87	<0.02	<2.78
Dimethylphthalate	53	53	< 0.8	< 1.2	< 1.1	**0.036**	**1.64**	<0.034	<0.87	<0.02	<2.78
Di-n-Butylphthalate	220	1,700	**1.3**	< 1.2	< 1.1	<0.02	<0.91	**0.038**	**0.97**	<0.02	<2.78
Di-n-Octyl phthalate	58	4,500	< 0.8	< 1.2	< 1.1	<0.02	<0.91	<0.034	<0.87	<0.02	<2.78
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	<0.028	**0.086**	< 0.027	**0.071**		**0.048**		**0.023**	
2,4-Dimethylphenol	0.029	0.029	< 0.014	< 0.017	< 0.014	<0.02		<0.034		<0.02	
2-Methylphenol	0.063	0.063	<0.014	< 0.017	< 0.014	<0.02		<0.034		<0.02	
4-Methylphenol	0.67	0.67	**0.047**	**0.095**	< 0.027	**0.45**		**0.34**		<0.02	
Pentachlorophenol	0.36	0.69	< 0.070	< 0.083	< 0.068	<0.099		<0.17		<0.099	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	<0.017	< 0.020	< 0.016	<0.02		<0.034		<0.02	
Benzoic Acid	0.65	0.65	<0.140	< 0.170	< 0.140	<0.2		<0.34		<0.2	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	< 0.23	< 0.36	< 0.33	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	2.3	2.3	< 0.14	< 0.25	< 0.21	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NV	NV	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	3.1	9	< 0.14	< 0.25	< 0.21	NA	NA	NA	NA	NA	NA
Dibenzofuran	15	58	**0.94**	< 1.2	< 1.1	**0.11**	**5.00**	**0.062**	**1.59**	<0.02	<2.78
Hexachlorobenzene	0.38	2.3	< 0.08	< 0.12	< 0.12	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	3.9	6.2	< 0.66	< 0.93	< 0.92	<0.02	<0.91	<0.034	<0.87	<0.02	<2.78
N-Nitrosodiphenylamine	11	11	< 0.49	< 0.71	< 0.67	<0.02	<0.91	<0.034	<0.87	<0.02	<2.78
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	< 0.4	< 0.6	< 0.58	<0.019	<0.86	<0.02	<0.51	<0.018	<2.5
Aroclor 1221	12	65	< 1.6	< 2.4	< 2.3	<0.038	<1.73	<0.039	<1	<0.037	<5.14
Aroclor 1232	12	65	< 0.4	< 0.6	< 0.58	<0.019	<0.86	<0.02	<0.51	<0.018	<2.5
Aroclor 1242	12	65	< 0.4	< 0.6	< 0.58	<0.019	<0.86	<0.02	<0.51	<0.018	<2.5
Aroclor 1248	12	65	< 0.4	< 0.6	< 0.58	<0.019	<0.86	<0.02	<0.51	<0.018	<2.5
Aroclor 1254	12	65	< 0.4	< 0.6	< 0.58	**0.081**	**3.68**	<0.035	<0.9	<0.018	<2.5
Aroclor 1260	12	65	< 0.4	**0.71**	< 0.58	<0.019	<0.86	<0.02	<0.51	<0.018	<2.5
Total PCBs	**12**	**65**	< 1.6	**0.71**	< 2.3	**0.081**	**3.68**	<0.039	<0.51	<0.037	<5.14

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 2-1 Summary of Historical Analytical Data

Grab Sample Chemistry Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HG-22A 3/24/1998		HG-1A 3/23/1998		HG-2A 3/24/1998		HG-3A 3/23/1998		HG-4A 3/24/1998	
Conventionals												
Total Solids (%)	NV	NV	**62.7**		**71.5**		**62**		**48.4**		**51.2**	
Total Preserved Solids (%)	NV	NV	NA		NA		NA		NA		NA	
Total Organic Carbon (%)	NV	NV	**1.1**		**1.4**		**2.9**		**3.2**		**3.2**	
N-Ammonia	NV	NV	NA		NA		NA		NA		NA	
Sulfide	NV	NV	NA		NA		NA		NA		NA	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	NA		NA		<20 J		NA		NA	
Arsenic	57	93	NA		NA		<20		NA		NA	
Cadmium	5.1	6.7	NA		NA		<0.7		NA		NA	
Chromium	260	270	NA		NA		**42**		NA		NA	
Copper	390	390	NA		NA		**207**		NA		NA	
Lead	450	530	NA		NA		**512**		NA		NA	
Mercury	0.41	0.59	NA		NA		**0.09 J**		NA		NA	
Nickel	NV	NV	NA		NA		**40**		NA		NA	
Silver	6.1	6.1	NA		NA		<1		NA		NA	
Zinc	410	960	NA		NA		**226**		NA		NA	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.073*		NA		NA		NA		NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.05**		NA		**0.04 B**		**0.04 B**		NA		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	NA	NA	NA	NA	<0.019	<0.66	NA	NA	NA	NA
Acenaphthene	16	57	NA	NA	NA	NA	**0.037**	**1.28**	NA	NA	NA	NA
Acenaphthylene	66	66	NA	NA	NA	NA	**0.036**	**1.24**	NA	NA	NA	NA
Anthracene	220	1,200	NA	NA	NA	NA	**0.22**	**7.59**	NA	NA	NA	NA
Fluorene	23	79	NA	NA	NA	NA	**0.043**	**1.48**	NA	NA	NA	NA
Naphthalene	99	170	NA	NA	NA	NA	**0.023**	**0.79**	NA	NA	NA	NA
Phenanthrene	100	480	NA	NA	NA	NA	**0.37**	**12.76**	NA	NA	NA	NA
Total LPAHs	**370**	**780**	NA	NA	NA	NA	**0.73**	**25.14**	NA	NA	NA	NA
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	NA	NA	NA	NA	**0.71**	**24.48**	NA	NA	NA	NA
Benzo(a)pyrene	99	210	NA	NA	NA	NA	**0.52**	**17.93**	NA	NA	NA	NA
Benzo(b)fluoranthene	230	450	NA	NA	NA	NA	**0.59**	**20.34**	NA	NA	NA	NA
Benzo(g,h,i)perylene	31	78	NA	NA	NA	NA	**0.23**	**7.93**	NA	NA	NA	NA
Benzo(k)fluoranthene	230	450	NA	NA	NA	NA	**0.54**	**18.62**	NA	NA	NA	NA
Chrysene	110	460	NA	NA	NA	NA	**0.95**	**32.76**	NA	NA	NA	NA
Dibenz(a,h)anthracene	12	33	NA	NA	NA	NA	**0.095**	**3.28**	NA	NA	NA	NA
Fluoranthene	160	1,200	NA	NA	NA	NA	**1.3**	**44.83**	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	34	88	NA	NA	NA	NA	**0.25**	**8.62**	NA	NA	NA	NA
Pyrene	1,000	1,400	NA	NA	NA	NA	**2**	**68.97**	NA	NA	NA	NA
Total HPAHs	**960**	**5,300**	NA	NA	NA	NA	**7.185**	**247.76**	NA	NA	NA	NA
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	NA	NA	NA	NA	**0.14**	**4.83**	NA	NA	NA	NA
Butylbenzylphthalate	4.9	64	NA	NA	NA	NA	<0.019	<0.66	NA	NA	NA	NA
Diethylphthalate	61	110	NA	NA	NA	NA	<0.019	<0.66	NA	NA	NA	NA
Dimethylphthalate	53	53	NA	NA	NA	NA	<0.019	<0.66	NA	NA	NA	NA
Di-n-Butylphthalate	220	1,700	NA	NA	NA	NA	<0.019	<0.66	NA	NA	NA	NA
Di-n-Octyl phthalate	58	4,500	NA	NA	NA	NA	<0.019	<0.66	NA	NA	NA	NA
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	NA		NA		<0.019		NA		NA	
2,4-Dimethylphenol	0.029	0.029	NA		NA		<0.019		NA		NA	
2-Methylphenol	0.063	0.063	NA		NA		<0.019		NA		NA	
4-Methylphenol	0.67	0.67	NA		NA		**0.02**		NA		NA	
Pentachlorophenol	0.36	0.69	NA		NA		<0.094		NA		NA	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	NA		NA		<0.019		NA		NA	
Benzoic Acid	0.65	0.65	NA		NA		<0.19		NA		NA	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	2.3	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NV	NV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	3.1	9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	15	58	NA	NA	NA	NA	**0.026**	**0.90**	NA	NA	NA	NA
Hexachlorobenzene	0.38	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	3.9	6.2	NA	NA	NA	NA	<0.019	<0.66	NA	NA	NA	NA
N-Nitrosodiphenylamine	11	11	NA	NA	NA	NA	<0.019	<0.66	NA	NA	NA	NA
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	<0.019	<1.73	NA	NA	<0.017	<0.59	<0.018	<0.56	<0.018	<0.56
Aroclor 1221	12	65	<0.038	<3.45	NA	NA	<0.035	<1.21	<0.037	<1.16	<0.036	<1.13
Aroclor 1232	12	65	<0.019	<1.73	NA	NA	<0.017	<0.59	<0.018	<0.56	<0.018	<0.56
Aroclor 1242	12	65	<0.019	<1.73	NA	NA	<0.017	<0.59	<0.018	<0.56	<0.018	<0.56
Aroclor 1248	12	65	<0.019	<1.73	NA	NA	<0.017	<0.59	<0.018	<0.56	<0.018	<0.56
Aroclor 1254	12	65	**0.019**	**1.73**	NA	NA	<0.028	<0.97	**0.68**	**21.25**	**1.8**	**56.25**
Aroclor 1260	12	65	<0.019	<1.73	NA	NA	**0.044**	**1.52**	**0.12**	**3.75**	<0.018	<0.56
Total PCBs	**12**	**65**	**0.019**	**1.73**	NA	NA	**0.044**	**1.52**	**0.8**	**25.00**	**1.8**	**56.25**

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 2-1 Summary of Historical Analytical Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HG-5A 3/24/1998		HG-6A 3/24/1998		HG-7A 3/24/1998		HG-8A 3/24/1998		HG-9A 3/24/1998	
Conventionals												
Total Solids (%)	NV	NV	**41.5**		**40.5**		**43.1**		**57.2**		**38.5**	
Total Preserved Solids (%)	NV	NV	NA		NA		NA		NA		NA	
Total Organic Carbon (%)	NV	NV	**2.2**		**2.1**		**1.7**		**2.8**		**2.2**	
N-Ammonia	NV	NV	NA		NA		NA		NA		NA	
Sulfide	NV	NV	NA		NA		NA		NA		NA	
Metals	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)	
Antimony	NV	NV	<6 J		NA		NA		NA		NA	
Arsenic	57	93	**11**		NA		NA		NA		NA	
Cadmium	5.1	6.7	**0.8**		NA		NA		NA		NA	
Chromium	260	270	**77.7**		NA		NA		NA		NA	
Copper	390	390	**68.8**		NA		NA		NA		NA	
Lead	450	530	**25**		NA		NA		NA		NA	
Mercury	0.41	0.59	**0.32 J**		NA		NA		NA		NA	
Nickel	NV	NV	**91**		NA		NA		NA		NA	
Silver	6.1	6.1	**0.5**		NA		NA		NA		NA	
Zinc	410	960	**117**		NA		NA		NA		NA	
Bulk Organotins	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.073*		NA		NA		NA		NA		NA	
Porewater Organotins	(ug/L)	(ug/L)	(µg/L)		(µg/L)		(µg/L)		(µg/L)		(µg/L)	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.05**		**0.02 B**		**0.03 B**		NA		**0.04 B**		NA	
LPAH	(ppm TOC)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)
2-Methylnaphthalene	38	64	**0.035**	**1.59**	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	16	57	**0.041**	**1.86**	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	66	66	**0.024**	**1.09**	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	220	1,200	**0.14**	**6.36**	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	23	79	**0.064**	**2.91**	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	99	170	**0.11**	**5.00**	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	100	480	**0.51**	**23.18**	NA	NA	NA	NA	NA	NA	NA	NA
Total LPAHs	**370**	**780**	**0.924**	**42.00**	NA	NA	NA	NA	NA	NA	NA	NA
HPAH	(ppm TOC)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)
Benzo(a)anthracene	110	270	**0.3**	**13.64**	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	99	210	**0.24**	**10.91**	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	230	450	**0.27**	**12.27**	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	31	78	**0.12**	**5.45**	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	230	450	**0.22**	**10.00**	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	110	460	**0.4**	**18.18**	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	12	33	**0.051**	**2.32**	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	160	1,200	**0.85**	**38.64**	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	34	88	**0.12**	**5.45**	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	1,000	1,400	**0.91**	**41.36**	NA	NA	NA	NA	NA	NA	NA	NA
Total HPAHs	**960**	**5,300**	**3.481**	**158.23**	NA	NA	NA	NA	NA	NA	NA	NA
Phthalates	(ppm TOC)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)
bis(2-Ethylhexyl)phthalate	47	78	**0.15**	**6.82**	NA	NA	NA	NA	NA	NA	NA	NA
Butylbenzylphthalate	4.9	64	<0.02	<0.91	NA	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	61	110	<0.02	<0.91	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylphthalate	53	53	<0.02	<0.91	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Butylphthalate	220	1,700	<0.02	<0.91	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Octyl phthalate	58	4,500	<0.02	<0.91	NA	NA	NA	NA	NA	NA	NA	NA
Phenols	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)	
Phenol	0.42	1.2	**0.046**		NA		NA		NA		NA	
2,4-Dimethylphenol	0.029	0.029	<0.02		NA		NA		NA		NA	
2-Methylphenol	0.063	0.063	<0.02		NA		NA		NA		NA	
4-Methylphenol	0.67	0.67	**0.18**		NA		NA		NA		NA	
Pentachlorophenol	0.36	0.69	<0.098		NA		NA		NA		NA	
Misc. Extractables	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)		(mg/kg)	
Benzyl Alcohol	0.057	0.073	<0.02		NA		NA		NA		NA	
Benzoic Acid	0.65	0.65	<0.2		NA		NA		NA		NA	
Misc. Extractables	(ppm TOC)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)
1,2,4-Trichlorobenzene	0.81	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	2.3	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NV	NV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	3.1	9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	15	58	**0.052**	**2.36**	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	0.38	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	3.9	6.2	<0.02	<0.91	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine	11	11	<0.02	<0.91	NA	NA	NA	NA	NA	NA	NA	NA
PCBs	(ppm TOC)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)
Aroclor 1016	12	65	<0.019	<0.86	NA	NA	<0.019	<1.12	<0.019	<0.68	<0.019	<0.86
Aroclor 1221	12	65	<0.038	<1.73	NA	NA	<0.037	<2.18	<0.038	<1.36	<0.038	<1.73
Aroclor 1232	12	65	<0.019	<0.86	NA	NA	<0.019	<1.12	<0.019	<0.68	<0.019	<0.86
Aroclor 1242	12	65	<0.019	<0.86	NA	NA	<0.019	<1.12	<0.019	<0.68	<0.019	<0.86
Aroclor 1248	12	65	<0.019	<0.86	NA	NA	<0.019	<1.12	<0.019	<0.68	<0.019	<0.86
Aroclor 1254	12	65	<0.026	<1.18	NA	NA	**0.11**	**6.47**	**0.65**	**23.21**	<0.056	<2.55
Aroclor 1260	12	65	<0.019	<0.86	NA	NA	<0.13	<7.65	**0.1**	**3.57**	<0.019	<0.86
Total PCBs	**12**	**65**	<0.038	<1.73	NA	NA	**0.11**	**6.47**	**0.75**	**26.79**	<0.056	<2.55

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 2-1 Summary of Historical Analytical Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HG-10A 3/24/1998		HG-11A 3/24/1998		HG-12A 3/24/1998		HG-13A 3/24/1998		HG-14A 3/23/1998	
Conventionals												
Total Solids (%)	NV	NV	**50.8**		**40.4**		**41.2**		**36**		**35.2**	
Total Preserved Solids (%)	NV	NV	NA		NA		NA		NA		NA	
Total Organic Carbon (%)	NV	NV	**2.4**		**1.8**		**2**		**2**		**2.4**	
N-Ammonia	NV	NV	NA		NA		NA		NA		NA	
Sulfide	NV	NV	NA		NA		NA		NA		NA	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	<9 J		NA		<6 J		<7 J		NA	
Arsenic	57	93	**23**		NA		**15**		**16**		NA	
Cadmium	5.1	6.7	**0.8**		NA		**3.6**		**1.2**		NA	
Chromium	260	270	**46.4**		NA		**70.7**		**81.2**		NA	
Copper	390	390	**397**		NA		**311**		**152**		NA	
Lead	450	530	**29**		NA		**26**		**28**		NA	
Mercury	0.41	0.59	**0.14 J**		NA		**0.20 J**		**0.41 J**		NA	
Nickel	NV	NV	**47**		NA		**80**		**94**		NA	
Silver	6.1	6.1	<0.6		NA		<0.3		**0.5**		NA	
Zinc	410	960	**290**		NA		**250**		**199**		NA	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.073*		NA		NA		NA		NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.05**		**0.04 B**		NA		NA		NA		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	**0.066**	**2.75**	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	16	57	**0.16**	**6.67**	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	66	66	<0.02	<0.83	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	220	1,200	**0.1**	**4.17**	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	23	79	**0.11**	**4.58**	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	99	170	**0.061**	**2.54**	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	100	480	**0.43**	**17.92**	NA	NA	NA	NA	NA	NA	NA	NA
Total LPAHs	**370**	**780**	**0.927**	**38.63**	NA	NA	NA	NA	NA	NA	NA	NA
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	**0.29**	**12.08**	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	99	210	**0.3**	**12.50**	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	230	450	**0.32**	**13.33**	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	31	78	**0.17**	**7.08**	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	230	450	**0.26**	**10.83**	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	110	460	**0.38**	**15.83**	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	12	33	**0.077**	**3.21**	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	160	1,200	**0.65**	**27.08**	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	34	88	**0.18**	**7.50**	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	1,000	1,400	**0.79**	**32.92**	NA	NA	NA	NA	NA	NA	NA	NA
Total HPAHs	**960**	**5,300**	**3.417**	**142.38**	NA	NA	NA	NA	NA	NA	NA	NA
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	**1.4**	**58.33**	NA	NA	NA	NA	NA	NA	NA	NA
Butylbenzylphthalate	4.9	64	**1.5**	**62.50**	NA	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	61	110	<0.02	<0.83	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylphthalate	53	53	<0.02	<0.83	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Butylphthalate	220	1,700	**0.028**	**1.17**	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Octyl phthalate	58	4,500	<0.02	<0.83	NA	NA	NA	NA	NA	NA	NA	NA
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	**0.021**		NA		NA		NA		NA	
2,4-Dimethylphenol	0.029	0.029	<0.02		NA		NA		NA		NA	
2-Methylphenol	0.063	0.063	<0.02		NA		NA		NA		NA	
4-Methylphenol	0.67	0.67	**0.16**		NA		NA		NA		NA	
Pentachlorophenol	0.36	0.69	<0.098		NA		NA		NA		NA	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	**0.027**		NA		NA		NA		NA	
Benzoic Acid	0.65	0.65	<0.2		NA		NA		NA		NA	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	2.3	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NV	NV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	3.1	9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	15	58	**0.094**	**3.92**	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	0.38	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	3.9	6.2	<0.02	<0.83	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine	11	11	<0.02	<0.83	NA	NA	NA	NA	NA	NA	NA	NA
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	<0.02	<0.83	<0.019	<1.06	<0.019	<0.95	<0.019	<0.95	<0.019	<0.79
Aroclor 1221	12	65	<0.039	<1.63	<0.038	<2.11	<0.038	<1.9	<0.039	<1.95	<0.038	<1.58
Aroclor 1232	12	65	<0.02	<0.83	<0.019	<1.06	<0.019	<0.95	<0.019	<0.95	<0.019	<0.79
Aroclor 1242	12	65	<0.02	<0.83	<0.019	<1.06	<0.019	<0.95	<0.019	<0.95	<0.019	<0.79
Aroclor 1248	12	65	<0.02	<0.83	<0.019	<1.06	<0.019	<0.95	<0.019	<0.95	<0.019	<0.79
Aroclor 1254	12	65	<0.02	<0.83	**0.032**	**1.78**	**0.058**	**2.90**	<0.025	<1.25	**0.041**	**1.71**
Aroclor 1260	12	65	<0.02	<0.83	<0.019	<1.06	<0.046	<2.3	<0.019	<0.95	<0.019	<0.79
Total PCBs	**12**	**65**	<0.039	<1.63	**0.032**	**1.78**	**0.058**	**2.90**	<0.039	<1.95	**0.041**	**1.71**

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 2-1 Summary of Historical Analytical Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HG-15A 3/24/1998		HG-16A 3/24/1998		HG-17A 3/24/1998		HG-18A 3/23/1998		HG-23A 3/24/1998	
Conventionals												
Total Solids (%)	NV	NV	**47.6**		**37.5**		**37.9**		**36.3**		**36.9**	
Total Preserved Solids (%)	NV	NV	NA		NA		NA		NA		NA	
Total Organic Carbon (%)	NV	NV	**1.8**		**2**		**2**		**2.1**		**2**	
N-Ammonia	NV	NV	NA		NA		NA		NA		NA	
Sulfide	NV	NV	NA		NA		NA		NA		NA	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	NA		<7 J		<6 J		<7 J		NA	
Arsenic	57	93	NA		**14**		**10**		**17**		NA	
Cadmium	5.1	6.7	NA		**0.8**		**0.9**		**1**		NA	
Chromium	260	270	NA		**89.5**		**83**		**83.6**		NA	
Copper	390	390	NA		**65.7**		**69.6**		**99.2**		NA	
Lead	450	530	NA		**18**		**16**		**22**		NA	
Mercury	0.41	0.59	NA		**0.28 J**		**0.25 J**		**0.28 J**		NA	
Nickel	NV	NV	NA		**105**		**99**		**99**		NA	
Silver	6.1	6.1	NA		**0.7**		**0.5**		**0.5**		NA	
Zinc	410	960	NA		**116**		**116**		**136**		NA	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.073*		NA		NA		NA		NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.05**		NA		**0.04 B**		NA		**0.03 B**		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	NA	NA	<0.02	<1	NA	NA	**0.062**	**2.95**	NA	NA
Acenaphthene	16	57	NA	NA	<0.02	<1	NA	NA	**0.047**	**2.24**	NA	NA
Acenaphthylene	66	66	NA	NA	<0.02	<1	NA	NA	**0.048**	**2.29**	NA	NA
Anthracene	220	1,200	NA	NA	**0.022**	**1.10**	NA	NA	**0.38**	**18.10**	NA	NA
Fluorene	23	79	NA	NA	<0.02	<1	NA	NA	**0.13**	**6.19**	NA	NA
Naphthalene	99	170	NA	NA	**0.046**	**2.30**	NA	NA	**0.23**	**10.95**	NA	NA
Phenanthrene	100	480	NA	NA	**0.059**	**2.95**	NA	NA	**0.58**	**27.62**	NA	NA
Total LPAHs	**370**	**780**	NA	NA	**0.127**	**6.35**	NA	NA	**1.477**	**70.33**	NA	NA
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	NA	NA	**0.039**	**1.95**	NA	NA	**0.27**	**12.86**	NA	NA
Benzo(a)pyrene	99	210	NA	NA	**0.047**	**2.35**	NA	NA	**0.25**	**11.90**	NA	NA
Benzo(b)fluoranthene	230	450	NA	NA	**0.04**	**2.00**	NA	NA	**0.26**	**12.38**	NA	NA
Benzo(g,h,i)perylene	31	78	NA	NA	**0.033**	**1.65**	NA	NA	**0.12**	**5.71**	NA	NA
Benzo(k)fluoranthene	230	450	NA	NA	**0.047**	**2.35**	NA	NA	**0.27**	**12.86**	NA	NA
Chrysene	110	460	NA	NA	**0.067**	**3.35**	NA	NA	**0.4**	**19.05**	NA	NA
Dibenz(a,h)anthracene	12	33	NA	NA	<0.02	<1	NA	NA	**0.055**	**2.62**	NA	NA
Fluoranthene	160	1,200	NA	NA	**0.1**	**5.00**	NA	NA	**0.72**	**34.29**	NA	NA
Indeno(1,2,3-cd)pyrene	34	88	NA	NA	**0.028**	**1.40**	NA	NA	**0.13**	**6.19**	NA	NA
Pyrene	1,000	1,400	NA	NA	**0.1**	**5.00**	NA	NA	**0.87**	**41.43**	NA	NA
Total HPAHs	**960**	**5,300**	NA	NA	**0.501**	**25.05**	NA	NA	**3.345**	**159.29**	NA	NA
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	NA	NA	**0.044**	**2.20**	NA	NA	**0.17**	**8.10**	NA	NA
Butylbenzylphthalate	4.9	64	NA	NA	<0.02	<1	NA	NA	<0.019	<0.9	NA	NA
Diethylphthalate	61	110	NA	NA	<0.02	<1	NA	NA	<0.019	<0.9	NA	NA
Dimethylphthalate	53	53	NA	NA	**0.076**	**3.80**	NA	NA	**0.023**	**1.10**	NA	NA
Di-n-Butylphthalate	220	1,700	NA	NA	<0.02	<1	NA	NA	<0.019	<0.9	NA	NA
Di-n-Octyl phthalate	58	4,500	NA	NA	<0.02	<1	NA	NA	<0.019	<0.9	NA	NA
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	NA		<0.02		NA		**0.043**		NA	
2,4-Dimethylphenol	0.029	0.029	NA		<0.02		NA		<0.019		NA	
2-Methylphenol	0.063	0.063	NA		<0.02		NA		<0.019		NA	
4-Methylphenol	0.67	0.67	NA		**0.21**		NA		**0.56**		NA	
Pentachlorophenol	0.36	0.69	NA		<0.098		NA		<0.097		NA	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	NA		<0.02		NA		<0.019		NA	
Benzoic Acid	0.65	0.65	NA		<0.2		NA		<0.19		NA	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	2.3	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NV	NV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	3.1	9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	15	58	NA	NA	<0.02	<1	NA	NA	**0.11**	**5.24**	NA	NA
Hexachlorobenzene	0.38	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	3.9	6.2	NA	NA	<0.02	<1	NA	NA	<0.019	<0.9	NA	NA
N-Nitrosodiphenylamine	11	11	NA	NA	<0.02	<1	NA	NA	<0.019	<0.9	NA	NA
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	<0.019	<1.06	<0.02	<1	<0.02	<1	<0.019	<0.9	<0.019	<0.95
Aroclor 1221	12	65	<0.037	<2.06	<0.04	<2	<0.039	<1.95	<0.039	<1.86	<0.039	<1.95
Aroclor 1232	12	65	<0.019	<1.06	<0.02	<1	<0.02	<1	<0.019	<0.9	<0.019	<0.95
Aroclor 1242	12	65	<0.019	<1.06	<0.02	<1	<0.02	<1	<0.019	<0.9	<0.019	<0.95
Aroclor 1248	12	65	<0.019	<1.06	<0.02	<1	<0.02	<1	<0.019	<0.9	<0.019	<0.95
Aroclor 1254	12	65	**0.095**	**5.28**	<0.049	<2.45	<0.028	<1.4	<0.048	<2.29	<0.03	<1.5
Aroclor 1260	12	65	<0.019	<1.06	<0.02	<1	<0.02	<1	<0.019	<0.9	<0.019	<0.95
Total PCBs	**12**	**65**	**0.095**	**5.28**	<0.049	<2.45	<0.039	<1.95	<0.048	<2.29	<0.039	<1.95

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 2-1 Summary of Historical Analytical Data

Vibracore Chemistry Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HV-3A (0-10cm) 3/26/1998		HV-3A (2-4) 3/26/1998		HV-3B (6-8) 3/26/1998		HV-4A Rep 1 (0-10cm) 3/26/1998		HV-4A Rep 1 (2.5-4.4) 3/26/1998	
Conventionals												
Total Solids (%)	NV	NV	**39.1**		**81.3**		**90.2**		**70.9**		**89.6**	
Total Preserved Solids (%)	NV	NV	NA		NA		NA		NA		NA	
Total Organic Carbon (%)	NV	NV	**2.6**		**0.71**		**0.34**		**1.8**		**1.7 J**	
N-Ammonia	NV	NV	NA		NA		NA		NA		NA	
Sulfide	NV	NV	NA		NA		NA		NA		NA	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	**17 J**		**5 J**		**4 J**		<7 J		<10 J	
Arsenic	57	93	**18**		**8**		**5**		**21**		<10	
Cadmium	5.1	6.7	**1.6**		**0.1**		**2.8**		**0.5**		<0.6	
Chromium	260	270	**79.3 J**		**34.3 J**		**31.4 J**		**35.5 J**		**50 J**	
Copper	390	390	**286**		**38**		**17.5**		**199**		**19.4**	
Lead	450	530	**49**		**13**		**3**		**74**		<6	
Mercury	0.41	0.59	**0.25 J**		**0.06 J**		**0.03 J**		**0.42 J**		**0.02 J**	
Nickel	NV	NV	**96**		**31.5**		**33**		**30**		**34**	
Silver	6.1	6.1	<0.4		<0.2		<0.2		<0.4		<0.9	
Zinc	410	960	**276**		**60.9**		**35.3**		**266**		**29**	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.073*		NA		NA		NA		NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.05**		NA		NA		NA		NA		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	16	57	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	66	66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	220	1,200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	23	79	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	99	170	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	100	480	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total LPAHs	**370**	**780**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	99	210	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	230	450	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	31	78	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	230	450	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	110	460	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	12	33	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	160	1,200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	34	88	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	1,000	1,400	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total HPAHs	**960**	**5,300**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Butylbenzylphthalate	4.9	64	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	61	110	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylphthalate	53	53	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Butylphthalate	220	1,700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Octyl phthalate	58	4,500	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	NA		NA		NA		NA		NA	
2,4-Dimethylphenol	0.029	0.029	NA		NA		NA		NA		NA	
2-Methylphenol	0.063	0.063	NA		NA		NA		NA		NA	
4-Methylphenol	0.67	0.67	NA		NA		NA		NA		NA	
Pentachlorophenol	0.36	0.69	NA		NA		NA		NA		NA	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	NA		NA		NA		NA		NA	
Benzoic Acid	0.65	0.65	NA		NA		NA		NA		NA	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	2.3	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NV	NV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	3.1	9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	15	58	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	0.38	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	3.9	6.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine	11	11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	<0.02	<0.77 J	<0.02	<2.82 J	<0.018	<5.29 J	<0.02	<1.11 J	<0.02	<1.18 J
Aroclor 1221	12	65	<0.039	<1.5 J	<0.039	<5.49 J	<0.037	<10.88 J	<0.04	<2.22 J	<0.039	<2.29 J
Aroclor 1232	12	65	<0.02	<0.77 J	<0.02	<2.82 J	<0.018	<5.29 J	<0.02	<1.11 J	<0.02	<1.18 J
Aroclor 1242	12	65	<0.02	<0.77 J	<0.02	<2.82 J	<0.018	<5.29 J	<0.026	<1.44 J	<0.02	<1.18 J
Aroclor 1248	12	65	<0.02	<0.77 J	<0.02	<2.82 J	<0.018	<5.29 J	<0.02	<1.11 J	<0.02	<1.18 J
Aroclor 1254	12	65	**0.25**	**9.62 J**	**0.015**	**2.11 J**	<0.018	<5.29 J	**0.6**	**33.3 J**	<0.02	<1.18 J
Aroclor 1260	12	65	<0.02	<0.77 J	<0.02	<2.82 J	<0.018	<5.29 J	**0.7**	**38.9 J**	<0.02	<1.18 J
Total PCBs	**12**	**65**	**0.25**	**9.62 J**	**0.015**	**2.11 J**	<0.037	<10.88 J	**1.3**	**72.2 J**	<0.039	<2.29 J

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 2-1 Summary of Historical Analytical Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HV-6A (0-10) 3/26/1998		HV-6A (2-4) 3/26/1998		HV-6B(6-8) 3/26/1998		HV-8A (0-10cm) 3/26/1998		HV-8A (2-4) 3/26/1998	
Conventionals												
Total Solids (%)	NV	NV	**51.7**		**80.5**		**85.4**		**80.6**		**86.5**	
Total Preserved Solids (%)	NV	NV	NA		NA		NA		NA		NA	
Total Organic Carbon (%)	NV	NV	**1.9**		**0.38**		**0.23**		**1.3 J**		**1.4 J**	
N-Ammonia	NV	NV	NA		NA		NA		NA		NA	
Sulfide	NV	NV	NA		NA		NA		NA		NA	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	**13 J**		**4 J**		**4 J**		**4 J**		<6 J	
Arsenic	57	93	**21**		**7**		**5**		**10**		**7**	
Cadmium	5.1	6.7	**0.7**		**0.2**		**0.1**		**0.3**		<0.2	
Chromium	260	270	**63.5 J**		**20.8 J**		**31.7 J**		**35.8 J**		**46 J**	
Copper	390	390	**69.4**		**8.6**		**9.1**		**37**		**12.6**	
Lead	450	530	**32**		**3**		**2**		**10**		**3**	
Mercury	0.41	0.59	**<u>0.51 J</u>**		**0.02 J**		**0.01 J**		**0.03 J**		<0.01 J	
Nickel	NV	NV	**75.7**		**16.4**		**21.9**		**29.1**		**32**	
Silver	6.1	6.1	<0.3		<0.2		<0.2		<0.2		<0.4	
Zinc	410	960	**134**		**22.4**		**23.1**		**37**		**34.4**	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.073*		NA		NA		NA		NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.05**		NA		NA		NA		NA		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene	16	57	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthylene	66	66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	220	1,200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	23	79	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	99	170	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	100	480	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total LPAHs	**370**	**780**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	99	210	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	230	450	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	31	78	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	230	450	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	110	460	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenz(a,h)anthracene	12	33	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	160	1,200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	34	88	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	1,000	1,400	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total HPAHs	**960**	**5,300**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Butylbenzylphthalate	4.9	64	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diethylphthalate	61	110	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dimethylphthalate	53	53	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Butylphthalate	220	1,700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-Octyl phthalate	58	4,500	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	NA		NA		NA		NA		NA	
2,4-Dimethylphenol	0.029	0.029	NA		NA		NA		NA		NA	
2-Methylphenol	0.063	0.063	NA		NA		NA		NA		NA	
4-Methylphenol	0.67	0.67	NA		NA		NA		NA		NA	
Pentachlorophenol	0.36	0.69	NA		NA		NA		NA		NA	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	NA		NA		NA		NA		NA	
Benzoic Acid	0.65	0.65	NA		NA		NA		NA		NA	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	2.3	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	NV	NV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	3.1	9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzofuran	15	58	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	0.38	2.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	3.9	6.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine	11	11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	<0.019	<1 J	<0.017	<4.47 J	<0.02	<8.7 J	<0.018	<1.38	<0.019	<1.36
Aroclor 1221	12	65	<0.038	<2 J	<0.035	<9.21 J	<0.039	<16.96 J-1	<0.036	<2.77	<0.039	<2.79
Aroclor 1232	12	65	<0.019	<1 J	<0.017	<4.47 J	<0.02	<8.7 J	<0.018	<1.38	<0.019	<1.36
Aroclor 1242	12	65	<0.019	<1 J	<0.017	<4.47 J	<0.02	<8.7 J	<0.018	<1.38	<0.019	<1.36
Aroclor 1248	12	65	<0.019	<1 J	<0.017	<4.47 J	<0.02	<8.7 J	<0.018	<1.38	<0.019	<1.36
Aroclor 1254	12	65	<0.019	<1 J	<0.017	<4.47 J	<0.02	<8.7 J	**0.011J**	**0.085J**	<0.019	<1.36
Aroclor 1260	12	65	<0.073	<3.84 J	<0.017	<4.47 J	<0.02	<8.7 J	<0.018	<1.38	<0.019	<1.36
Total PCBs	**12**	**65**	<0.073	<3.84 J	<0.035	<9.21 J	<0.039	<16.96 J-1	**0.011J**	**0.85J**	<0.039	<2.79

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 4-1 Grain Size Data

Sample ID	Gravel	Sand						Silt					Clay			
		V. Coarse	Coarse	Med	Fine	Very Fine	Total	Coarse	Med	Fine	V. Fine	Total	8 to 9	9 to 10	<10	Total
HG-30	**37.0**	11.0	12.1	10.3	9.5	3.7	**46.6**	1.3	6.7	2.4	1.3	**11.7**	0.9	1.2	2.7	**4.8**
HG-31	**52.2**	22.3	11.1	4.5	1.9	0.8	**40.6**	0.2	0.8	1.1	1.3	**3.4**	1.2	1.1	1.5	**3.8**
HG-34	**2.2**	3.5	2.5	5.0	7.7	3.1	**21.8**	2.2	10.7	12.6	14.2	**39.7**	11.1	8.9	16.2	**36.2**
HG-35	**3.8**	4.2	2.5	5.4	6.7	2.8	**21.6**	2.3	8.3	14.7	14.1	**39.4**	10.5	11.1	13.6	**35.2**
HG-38	**26.2**	10.8	11.1	11.2	10.9	3.0	**47.0**	2.1	15.6	2.6	1.2	**21.5**	1.0	1.0	3.3	**5.3**
HG-39	**43.7**	8.7	10.6	10.8	14.9	5.2	**50.2**	0.5	0.7	0.9	0.6	**2.7**	0.9	1.0	1.5	**3.4**
HG-41	**5.1**	4.7	4.2	7.7	26.5	21.4	**64.5**	2.4	3.1	5.9	4.4	**15.8**	3.6	3.8	7.2	**14.6**
HG-42	**6.7**	7.0	12.4	17.8	18.6	5.1	**60.9**	1.8	6.2	8.5	4.1	**20.6**	2.9	2.9	6.0	**11.8**
HG-44 Rep 1	**27.9**	14.7	9.0	11.2	11.3	2.9	**49.1**	1.3	4.1	5.3	2.8	**13.5**	2.3	2.3	4.9	**9.5**
HG-44 Rep 2	**26.8**	15.1	8.8	11.0	11.0	2.8	**48.7**	3.5	4.2	5.1	3.1	**15.9**	1.9	2.0	4.7	**8.6**
HG-44 Rep 3	**28.3**	16.0	8.5	11.4	10.9	2.9	**49.7**	1.1	3.4	5.3	3.0	**12.8**	2.3	1.9	4.8	**9.0**
HG-44 Average	**27.7**	15.3	8.8	11.2	11.1	2.9	**49.2**	2.0	3.9	5.2	3.0	**14.1**	2.2	2.1	4.8	**9.0**
HG-100	**39.8**	10.0	9.9	9.4	8.7	3.8	**41.8**	0.7	3.7	4.0	2.1	**10.5**	1.8	2.0	4.1	**7.9**
HG-200	**36.6**	10.0	12.1	12.0	16.1	6.0	**56.2**	0.7	0.6	1.1	0.9	**3.3**	0.9	1.5	1.5	**3.9**
HG-32	**45.9**	26.7	9.1	3.5	1.8	0.9	**42.0**	2.0	4.6	0.9	0.7	**8.2**	0.6	0.1	3.1	**3.8**
HG-33	**7.6**	9.5	9.9	19.2	31.4	11.5	**81.5**	1.7	2.8	1.7	0.9	**7.1**	0.8	1.1	1.8	**3.7**
HG-36	**44.3**	12.0	5.4	3.3	3.2	2.5	**26.4**	5.5	17.5	1.0	0.6	**24.6**	0.7	0.6	3.3	**4.6**
HG-37	**35.3**	12.4	7.7	9.2	10.0	4.2	**43.5**	3.9	12.7	0.5	0.5	**17.6**	0.4	0.4	2.7	**3.5**
HG-40	**64.3**	10.3	6.9	9.2	7.9	0.9	**35.2**	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**
PORTB-REFSD1	**0.0**	0.6	4.0	42.9	26.8	3.5	**77.8**	4.8	4.8	3.3	2.1	**15.0**	1.7	1.5	4.1	**7.3**
HB-1*	**0.7**	0.5	2.4	10.7	12.6	4.3	**30.5**	4.2	12.1	14.5	10.7	**41.5**	9.2	6.5	11.6	**27.3**
HB-2*	**0.9**	0.7	1.5	7.4	5.6	3.3	**18.5**	4.1	17.2	18.7	10.6	**50.6**	8.2	7.6	14.3	**30.1**
HB-3 Rep 1*	**0.9**	1.7	2.1	4.7	7.1	2.9	**18.5**	5.5	10.8	16.7	12.8	**45.8**	11.7	9.9	13.3	**34.9**
HB-3 Rep 2*	**1.6**	2.6	1.8	4.0	6.9	3.2	**18.5**	3.5	12.5	17.1	12.5	**45.6**	11.8	7.7	15.0	**34.5**
HB-3 Rep 3*	**1.7**	0.5	2.7	5.0	7.3	3.0	**18.5**	3.0	14.0	17.1	12.6	**46.7**	10.4	8.6	14.1	**33.1**
HB-3 Average*	**1.4**	1.6	2.2	4.6	7.1	3.0	**18.5**	4.0	12.4	17.0	12.6	**46.0**	11.3	8.7	14.1	**34.2**
HB-4*	**0.2**	0.6	0.9	5.5	4.5	3.9	**15.4**	4.0	15.5	19.7	10.9	**50.1**	9.1	9.2	16.1	**34.4**
REF-1*	**0.0**	2.1	1.8	1.0	0.8	2.0	**7.7**	24.6	23.3	13.9	11.3	**73.1**	5.9	3.5	9.7	**19.1**
HC-1A-S1	**21.2**	3.6	7.1	16.9	24.0	10.7	**62.3**	2.9	2.0	2.2	2.0	**9.1**	1.8	3.5	2.1	**7.4**
HC-1B-S1	**7.8**	3.0	9.1	23.6	28.1	6.7	**70.5**	1.5	2.0	3.4	3.5	**10.4**	2.6	5.8	2.7	**11.1**
HC-2-S1	**56.7**	10.4	8.2	6.1	4.4	1.9	**31.0**	2.8	1.7	2.4	0.6	**7.5**	1.3	2.3	1.3	**4.9**
HC-3-S1	**43.8**	10.6	10.5	12.7	12.5	3.7	**50.0**	0.6	0.4	0.9	0.9	**2.8**	1.1	0.3	2.0	**3.4**
HC-4-S1-A	**12.7**	7.1	11.9	21.4	18.4	5.6	**64.4**	4.3	0.2	4.0	3.6	**12.1**	2.6	2.1	5.9	**10.6**
HC-4-S1-B	**12.6**	7.6	12.7	22.0	18.9	5.8	**67.0**	1.4	2.0	3.5	2.6	**9.5**	2.9	0.3	7.7	**10.9**
HC-4-S1-C	**12.3**	7.2	12.2	21.6	19.2	6.2	**66.4**	0.1	2.8	3.4	3.4	**9.7**	2.9	2.4	6.4	**11.7**
HC-4-S1 avg	**12.5**	7.3	12.3	21.7	18.8	5.9	**65.9**	1.9	1.7	3.6	3.2	**10.4**	2.8	1.6	6.7	**11.1**
HC-7B-S1	**0.3**	1.7	8.8	23.5	30.2	7.8	**72.0**	0.1	2.6	4.7	4.9	**12.3**	3.9	3.2	8.4	**15.5**
REF-1	**0.3**	0.8	1.9	14.1	11.9	8.4	**37.1**	12.0	16.8	6.5	6.3	**41.6**	4.4	3.8	12.9	**21.1**
REF-2	**0.3**	0.6	3.2	20.9	14.3	7.7	**46.7**	10.7	15.4	5.3	5.5	**36.9**	2.5	3.3	10.2	**16.0**

*** Data from July 24, 2003 sampling.**

Table 4-3 Summary of Remedial Investigation Analytical Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HG-13 08/22/00	HG-30 08/22/00		HG-100 (Dup of HG-30) 08/22/00		HG-31 08/22/00	
Conventionals									
Total Solids (%)	NV	NV	NA	**58.3**		**56.7**		**84.2**	
Total Preserved Solids (%)	NV	NV	NA	**54.7**		**57.4**		**79.9**	
Total Organic Carbon (%)	NV	NV	NA	**3.6**		**5.8**		**2.5**	
N-Ammonia	NV	NV	NA	**17.0**		**20.0**		**2.7**	
Sulfide	NV	NV	NA	**1,100**		**2,500**		**250**	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	NA	< 9		**11**		**8**	
Arsenic	57	93	NA	**13**		**10**		**13**	
Cadmium	5.1	6.7	NA	**0.9**		**0.9**		**0.3**	
Chromium	260	270	NA	**32.4**		**36.2**		**30.6**	
Copper	390	390	NA	**149**		**428**		**107**	
Lead	450	530	NA	**143**		**151**		**65**	
Mercury	0.41	0.59	**0.30**	**0.36**		**0.16**		< 0.06	
Nickel	NV	NV	NA	**33**		**45**		**38**	
Silver	6.1	6.1	NA	< 0.5		< 0.5		< 0.4	
Zinc	410	960	NA	**194**		**166**		**191**	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA	NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA	NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA	NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA	NA		NA		NA	
Tributyl Tin Ion	0.073*		NA	NA		NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*	*(µg/L)*		*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA	NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA	NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA	NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA	NA		NA		NA	
Tributyl Tin Ion	0.05**		NA	NA		NA		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	NA	**0.066**	**1.83**	**0.062**	**1.069**	< 0.020	< 0.80
Acenaphthene	16	57	NA	**0.120**	**3.33**	**0.078**	**1.345**	< 0.020	< 0.80
Acenaphthylene	66	66	NA	**0.31**	**8.61**	**0.13**	**2.24**	< 0.02	< 0.80
Anthracene	220	1,200	NA	**0.75**	**20.8**	**0.3**	**5.2**	**0.024**	**0.96**
Fluorene	23	79	NA	**0.21**	**5.83**	**0.12**	**2.07**	< 0.02	< 0.80
Naphthalene	99	170	NA	**0.13**	**3.61**	**0.13**	**2.24**	< 0.02	< 0.80
Phenanthrene	100	480	NA	**1.5**	**41.7**	**0.85**	**14.7**	**0.069**	**2.76**
Total LPAHs	**370**	**780**		**3.086**	**85.7**	**1.7**	**28.8**	**0.093**	**3.72**
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	NA	**2 D**	**55.6 D**	**0.81**	**14.0**	**0.066**	**2.64**
Benzo(a)pyrene	99	210	NA	**1.8 D**	**50.0 D**	**0.88**	**15.2**	**0.066**	**2.64**
Benzo(b)fluoranthene	230	450	NA	**1.6 D**	**44.4 D**	**1.0**	**17.2**	**0.068**	**2.72**
Benzo(g,h,i)perylene	31	78	NA	**0.63**	**17.5**	**0.27**	**4.66**	**0.022**	**0.88**
Benzo(k)fluoranthene	230	450	NA	**1.5**	**41.7**	**1.0**	**17.2**	**0.096**	**3.84**
Chrysene	110	460	NA	**2.1 D**	**58.3 D**	**0.97**	**16.7**	**0.11**	**4.40**
Dibenz(a,h)anthracene	12	33	NA	**0.21**	**5.83**	**0.058**	**1.0**	< 0.02	< 0.80
Fluoranthene	160	1,200	NA	**5.9 D**	**164 D**	**1.6 D**	**27.6 D**	**0.15**	**6.0**
Indeno(1,2,3-cd)pyrene	34	88	NA	**0.74**	**20.6**	**0.29**	**5.0**	**0.027**	**1.08**
Pyrene	1,000	1,400	NA	**6.4 D**	**177.8 D**	**1.9 D**	**32.8 D**	**0.18**	**7.2**
Total HPAHs	**960**	**5,300**		**22.9**	**635.6**	**8.8**	**151.3**	**0.8**	**31.40**
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	NA	**2.4 D**	**66.7 D**	**0.33**	**5.69**	**0.05**	**2.0**
Butylbenzylphthalate	4.9	64	NA	< 0.019	< 0.53	< 0.02	< 0.34	< 0.02	< 0.80
Diethylphthalate	61	110	NA	< 0.019	< 0.53	< 0.02	< 0.34	< 0.02	< 0.80
Dimethylphthalate	53	53	NA	**0.026**	**0.72**	< 0.02	< 0.34	< 0.02	< 0.80
Di-n-Butylphthalate	220	1,700	NA	< 0.019	< 0.53	**0.034**	**0.586**	< 0.02	< 0.80
Di-n-Octyl phthalate	58	4,500	NA	< 0.019	< 0.53	< 0.02	< 0.34	< 0.02	< 0.80
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	NA	< 0.019		< 0.02		< 0.02	
2,4-Dimethylphenol	0.029	0.029	NA	**0.031**		**0.022**		< 0.02	
2-Methylphenol	0.063	0.063	NA	< 0.019		< 0.02		< 0.02	
4-Methylphenol	0.67	0.67	NA	**0.120**		**0.1**		< 0.02	
Pentachlorophenol	0.36	0.69	NA	< 0.095		< 0.098		< 0.098	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	NA	< 0.019		< 0.02		< 0.02	
Benzoic Acid	0.65	0.65	NA	< 0.190		< 0.2		< 0.20	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	NA	< 0.019	< 0.53	< 0.02	< 0.34	< 0.02	< 0.80
1,2-Dichlorobenzene	2.3	2.3	NA	< 0.019	< 0.53	< 0.02	< 0.34	< 0.02	< 0.80
1,3-Dichlorobenzene	NV	NV	NA	< 0.019	< 0.53	< 0.02	< 0.34	< 0.02	< 0.80
1,4-Dichlorobenzene	3.1	9	NA	< 0.019	< 0.53	< 0.02	< 0.34	< 0.02	< 0.80
Dibenzofuran	15	58	NA	**0.09**	**2.5**	**0.067**	**1.16**	< 0.02	< 0.80
Hexachlorobenzene	0.38	2.3	NA	< 0.019	< 0.53	< 0.02	< 0.34	< 0.02	< 0.80
Hexachlorobutadiene	3.9	6.2	NA	< 0.019	< 0.53	< 0.02	< 0.34	< 0.02	< 0.80
N-Nitrosodiphenylamine	11	11	NA	< 0.019	< 0.53	< 0.02	< 0.34	< 0.02	< 0.80
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	NA	< 0.018	< 0.50	< 0.018	< 0.310	< 0.02	< 0.80
Aroclor 1221	12	65	NA	< 0.036	< 1.00	< 0.037	< 0.638	< 0.039	< 1.56
Aroclor 1232	12	65	NA	< 0.018	< 0.50	< 0.018	< 0.310	< 0.02	< 0.80
Aroclor 1242	12	65	NA	< 0.018	< 0.50	< 0.018	< 0.310	< 0.02	< 0.80
Aroclor 1248	12	65	NA	< 0.092	< 2.56	< 0.12	< 2.07	< 0.02	< 0.80
Aroclor 1254	12	65	NA	< 0.27	< 7.50	**0.28**	**4.83**	< 0.027	< 1.08
Aroclor 1260	12	65	NA	**0.52**	**14.4**	**0.4**	**6.9**	< 0.02	< 0.80
Total PCBs	**12**	**65**	NA	**0.5**	**14.4**	**0.7**	**11.7**	< 0.039	< 1.56

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 4-3 Summary of Remedial Investigation Analytical Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HG-32 08/31/00		HG-33 08/31/00		HG-34 08/23/00		HG-35 08/22/00	
Conventionals										
Total Solids (%)	NV	NV	52.2		67.9		37.8		38.0	
Total Preserved Solids (%)	NV	NV	55.8		69.4		40.8		39.5	
Total Organic Carbon (%)	NV	NV	1.1		1.2		2.3		2.2	
N-Ammonia	NV	NV	18.0		14.0		14.0		16.0	
Sulfide	NV	NV	640		600		1,900		1,600	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	< 20 J		< 20		< 10		< 10	
Arsenic	57	93	< 20		30		< 10		< 10	
Cadmium	5.1	6.7	< 0.7		1.0		0.7		0.9	
Chromium	260	270	10.0		32.0		70.0		71.0	
Copper	390	390	115 J		608		76.3		84.3	
Lead	450	530	27		129		22		19	
Mercury	0.41	0.59	< 0.07		0.14		0.40		0.24	
Nickel	NV	NV	9		28		90		91	
Silver	6.1	6.1	< 1.0		< 1.0		< 0.8		< 0.8	
Zinc	410	960	138 J		536		141		126	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tributyl Tin Ion	0.073*		NA		NA		NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tributyl Tin Ion	0.05**		NA		NA		NA		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	< 0.020	< 1.82	0.036	3.0	0.039	1.70	0.029	1.32
Acenaphthene	16	57	0.038	3.45	0.092	7.67	0.042	1.83	0.019 J	0.86 J
Acenaphthylene	66	66	0.049	4.45	0.085	7.08	0.03	1.30	< 0.02	< 0.91
Anthracene	220	1,200	0.2	18.2	0.42	35.0	0.1	4.35	0.2	9.09
Fluorene	23	79	0.042	3.82	0.12	10.0	0.046	2.0	0.053	2.41
Naphthalene	99	170	0.022	2.0	0.056	4.67	0.13	5.65	0.098	4.45
Phenanthrene	100	480	0.3	27.3	0.97	80.8	0.28	12.2	0.22	10.0
Total LPAHs	**370**	**780**	0.651	59.2	1.779	148.3	0.667	29.0	0.619	28.1
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	0.43	39.1	1.2	100.0	0.19	8.26	0.12	5.45
Benzo(a)pyrene	99	210	0.28	25.5	0.87	72.5	0.16	6.96	0.088	4.00
Benzo(b)fluoranthene	230	450	0.37	33.6	1.1	91.7	0.22	9.57	0.11	5.00
Benzo(g,h,i)perylene	31	78	0.078	7.0909	0.23	19.2	0.059	2.57	0.03	1.36
Benzo(k)fluoranthene	230	450	0.41	37.3	1	83.3	0.21	9.13	0.13	5.91
Chrysene	110	460	0.63	57.3	1.5	125.0	0.24	10.4	0.18	8.18
Dibenz(a,h)anthracene	12	33	0.023	2.0909	0.071	5.92	< 0.02	< 0.87	< 0.02	< 0.91
Fluoranthene	160	1,200	0.58	52.7	2 D	166.7 D	0.52	22.6	0.3	13.6
Indeno(1,2,3-cd)pyrene	34	88	0.12	10.9	0.36	30.0	0.065	2.83	0.034	1.55
Pyrene	1,000	1,400	0.52	47.3	1.5	125.0	0.46	20.0	0.24	10.9
Total HPAHs	**960**	**5,300**	3.4	312.8	9.8	819.3	2.1	92.3	1.2	56.0
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	0.26 B	23.6 B	0.53	44.2	0.19	8.26	0.2	9.09
Butylbenzylphthalate	4.9	64	0.036	3.27	0.049	4.08	< 0.02	< 0.87	< 0.02	< 0.91
Diethylphthalate	61	110	< 0.02	< 1.82	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
Dimethylphthalate	53	53	0.026	2.36	0.026	2.17	< 0.02	< 0.87	< 0.02	< 0.91
Di-n-Butylphthalate	220	1,700	< 0.02	< 1.82	0.027	2.25	< 0.02	< 0.87	< 0.02	< 0.91
Di-n-Octyl phthalate	58	4,500	< 0.02	< 1.82	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	0.11		< 0.02		< 0.02		< 0.02	
2,4-Dimethylphenol	0.029	0.029	< 0.02		< 0.02		< 0.02		< 0.02	
2-Methylphenol	0.063	0.063	< 0.02		< 0.02		< 0.02		< 0.02	
4-Methylphenol	0.67	0.67	0.021		0.071		0.26		0.25	
Pentachlorophenol	0.36	0.69	0.20		0.21		< 0.099		< 0.10	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	0.31		< 0.02		< 0.02		< 0.02	
Benzoic Acid	0.65	0.65	< 0.20		< 0.20		< 0.20		< 0.20	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	< 0.02	< 1.82	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
1,2-Dichlorobenzene	2.3	2.3	< 0.02	< 1.82	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
1,3-Dichlorobenzene	NV	NV	< 0.02	< 1.82	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
1,4-Dichlorobenzene	3.1	9	< 0.02	< 1.82	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
Dibenzofuran	15	58	0.029	2.64	0.069	5.75	0.054	2.35	0.043	1.95
Hexachlorobenzene	0.38	2.3	< 0.02	< 1.82	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
Hexachlorobutadiene	3.9	6.2	< 0.02	< 1.82	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
N-Nitrosodiphenylamine	11	11	< 0.02	< 1.82	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	< 0.019	< 1.73	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
Aroclor 1221	12	65	< 0.037	< 3.36	< 0.039	< 3.25	< 0.039	< 1.70	< 0.04	< 1.82
Aroclor 1232	12	65	< 0.019	< 1.73	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
Aroclor 1242	12	65	< 0.019	< 1.73	< 0.02	< 1.67	< 0.02	< 0.87	< 0.02	< 0.91
Aroclor 1248	12	65	< 0.019	< 1.73	< 0.02	< 1.67	< 0.029	< 1.26	< 0.034	< 1.55
Aroclor 1254	12	65	0.038	3.45	0.22	18.3	0.043	1.87	0.025	1.14
Aroclor 1260	12	65	< 0.021	< 1.91	< 0.065	< 5.42	0.029	1.26	< 0.02	< 0.91
Total PCBs	**12**	**65**	0.038	3.45	0.2200	18.3	0.0720	3.13	0.0250	1.14

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 4-3 Summary of Remedial Investigation Analytical Data

Parameter	SMS Criteria SQS	MCUL	HG-36 08/31/00		HG-37 08/31/00		HG-38 08/22/00	
Conventionals								
Total Solids (%)	NV	NV	**53.0**		**84.1**		**54.0**	
Total Preserved Solids (%)	NV	NV	**45.6**		**52.1**		**55.3**	
Total Organic Carbon (%)	NV	NV	**2.0**		**1.1**		**3.0**	
N-Ammonia	NV	NV	**16.0**		**12.0**		**18.0**	
Sulfide	NV	NV	**1,700**		**1,600**		**2,100**	
Metals	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)		(mg/kg)	
Antimony	NV	NV	< 20		< 10		**10 J**	
Arsenic	57	93	< 20		< 10		**30**	
Cadmium	5.1	6.7	**2.0**		**0.5**		**0.9**	
Chromium	260	270	**23.0**		**16.0**		**44.0**	
Copper	390	390	**70**		**74**		**959**	
Lead	450	530	**10**		**10**		**49**	
Mercury	0.41	0.59	**0.10**		**0.10**		**0.16**	
Nickel	NV	NV	**27**		**19**		**43**	
Silver	6.1	6.1	< 1.0		< 0.6		< 0.6	
Zinc	410	960	**127**		**90**		**901**	
Bulk Organotins	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)		(mg/kg)	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tributyl Tin Ion	0.073*		NA		NA		NA	
Porewater Organotins	(ug/L)	(ug/L)	(µg/L)		(µg/L)		(µg/L)	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tributyl Tin Ion	0.05**		NA		NA		NA	
LPAH	(ppm TOC)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)
2-Methylnaphthalene	38	64	**0.029**	**1.45**	**0.036**	**3.27**	**0.031**	**1.03**
Acenaphthene	16	57	**0.038**	**1.90**	**0.037**	**3.36**	**0.058**	**1.93**
Acenaphthylene	66	66	**0.042**	**2.10**	**0.022**	**2.0**	**0.022**	**0.73**
Anthracene	220	1,200	**0.3**	**15.0**	**0.14**	**12.7**	**0.1**	**3.33**
Fluorene	23	79	**0.05**	**2.50**	**0.055**	**5.0**	**0.049**	**1.63**
Naphthalene	99	170	**0.06**	**3.0**	**0.059**	**5.4**	**0.039**	**1.30**
Phenanthrene	100	480	**0.35**	**17.5**	**0.47**	**42.7**	**0.34**	**11.3**
Total LPAHs	**370**	**780**	**0.869**	**43.5**	**0.819**	**74.5**	**0.639**	**21.3**
HPAH	(ppm TOC)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)
Benzo(a)anthracene	110	270	**0.63**	**31.5**	**0.22**	**20.0**	**0.26**	**8.67**
Benzo(a)pyrene	99	210	**0.34**	**17.0**	**0.26**	**23.6**	**0.22**	**7.33**
Benzo(b)fluoranthene	230	450	**0.48**	**24.0**	**0.24**	**21.8**	**0.29**	**9.67**
Benzo(g,h,i)perylene	31	78	**0.072**	**3.6**	**0.06**	**5.45**	**0.076**	**2.53**
Benzo(k)fluoranthene	230	450	**0.45**	**22.5**	**0.30**	**27.3**	**0.25**	**8.33**
Chrysene	110	460	**1.1**	**55.0**	**0.36**	**32.7**	**0.34**	**11.3**
Dibenz(a,h)anthracene	12	33	**0.024**	**1.20**	**0.02**	**1.82**	**0.019 J**	**0.63 J**
Fluoranthene	160	1,200	**0.87**	**43.5**	**0.58**	**52.7**	**0.55**	**18.3**
Indeno(1,2,3-cd)pyrene	34	88	**0.11**	**5.50**	**0.094**	**8.55**	**0.092**	**3.07**
Pyrene	1,000	1,400	**0.72**	**36.0**	**0.54**	**49.1**	**0.53**	**17.7**
Total HPAHs	**960**	**5,300**	**4.8**	**239.8**	**2.674**	**243.1**	**2.6**	**87.6**
Phthalates	(ppm TOC)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)
bis(2-Ethylhexyl)phthalate	47	78	**0.43**	**21.5**	**0.45**	**40.9**	**0.54**	**18.0**
Butylbenzylphthalate	4.9	64	< 0.019	< 0.95	< 0.019	< 1.73	**0.23**	**7.67**
Diethylphthalate	61	110	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
Dimethylphthalate	53	53	< 0.019	< 0.95	**0.068**	**6.18**	< 0.02	< 0.67
Di-n-Butylphthalate	220	1,700	< 0.019	< 0.95	< 0.019	< 1.73	**0.021**	**0.70**
Di-n-Octyl phthalate	58	4,500	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
Phenols	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)		(mg/kg)	
Phenol	0.42	1.2	< 0.02		**0.027**		< 0.02	
2,4-Dimethylphenol	0.029	0.029	< 0.02		< 0.019		< 0.02	
2-Methylphenol	0.063	0.063	< 0.02		< 0.019		< 0.02	
4-Methylphenol	0.67	0.67	**0.12**		**0.087**		**0.10**	
Pentachlorophenol	0.36	0.69	< 0.095		< 0.096		< 0.098	
Misc. Extractables	(mg/kg)	(mg/kg)	(mg/kg)		(mg/kg)		(mg/kg)	
Benzyl Alcohol	0.057	0.073	**0.17**		< 0.019		**0.076**	
Benzoic Acid	0.65	0.65	< 0.19		< 0.19		< 0.20	
Misc. Extractables	(ppm TOC)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)
1,2,4-Trichlorobenzene	0.81	1.8	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
1,2-Dichlorobenzene	2.3	2.3	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
1,3-Dichlorobenzene	NV	NV	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
1,4-Dichlorobenzene	3.1	9	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
Dibenzofuran	15	58	**0.039**	**1.95**	**0.032**	**2.91**	**0.035**	**1.17**
Hexachlorobenzene	0.38	2.3	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
Hexachlorobutadiene	3.9	6.2	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
N-Nitrosodiphenylamine	11	11	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
PCBs	(ppm TOC)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)	(mg/kg)	(ppm TOC)
Aroclor 1016	12	65	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
Aroclor 1221	12	65	< 0.038	< 1.90	< 0.038	< 3.45	< 0.039	< 1.30
Aroclor 1232	12	65	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
Aroclor 1242	12	65	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
Aroclor 1248	12	65	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
Aroclor 1254	12	65	**0.022**	**1.10**	**0.019**	**1.73**	< 0.02	< 0.67
Aroclor 1260	12	65	< 0.019	< 0.95	< 0.019	< 1.73	< 0.02	< 0.67
Total PCBs	**12**	**65**	**0.0220**	**1.10**	**0.0190**	**1.73**	< 0.039	< 1.30

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 4-3 Summary of Remedial Investigation Analytical Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HG-39 08/22/00		HG-200 (Dup of HG-39) 08/22/00		HG-40 08/31/00		HG-41 08/22/00	
Conventionals										
Total Solids (%)	NV	NV	**78.4**		**75.5**		**90.8**		**47.4**	
Total Preserved Solids (%)	NV	NV	**78.2**		**76.0**		**87.2**		**47.9**	
Total Organic Carbon (%)	NV	NV	**0.90**		**1.4**		**0.29**		**2.4**	
N-Ammonia	NV	NV	**11.0**		**8.9**		**7.3**		**24.0**	
Sulfide	NV	NV	**910**		**950**		**42**		**2,600**	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	< 7		< 7		< 10		< 10	
Arsenic	57	93	< 7		**7**		**20**		**10**	
Cadmium	5.1	6.7	**0.5**		**0.4**		< 0.5		**0.5**	
Chromium	260	270	**27.3**		**31.3**		**22.0**		**46.0**	
Copper	390	390	**99.9**		**657**		**96.3**		**238**	
Lead	450	530	**18**		**33**		**30**		**58**	
Mercury	0.41	0.59	**0.13**		**0.06**		< 0.05		**0.30**	
Nickel	NV	NV	**25**		**23**		**19**		**49**	
Silver	6.1	6.1	< 0.4		< 0.4		< 0.8		< 0.7	
Zinc	410	960	**184**		**372**		**233**		**267**	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tributyl Tin Ion	0.073*		NA		NA		NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA	
Tributyl Tin Ion	0.05**		NA		NA		NA		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	**0.160**	**17.8**	**0.018**	**1.29**	< 0.019	< 6.55	**0.036**	**1.50**
Acenaphthene	16	57	**0.070**	**7.78**	**0.051**	**3.64**	< 0.019	< 6.55	**0.059**	**2.46**
Acenaphthylene	66	66	**0.025**	**2.78**	**0.015 J**	**1.07 J**	< 0.019	< 6.55	**0.076**	**3.17**
Anthracene	220	1,200	**0.97**	**107.8**	**0.33**	**23.6**	< 0.019	< 6.55	**0.32**	**13.3**
Fluorene	23	79	**0.42**	**46.7**	**0.072**	**5.14**	< 0.019	< 6.55	**0.072**	**3.0**
Naphthalene	99	170	**0.04**	**4.44**	**0.028**	**2.0**	< 0.019	< 6.55	**0.044**	**1.83**
Phenanthrene	100	480	**1.3**	**144.4**	**0.62**	**44.3**	< 0.019	< 6.55	**0.74**	**30.8**
Total LPAHs	**370**	**780**	**2.985**	**331.7**	**1.13**	**81.0**	< 0.019	< 6.55	**1.347**	**56.1**
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	**0.32**	**35.6**	**0.56**	**40**	< 0.019	< 6.55	**0.61**	**25.4**
Benzo(a)pyrene	99	210	**0.16**	**17.8**	**0.4**	**28.6**	< 0.019	< 6.55	**0.61**	**25.4**
Benzo(b)fluoranthene	230	450	**0.24**	**26.7**	**0.57**	**40.7**	< 0.019	< 6.55	**0.92**	**38.3**
Benzo(g,h,i)perylene	31	78	**0.039**	**4.33**	**0.09**	**6.43**	< 0.019	< 6.55	**0.21**	**8.75**
Benzo(k)fluoranthene	230	450	**0.23**	**25.6**	**0.44**	**31.4**	< 0.019	< 6.55	**0.67**	**27.9**
Chrysene	110	460	**0.52**	**57.8**	**0.57**	**40.7**	< 0.019	< 6.55	**1**	**41.7**
Dibenz(a,h)anthracene	12	33	< 0.019	< 2.11	**0.029**	**2.07**	< 0.019	< 6.55	**0.054**	**2.25**
Fluoranthene	160	1,200	**0.98**	**108.9**	**1.2**	**85.7**	< 0.019	< 6.55	**1.3**	**54.2**
Indeno(1,2,3-cd)pyrene	34	88	**0.048**	**5.33**	**0.12**	**8.57**	< 0.019	< 6.55	**0.25**	**10.4**
Pyrene	1,000	1,400	**1**	**111.1**	**0.89 D**	**63.6 D**	< 0.019	< 6.55	**1.5**	**62.5**
Total HPAHs	**960**	**5,300**	**3.5**	**393.0**	**4.9**	**347.8**	< 0.0	< 6.6	**7.1**	**296.8**
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	**0.071**	**7.89**	**0.072**	**5.14**	**0.089 B**	**30.7 B**	**0.33**	**13.8**
Butylbenzylphthalate	4.9	64	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	**0.033**	**1.38**
Diethylphthalate	61	110	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	< 0.02	< 0.83
Dimethylphthalate	53	53	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	**0.028**	**1.17**
Di-n-Butylphthalate	220	1,700	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	< 0.02	< 0.83
Di-n-Octyl phthalate	58	4,500	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	< 0.02	< 0.83
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	< 0.019		< 0.015		< 0.019		< 0.02	
2,4-Dimethylphenol	0.029	0.029	< 0.019		< 0.015		< 0.019		< 0.02	
2-Methylphenol	0.063	0.063	< 0.019		< 0.015		< 0.019		< 0.02	
4-Methylphenol	0.67	0.67	**0.034**		**0.03**		< 0.019		**0.066**	
Pentachlorophenol	0.36	0.69	< 0.097		< 0.076		< 0.094		**0.12**	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	< 0.019		< 0.015		< 0.019		< 0.02	
Benzoic Acid	0.65	0.65	< 0.19		< 0.150		< 0.19		< 0.20	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	< 0.02	< 0.83
1,2-Dichlorobenzene	2.3	2.3	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	< 0.02	< 0.83
1,3-Dichlorobenzene	NV	NV	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	< 0.02	< 0.83
1,4-Dichlorobenzene	3.1	9	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	< 0.02	< 0.83
Dibenzofuran	15	58	**0.14**	**15.6**	**0.042**	**3.0**	< 0.019	< 6.55	**0.041**	**1.71**
Hexachlorobenzene	0.38	2.3	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	< 0.02	< 0.83
Hexachlorobutadiene	3.9	6.2	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	< 0.02	< 0.83
N-Nitrosodiphenylamine	11	11	< 0.019	< 2.11	< 0.015	< 1.07	< 0.019	< 6.55	< 0.02	< 0.83
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	< 0.018	< 2.0	< 0.018	< 1.29	< 0.019	< 6.55	< 0.02	< 0.83
Aroclor 1221	12	65	< 0.036	< 4.0	< 0.037	< 2.64	< 0.037	< 12.8	< 0.039	< 1.63
Aroclor 1232	12	65	< 0.018	< 2.0	< 0.018	< 1.29	< 0.019	< 6.55	< 0.02	< 0.83
Aroclor 1242	12	65	< 0.018	< 2.0	< 0.018	< 1.29	< 0.019	< 6.55	< 0.02	< 0.83
Aroclor 1248	12	65	< 0.018	< 2.0	< 0.018	< 1.29	< 0.019	< 6.55	< 0.032	< 1.33
Aroclor 1254	12	65	**0.021**	**2.33**	< 0.018	< 1.29	**0.0096 J**	**3.31 J**	**0.058**	**2.42**
Aroclor 1260	12	65	< 0.018	< 2.0	< 0.018	< 1.29	< 0.019	< 6.55	**0.04**	**1.67**
Total PCBs	**12**	**65**	**0.0210**	**2.33**	< 0.037	< 2.64	**0.0096**	**3.31**	**0.0980**	**4.08**

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 4-3 Summary of Remedial Investigation Analytical Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HG-42 08/23/00	HG-42 08/23/00	HG-44 11/09/00	HG-44 11/09/00	HG-45 11/09/00	HG-45 11/09/00
Conventionals								
Total Solids (%)	NV	NV	**62.2**		**61.8**		**56.5**	
Total Preserved Solids (%)	NV	NV	**62.6**		NA		NA	
Total Organic Carbon (%)	NV	NV	**2.4**		**1.5**		**1.1**	
N-Ammonia	NV	NV	**35.0**		NA		NA	
Sulfide	NV	NV	**2,700**		NA		NA	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	**21**		< 20		< 20	
Arsenic	57	93	**158**		< 20		< 20	
Cadmium	5.1	6.7	**2.4**		< 0.7		< 0.9	
Chromium	260	270	**42.7**		**28.0**		**44**	
Copper	390	390	**669**		**372**		**42.1**	
Lead	450	530	**168**		**15**		**20**	
Mercury	0.41	0.59	**0.16**		**0.13**		< 0.07	
Nickel	NV	NV	**40**		**32**		**37**	
Silver	6.1	6.1	< 0.5		< 1.0		< 1.0	
Zinc	410	960	**1620**		**155**		**71**	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tributyl Tin Ion	0.073*		NA		NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*		*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA	
Tributyl Tin Ion	0.05**		NA		NA		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	**0.039**	**1.63**	**0.031**	**2.07**	**0.055**	**5.00**
Acenaphthene	16	57	**0.220**	**9.17**	< 0.020	< 1.33	**0.300**	**27.27**
Acenaphthylene	66	66	**0.038**	**1.58**	< 0.02	< 1.33	**0.063**	**5.73**
Anthracene	220	1,200	**0.76**	**31.7**	**0.054**	**3.60**	**0.380**	**34.55**
Fluorene	23	79	**0.27**	**11.3**	**0.022**	**1.47**	**0.280**	**25.45**
Naphthalene	99	170	**0.064**	**2.67**	**0.052**	**3.47**	**0.081**	**7.36**
Phenanthrene	100	480	**2.8 D**	**116.7 D**	**0.17**	**11.33**	**1.20**	**109.09**
Total LPAHs	**370**	**780**	**4.191**	**174.6**	**0.329**	**21.9**	**2.359**	**214.5**
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	**1.1**	**45.8**	**0.120**	**8.00**	**1.00**	**90.91**
Benzo(a)pyrene	99	210	**0.79**	**32.9**	**0.100**	**6.67**	**0.550**	**50.00**
Benzo(b)fluoranthene	230	450	**1.3**	**54.2**	**0.120**	**8.00**	**0.630**	**57.27**
Benzo(g,h,i)perylene	31	78	**0.25**	**10.4**	**0.061**	**4.07**	**0.100**	**9.09**
Benzo(k)fluoranthene	230	450	**0.89**	**37.1**	**0.094**	**6.27**	**0.490**	**44.55**
Chrysene	110	460	**1.1**	**45.8**	**0.170**	**11.33**	**1.20**	**109.09**
Dibenz(a,h)anthracene	12	33	**0.067**	**2.79**	< 0.020	< 1.33	**0.052**	**4.73**
Fluoranthene	160	1,200	**3 D**	**125.0 D**	**0.340**	**22.67**	**2.70**	**245.45**
Indeno(1,2,3-cd)pyrene	34	88	**0.31**	**12.9**	**0.062**	**4.13**	**0.160**	**14.55**
Pyrene	1,000	1,400	**2.5 D**	**104.2 D**	**0.390**	**26.00**	**4.00**	**363.64**
Total HPAHs	**960**	**5,300**	**11.3**	**471.1**	**1.5**	**97.1**	**10.9**	**989.3**
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	**0.14**	**5.83**	**0.25**	**16.67**	**0.110**	**10.00**
Butylbenzylphthalate	4.9	64	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.73
Diethylphthalate	61	110	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.73
Dimethylphthalate	53	53	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.73
Di-n-Butylphthalate	220	1,700	< 0.02	< 0.83	**0.045 B**	**3.00 B**	< 0.019	< 1.73
Di-n-Octyl phthalate	58	4,500	< 0.02	< 0.83	**0.200**	**13.33**	< 0.019	< 1.73
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	< 0.02		< 0.020		< 0.019	
2,4-Dimethylphenol	0.029	0.029	< 0.02		< 0.020		< 0.019	
2-Methylphenol	0.063	0.063	< 0.02		< 0.020		< 0.019	
4-Methylphenol	0.67	0.67	**0.062**		**0.073**		< 0.019	
Pentachlorophenol	0.36	0.69	< 0.098		< 0.099		< 0.097	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	**0.05**		**0.11**		< 0.019	
Benzoic Acid	0.65	0.65	< 0.20		< 0.20		< 0.19	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.73
1,2-Dichlorobenzene	2.3	2.3	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.73
1,3-Dichlorobenzene	NV	NV	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.73
1,4-Dichlorobenzene	3.1	9	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.73
Dibenzofuran	15	58	**0.14**	**5.83**	< 0.020	< 1.33	**0.190**	**17.3**
Hexachlorobenzene	0.38	2.3	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.73
Hexachlorobutadiene	3.9	6.2	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.73
N-Nitrosodiphenylamine	11	11	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.73
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.72
Aroclor 1221	12	65	< 0.039	< 1.63	< 0.040	< 2.67	< 0.039	< 3.55
Aroclor 1232	12	65	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.72
Aroclor 1242	12	65	< 0.02	< 0.83	< 0.020	< 1.33	< 0.019	< 1.72
Aroclor 1248	12	65	< 0.023	< 0.96	< 0.020	< 1.33	< 0.019	< 1.72
Aroclor 1254	12	65	**0.051**	**2.13**	**0.210**	**14.00**	< 0.019	< 1.72
Aroclor 1260	12	65	**0.034**	**1.42**	< 0.020	< 1.33	< 0.019	< 1.72
Total PCBs	**12**	**65**	**0.0850**	**3.54**	**0.210**	**14.00**	< 0.039	< 3.55

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 4-3 Summary of Remedial Investigation Analytical Data

Parameter	SMS Criteria SQS	MCUL	HV-30-S2 08/31/00		HV-30-S3 08/31/00	HV-31-S2 08/30/00	HV-38-S2 08/31/00	
Conventionals								
Total Solids (%)	NV	NV	**86.0**		NA	NA	**78.6**	
Total Preserved Solids (%)	NV	NV	NA		NA	NA	NA	
Total Organic Carbon (%)	NV	NV	**0.14**		NA	NA	**1.3**	
N-Ammonia	NV	NV	NA		NA	NA	NA	
Sulfide	NV	NV	NA		NA	NA	NA	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	
Antimony	NV	NV	NA		NA	NA	< 3	
Arsenic	57	93	NA		NA	NA	< 3	
Cadmium	5.1	6.7	NA		NA	NA	< 0.1	
Chromium	260	270	NA		NA	NA	**10.6**	
Copper	390	390	NA		NA	NA	**15.3**	
Lead	450	530	NA		NA	NA	**2**	
Mercury	0.41	0.59	< 0.04		< 0.06	**0.07**	< 0.06	
Nickel	NV	NV	NA		NA	NA	**9.7**	
Silver	6.1	6.1	NA		NA	NA	< 0.2	
Zinc	410	960	NA		NA	NA	**14.7**	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA	NA	NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA	NA	NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA	NA	NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA	NA	NA	
Tributyl Tin Ion	0.073*		NA		NA	NA	NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*		*(µg/L)*	*(µg/L)*	*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA	NA	NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA	NA	NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA	NA	NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA	NA	NA	
Tributyl Tin Ion	0.05**		NA		NA	NA	NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Acenaphthene	16	57	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Acenaphthylene	66	66	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Anthracene	220	1,200	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Fluorene	23	79	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Naphthalene	99	170	< 0.018	< 12.86	NA	NA	**0.017 J**	**1.3 J**
Phenanthrene	100	480	< 0.018	< 12.86	NA	NA	**0.032**	**2.5**
Total LPAHs	**370**	**780**	< 0.018	< 12.86	NA	NA	**0.049**	**3.8**
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	< 0.018	< 12.86	NA	NA	**0.019 J**	**1.5 J**
Benzo(a)pyrene	99	210	< 0.018	< 12.86	NA	NA	**0.017 J**	**1.3 J**
Benzo(b)fluoranthene	230	450	< 0.018	< 12.86	NA	NA	**0.013 J**	**1.0 J**
Benzo(g,h,i)perylene	31	78	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Benzo(k)fluoranthene	230	450	< 0.018	< 12.86	NA	NA	**0.020**	**1.5**
Chrysene	110	460	< 0.018	< 12.86	NA	NA	**0.025**	**1.9**
Dibenz(a,h)anthracene	12	33	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Fluoranthene	160	1,200	< 0.018	< 12.86	NA	NA	**0.036**	**2.8**
Indeno(1,2,3-cd)pyrene	34	88	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Pyrene	1,000	1,400	< 0.018	< 12.86	NA	NA	**0.049**	**3.8**
Total HPAHs	**960**	**5,300**	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	< 0.018	< 12.86	NA	NA	**0.015 J**	**1.2 J**
Butylbenzylphthalate	4.9	64	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Diethylphthalate	61	110	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Dimethylphthalate	53	53	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Di-n-Butylphthalate	220	1,700	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Di-n-Octyl phthalate	58	4,500	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	
Phenol	0.42	1.2	< 0.018		NA	NA	< 0.019	
2,4-Dimethylphenol	0.029	0.029	< 0.018		NA	NA	< 0.019	
2-Methylphenol	0.063	0.063	< 0.018		NA	NA	< 0.019	
4-Methylphenol	0.67	0.67	< 0.018		NA	NA	< 0.019	
Pentachlorophenol	0.36	0.69	< 0.091		NA	NA	< 0.097	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	< 0.018		NA	NA	< 0.019	
Benzoic Acid	0.65	0.65	< 0.18		NA	NA	< 0.19	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
1,2-Dichlorobenzene	2.3	2.3	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
1,3-Dichlorobenzene	NV	NV	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
1,4-Dichlorobenzene	3.1	9	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Dibenzofuran	15	58	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Hexachlorobenzene	0.38	2.3	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
Hexachlorobutadiene	3.9	6.2	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
N-Nitrosodiphenylamine	11	11	< 0.018	< 12.86	NA	NA	< 0.019	< 1.5
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	< 0.018	< 12.86	NA	NA	< 0.018	< 1.4
Aroclor 1221	12	65	< 0.036	< 25.71	NA	NA	< 0.036	< 2.8
Aroclor 1232	12	65	< 0.018	< 12.86	NA	NA	< 0.018	< 1.4
Aroclor 1242	12	65	< 0.018	< 12.86	NA	NA	< 0.018	< 1.4
Aroclor 1248	12	65	< 0.018	< 12.86	NA	NA	< 0.018	< 1.4
Aroclor 1254	12	65	< 0.018	< 12.86	NA	NA	< 0.018	< 1.4
Aroclor 1260	12	65	< 0.018	< 12.86	NA	NA	< 0.018	< 1.4
Total PCBs	**12**	**65**	< 0.036	< 25.71	NA	NA	< 0.036	< 2.8

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 4-3 Summary of Remedial Investigation Analytical Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HV-39-S2 08/31/00		HV-41-S2 08/31/00	HV-50-S2 08/31/00		HV-50-S3 08/31/00	
Conventionals									
Total Solids (%)	NV	NV	**87.4**		NA	**85.3**		**83.1**	
Total Preserved Solids (%)	NV	NV	NA		NA	NA		NA	
Total Organic Carbon (%)	NV	NV	**0.16**		NA	**0.19**		**0.085**	
N-Ammonia	NV	NV	NA		NA	NA		NA	
Sulfide	NV	NV	NA		NA	NA		NA	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	< 3		NA	< 5 **J**		NA	
Arsenic	57	93	< 3		NA	< 5		NA	
Cadmium	5.1	6.7	< 0.1		NA	< 0.2		NA	
Chromium	260	270	**23.3**		NA	**31.6**		NA	
Copper	390	390	**8.9**		NA	**7.2**		NA	
Lead	450	530	**1**		NA	**3**		NA	
Mercury	0.41	0.59	< 0.05		**0.05**	< 0.04		NA	
Nickel	NV	NV	**17.9**		NA	**25**		NA	
Silver	6.1	6.1	< 0.2		NA	< 0.3		NA	
Zinc	410	960	**16.2**		NA	**24**		NA	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA	NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA	NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA	NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA	NA		NA	
Tributyl Tin Ion	0.073*		NA		NA	NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*		*(µg/L)*	*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA	NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA	NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA	NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA	NA		NA	
Tributyl Tin Ion	0.05**		NA		NA	NA		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	< 0.019	< 11.9	NA	< 0.020	< 10.5	< 0.019	< 22.4
Acenaphthene	16	57	< 0.019	< 11.9	NA	< 0.020	< 10.5	< 0.019	< 22.4
Acenaphthylene	66	66	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Anthracene	220	1,200	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Fluorene	23	79	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Naphthalene	99	170	**0.020**	**12.5**	NA	< 0.02	< 10.5	< 0.019	< 22.4
Phenanthrene	100	480	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Total LPAHs	**370**	**780**	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Benzo(a)pyrene	99	210	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Benzo(b)fluoranthene	230	450	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Benzo(g,h,i)perylene	31	78	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Benzo(k)fluoranthene	230	450	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Chrysene	110	460	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Dibenz(a,h)anthracene	12	33	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Fluoranthene	160	1,200	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Indeno(1,2,3-cd)pyrene	34	88	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Pyrene	1,000	1,400	**0.014 J**	**8.8 J**	NA	< 0.02	< 10.5	< 0.019	< 22.4
Total HPAHs	**960**	**5,300**	< 0.019	< 11.9	NA	< 0.0	< 10.5	< 0.019	< 22.4
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	< 0.019	< 11.9	NA	**0.4**	**210.5**	< 0.019	< 22.4
Butylbenzylphthalate	4.9	64	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Diethylphthalate	61	110	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Dimethylphthalate	53	53	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Di-n-Butylphthalate	220	1,700	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Di-n-Octyl phthalate	58	4,500	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	< 0.019		NA	< 0.02		< 0.019	
2,4-Dimethylphenol	0.029	0.029	< 0.019		NA	< 0.02		< 0.019	
2-Methylphenol	0.063	0.063	< 0.019		NA	< 0.02		< 0.019	
4-Methylphenol	0.67	0.67	< 0.019		NA	< 0.02		< 0.019	
Pentachlorophenol	0.36	0.69	< 0.097		NA	< 0.10		< 0.093	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	< 0.019		NA	< 0.02		< 0.019	
Benzoic Acid	0.65	0.65	< 0.19		NA	< 0.20		< 0.19	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
1,2-Dichlorobenzene	2.3	2.3	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
1,3-Dichlorobenzene	NV	NV	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
1,4-Dichlorobenzene	3.1	9	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Dibenzofuran	15	58	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Hexachlorobenzene	0.38	2.3	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
Hexachlorobutadiene	3.9	6.2	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
N-Nitrosodiphenylamine	11	11	< 0.019	< 11.9	NA	< 0.02	< 10.5	< 0.019	< 22.4
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	< 0.020	< 12.5	NA	< 0.018	< 9.47	NA	NA
Aroclor 1221	12	65	< 0.039	< 24.4	NA	< 0.037	< 19.5	NA	NA
Aroclor 1232	12	65	< 0.020	< 12.5	NA	< 0.018	< 9.47	NA	NA
Aroclor 1242	12	65	< 0.020	< 12.5	NA	< 0.018	< 9.47	NA	NA
Aroclor 1248	12	65	< 0.020	< 12.5	NA	< 0.018	< 9.47	NA	NA
Aroclor 1254	12	65	< 0.020	< 12.5	NA	< 0.018	< 9.47	NA	NA
Aroclor 1260	12	65	< 0.020	< 12.5	NA	< 0.018	< 9.47	NA	NA
Total PCBs	**12**	**65**	< 0.039	< 24.4	NA	< 0.0370	< 19.5	NA	NA

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 4-3 Summary of Remedial Investigation Analytical Data

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HV51S2A 09/05/00		HV52S2 09/05/00		HV53S2 09/05/00		HV-54-S2 09/01/00		HV-54-S3 09/01/00	
Conventionals												
Total Solids (%)	NV	NV	**80.9**		**83.5**		**78.8**		**90.2**		**83.4**	
Total Preserved Solids (%)	NV	NV	NA		NA		NA		NA		NA	
Total Organic Carbon (%)	NV	NV	**0.19**		**0.13**		**1.4**		**0.28**		**0.32**	
N-Ammonia	NV	NV	NA		NA		NA		NA		NA	
Sulfide	NV	NV	NA		NA		NA		NA		NA	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Antimony	NV	NV	< 6 **J**		< 10		< 6		< 10		NA	
Arsenic	57	93	< 6		< 10		< 6		**10**		NA	
Cadmium	5.1	6.7	< 0.2		< 0.6		**0.5**		< 0.5		NA	
Chromium	260	270	**17.5**		**28.0**		**26.7**		**24.0**		NA	
Copper	390	390	**6.8**		**8.2**		**24.8**		**15.1**		NA	
Lead	450	530	**3**		< 6		**51**		< 5		NA	
Mercury	0.41	0.59	< 0.06		< 0.04		**0.06**		< 0.05		NA	
Nickel	NV	NV	**15**		**29**		**24**		**36**		NA	
Silver	6.1	6.1	< 0.4		< 0.9		< 0.3		< 0.8		NA	
Zinc	410	960	**20**		**23**		**55**		**28**		NA	
Bulk Organotins	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.073*		NA		NA		NA		NA		NA	
Porewater Organotins	*(ug/L)*	*(ug/L)*	*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*		*(µg/L)*	
Butyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Dibutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tetrabutyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin (as Chloride)	NV	NV	NA		NA		NA		NA		NA	
Tributyl Tin Ion	0.05**		NA		NA		NA		NA		NA	
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
2-Methylnaphthalene	38	64	< 0.019	< 10.0	< 0.020	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
Acenaphthene	16	57	< 0.019	< 10.0	< 0.020	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
Acenaphthylene	66	66	< 0.019	< 10.0	< 0.02	< 15.4	**0.037**	**2.64**	< 0.018	< 6.43	< 0.018	< 5.63
Anthracene	220	1,200	< 0.019	< 10.0	< 0.02	< 15.4	**0.075**	**5.36**	< 0.018	< 6.43	< 0.018	< 5.63
Fluorene	23	79	< 0.019	< 10.0	< 0.02	< 15.4	**0.034**	**2.43**	< 0.018	< 6.43	< 0.018	< 5.63
Naphthalene	99	170	< 0.019	< 10.0	< 0.02	< 15.4	**0.055**	**3.93**	< 0.018	< 6.43	< 0.018	< 5.63
Phenanthrene	100	480	< 0.019	< 10.0	< 0.02	< 15.4	**0.19**	**13.6**	< 0.018	< 6.43	< 0.018	< 5.63
Total LPAHs	**370**	**780**	< 0.019	< 10.0	< 0.02	< 15.4	**0.391**	**27.9**	< 0.018	< 6.43	< 0.018	< 5.63
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Benzo(a)anthracene	110	270	< 0.019	< 10.0	< 0.02	< 15.4	**0.3**	**21.4**	**0.06**	**21.4**	< 0.018	< 5.63
Benzo(a)pyrene	99	210	< 0.019	< 10.0	< 0.02	< 15.4	**0.22**	**15.7**	**0.042**	**15.0**	< 0.018	< 5.63
Benzo(b)fluoranthene	230	450	< 0.019	< 10.0	< 0.02	< 15.4	**0.16**	**11.4**	**0.041**	**14.6**	< 0.018	< 5.63
Benzo(g,h,i)perylene	31	78	< 0.019	< 10.0	< 0.02	< 15.4	**0.093**	**6.64**	< 0.018	< 6.43	< 0.018	< 5.63
Benzo(k)fluoranthene	230	450	< 0.019	< 10.0	< 0.02	< 15.4	**0.26**	**18.6**	**0.063**	**22.5**	< 0.018	< 5.63
Chrysene	110	460	< 0.019	< 10.0	< 0.02	< 15.4	**0.29**	**20.7**	**0.094**	**33.6**	< 0.018	< 5.63
Dibenz(a,h)anthracene	12	33	< 0.019	< 10.0	< 0.02	< 15.4	**0.04**	**2.86**	< 0.018	< 6.43	< 0.018	< 5.63
Fluoranthene	160	1,200	< 0.019	< 10.0	< 0.02	< 15.4	**1.1**	**78.6**	**0.25**	**89.3**	< 0.018	< 5.63
Indeno(1,2,3-cd)pyrene	34	88	< 0.019	< 10.0	< 0.02	< 15.4	**0.086**	**6.14**	< 0.018	< 6.43	< 0.018	< 5.63
Pyrene	1,000	1,400	< 0.019	< 10.0	< 0.02	< 15.4	**1.1**	**78.6**	**0.14**	**50.0**	< 0.018	< 5.63
Total HPAHs	**960**	**5,300**	< 0.019	< 10.0	< 0.0	< 15.4	**3.6**	**260.6**	**0.7**	**246.4**	< 0.018	< 5.63
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
bis(2-Ethylhexyl)phthalate	47	78	< 0.019	< 10.0	**0.021**	**16.2**	< 0.019	< 1.36	**0.4**	**143**	< 0.018	< 5.63
Butylbenzylphthalate	4.9	64	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
Diethylphthalate	61	110	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
Dimethylphthalate	53	53	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
Di-n-Butylphthalate	220	1,700	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
Di-n-Octyl phthalate	58	4,500	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Phenol	0.42	1.2	< 0.019		< 0.02		< 0.019		< 0.018		< 0.018	
2,4-Dimethylphenol	0.029	0.029	< 0.019		< 0.02		< 0.019		< 0.018		< 0.018	
2-Methylphenol	0.063	0.063	< 0.019		< 0.02		< 0.019		< 0.018		< 0.018	
4-Methylphenol	0.67	0.67	< 0.019		< 0.02		**0.038**		< 0.018		< 0.018	
Pentachlorophenol	0.36	0.69	< 0.094		< 0.099		< 0.096		< 0.092		< 0.092	
Misc. Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*		*(mg/kg)*	
Benzyl Alcohol	0.057	0.073	< 0.019		< 0.02		< 0.019		< 0.018		< 0.018	
Benzoic Acid	0.65	0.65	< 0.19		< 0.20		< 0.19		< 0.18		< 0.18	
Misc. Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
1,2,4-Trichlorobenzene	0.81	1.8	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
1,2-Dichlorobenzene	2.3	2.3	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
1,3-Dichlorobenzene	NV	NV	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
1,4-Dichlorobenzene	3.1	9	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
Dibenzofuran	15	58	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
Hexachlorobenzene	0.38	2.3	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
Hexachlorobutadiene	3.9	6.2	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
N-Nitrosodiphenylamine	11	11	< 0.019	< 10.0	< 0.02	< 15.4	< 0.019	< 1.36	< 0.018	< 6.43	< 0.018	< 5.63
PCBs	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*
Aroclor 1016	12	65	< 0.018	< 9.47	< 0.02	< 15.4	< 0.018	< 1.29	< 0.018	< 6.43	NA	NA
Aroclor 1221	12	65	< 0.035	< 18.4	< 0.039	< 30.0	< 0.036	< 2.57	< 0.037	< 13.2	NA	NA
Aroclor 1232	12	65	< 0.018	< 9.47	< 0.02	< 15.4	< 0.018	< 1.29	< 0.018	< 6.4	NA	NA
Aroclor 1242	12	65	< 0.018	< 9.47	< 0.02	< 15.4	< 0.018	< 1.29	< 0.018	< 6.4	NA	NA
Aroclor 1248	12	65	< 0.018	< 9.47	< 0.02	< 15.4	< 0.018	< 1.29	< 0.018	< 6.4	NA	NA
Aroclor 1254	12	65	< 0.018	< 9.47	< 0.02	< 15.4	< 0.018	< 1.29	< 0.018	< 6.4	NA	NA
Aroclor 1260	12	65	< 0.018	< 9.47	< 0.02	< 15.4	< 0.018	< 1.29	< 0.018	< 6.4	NA	NA
Total PCBs	**12**	**65**	< 0.035	< 18.4	< 0.039	< 30.0	< 0.036	< 2.57	< 0.037	< 13.21	NA	NA

NOTES:

Bold values detected at or above the laboratory detection limit.
Single underlined values exceed the SQS value.
Double underlined values exceed the MCUL value.
NV - No Value.
NA - Not Analyzed.
D - Indicates value reported in diluted sample.
J - Estimated value.
* The 0.073 mg/kg criteria for bulk TBT derived from PSDDA screening level for sediments
** The 0.05 ug/kg criteria for porewater TBT is based on a no adverse effects level that would protect most (~95%) of Puget Sound species tested (Michelsen et al, 1998)

Table 4-4 Summary of Supplemental Surface Sediment Chemical Concentrations

Parameter	SMS Criteria SQS	SMS Criteria MCUL	HB-1			HB-2			HB-3			HB-4			REF-1		
Conventionals			***Round 1***	***Round 2***		***Round 1***	***Round 2***		***Round 1***	***Round 2***		***Round 1***	***Round 2***		***Round 1***	***Round 2***	
Total Solids (%)	nv	nv	**38.7**	**30.5**		**33.0**	**32.6**		**37.3**	**34.7**		**31.2**	**28.1**		**34.3**	**33.1**	
Total Volatile Solids(%)	nv	nv	**6.6**	**-**		**8.4**	**-**		**7.5**	**-**		**9.1**	**-**		**7.5**	**-**	
Total Organic Carbon (%)	nv	nv	**2.6**	**-**		**2.6**	**-**		**2.3**	**-**		**2.5**	**-**		**1.9**	**-**	
Ammonia (mg/kg)	nv	nv	**19**	**41**		**54**	**26**		**16**	**19**		**34**	**50**		**12**	**15**	
Total Sulfides (mg/kg)	nv	nv	**1,200**	**2,400**		**1,900**	**3,100**		**1,900**	**1,600**		**1,600**	**3,800**		**160**	**1,200**	
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*		
Antimony	nv	nv	<10		U	<10		U	<10		U	<20		U	<10		U
Arsenic	57	93	<10		U	<10		U	<10		U	<20		U	<10		U
Cadmium	5.1	6.7	**0.9**			**0.7**			**1.5**			**1.2**			<0.6		U
Chromium	260	270	**58**			**71**			**77**			**71**			**44**		
Copper	390	390	**69.7**			**106**			**114**			**90.1**			**31.1**		
Lead	450	530	**17**			**22**			**18**			**23**			**14**		
Mercury	0.41	0.59	**0.2**			**0.3**			**0.3**			**0.3**			<0.1		U
Nickel	nv	nv	**77**			**91**			**96**			**93**			**38**		
Silver	6.1	6.1	<0.8		U	<0.9		U	<0.8		U	<1		U	<0.9		U
Zinc	410	960	**104**			**145**			**129**			**151**			**81**		
Organotins (porewater)*	*(µg/L)*	*(µg/L)*	*(µg/L)*			*(µg/L)*			*(µg/L)*			*(µg/L)*			*(µg/L)*		
Monobutyl Tin	nv	nv	<0.045		UG	<0.045		UG	<0.045		UG	<0.045		UG	**0.067**		**E**
Dibutyl Tin	nv	nv	<0.045		UG	<0.045		UG	<0.045		UG	<0.045		UG	**0.054**		**E**
Tributyl Tin	0.05 *	nv	<0.022		U	<0.022		U	<0.022		U	<0.022		U	<0.022		U
Organotins *	*(µg/kg)*	*(µg/kg)*	*(µg/kg)*			*(µg/kg)*			*(µg/kg)*			*(µg/kg)*			*(µg/kg)*		
Monobutyl Tin	nv	nv	<5.3		U	<5.3		U	<5.3		U	<5.3		U	<5.3		U
Dibutyl Tin	nv	nv	**5.4**		**E**	**7.8**		**E**	<5.3		UG	**5.5**		**E**	<5.3		UG
Tributyl Tin	nv	nv	**25.8**		**E**	**44.5**			**32.0**			**32.0**			<5.3		U
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Naphthalene	99	170	**0.067**	**3.54**		**0.034**	**1.31**		**0.037**	**1.43**		<0.020	<0.80	U	<0.020	<1.05	U
Acenaphthylene	66	66	**0.023**	**1.19**		<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Acenaphthene	16	57	<0.020	<0.77	U	<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Fluorene	23	79	**0.023**	**1.23**		<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Phenanthrene	100	480	**0.124**	**6.54**		**0.078**	**3.00**		**0.105**	**4.04**		**0.267**	**11.60**		<0.020	<1.05	U
Anthracene	220	1200	**0.057**	**3.00**		**0.042**	**1.62**		**0.036**	**1.39**		**0.120**	**5.20**		<0.020	<1.05	U
2-Methylnaphthalene	38	64	**0.020**	**1.04**		<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Total LPAH	370	780	**0.5**	**17.3**		**0.2**	**9.0**		**0.3**	**10.3**		**0.5**	**20.8**		<0.020	<1.05	U
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Fluoranthene	160	1200	**0.219**	**11.54**		**0.180**	**6.92**		**0.226**	**8.70**		**0.635**	**27.60**		<0.020	<1.05	U
Pyrene	1000	1400	**0.227**	**11.92**		**0.150**	**5.77**		**0.170**	**6.52**		**0.469**	**20.40**		<0.020	<1.05	U
Benzo(a)anthracene	110	270	**0.095**	**5.00**		**0.100**	**3.85**		**0.081**	**3.13**		**0.304**	**13.20**		<0.020	<1.05	U
Chrysene	110	460	**0.168**	**8.85**		**0.160**	**6.15**		**0.158**	**6.09**		**0.359**	**15.60**		<0.020	<1.05	U
Benzofluoranthenes	230	450	**0.234**	**12.31**		**0.195**	**7.50**		**0.173**	**6.65**		**0.377**	**16.40**		<0.040	<2.10	U
Benzo(a)pyrene	99	210	**0.110**	**5.77**		**0.088**	**3.38**		**0.081**	**3.13**		**0.184**	**8.00**		<0.020	<1.05	U
Indeno(1,2,3-cd)pyrene	34	88	**0.071**	**3.73**		**0.044**	**1.69**		**0.054**	**2.09**		**0.079**	**3.44**		<0.020	<1.05	U
Dibenzo(a,h)anthracene	12	33	**0.015**	**0.81**		<0.020	<0.77	U	<0.020	<0.87	U	**0.032**	**1.40**		<0.020	<1.05	U
Benzo(g,h,i)perylene	31	78	**0.054**	**2.85**		**0.035**	**1.35**		**0.038**	**1.48**		**0.057**	**2.48**		<0.020	<1.05	U
Total HPAH	960	5300	**1.2**	**62.8**		**1.0**	**37.4**		**1.0**	**38.7**		**2.5**	**108.5**		<0.040	<2.10	U
Chlorinated Hydrocarbons	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
1,3-Dichlorobenzene	nv	nv	<0.020	<0.77	U	<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.002	<0.12	U
1,4-Dichlorobenzene	3.1	9	<0.020	<0.77	U	<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.002	<0.12	U
1,2-Dichlorobenzene	2.3	2.3	<0.020	<0.77	U	<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.002	<0.12	U
1,2,4-Trichlorobenzene	0.81	1.8	<0.020	<0.77	U	<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.011	<0.58	U
Hexachlorobenzene	0.38	2.3	<0.001	<0.038	U	<0.001	<0.037	U	<0.001	<0.043	Y	<0.001	<0.039	U	<0.001	<0.052	U
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Dimethyl phthalate	53	53	<0.020	<0.77	U	<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Diethyl phthalate	61	110	<0.020	<0.77	U	**0.065**	**2.5**		<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Di-n-butyl phthalate	220	1700	<0.020	<0.77	U	<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Butyl benzyl phthalate	4.9	64	<0.020	<0.77	U	<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Bis(2-ethylhexyl)phthalate	47	78	**0.130**	**5.00**	**B**	**0.140**	**5.38**	**B**	**0.049**	**2.13**	**B**	**0.024**	**0.96**	**B**	<0.020	<1.05	U
Di-n-octyl phthalate	58	4500	<0.020	<0.77	U	<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*		
Phenol	0.42	1	**0.025**		**M**	**0.037**		**M**	**0.025**		**M**	**0.024**		**M**	<0.020		U
2-Methylphenol	0.063	0.063	<0.020		U	<0.020		U	<0.020		U	<0.020		U	<0.020		U
4-Methylphenol	0.67	0.67	**0.13**			**0.095**			**0.170**			**0.120**			<0.020		U
2,4-Dimethylphenol	0.029	0.029	<0.020		U	<0.020		U	<0.020		U	<0.020		U	<0.020		U
Pentachlorophenol	0.36	0.69	**0.13**			<0.098		U	<0.099		U	<0.099		U	<0.099		U
Miscellaneous Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*		
Benzyl alcohol	0.057	0.073	<0.020		U	<0.020		U	<0.020		U	<0.020		U	<0.020		U
Benzoic acid	0.65	0.65	<0.200		U	<0.200		U	<0.200		U	<0.200		U	<0.200		U
Miscellaneous Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Dibenzofuran	15	58	**0.027**	**1.42**		<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Hexachloroethane	nv	nv	<0.020	<0.77	U	<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Hexachlorobutadiene	3.9	6.2	<0.001	<0.038	U	<0.001	<0.037	U	<0.001	<0.042	U	<0.001	<0.044	Y	<0.001	<0.052	U
N-Nitrosodiphenylamine	11	11	<0.020	<0.77	U	<0.020	<0.77	U	<0.020	<0.87	U	<0.020	<0.80	U	<0.020	<1.05	U
Volatile Organics	*(µg/kg)*	*(µg/kg)*	*(µg/kg)*			*(µg/kg)*			*(µg/kg)*			*(µg/kg)*			*(µg/kg)*		
Trichloroethene	nv	nv	-			-			-			-			<2.3		U
Tetrachlorethene	nv	nv	-			-			-			-			<2.3		U
Ethylbenzene	nv	nv	-			-			-			-			<2.3		U
Total xylenes	nv	nv	-			-			-			-			<4.6		U
Pesticides	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
DDT	nv	nv	<0.002	<0.077	U	<0.002	<0.073	U	<0.002	<0.083	U	<0.002	<0.080	U	<0.002	<0.105	U
Aldrin	nv	nv	<0.001	<0.038	U	<0.001	<0.037	U	<0.001	<0.042	U	<0.001	<0.039	U	<0.001	<0.052	U
alpha-chlordane	nv	nv	<0.001	<0.038	U	<0.001	<0.037	U	<0.001	<0.042	U	<0.001	<0.039	U	<0.001	<0.052	U
dieldrin	nv	nv	<0.002	<0.077	U	<0.002	<0.073	U	<0.002	<0.083	U	<0.002	<0.080	U	<0.002	<0.105	U
heptachlor	nv	nv	<0.001	<0.038	U	<0.001	<0.037	U	<0.001	<0.042	U	<0.001	<0.039	U	<0.001	<0.052	U
gamma-BHC (Lindane)	nv	nv	<0.001	<0.038	U	<0.001	<0.037	U	<0.001	<0.042	U	<0.001	<0.039	U	<0.001	<0.052	U
Aroclor 1016	nv	nv	<0.019	<0.73	U	<0.019	<0.73	U	<0.019	<0.83	U	<0.019	<0.76	U	<0.019	<1.00	U
Aroclor 1242	nv	nv	<0.020	<0.77	U	<0.019	<0.73	U	<0.019	<0.83	U	<0.020	<0.80	U	<0.020	<1.05	U
Aroclor 1248	nv	nv	<0.020	<0.77	U	<0.019	<0.73	U	<0.019	<0.83	U	<0.020	<0.80	U	<0.020	<1.05	U
Aroclor 1254	nv	nv	<0.020	<0.77	U	<0.019	<0.73	U	<0.019	<0.83	U	<0.020	<0.80	U	<0.020	<1.05	U
Aroclor 1260	nv	nv	<0.020	<0.77	U	<0.019	<0.73	U	<0.019	<0.83	U	<0.020	<0.80	U	<0.020	<1.05	U
Aroclor 1221	nv	nv	<0.039	<1.50	U	<0.076	<2.92	Y	<0.039	<1.70	U	<0.039	<1.56	U	<0.039	<2.05	U
Aroclor 1232	nv	nv	<0.023	<0.88	Y	<0.021	<0.81	Y	<0.025	<1.09	Y	<0.023	<0.92	Y	<0.020	<1.05	U
Total PCBs ***	12	65	<0.039	<1.50	U	<0.076	<2.92	U	<0.039	<1.70	U	<0.039	<1.56	U	<0.039	<8.3	U

Notes:
Bold values at or above laboratory detection limit and underlined values exceed the SQS value.
All data has been validated according to QA-2 protocols.
* Ecology's 1996 SMARM paper establishes 0.050 ug/L as a conceptual equivalent of an SQS for tributyl tin in porewater.
** Bulk and porewater TBT were originally reported as TBT-chloride (in ppb) and converted to TBT (in ppb) by multiplying by 0.89.
*** Total PCBs are calculated by summing detected concentrations of Aroclors.
nv - No value currently established under SMS or PSDDA.
U = Undetected
B = False positivite, blank contamination
Y = Raised reporting limit due to background interference
P = High RPD for dual column GC analyses
M = Estimated value but with low spectral match
E = Estimated concentration, direction of bias, if determined, is identified in the data verification report
UG = Undetected, reporting limit may be biased low

Table 4-5 Summary of PSDDA Investigation Chemical Concentrations

Parameter	SMS Criteria		PSDDA Criteria [15]			HC-1A-S1			HC-1B-S1			HC-2-S1			HC-3-S1		
	SQS	MCUL	SL	BT	ML												
Conventionals																	
Total Solids (%)	nv	nv	nv	nv	nv	**72.2**			**74.7**			**78.5**			**85**		
Total Volatile Solids(%)	nv	nv	nv	nv	nv	**3.3**			**1.9**			**2.1**			**1.4**		
Total Organic Carbon (%)	nv	nv	nv	nv	nv	**1.2**			**1.6**			**1.4**			**0.25**		
Ammonia (mg/kg)	nv	nv	nv	nv	nv	**3.4**			**2.9**			**4.5**			**0.45**		
Total Sulfides (mg/kg)	nv	nv	nv	nv	nv	**120**			**140**			**11,000**			<1.10		U
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*		
Antimony	nv	nv	150	nv	200	<7		U	<7		U	<7		U	<6		U
Arsenic	57	93	57	507.1	700	**10**			**10**			**67**			**14**		
Cadmium	5.1	6.7	5.1	11.3	14	**0.3**			**0.4**			**0.9**			**0.3**		
Chromium	260	270	nv	267	nv	**26.1**		**J**	**30.3**		**J**	**47.9**		**J**	**34.6**		**J**
Copper	390	390	390	1,027	1,300	**19.9**			**43.9**			**195**			**79.1**		
Lead	450	530	450	975	1,200	**9**			**10**			**86**			**39**		
Mercury	0.41	0.59	0.41	1.5	2.3	**0.08**			**0.09**			**0.12**			<0.05		U
Nickel	nv	nv	140	370	370	**24**			**29**			**29**			**55**		
Silver	6.1	6.1	6.1	6.1	8.4	<0.4		U	<0.4		U	<0.4		U	<0.4		U
Zinc	410	960	410	2,783	3,800	**38.4**			**55.2**			**622**			**189**		
Porewater Organotins *	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*			*(µg/L)*			*(µg/L)*			*(µg/L)*		
Monobutyl Tin	nv	nv	nv	nv	nv	<0.045		UG	**0.340**		**J**	<0.055		UG	N/A		
Dibutyl Tin	nv	nv	nv	nv	nv	<0.045		UG	**0.890**		**J**	<0.055		UG	N/A		
Tributyl Tin	0.05 *	nv	0.15	0.15	nv	<0.022		UG	<0.022		UG	<0.028		UG	N/A		
Porewater Organotins * (reextracted)	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*			*(µg/L)*			*(µg/L)*			*(µg/L)*		
Monobutyl Tin	nv	nv	nv	nv	nv	<0.060		UG	<0.045		UG	N/A			N/A		
Dibutyl Tin	nv	nv	nv	nv	nv	<0.060		UG	<0.045		UG	N/A			N/A		
Tributyl Tin	0.05 *	nv	0.15	0.15	nv	<0.029		UG	<0.022		UG	N/A			N/A		
Organotins *	*(µg/kg)*	*(µg/kg)*	*(µg/kg)*	*(µg/kg)*	*(µg/kg)*	*(µg/kg)*			*(µg/kg)*			*(µg/kg)*			*(µg/kg)*		
Monobutyl Tin	nv	nv	nv	nv	nv	<5.0		U	<5.3		U	<5.0		U	<5.3		U
Dibutyl Tin	nv	nv	nv	nv	nv	<5.0		UG	**16.9**		**J**	<5.0		UG	**14.2**		**J**
Tributyl Tin	nv	nv	nv	nv	nv	<5.0		U	**28.0**			**8.9**			**55.2**		
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Naphthalene	99	170	2.1	nv	2.4	<0.020	<1.7	U	<0.019	<1.2	U	**0.041**	**2.9**		<0.020	<8.0	U
Acenaphthylene	66	66	0.56	nv	1.3	<0.020	<1.7	U	<0.019	<1.2	U	**0.037**	**2.6**		<0.020	<8.0	U
Acenaphthene	16	57	0.5	nv	2	<0.020	<1.7	U	<0.019	<1.2	U	**1.4**	**100**		<0.020	<8.0	U
Fluorene	23	79	0.54	nv	3.6	<0.020	<1.7	U	<0.019	<1.2	U	**1.2**	**86**		<0.020	<8.0	U
Phenanthrene	100	480	1.5	nv	21	**0.024**	**2.0**		**0.037**	**2.3**		**4.6**	**329**		**0.120**	**48.0**	
Anthracene	220	1200	0.96	nv	13	<0.020	<1.7	U	<0.019	<1.2	U	**0.780**	**55.7**		**0.033**	**13**	
2-Methylnaphthalene	38	64	0.67	nv	1.9	<0.020	<1.7	U	<0.019	<1.2	U	<0.019	<1.4	U	<0.020	<8.0	U
Total LPAH	370	780	5.2	nv	29	**0.024**	**12.0**		**0.037**	**9.4**		**8.058**	**577**		**0.153**	**101**	
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Fluoranthene	160	1200	1.7	4.6	30	**0.048**	**4.0**		**0.069**	**4.3**		**6.300**	**450**		**0.540**	**216**	
Pyrene	1000	1400	2.6	11.98	16	**0.057**	**4.8**		**0.071**	**4.4**		**5.200**	**371**		**0.390**	**156**	
Benzo(a)anthracene	110	270	1.3	nv	5.1	**0.022**	**1.8**		**0.036**	**2.3**		**1.300**	**92.86**		**0.069**	**28**	
Chrysene	110	460	1.4	nv	21	**0.035**	**2.9**		**0.057**	**3.6**		**1.000**	**71.43**		**0.190**	**76.0**	
Benzofluoranthenes	230	450	3.2	nv	9.9	**0.062**	**5.2**		**0.082**	**5.1**		**1.740**	**124.3**		**0.240**	**96.0**	
Benzo(a)pyrene	99	210	1.6	nv	3.6	**0.030**	**2.5**		**0.040**	**2.5**		**0.850**	**60.7**		**0.083**	**33**	
Indeno(1,2,3-cd)pyrene	34	88	0.6	nv	4.4	<0.020	<1.7	U	**0.023**	**1.4**		**0.260**	**18.6**		**0.035**	**14**	
Dibenzo(a,h)anthracene	12	33	0.23	nv	1.9	<0.020	<1.7	U	<0.019	<1.2	U	**0.110**	**7.86**		<0.020	<8.0	U
Benzo(g,h,i)perylene	31	78	0.67	nv	3.2	<0.020	<1.7	U	**0.022**	**1.4**		**0.230**	**16.4**		**0.029**	**12**	
Total HPAH	960	5300	12	nv	69	**0.254**	**26.2**		**0.400**	**26.2**		**16.990**	**1,214**		**1.576**	**638**	
Chlorinated Hydrocarbons	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
1,3-Dichlorobenzene	nv	nv	0.17	nv	nv	<0.001	<0.08	U	<0.001	<0.06	U	<0.001	<0.07	U	<0.001	<0.4	U
1,4-Dichlorobenzene	3.1	9	0.11	nv	0.12	<0.001	<0.08	U	<0.001	<0.06	U	<0.001	<0.07	U	<0.001	<0.4	U
1,2-Dichlorobenzene	2.3	2.3	0.035	nv	0.11	<0.001	<0.08	U	<0.001	<0.06	U	<0.001	<0.07	U	<0.001	<0.4	U
1,2,4-Trichlorobenzene	0.81	1.8	0.031	nv	0.064	<0.005	<0.4	U	<0.005	<0.3	U	<0.006	<0.4	U	<0.004	<2	U
Hexachlorobenzene	0.38	2.3	0.022	0.168	0.23	<0.001	<0.08	U	<0.001	<0.06	U	<0.001	<0.07	U	<0.001	<0.4	U
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Dimethyl phthalate	53	53	1.4	nv	nv	<0.020	<1.7	U	<0.019	<1.2	U	<0.019	<1.4	U	<0.020	<8.0	U
Diethyl phthalate	61	110	1.2	nv	nv	<0.020	<1.7	U	<0.019	<1.2	U	<0.019	<1.4	U	<0.020	<8.0	U
Di-n-butyl phthalate	220	1700	5.1	nv	nv	<0.020	<1.7	U	<0.019	<1.2	U	<0.019	<1.4	U	<0.020	<8.0	U
Butyl benzyl phthalate	4.9	64	0.97	nv	nv	<0.020	<1.7	U	<0.019	<1.2	U	<0.019	<1.4	U	<0.020	<8.0	U
Bis(2-ethylhexyl)phthalate	47	78	8.3	nv	nv	<0.020	<1.7	U	<0.019	<1.2	U	**0.041**	**2.9**		**0.053**	**21**	
Di-n-octyl phthalate	58	4500	6.2	nv	nv	<0.020	<1.7	U	<0.019	<1.2	U	<0.019	<1.4	U	<0.020	<8.0	U
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*		
Phenol	0.42	1	0.42	nv	1.2	<0.020		U	<0.019		U	<0.019		U	<0.020		U
2-Methylphenol	0.063	0.063	0.063	nv	0.077	<0.020		U	<0.019		U	<0.019		U	<0.020		U
4-Methylphenol	0.67	0.67	0.67	nv	3.6	<0.020		U	<0.019		U	<0.019		U	<0.020		U
2,4-Dimethylphenol	0.029	0.029	0.029	nv	0.21	<0.020		U	<0.019		U	<0.019		U	<0.020		U
Pentachlorophenol	0.36	0.69	0.4	0.504	0.69	<0.099		U	<0.096		U	<0.097		U	<0.098		U
Miscellaneous Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*		
Benzyl alcohol	0.057	0.073	0.057	nv	0.87	<0.020		UG	<0.019		UG	<0.019		UG	<0.020		UG
Benzoic acid	0.65	0.65	0.65	nv	0.76	<0.200		U	<0.190		U	<0.190		U	<0.200		U
Miscellaneous Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Dibenzofuran	15	58	0.54	nv	1.7	<0.020	<1.7	U	<0.019	<1.2	U	**0.210**	**15.0**		<0.020	<8.0	U
Hexachloroethane	nv	nv	1.4	nv	14	<0.020	<1.7	U	<0.019	<1.2	U	<0.019	<1.4	U	<0.020	<8.0	U
Hexachlorobutadiene	3.9	6.2	0.029	nv	0.27	<0.001	<0.08	U	<0.001	<0.06	U	<0.001	<0.07	U	<0.001	<0.4	U
N-Nitrosodiphenylamine	11	11	0.028	nv	0.13	<0.020	<1.7	U	<0.019	<1.2	U	<0.019	<1.4	U	<0.020	<8.0	U
Volatile Organics	*(µg/kg)*	*(µg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(µg/kg)*			*(µg/kg)*			*(µg/kg)*			*(µg/kg)*		
Trichloroethene	nv	nv	0.16	nv	1.6	<0.001		U	<0.001		U	<0.001		U	<0.001		U
Tetrachlorethene	nv	nv	0.057	nv	0.21	<0.001		U	<0.001		U	<0.001		U	<0.001		U
Ethylbenzene	nv	nv	0.01	nv	0.05	<0.001		U	<0.001		U	<0.001		U	<0.001		U
Total xylenes	nv	nv	0.04	nv	0.16	<0.002		U	<0.002		U	<0.002		U	<0.002		U
Pesticides	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
DDT	nv	nv	0.0069	0.05	0.069	<0.006	<0.5	U	<0.006	<0.4	U	<0.011	<0.79	Y	<0.006	<2.4	U
Aldrin	nv	nv	0.01	nv	nv	<0.001	<0.08	U	<0.001	<0.06	U	<0.001	<0.07	U	<0.001	<0.4	U
alpha-chlordane	nv	nv	0.01	0.037	nv	<0.001	<0.08	U	<0.001	<0.06	U	<0.001	<0.07	U	<0.001	<0.4	U
dieldrin	nv	nv	0.01	nv	nv	<0.002	<0.2	U	<0.002	<0.1	U	<0.002	<0.1	U	<0.002	<0.8	U
heptachlor	nv	nv	0.01	nv	nv	<0.001	<0.08	U	<0.001	<0.06	U	<0.001	<0.07	U	<0.001	<0.4	U
alpha-BHC	nv	nv	nv	10 **	nv	<0.001	<0.083	U	<0.001	<0.063	U	<0.009	<0.614	Y	**0.012**	**4.8**	
gamma-BHC (Lindane)	nv	nv	0.01	nv	nv	<0.001	<0.08	U	<0.001	<0.06	U	<0.001	<0.07	U	<0.001	<0.4	U
Aroclor 1016	nv	nv	nv	nv	nv	<0.020	<1.7	U	<0.020	<1.3	U	<0.020	<1.4	U	<0.020	<8.0	U
Aroclor 1242	nv	nv	nv	nv	nv	<0.020	<1.7	U	<0.020	<1.3	U	<0.020	<1.4	U	<0.020	<8.0	U
Aroclor 1248	nv	nv	nv	nv	nv	<0.020	<1.7	U	<0.020	<1.3	U	<0.020	<1.4	U	<0.020	<8.0	U
Aroclor 1254	nv	nv	nv	nv	nv	<0.020	<1.7	U	<0.020	<1.3	U	**0.058**	**4.1**		<0.020	<8.0	U
Aroclor 1260	nv	nv	nv	nv	nv	<0.020	<1.7	U	<0.020	<1.3	U	<0.076	<5.4	Y	<0.020	<8.0	U
Aroclor 1221	nv	nv	nv	nv	nv	<0.039	<3.3	U	<0.039	<2.4	U	<0.039	<2.8	U	<0.040	<16.0	U
Aroclor 1232	nv	nv	nv	nv	nv	<0.020	<1.7	U	<0.020	<1.3	U	<0.020	<1.4	U	<0.020	<8.0	U
Total PCBs ***	12	65	0.13	38**	3.1		<3.3	U	<0.039	<2.4	U	**0.058**	**4.1**		<0.040	<16.0	U

Notes:
Bold values at or above laboratory detection limit
Underlined values exceed the SQS value in SMS or the SL value of PSDDA
Double underlined values exceed the CSL
Data has been validated according to QA-2 protocols.
* Bulk and porewater TBT were originally reported as TBT-chloride (in ppb) and converted to TBT (in ppb) by multiplying by 0.89.
** This value is normalized to total organic carbon, and is expressed in mg/kg (TOC normalized).
*** Total PCBs are calculated by summing detected concentrations of Aroclors.
nv - No value currently established under PSDDA.
NA = Not analyzed
U = Undetected
Y = Raised reporting limit due to background interference
J = Estimated concentration
UG = Undetected, reporting limit may be biased low
UJ = Undetected, reporting limit is estimated, direction of bias is not determined

Table 4-5 Summary of PSDDA Investigation Chemical Concentrations

Parameter	SMS Criteria		PSDDA Criteria [15]			HC-4-S1			HC-7B-S1			REF-1			REF-2		
	SQS	MCUL	SL	BT	ML												
Conventionals																	
Total Solids (%)	nv	nv	nv	nv	nv	**72.9**			**68.6**			**54.8**			**58.7**		
Total Volatile Solids(%)	nv	nv	nv	nv	nv	**2.2**			**2.6**			**4.6**			**3.4**		
Total Organic Carbon (%)	nv	nv	nv	nv	nv	**0.57**			**1.8**			**1.7**			**1.4**		
Ammonia (mg/kg)	nv	nv	nv	nv	nv	**4.5**			**4.1**			**18**			**21**		
Total Sulfides (mg/kg)	nv	nv	nv	nv	nv	**9.90**			**93.0**			**270**			**240**		
Metals	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*		
Antimony	nv	nv	150	nv	200	<7		U	<7		U	NA			NA		
Arsenic	57	93	57	507.1	700	**8**			**11**			NA			NA		
Cadmium	5.1	6.7	5.1	11.3	14	**0.3**			**0.4**			NA			NA		
Chromium	260	270	nv	267	nv	**35.1**		J	**32.5**		J	NA			NA		
Copper	390	390	390	1,027	1,300	**33.1**			**25.6**			NA			NA		
Lead	450	530	450	975	1,200	**12**			**11**			NA			NA		
Mercury	0.41	0.59	0.41	1.5	2.3	**0.08**			**0.09**			NA			NA		
Nickel	nv	nv	140	370	370	**32**			**35**			NA			NA		
Silver	6.1	6.1	6.1	6.1	8.4	<0.4		U	<0.4		U	NA			NA		
Zinc	410	960	410	2,783	3,800	**53.9**			**49.8**			NA			NA		
Porewater Organotins *	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*			*(µg/L)*			*(µg/L)*			*(µg/L)*		
Monobutyl Tin	nv	nv	nv	nv	nv	<0.045		UG	<0.045		UG	NA			NA		
Dibutyl Tin	nv	nv	nv	nv	nv	<0.045		UG	<0.045		UG	NA			NA		
Tributyl Tin	0.05 *	nv	0.15	0.15	nv	<0.022		UG	<0.022		UG	NA			NA		
Porewater Organotins * (reextracted)	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*	*(µg/L)*			*(µg/L)*			*(µg/L)*			*(µg/L)*		
Monobutyl Tin	nv	nv	nv	nv	nv	<0.045		UG	<0.060		UG	NA			NA		
Dibutyl Tin	nv	nv	nv	nv	nv	<0.045		UG	<0.060		UG	NA			NA		
Tributyl Tin	0.05 *	nv	0.15	0.15	nv	<0.022		UG	<0.029		UG	NA			NA		
Organotins *	*(µg/kg)*	*(µg/kg)*	*(µg/kg)*	*(µg/kg)*	*(µg/kg)*	*(µg/kg)*			*(µg/kg)*			*(µg/kg)*			*(µg/kg)*		
Monobutyl Tin	nv	nv	nv	nv	nv	<5.2		U	<5.2		U	NA			NA		
Dibutyl Tin	nv	nv	nv	nv	nv	<5.2		UG	<5.2		UG	NA			NA		
Tributyl Tin	nv	nv	nv	nv	nv	**10.7**			**11.6**			NA			NA		
LPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Naphthalene	99	170	2.1	nv	2.4	<0.020	<3.5	U	**0.023**	**1.3**		NA	NA		NA	NA	
Acenaphthylene	66	66	0.56	nv	1.3	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Acenaphthene	16	57	0.5	nv	2	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Fluorene	23	79	0.54	nv	3.6	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Phenanthrene	100	480	1.5	nv	21	**0.040**	**7.0**		**0.049**	**2.7**		NA	NA		NA	NA	
Anthracene	220	1200	0.96	nv	13	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
2-Methylnaphthalene	38	64	0.67	nv	1.9	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Total LPAH	370	780	5.2	nv	29	**0.040**	**28**		**0.072**	**9.3**		NA	NA		NA	NA	
HPAH	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Fluoranthene	160	1200	1.7	4.6	30	**0.094**	**16**		**0.087**	**4.8**		NA	NA		NA	NA	
Pyrene	1000	1400	2.6	11.98	16	**0.079**	**14**		**0.082**	**4.6**		NA	NA		NA	NA	
Benzo(a)anthracene	110	270	1.3	nv	5.1	**0.042**	**7.4**		**0.034**	**1.9**		NA	NA		NA	NA	
Chrysene	110	460	1.4	nv	21	**0.054**	**9.5**		**0.044**	**2.4**		NA	NA		NA	NA	
Benzofluoranthenes	230	450	3.2	nv	9.9	**0.077**	**14**		**0.081**	**4.5**		NA	NA		NA	NA	
Benzo(a)pyrene	99	210	1.6	nv	3.6	**0.038**	**6.7**		**0.040**	**2.2**		NA	NA		NA	NA	
Indeno(1,2,3-cd)pyrene	34	88	0.6	nv	4.4	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Dibenzo(a,h)anthracene	12	33	0.23	nv	1.9	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Benzo(g,h,i)perylene	31	78	0.67	nv	3.2	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Total HPAH	960	5300	12	nv	69	**0.384**	**78**		**0.368**	**23.6**		NA	NA		NA	NA	
Chlorinated Hydrocarbons	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
1,3-Dichlorobenzene	nv	nv	0.17	nv	nv	<0.001	<0.2	U	<0.001	<0.06	U	NA	NA		NA	NA	
1,4-Dichlorobenzene	3.1	9	0.11	nv	0.12	<0.001	<0.2	U	<0.001	<0.06	U	NA	NA		NA	NA	
1,2-Dichlorobenzene	2.3	2.3	0.035	nv	0.11	<0.001	<0.2	U	<0.001	<0.06	U	NA	NA		NA	NA	
1,2,4-Trichlorobenzene	0.81	1.8	0.031	nv	0.064	<0.004	<0.7	U	<0.005	<0.3	U	NA	NA		NA	NA	
Hexachlorobenzene	0.38	2.3	0.022	0.168	0.23	<0.001	<0.2	U	<0.001	<0.06	U	NA	NA		NA	NA	
Phthalates	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Dimethyl phthalate	53	53	1.4	nv	nv	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Diethyl phthalate	61	110	1.2	nv	nv	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Di-n-butyl phthalate	220	1700	5.1	nv	nv	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Butyl benzyl phthalate	4.9	64	0.97	nv	nv	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Bis(2-ethylhexyl)phthalate	47	78	8.3	nv	nv	**0.033**	**5.8**		<0.019	<1.1	U	NA	NA		NA	NA	
Di-n-octyl phthalate	58	4500	6.2	nv	nv	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Phenols	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*		
Phenol	0.42	1	0.42	nv	1.2	<0.020		U	<0.019		U	NA			NA		
2-Methylphenol	0.063	0.063	0.063	nv	0.077	<0.020		U	<0.019		U	NA			NA		
4-Methylphenol	0.67	0.67	0.67	nv	3.6	<0.020		U	<0.019		U	NA			NA		
2,4-Dimethylphenol	0.029	0.029	0.029	nv	0.21	<0.020		U	<0.019		U	NA			NA		
Pentachlorophenol	0.36	0.69	0.4	0.504	0.69	<0.098		U	<0.097		U	NA			NA		
Miscellaneous Extractables	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*			*(mg/kg)*			*(mg/kg)*			*(mg/kg)*		
Benzyl alcohol	0.057	0.073	0.057	nv	0.87	<0.020		UG	<0.019		UG	NA			NA		
Benzoic acid	0.65	0.65	0.65	nv	0.76	<0.200		U	<0.190		U	NA			NA		
Miscellaneous Extractables	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
Dibenzofuran	15	58	0.54	nv	1.7	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Hexachloroethane	nv	nv	1.4	nv	14	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Hexachlorobutadiene	3.9	6.2	0.029	nv	0.27	<0.001	<0.2	U	<0.019	<1.1	U	NA	NA		NA	NA	
N-Nitrosodiphenylamine	11	11	0.028	nv	0.13	<0.020	<3.5	U	<0.019	<1.1	U						
Volatile Organics	*(µg/kg)*	*(µg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(µg/kg)*			*(µg/kg)*			*(µg/kg)*			*(µg/kg)*		
Trichloroethene	nv	nv	0.16	nv	1.6	<0.001		U	<0.001		U	NA			NA		
Tetrachlorethene	nv	nv	0.057	nv	0.21	<0.001		U	<0.001		U	NA			NA		
Ethylbenzene	nv	nv	0.01	nv	0.05	<0.001		U	<0.001		U	NA			NA		
Total xylenes	nv	nv	0.04	nv	0.16	<0.002		U	<0.002		U	NA			NA		
Pesticides	*(ppm TOC)*	*(ppm TOC)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*		*(mg/kg)*	*(ppm TOC)*	
DDT	nv	nv	0.0069	0.05	0.069	<0.007	<1.2	Y	<0.006	<0.3	U	NA	NA		NA	NA	
Aldrin	nv	nv	0.01	nv	nv	<0.001	<0.2	U	<0.001	<0.06	U	NA	NA		NA	NA	
alpha-chlordane	nv	nv	0.01	0.037	nv	<0.001	<0.2	U	<0.001	<0.06	U	NA	NA		NA	NA	
dieldrin	nv	nv	0.01	nv	nv	<0.002	<0.4	U	<0.002	<0.1	U	NA	NA		NA	NA	
heptachlor	nv	nv	0.01	nv	nv	<0.001	<0.2	U	<0.001	<0.06	U	NA	NA		NA	NA	
alpha-BHC	nv	nv	nv	10 **	nv	<0.001	<0.175	U	<0.001	<0.056	U	NA	NA		NA	NA	
gamma-BHC (Lindane)	nv	nv	0.01	nv	nv	<0.001	<0.2	U	<0.001	<0.06	U	NA	NA		NA	NA	
Aroclor 1016	nv	nv	nv	nv	nv	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Aroclor 1242	nv	nv	nv	nv	nv	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Aroclor 1248	nv	nv	nv	nv	nv	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Aroclor 1254	nv	nv	nv	nv	nv	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Aroclor 1260	nv	nv	nv	nv	nv	**0.026**	**4.6**		<0.019	<1.1	U	NA	NA		NA	NA	
Aroclor 1221	nv	nv	nv	nv	nv	<0.039	<6.8	U	<0.039	<2.2	U	NA	NA		NA	NA	
Aroclor 1232	nv	nv	nv	nv	nv	<0.020	<3.5	U	<0.019	<1.1	U	NA	NA		NA	NA	
Total PCBs ***	12	65	0.13	38**	3.1	**0.026**	**4.6**		<0.039	<2.2	U	NA	NA		NA	NA	

Notes:
Bold values at or above laboratory detection limit
Underlined values exceed the SQS value in SMS or the SL value of PSDDA
Double underlined values exceed the CSL
Data has been validated according to QA-2 protocols.
* Bulk and porewater TBT were originally reported as TBT-chloride (in ppb) and converted to TBT (in ppb) by multiplying b
** This value is normalized to total organic carbon, and is expressed in mg/kg (TOC normalized).
*** Total PCBs are calculated by summing detected concentrations of Aroclors.
nv - No value currently established under PSDDA.
NA = Not analyzed
U = Undetected
Y = Raised reporting limit due to background interference
J = Estimated concentration
UG = Undetected, reporting limit may be biased low
UJ = Undetected, reporting limit is estimated, direction of bias is not determined

Table 4-6 Summary of SMS Chemical Exceedances

Sample Location	Parameter	Concentration	SQS Criteria	MCUL Criteria	Units	SQS Exceedance	MCUL Exceedance
PSDDA Sampling							
HC-2-S1	Arsenic	67	57	93	mg/kg	X	
HC-2-S1	Zinc	622	410	960	mg/kg	X	
HC-2-S1	Acenaphthene	100	16	57	ppm TOC		X
HC-2-S1	Fluorene	86	23	79	ppm TOC		X
HC-2-S1	Phenanthrene	329	100	480	ppm TOC	X	
HC-2-S1	Total LPAH	577	562	780	ppm TOC	X	
HC-2-S1	Fluoranthene	450	160	1,200	ppm TOC	X	
HC-2-S2	Total HPAH	1,214	960	5,300	ppm TOC	X	
HC-2-S1	Dibenzofuran	15.0	15	58	ppm TOC	X	
RI Sampling							
HG-30	Fluoranthene	164	160	1,200	ppm TOC	X	
HG-30	bis(2-Ethylhexyl)phthalate	255	47	78	ppm TOC		X
HG-30	2,4-Dimethylphenol	0.031	0.029	0.029	mg/kg		X
HG-30	Total PCBs	14.4	12[a]	65	ppm TOC	X	
HG-30 Dup	Copper	428	390	390	mg/kg dry wt.		X
HG-32	Benzyl alcohol	0.31	0.057	0.073	mg/kg dry wt.		X
HG-33	Copper	608	390	390	mg/kg dry wt.		X
HG-33	Zinc	536	410	960	mg/kg dry wt.	X	
HG-33	Chrysene	125	110	460	ppm TOC	X	
HG-33	Fluoranthene	167	160	1,200	ppm TOC	X	
HG-33	Total PCBs	18.3	12[a]	65	ppm TOC	X	
HG-36	Benzyl alcohol	0.17	0.057	0.073	mg/kg dry wt.		X
HG-38	Copper	959	390	390	mg/kg dry wt.		X
HG-38	Zinc	901	410	960	mg/kg dry wt.	X	
HG-38	Butylbenzylphthalate	7.67	4.9	64	ppm TOC	X	
HG-38	Benzyl alcohol	0.076	0.057	0.073	mg/kg dry wt.		X
HG-39	Fluorene	46.7	23	79	ppm TOC	X	
HG-39	Phenanthrene	144	100	480	ppm TOC	X	
HG-39	Dibenzofuran	15.6	15	58	ppm TOC	X	
HG-39 Dup	Copper	657	390	390	mg/kg dry wt.		X
HG-45	Acenaphthene	27.3	16	57	ppm TOC	X	
HG-45	Fluorene	25.5	23	79	ppm TOC	X	
HG-45	Phenanthrene	109	100	480	ppm TOC	X	
HG-45	Fluoranthene	245	160	1,200	ppm TOC	X	
HG-45	Total HPAH	989.3	960	5,300	ppm TOC	X	
HG-45	Dibenzofuran	17.3	15	58	ppm TOC	X	
HG-42	Arsenic	158	57	93	mg/kg dry wt.		X
HG-42	Copper	669	390	390	mg/kg dry wt.		X
HG-42	Zinc	1620	410	960	mg/kg dry wt.		X
HG-44	Benzyl alcohol	0.11	0.057	0.073	mg/kg dry wt.		X
HG-44	Total PCBs	14.0	12[a]	65	ppm TOC	X	
HV-50-S2	bis(2-Ethylhexyl)phthalate	210.5	47	78	ppm TOC		X
HV-54-S2	bis(2-Ethylhexyl)phthalate	142.9	47	78	ppm TOC		X
Phase 2 Sampling							
HG-2	Lead	512	450	530	mg/kg dry wt.	X	
HG-3	Total PCBs	25.0	12	65	ppm TOC	X	
HG-4	Total PCBs	56.25	12	65	ppm TOC	X	
HG-8	Total PCBs	26.79	12	65	ppm TOC	X	
HG-10	Copper	397	390	390	mg/kg dry wt.		X
HG-10	bis(2-Ethylhexyl)phthalate	58.3	47	78	ppm TOC	X	
HG-10	Butylbenzylphthalate	62.5	4.9	64	ppm TOC	X	
HV-4A (0-10cm)	Mercury	0.42	0.41	0.59	mg/kg dry wt.	X	
HV-4A (0-10cm)	Total PCBs	72.2 J	12	65	ppm TOC		X
HV-6A (0-10cm)	Mercury	0.51	0.41	0.59	mg/kg dry wt.	X	

NOTES:

[a] A site-specific total PCBs criteria of 6 ppm TOC was established based on a human health risk assessment.

[b] The TOC normalized concentations exceed criteria. However this is in large part due to the low TOC content of these samples, (0.19% and 0.28%, respectively). If a TOC content of 1 % is used for normalization, both samples would pass the SQS chemical criteria.

Table 4-8 Summary of 2000 RI/FS Sampling 10-Day Amphipod Bioassay Testing

Sample Location	Replicate	Initial Count	Final Count	Percent Mortality
Control	A	20	16	20
	B	20	19	5
	C	20	17	15
	D	20	19	5
	E	20	16	20
	Mean	20	17.4	**13**
Reference	A	20	18	10
	B	20	19	5
	C	20	17	15
	D	20	20	0
	E	20	17	15
	Mean	20	18.2	**9**
HG-38	A	20	16	20
	B	20	19	5
	C	20	15	25
	D	20	15	25
	E	20	16	20
	Mean	20	16.2	**19**
HG-42	A	20	17	15
	B	20	16	20
	C	20	18	10
	D	20	16	20
	E	20	19	5
	Mean	20	17.2	**14**

Table 4-9 Summary of 2000 RI/FS Neanthes Bioassay Testing

Sample Location	Replicate	Initial Count	Final Count	Percent Survival	Total Worm Weight (mg)	Average Weight Per Worm (mg)	Mean Individual Growth Rate (mg/ind/day)
Control	A	5	5	100	73.37	14.67	0.73
	B	5	5	100	82.52	16.50	0.83
	C	5	5	100	64.69	12.94	0.65
	D	5	5	100	62.18	12.44	0.62
	E	5	5	100	79.66	15.93	0.80
	Mean			100		14.50	**0.72**
Reference	A	5	5	100	65.21	13.04	0.65
	B	5	3	60	40.58	13.53	0.68
	C	5	5	100	58.27	11.65	0.58
	D	5	5	100	55.89	11.18	0.56
	E	5	5	100	73.03	14.61	0.73
	Mean			92		12.80	**0.64**
HG-38	A	5	5	100	73.16	14.63	0.73
	B	5	3	60	36.04	12.01	0.60
	C	5	5	100	42.93	8.59	0.43
	D	5	5	100	55.5	11.10	0.56
	E	5	5	100	60.78	12.16	0.61
	Mean			92		11.70	**0.58**
HG-42	A	5	5	100	72.55	14.51	0.73
	B	5	5	100	59.48	11.90	0.59
	C	5	5	100	62.58	12.52	0.63
	D	5	5	100	58.31	11.66	0.58
	E	5	5	100	63.7	12.74	0.64
	Mean			100		12.66	**0.63**

Table 4-10 Summary of 2000 RI/FS Larval Bioassay Results – 11/01/00 Test Date

Site	Replicate	Initial Number of Embryos, T=0	Number Normal	Number Abnormal	Total Number	N_C/ Mean Initial
Control	A	156	264	111	375	0.99
	B	288	268	65	333	1.00
	C	286	279	88	367	1.04
	D	308	254	98	352	0.95
	E	302	291	81	372	1.09
	Mean	268	271	89	360	**1.01**

Site	Replicate	Number Normal	Number Abnormal	Total Number	N_R/N_C
Ref-S2	A	83	58	141	0.31
	B	136	58	194	0.50
	C	110	53	163	0.41
	D	106	37	143	0.39
	E	60	44	104	0.22
	Mean	99	50	149	**0.37**

Site	Replicate	Number Normal	Number Abnormal	Total Number	N_T/N_C	$[(N_T/N_C)/(N_R/N_C)]$	Mean $[(N_T/N_C)/(N_R/N_C)]$
HG-38	A	3	6	9	0.011	0.03	
	B	10	13	23	0.037	0.101	
	C	9	12	21	0.033	0.09	
	D	6	12	18	0.022	0.061	
	E	11	38	49	0.041	0.1111	**0.079**
HG-42	A	7	5	12	0.026	0.07	
	B	19	7	26	0.070	0.19	
	C	70	61	131	0.26	0.71	
	D	7	9	16	0.026	0.07	
	E	13	37	50	0.048	0.13	**0.23**

Table 4-11 Summary of 2000 RI/FS Larval Bioassay Results – 11/15/00 Test Date

Site	Replicate	Initial Number of Embryos, T=0	Number Normal	Number Abnormal	Total Number	N_C/Mean Initial
Control	A	302	289	49	338	0.78
	B	377	268	54	322	0.72
	C	400	287	31	318	0.77
	D	408	288	68	356	0.78
	E	369	295	56	351	0.79
	Mean	371	285.4	51.6	337	**0.77**

Site	Replicate	Number Normal	Number Abnormal	Total Number	N_R/N_C
Ref - S2	A	221	22	243	0.77
	B	85	17	102	0.30
	C	163	51	214	0.57
	D	214	31	245	0.75
	E	112	81	193	0.39
	Mean	159	40.4	199.4	**0.56**

Site	Replicate	Number Normal	Number Abnormal	Total Number	N_T/N_C	Normal Survival $[(N_T/N_C)/(N_R/N_C)]$	Mean Nor. Surv. $[(N_T/N_C)/(N_R/N_C)]$
HG-32	A	24	30	54	0.084	0.15	
	B	6	7	13	0.021	0.038	
	C	23	56	79	0.081	0.14	
	D	10	35	45	0.035	0.063	
	E	1	28	29	0.0035	0.0063	**0.081**
HG-36	A	42	18	60	0.15	0.26	
	B	28	51	79	0.10	0.18	
	C	65	51	116	0.23	0.41	
	D	72	11	83	0.25	0.45	
	E	43	31	74	0.15	0.27	**0.31**
HG-38	A	5	9	14	0.018	0.03	
	B	12	24	36	0.042	0.08	
	C	9	3	12	0.032	0.06	
	D	6	10	16	0.021	0.04	
	E	6	17	23	0.021	0.04	**0.048**
HG-39	A	108	66	174	0.38	0.68	
	B	65	20	85	0.23	0.41	
	C	85	36	121	0.30	0.53	
	D	67	29	96	0.23	0.42	
	E	74	54	128	0.26	0.47	**0.50**
HG-42	A	23	12	35	0.081	0.14	
	B	11	24	35	0.039	0.07	
	C	40	28	68	0.14	0.25	
	D	59	46	105	0.21	0.37	
	E	32	41	73	0.11	0.20	**0.21**

Table 4-12 Summary of 2000 RI/FS Larval Bioassay Results – 11/29/00 Test Date

Site	Replicate	Initial Number of Embryos, T=0	Number Normal	Number Abnormal	Total Number	N_C/Mean Initial
Control	A	119	94	25	119	0.48
	B	196	168	28	196	0.86
	C	229	198	31	229	1.01
	D	230	190	40	230	0.97
	E	203	169	34	203	0.86
	Mean	195	163.8	31.6	195.4	**0.84**

Site	Replicate	Number Normal	Number Abnormal	Total Number	N_R/N_C
Ref - S2	A	34	43	77	0.21
	B	90	17	107	0.55
	C	116	26	142	0.71
	D	120	22	142	0.73
	E	167	25	192	1.02
	Mean	105.4	26.6	132	**0.64**

Site	Replicate	Number Normal	Number Abnormal	Total Number	N_T/N_C	$[(N_T/N_C)/(N_R/N_C)]$	Mean $[(N_T/N_C)/(N_R/N_C)]$
HG-32	A	151	17	168	0.92	1.43	
	B	63	4	67	0.38	0.598	
	C	44	19	63	0.27	0.42	
	D	40	17	57	0.24	0.380	
	E	34	29	63	0.21	0.3226	**0.63**
HG-36	A	50	1	51	0.31	0.47	
	B	64	5	69	0.39	0.61	
	C	69	6	75	0.42	0.65	
	D	22	10	32	0.13	0.21	
	E	19	5	24	0.12	0.18	**0.43**
HG-38	A	26	19	45	0.159	0.25	
	B	14	25	39	0.085	0.13	
	C	12	4	16	0.073	0.11	
	D	20	2	22	0.12	0.19	
	E	5	11	16	0.031	0.05	**0.15**
HG-39	A	42	8	50	0.26	0.40	
	B	66	7	73	0.40	0.63	
	C	80	22	102	0.49	0.76	
	D	58	8	66	0.35	0.55	
	E	93	13	106	0.57	0.88	**0.64**
HG-42	A	23	18	41	0.140	0.22	
	B	47	36	83	0.287	0.45	
	C	34	31	65	0.21	0.32	
	D	33	32	65	0.20	0.31	
	E	96	25	121	0.59	0.91	**0.44**

Table 4-13 Summary of 2003 Supplemental Amphipod (Ampelisca abdita) Testing – September 19, 2003 Test Date

Sample Location	Replicate	Initial Count	Final Count	Percent Mortality
Control	A	20	18	10%
	B	20	17	15%
	C	20	18	10%
	D	20	18	10%
	E	20	18	10%
	Mean	20	17.8	**11%**
Reference	A	20	16	20%
	B	20	16	20%
	C	20	16	20%
	D	20	15	25%
	E	20	19	5%
	Mean	20	16.4	**18%**
HB-1	A	20	16	20%
	B	20	15	25%
	C	20	14	30%
	D	20	14	30%
	E	20	16	20%
	Mean	20	15	**25%**
HB-2	A	20	16	20%
	B	20	14	30%
	C	20	15	25%
	D	20	14	30%
	E	20	19	5%
	Mean	20	15.6	**22%**
HB-3	A	20	13	35%
	B	20	18	10%
	C	20	17	15%
	D	20	18	10%
	E	20	15	25%
	Mean	20	16.2	**19%**
HB-4 [1]	A	20	4	80%
	B	20	3	85%
	C	20	5	75%
	D	20	3	85%
	E	20	2	90%
	Mean	20	3.4	**83%**

[1] Sediment from HB-4 was recollected on November 6, 2003 and retested to confirm toxicity. See Table 4-14.

Table 4-14 Summary of 2003 Supplemental Amphipod (Ampelisca abdita) Testing – November 15, 2003 Test Date

Sample Location	Replicate	Initial Count	Final Count	Percent Mortality
Control	A	20	16	20%
	B	20	15	25%
	C	20	18	10%
	D	20	19	5%
	E	20	19	5%
	Mean	20	17.4	**13%**
Reference	A	20	16	20%
	B	20	6	70%
	C	20	0	100%
	D	20	13	35%
	E	20	13	35%
	Mean	20	9.6	**52%**
HB-4	A	20	10	50%
	B	20	16	20%
	C	20	11	45%
	D	20	12	40%
	E	20	14	30%
	Mean	20	12.6	**37%**

Note: Reference survival did not meet criteria; therefore, the test was rerun. See Table 4-15.

Table 4-15 Summary of 2003 Supplemental Amphipod (Ampelisca abdita) Testing – January 6, 2004 Test Date

Sample Location	Replicate	Initial Count	Final Count	Percent Mortality
Control	A	20	20	0%
	B	20	20	0%
	C	20	17	15%
	D	20	20	0%
	E	20	18	10%
	Mean	20	19	**5%**
Reference	A	20	15	25%
	B	20	17	15%
	C	20	14	30%
	D	20	18	10%
	E	20	16	20%
	Mean	20	16	**20%**
HB-4	A	20	18	10%
	B	20	3	85%
	C	20	16	20%
	D	20	16	20%
	E	20	17	15%
	Mean	20	14	**30%**

Note:

The amphipod test was reperformed on sediment recollected on November 6, 2003 from HB-4. Due to low reference survival, the test was rerun.

Table 4-16 Summary of 2003 Supplemental Neanthes Testing – September 5, 2003 Test Date

Sample Location	Replicate	Initial Count	Final Count	Percent Survival	Total Weight Per Worm (mg)	Growth Per Worm (mg)	Mean Individual Growth Rate (mg/ind/day)
Control	A	5	5	100	12.67	11.95	0.60
	B	5	5	100	9.06	8.34	0.42
	C	5	5	100	10.53	9.82	0.49
	D	5	5	100	9.81	9.09	0.45
	E	5	5	100	10.66	9.95	0.50
	Mean			100	10.55	9.83	**0.49**
Reference	A	5	5	100	11.15	10.43	0.52
	B	5	5	100	7.94	7.22	0.36
	C	5	4	80	10.95	10.23	0.51
	D	5	4	80	11.75	11.03	0.55
	E	5	5	100	8.14	7.42	0.37
	Mean			92	9.98	9.27	**0.46**
HB-1	A	5	5	100	12.32	11.60	0.58
	B	5	5	100	10.10	9.38	0.47
	C	5	4	80	10.84	10.12	0.51
	D	5	4	80	11.57	10.85	0.54
	E	5	5	100	8.09	7.37	0.37
	Mean			92	10.58	9.87	**0.49**
HB-2	A	5	5	100	9.58	8.86	0.44
	B	5	5	100	13.50	12.79	0.64
	C	5	5	100	14.83	14.12	0.71
	D	5	5	100	14.94	14.22	0.71
	E	5	4	80	13.33	12.62	0.63
	Mean			96	13.24	12.52	**0.63**
HB-3	A	5	5	100	11.46	10.75	0.54
	B	5	5	100	15.74	15.03	0.75
	C	5	5	100	12.50	11.79	0.59
	D	5	5	100	11.51	10.79	0.54
	E	5	5	100	18.69	17.97	0.90
	Mean			100	13.98	13.27	**0.66**
HB-4	A	5	5	100	14.74	14.03	0.70
	B	5	4	80	11.87	11.16	0.56
	C	5	5	100	13.37	12.65	0.63
	D	5	5	100	18.05	17.33	0.87
	E	5	5	100	8.12	7.40	0.37
	Mean			96	13.23	12.51	**0.63**

Note: Initial organism weight estimated from 5 replicates = 0.72 mg/org.

Table 4-17 Summary of 2003 Supplemental Larval Testing – September 4, 2003 Test Date

Site	Replicate	Initial Number of Embryos, T=0	Number Normal	Number Abnormal	Total Number	N_C/Mean Initial
Control	A	216	94	5	99	0.44
	B	216	60	6	66	0.28
	C	216	100	9	109	0.46
	D	216	79	13	92	0.37
	E	216	108	8	116	0.50
	Mean	216	88.2	8.2	96.4	**0.41**

Site	Replicate	Number Normal	Number Abnormal	Total Number	N_R/N_C
Reference	A	92	10	102	1.04
	B	107	8	115	1.21
	C	105	10	115	1.19
	D	62	15	77	0.70
	E	98	7	105	1.11
	Mean	92.8	10	103	**1.05**

Site	Replicate	Number Normal	Number Abnormal	Total Number	N_T/N_C	$[(N_T/N_C)/(N_R/N_C)]$	Mean $[(N_T/N_C)/(N_R/N_C)]$
HB-1	A	78	11	89	0.88	0.84	
	B	78	20	98	0.88	0.84	
	C	73	15	88	0.83	0.79	
	D	82	14	96	0.93	0.88	
	E	69	15	84	0.78	0.74	**0.82**
HB-2	A	83	16	99	0.94	0.89	
	B	94	10	104	1.07	1.01	
	C	39	19	58	0.44	0.42	
	D	86	11	97	0.98	0.93	
	E	69	7	76	0.78	0.74	**0.80**
HB-3	A	79	7	86	0.896	0.85	
	B	63	13	76	0.714	0.68	
	C	49	18	67	0.556	0.53	
	D	65	10	75	0.74	0.70	
	E	58	16	74	0.658	0.63	**0.68**
HB-4	A	64	13	77	0.73	0.69	
	B	40	9	49	0.45	0.43	
	C	58	13	71	0.66	0.63	
	D	60	6	66	0.68	0.65	
	E	73	5	78	0.83	0.79	**0.64**

*Compared to SMS Criteria

Note: Due to low normal survival in the control, the test was rerun on recollected sediment. See Table 4-18.

Table 4-18 Summary of 2003 Supplemental Larval Test Results – November 12, 2003 Test Date

Site	Replicate	Initial Number of Embryos, T=0	Number Normal	Number Abnormal	Total Number	N_C/Mean Initial
Control	A	203	224	13	237	1.10
	B	203	160	35	195	0.79
	C	203	130	22	152	0.64
	D	203	143	16	159	0.70
	E	203	100	12	112	0.49
	Mean	203	151.4	19.6	171	**0.75**

Site	Replicate	Number Normal	Number Abnormal	Total Number	N_R/N_C
Reference	A	138	4	142	0.91
	B	150	5	155	0.99
	C	99	17	116	0.65
	D	131	11	142	0.87
	E	152	5	157	1.00
	Mean	134	8	142	**0.89**

Site	Replicate	Number Normal	Number Abnormal	Total Number	N_T/N_C	$[(N_T/N_C)/(N_R/N_C)]$	Mean $[(N_T/N_C)/(N_R/N_C)]$
HB-1	A	197	9	206	1.30	1.47	
	B	152	9	161	1.00	1.13	
	C	164	12	176	1.08	1.22	
	D	163	13	176	1.08	1.22	
	E	164	16	180	1.08	1.22	**1.25**
HB-2	A	179	11	190	1.18	1.34	
	B	172	11	183	1.14	1.28	
	C	148	5	153	0.98	1.10	
	D	177	9	186	1.17	1.32	
	E	153	10	163	1.01	1.14	**1.24**
HB-3	A	124	6	130	0.819	0.93	
	B	144	10	154	0.951	1.07	
	C	173	12	185	1.143	1.29	
	D	132	9	141	0.87	0.99	
	E	170	7	177	1.123	1.27	**1.11**
HB-4	A	160	15	175	1.06	1.19	
	B	173	18	191	1.14	1.29	
	C	161	18	179	1.06	1.20	
	D	138	14	152	0.91	1.03	
	E	170	15	185	1.12	1.27	**1.20**

*Compared to SMS Criteria

Table 4-22 Bioassay Endpoint Evaluation

Bioassay Test	Test Date	Site	Statistical Difference Present (Yes/No) [1,2]	Exceeds SQS Effect Criteria (Yes/No)	Exceeds MCUL Effect Criteria (Yes/No)	SQS Bioligical Criteria (Pass/Fail) [3]	MCUL Biological Criteria (Pass/Fail) [3]
Amphipod			*t-test, p=0.05*	M_T > 25%, Absolute	$M_T - M_C$ >30%		
	11/1/2000	HG-38	Yes	No	No	Pass	Pass
	11/1/2000	HG-42	No	No	No	Pass	Pass
	9/19/2003	HB-1	No	No	No	Pass	Pass
	9/19/2003	HB-2	No	No	No	Pass	Pass
	9/19/2003	HB-3	No	No	No	Pass	Pass
	9/19/2003	HB-4	Yes	Yes	Yes	Fail	Fail
	11/15/2003	HB-4	No	No	No	Pass	Pass
	1/6/2004	HB-4	No	No	No	Pass	Pass
Juvenile Polychaete			*t-test, p=0.05*	MIG_T/MIG_R<0.70	MIG_T/MIG_R<0.50		
	11/1/2000	HG-38	No	No	No	Pass	Pass
	11/1/2000	HG-42	No	No	No	Pass	Pass
	9/5/2003	HB-1	No	No	No	Pass	Pass
	9/5/2003	HB-2	No	No	No	Pass	Pass
	9/5/2003	HB-3	No	No	No	Pass	Pass
	9/5/2003	HB-4	No	No	No	Pass	Pass
Larval			*t-test, p=0.05*	$(N_T/N_C)/(N_R/N_C)$<0.85	$(N_T/N_C)/(N_R/N_C)$<0.70		
	11/1/2000	HG-38	Yes	Yes	Yes	Fail	Fail
	11/1/2000	HG-42	Yes	Yes	Yes	Fail	Fail
	11/15/2000	HG-32	Yes	Yes	Yes	Fail	Fail
	11/15/2000	HG-36	Yes	Yes	Yes	Fail	Fail
	11/15/2000	HG-38	Yes	Yes	Yes	Fail	Fail
	11/15/2000	HG-39	Yes	Yes	Yes	Fail	Fail
	11/15/2000	HG-42	Yes	Yes	Yes	Fail	Fail
	11/29/2000	HG-32	No	Yes	Yes	Pass	Pass
	11/29/2000	HG-36	Yes	Yes	Yes	Fail	Fail
	11/29/2000	HG-38	Yes	Yes	Yes	Fail	Fail
	11/29/2000	HG-39	No	Yes	Yes	Pass	Pass
	11/29/2000	HG-42	Yes	Yes	Yes	Fail	Fail
	9/4/2003	HB-1	Yes	Yes	No	Fail	Pass
	9/4/2003	HB-2	No	Yes	No	Pass	Pass
	9/4/2003	HB-3	Yes	Yes	Yes	Fail	Fail
	9/4/2003	HB-4	Yes	Yes	Yes	Fail	Fail
	11/12/2003	HB-1	No	No	No	Pass	Pass
	11/12/2003	HB-2	No	No	No	Pass	Pass
	11/12/2003	HB-3	No	No	No	Pass	Pass
	11/12/2003	HB-4	No	No	No	Pass	Pass

[1] Statistical analyses conducted using DMMP/SMS Bioassay Statistics Program Beta v2.0c developed by the Corps of Engineers, Seattle District.
[2] Statistical reports generated using the DMMP/SMS Bioassay Statistics Program are included in Appendix H.
[3] SQS and MCUL Biological Criteria for each bioassay are stated in Table 4-21.
M = mortalilty, N = normal counts, MIG = mean individual growth rate
Subscripts: R = reference sediment, T = test sediment, C = negative control

Table 4-23 Summary of Cesium-137 Testing

Sample Location	Uncorrected Sample Interval (cm)	Corrected Sample Interval (cm)	Cs 137 dis/min/g dry wt.
HCS-34	0.0 to 2.0	0.0 to 2.6	0.267
	4.0 to 6.0	5.1 to 7.7	0.323
	8.0 to 10.0	10.3 to 12.8	0.216
	12.0 to 14.0	15.4 to 17.9	0.301
	16.0 to 18.0	20.5 to 23.1	0.206
	18.0 to 20.0	23.1 to 25.6	0.347
	20.0 to 22.0	25.6 to 28.2	0.125
	22.0 to 24.0	28.2 to 30.8	0.130
	24.0 to 26.0	30.8 to 33.3	< 0.090
	36.0 to 38.0	46.2 to 48.7	< 0.057
	48.0 to 50.0	61.5 to 64.1	< 0.044
	66.0 to 68.0	84.6 to 87.2	< 0.044
HCS-41	0.0 to 2.0	0.0 to 2.3	0.196
	4.0 to 6.0	4.7 to 7.0	0.098
	8.0 to 10.0	9.3 to 11.6	0.178
	12.0 to 14.0	14.0 to 16.3	0.119
	16.0 to 18.0	18.6 to 20.9	0.208
	24.0 to 26.0	27.9 to 30.2	0.201
	36.0 to 38.0	41.9 to 44.2	0.03
	48.0 to 50.0	55.8 to 58.1	0.102
	66.0 to 68.0	76.7 to 79.1	0.032
HCS-50	0.0 to 2.0	0.0 to 2.4	0.218
	4.0 to 6.0	4.8 to 7.1	0.091
	8.0 to 10.0	9.5 to 11.9	0.106
	12.0 to 14.0	14.3 to 16.7	0.137
	16.0 to 18.0	19.0 to 21.4	0.155
	24.0 to 26.0	28.6 to 31.0	0.328
	36.0 to 38.0	42.9 to 45.2	0.072
	48.0 to 50.0	57.1 to 59.5	0.070
	66.0 to 68.0	78.6 to 81.0	0.054

Table 5-2 Potentially Applicable Cleanup Levels

	SMS Criteria [1]		PSDDA Criteria [2]			MTCA, 2001 [3]	MTCA, 2001	MTCA, Method B [4]	MTCA, 2001	Maximum Detected Concentration (mg/kg, except porewater organotins ug/L)						
	SQS	MCUL	SL	BT	ML	Method A, Residential	Method A, Industrial	Residential (1996 & 2001)	Ecological [5]	Eastern Unit [7]	North-Eastern Unit [8]	North-Central Unit [9]	South-Central Unit [10]	Drydock Unit [11]	Marine Railway Unit [12]	Under Pier Unit [13]
Metals	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*		*mg/kg*	*mg/kg*							
Antimony	NV	NV	150	150	200	NV	NV	32 (most stringent of Sb forms)	NE	9	21	<7	17	10.0	ND	ND
Arsenic	57	93	**57**	507.1	700	**20**	**20**	NV	**20**	**67**	**158**	10	18	**30.0**	**21**	**30**
Cadmium	5.1	6.7	5.1	NV	14	**2**	**2**	NV	36	0.9	**2.4**	0.4	1.6	**2.0**	0.5	1
Chromium	260	270	NV	NV	NV	2000 (19 for Cr VI)	2000 (19 for Cr VI)	NV	135	47.9	63.5	30.3	79.3	46.4	35.5	32
Copper	390	390	**390**	NV	1,300	NV	NV	2960	**550**	195	**669**	43.9	286	**959.0**	199	**608**
Lead	450	530	450	NV	1,200	250	1000	NV	220	143	168	10	49	49.0	74	129
Mercury	0.41	0.59	**0.41**	1.5	2.3	2	2	NV	9, (0.7)	0.36	**0.51**	0.09	0.25	0.16	**0.42**	0.234
Nickel	NV	NV	140	370	370	NV	NV	1600	1850	33	75.7	29	96	47.0	30	28
Silver	6.1	6.1	6.1	6.1	8.4	NV	NV	400	NE	0.5	1	<0.4	ND	ND	ND	0.19
Zinc	410	960	**410**	NV	3,800	NV	NV	24000	**570**	**622**	**1620**	55.2	276	**901.0**	266	**536**
Porewater Organotins										ug/L	ug/L		ug/L	ug/L		
Tributyl Tin	NV	NV	0.15	0.15	NV	NV	NV	NV	NV	ND	0.040	ND	0.04	0.04	NA	NA
Bulk Organotins																
Tributyl Tin	NV	NV	73 [6]	NV	NV	NV	NV	2.4 mg/kg for bulk sediment (as TBT oxide)	NV	8.900	ND	28.0	55.2	10.7	NA	NA
LPAH	*ppm TOC*	*ppm TOC*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*							
2-Methylnaphthalene	38	64	0.67	NV	1.9	see total Naphthalene	see total Naphthalene	NV	NV	0.066	0.055	ND	ND	0.16	NA	0.036
Acenaphthene	16	57	0.5	NV	2	NV	NV	4800	NE	**1.40**	0.300	ND	ND	0.16	NA	0.092
Acenaphthylene	66	66	0.56	NV	1.3	NV	NV	NV	NV	0.310	0.063	ND	ND	0.04	NA	0.085
Anthracene	220	1200	**0.96**	NV	13	NV	NV	24000	NV	0.78	0.760	ND	0.033	**0.97**	NA	0.42
Fluorene	23	79	0.54	NV	3.6	NV	NV	3200	NV	**1.20**	0.280	ND	ND	0.42	NA	0.12
Naphthalene	99	170	2.1	NV	2.4	see total Naphthalene	see total Naphthalene	3200	NV	0.13	0.081	ND	ND	0.06	NA	0.056
Phenanthrene	100	480	**1.5**	NV	21	NV	NV	NV	NV	**4.60**	**2.800**	0.037	0.120	1.30	NA	0.97
Total LPAHs	370	780	5.2	NV	29	NV	NV	NV	NV	**8.06**	4.191	0.037	ND	2.99	NA	1.779
Naphthalene + 2-Methylnaphthalene	NV	NV	NV	NV	NV	5 (Total naphthalene)	5 (Total naphthalene)	NV	NV	0.20	0.136	ND	0.153	0.22	NA	0.09
HPAH	*ppm TOC*	*ppm TOC*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*							
Benzo(a)anthracene	110	270	**1.3**	NV	5.1	NV	see total carcingoenic PAHs	0.137	NV	**2.00**	1.100	0.036	0.069	0.63	NA	1.2
Benzo(a)pyrene	99	210	**1.6**	3.6	3.6	0.1	2	NV	300	**1.80**	0.790	0.040	0.083	0.40	NA	0.87
Benzo(b)fluoranthene	230	450	3.2 [14]	NV	9.9 [14]	NV	see total carcingoenic PAHs	0.137	NV	1.74	1.300	0.082	0.240	0.57	NA	1.1
Benzo(g,h,i)perylene	31	78	0.67	NV	3.2	NV	NV	NV	NV	0.63	0.250	0.022	0.029	0.17	NA	0.23
Benzo(k)fluoranthene	230	460	3.2 [14]	NV	9.9 [14]	NV	see total carcingoenic PAHs	0.137	NV	1.74	0.890	0.082	0.240	0.45	NA	1
Chrysene	110	450	**1.4**	NV	21	NV	see total carcingoenic PAHs	0.137	NV	2.10	1.200	0.057	0.190	1.10	NA	**1.5**
Dibenz(a,h)anthracene	12	33	0.23	NV	1.9	NV	see total carcingoenic PAHs	0.137	NV	0.21	0.067	ND	ND	0.08	NA	0.071
Fluoranthene	160	1200	**1.7**	4.6	30	NV	NV	3200	NV	**6.30**	**3.000**	0.069	0.540	1.20	NA	**2**
Indeno(1,2,3-cd)pyrene	34	34	**0.6**	NV	4.4	NV	see total carcingoenic PAHs	0.137	NV	**0.74**	0.310	0.023	0.035	0.18	NA	0.36
Pyrene	1000	1400	**2.6**	NV	16	NV	NV	2400	NV	**6.40**	**4.000**	0.071	0.390	1.00	NA	1.5
Total HPAHs	960	5300	12	NV	69	NV	NV	NV	NV	**22.88**	11.307	0.400	1.576	4.87	NA	9.831
Total Carcinogenic PAHs[15]	NV	NV	NV	NV	NV	**2 (benzo(a)pyrene eq)**	**2 (benzo(a)pyrene eq)**	NV	NV	**2.653**	1.229	0.063	0.143	0.671	NA	1.322
Phthalates	*ppm TOC*	*ppm TOC*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*							
bis(2-Ethylhexyl)phthalate	47	78	8.3	13.87	NV	NV	NV	71.4	NE	2.40	0.250	ND	0.053	1.4	NA	0.53
Butylbenzylphthalate	4.9	64	**0.97**	NV	NV	NV	NV	16000	NV	ND	ND	ND	ND	**1.5**	NA	0.049
Diethylphthalate	61	110	1.2	NV	NV	NV	NV	64000	NV	ND	ND	ND	ND	ND	NA	ND
Dimethylphthalate	53	53	1.4	1.4	NV	NV	NV	80000	NV	0.03	ND	ND	ND	ND	NA	0.028
Di-n-Butylphthalate	220	1700	5.1	10.22	NV	NV	NV	8000	NE	ND	0.045	ND	ND	0.028	NA	0.0455
Di-n-Octyl phthalate	58	4500	6.2	NV	NV	NV	NV	1600	NV	ND	0.200	ND	ND	ND	NA	*ND*
Phenols	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*							
Phenol	0.42	1	0.42	0.876	1.2	NV	NV	48000	NV	ND	ND	ND	ND	0.021	NA	0.11
2,4-Dimethylphenol	0.029	0.029	**0.029**	NV	0.21	NV	NV	1600	NV	**0.031**	ND	ND	ND	ND	NA	ND
2-Methylphenol	0.063	0.063	0.063	NV	0.077	NV	NV	NV	NV	ND	ND	ND	ND	ND	NA	ND
4-Methylphenol	0.67	0.67	0.67	NV	3.6	NV	NV	NV	NV	**0.120**	0.073	ND	ND	0.16	NA	0.071
Pentachlorophenol	0.36	0.69	0.4	0.504	0.69	NV	NV	8.3	11	ND	ND	ND	ND	ND	NA	*0.21*
Misc. Extractables	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*							
Benzyl Alcohol	0.057	0.073	**0.057**	NV	0.87	NV	NV	24000		ND	**0.110**	ND	ND	0.17	NA	**0.31**
Benzoic Acid	0.65	0.65	0.65	NV	0.76	NV	NV	320000		ND	ND	ND	ND	ND	NA	ND
Misc. Extractables	*ppm TOC*	*ppm TOC*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*							
1,2,4-Trichlorobenzene	0.81	1.8	0.031	NV	0.8	NV	NV	800	NV	ND	ND	ND	ND	ND	NA	ND
1,2-Dichlorobenzene	2.3	2.3	0.035	0.037	7.2	NV	NV	7200	NV	ND	ND	ND	ND	ND	NA	ND
1,3-Dichlorobenzene	NV	NV	0.17	1.241	NV	NV	NV	NV	NV	ND	ND	ND	ND	ND	NA	*ND*
1,4-Dichlorobenzene	3.1	9	0.11	0.12	0.041667	NV	NV	41.7	NV	ND	ND	ND	ND	ND	NA	ND
Dibenzofuran	15	58	0.54	NV	1.7	NV	NV	NV	NV	0.21	0.190	ND	ND	0.140	NA	0.069
Hexachlorobenzene	0.38	2.3	0.022	0.168	0.000625	NV	NV	0.63	31	ND	ND	ND	ND	ND	NA	ND
Hexachlorobutadiene	3.9	6.2	0.029	0.212	0.27	NV	NV	12.8	NV	ND	ND	ND	ND	ND	NA	ND
N-Nitrosodiphenylamine	11	11	0.028	0.13	0.13	NV	NV	204	NV	ND	ND	ND	ND	ND	NA	ND
PCBs	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*	*mg/kg*
Total PCBs (mg/kg)	NV	NV	**0.13**	NV	3.1	**1**	10	NV	2	**1.800**	**0.210**	0.110	0.75	0.032	**1.3**	**0.22**
	ppm TOC	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*	*ppm TOC*
Total PCBs (ppm TOC)	12	65	NV	**38**	NV	NV	NV	NV	NV	**56.25**	14.00	6.47	26.79	2.33	33.3	18.3

[1] Sediment Management Standards, 1995
[2] Puget Sound Dredged Disposal Analysis Program, 2000
[3] Model Toxics Control Act Cleanup Regulation, Ecology 2001
[4] Model Toxics Control Act Cleanup Regulation, Ecology 1996 - NV used if Method A criteria exists
[5] Industrial/Commercial Ecological Risk Criteria MTCA, 2001 Table 749-2
[6] The former PSDDA SL for sediments was 73 ug TBT/kg. The porewater SL is the current SL for PSDDA evaluation of sediments.
[7] Samples HG-30, HC-2, HG-4, HV-30 (0-10cm) included in evaluation
[8] Samples HG-42, HG-44, HG-45, HG-1A, HV-6 (0-10 cm), HC-1A included in evaluation
[9] Samples HG-6, HG-7, HC-1B included in evaluation
[10] Samples HG-8, HV-8 (0-10cm), HV-3 (0-10cm) included in evaluation
[11] Samples HG-10, HG-11, HG-36, HG-38, HG-39 duplicate included in evaluation
[12] Samples HG-3, HV-4 (0-10cm) included in evaluation
[13] Samples SS-1, HG-32, HG-33 included in evaluation
[14] Value for total benzofluoranthenes (b+k)
[15] Total carcinogenic PAHs calculated using CalEPA benzo(a)pyrene equivalent as described in MTCA, 2001
NV No value
NE Safe concentration has not yet been established
NA Not Analyzed
ND Not Detected

Appendix B: Analytical Data Tables from RETEC Phase 2 Sampling of Soil and Groundwater at Harris Avenue Shipyard, September 21, 1998

Table 4-1. Measured Chemical Concentrations in Vadose Soils

Parameters	MTCA Direct Contact Cleanup Levels for Industrial Soils	MW-4 2.5 ft. 4/28/1998	TP-3 4 ft. 4/27/1998	TP-4 0.9 ft. 4/27/1998	TP-6 0.9 ft. 4/27/1998	TP-8 0.9 ft. 4/27/1998
Metals (mg/kg):						
Antimony	1400 c	7.0	< 6.0	40	20	60
Arsenic	219 c	53	9.0	750	210	1,140
Beryllium	30.5 c	0.20	0.20	< 0.5	0.3	< 0.5
Cadmium	320 c	1.0	0.40	8.7	3.2	12
Chromium	17500 c	44.7	116	76	81	83
Copper	130000 c	404	74	3,180	696	2,370
Lead	1000 a	203	67	665	263	1,680
Mercury	1500 c	0.29	0.09	0.33	0.09	0.12
Nickel	70000 c	47	54	35	54	51
Selenium	17500 c	8.0	< 6.0	< 20	< 10	< 30
Silver	17500 c	< 0.30	< 0.3	2	1	3
Thallium	245 c	< 6.00	< 6.0	< 20	< 10	< 30
Zinc	1050000 c	900	491	8,470	3,710	10,100
Purgeable Hydrocarbons (WTPH-g)						
Gasoline (Toluene to n-C12)	NV	< 5.6	< 5.5	NA	NA	NA
Extractable Hydrocarbons (WTPH-d extended)						
Diesel (n-C12 to n-C24)	NV	110	270	560	330	86
Motor Oil (n-C24 to n-C32)	NV	240	1,100	740	760	300
Total Diesel & Oil	NV	350	1,370	1,300	1,090	386
Interim TPH Policy Results						
Toxicity (Industrial Site)	Haz. Index < 1.0	NA	NA	NA	NA	NA
Leachability	Predicted Conc. < 1.0 mg/L	NA	NA	NA	NA	NA
Volatile Organics (EPA 8260)						
Benzene	4,530 c	< 0.0011				
Toluene	700,000 c	< 0.0011				
Ethylbenzene	350,000 c	< 0.0011	< 0.0011	NA	NA	NA
m,p-Xylene	7,000,000 c	< 0.0022	< 0.0022	NA	NA	NA
o-Xylene	7,000,000 c	< 0.0011	< 0.0011	NA	NA	NA
1,2,4-Trimethylbenzene	NV	< 0.0011	< 0.0011	NA	NA	NA
1,3,5-Trimethylbenzene	NV	< 0.0011	< 0.0011	NA	NA	NA
4-Isopropyltoluene	NV	< 0.0011	< 0.0011	NA	NA	NA
Isopropylbenzene	NV	< 0.0011	< 0.0011	NA	NA	NA
n-Butylbenzene	NV	< 0.0022	< 0.0022	NA	NA	NA
n-Propylbenzene	NV	< 0.0011	< 0.0011	NA	NA	NA
sec-Butylbenzene	NV	< 0.0011	< 0.0011	NA	NA	NA
Acetone	350,000 c	0.013 B	0.0075 B	NA	NA	NA
PAH (EPA 8270)						
Naphthalene	140,000 c	NA	0.25 J	NA	NA	NA
2-Methylnaphthalene	NV	NA	< 0.11 UJ	NA	NA	NA
Acenaphthylene	NV					
Acenaphthene	210,000 c	NA	< 0.11 UJ	NA	NA	NA
Fluorene	140,000 c	NA	0.30 J	NA	NA	NA
Phenanthrene	NV	NA	2.9 J	NA	NA	NA
Anthracene	1,050,000 c	NA	0.74 J	NA	NA	NA
Fluoranthene	140,000 c	NA	5.9 J	NA	NA	NA
Pyrene	105,000 c	NA	8.5 J	NA	NA	NA
Benzo(a)anthracene *	18 c	NA	3.4 J	NA	NA	NA
Chrysene *	18 c	NA	5.2 J	NA	NA	NA
Benzo(b)fluoranthene *	18 c	NA	4.2 J	NA	NA	NA
Benzo(k)fluoranthene *	18 c	NA	3.7 J	NA	NA	NA
Benzo(a)pyrene *	18 c	NA	3.8 J	NA	NA	NA
Indeno(1,2,3-cd)pyrene *	18 c	NA	2.8 J	NA	NA	NA
Dibenz(a,h)anthracene *	18 c	NA	0.65 J	NA	NA	NA
Benzo(g,h,i)perylene	NV	NA	2.8 J	NA	NA	NA
Total PAH	NV	NC	45.3 J	NC	NC	NC
Total Carcinogenic PAH (*)	18 c	NC	23.8 J	NC	NC	NC
Other Semivolatile Organics						
2,4-Dimethylphenol	NV	NA	< 0.34	NA	NA	NA
bis(2-Ethylhexyl)phthalate	9,370 c	NA	0.26	NA	NA	NA
Carbazole	6,560 c	NA	0.6	NA	NA	NA
Dibenzofuran	NV	NA	0.13	NA	NA	NA

Notes:

All concentrations are expressed as mg/kg dry weight.
c - Method C cleanup level for industrial soils
a - Method A cleanup level for industrial soils
B - Acetone detected in Method Blank, see Appendix E.
J - Estimated value
UJ - Detection limit estimated
NA - Not analyzed NC - Not calculated

Table 4-1. Measured Chemical Concentrations in Vadose Soils

Parameters	MTCA Direct Contact Cleanup Levels for Industrial Soils	TP-9		TP-10	TP-13	TP-15	
		1.8 ft. 4/30/1998	6 ft. 4/30/1998	1.2 ft. 4/27/1998	4 ft. 4/30/1998	0.7 ft. 4/27/1998	6 ft. 4/27/1998
Metals (mg/kg):							
Antimony	1400 c	< 5	< 6	70	< 10	< 5	< 5
Arsenic	219 c	8	10	1,240	30	25	28
Beryllium	30.5 c	0.14	0.3	0.6	0.4	0.2	0.2
Cadmium	320 c	< 0.2	< 0.2	12.6	0.9	0.4	< 0.2
Chromium	17500 c	37.6	49.7	81	53	58.7	55.6
Copper	130000 c	29.3	26.7	3,550	1,400	369	42.6
Lead	1000 a	7	5	1,210	443	197	16
Mercury	1500 c	< 0.05	< 0.05	0.09	0.43	2.9	0.06
Nickel	70000 c	26.1	48	38	51	55	52
Selenium	17500 c	< 5	< 6	< 20	< 10	< 5	< 5
Silver	17500 c	< 0.3	< 0.3	3	1.2	< 0.3	< 0.3
Thallium	245 c	< 5	< 6	< 20	< 10	< 5	< 5
Zinc	1050000 c	49.1	43.9	12,600	439	164	70.3
Purgeable Hydrocarbons (WTPH-g)							
Gasoline (Toluene to n-C12)	NV	230	170	NA	NA	100	470
Extractable Hydrocarbons (WTPH-d extended)							
Diesel (n-C12 to n-C24)	NV	12,000	2,600	NA	150	4,300	4,200
Motor Oil (n-C24 to n-C32)	NV	1,700	24	NA	460	1,300	110
Total Diesel & Oil	NV	13,700	2,624	NC	610	5,600	4,310
Interim TPH Policy Results							
Toxicity (Industrial Site)	Haz. Index < 1.0	Pass	Pass	NA	NA	NA	Pass
Leachability	Predicted Conc. < 1.0 mg/L	Pass	Pass	NA	NA	NA	Pass
Volatile Organics (EPA 8260)							
Benzene	4,530 c						
Toluene	700,000 c						
Ethylbenzene	350,000 c	NA	0.22	NA	NA	NA	0.048
m,p-Xylene	7,000,000 c	NA	0.31	NA	NA	NA	0.12
o-Xylene	7,000,000 c	NA	0.12	NA	NA	NA	0.082
1,2,4-Trimethylbenzene	NV	NA	1.6	NA	NA	NA	0.41
1,3,5-Trimethylbenzene	NV	NA	0.34	NA	NA	NA	0.31
4-Isopropyltoluene	NV	NA	0.42	NA	NA	NA	0.19
Isopropylbenzene	NV	NA	0.18	NA	NA	NA	0.036
n-Butylbenzene	NV	NA	0.56	NA	NA	NA	0.200
n-Propylbenzene	NV	NA	0.38	NA	NA	NA	0.056
sec-Butylbenzene	NV	NA	0.30	NA	NA	NA	0.068
Acetone	350,000 c	NA	0.25 B	NA	NA	NA	0.18 B
PAH (EPA 8270)							
Naphthalene	140,000 c	< 0.11	0.90	NA	NA	NA	62
2-Methylnaphthalene	NV	0.17	3.2	NA	NA	NA	31
Acenaphthylene	NV	< 0.11	< 0.12				
Acenaphthene	210,000 c	0.89	0.46	NA	NA	NA	35
Fluorene	140,000 c	3.8	1.3	NA	NA	NA	28
Phenanthrene	NV	4.5	2.3	NA	NA	NA	84
Anthracene	1,050,000 c	0.19	< 0.12	NA	NA	NA	10
Fluoranthene	140,000 c	0.44	0.17	NA	NA	NA	37
Pyrene	105,000 c	0.50	0.15	NA	NA	NA	44
Benzo(a)anthracene *	18 c	< 0.11	< 0.12	NA	NA	NA	7.4
Chrysene *	18 c	0.18	< 0.12	NA	NA	NA	6.2
Benzo(b)fluoranthene *	18 c	0.13	< 0.12	NA	NA	NA	5.2
Benzo(k)fluoranthene *	18 c	< 0.11	< 0.12	NA	NA	NA	3.3
Benzo(a)pyrene *	18 c	< 0.11	< 0.12	NA	NA	NA	4.5
Indeno(1,2,3-cd)pyrene *	18 c	< 0.11	< 0.12	NA	NA	NA	1.9
Dibenz(a,h)anthracene *	18 c	< 0.11	< 0.12	NA	NA	NA	0.30
Benzo(g,h,i)perylene	NV	< 0.11	< 0.12	NA	NA	NA	1.9
Total PAH	NV	11.2	9.1	NC	NC	NC	361.7
Total Carcinogenic PAH (*)	18 c	0.59	0.42	NC	NC	NC	28.8
Other Semivolatile Organics							
2,4-Dimethylphenol	NV	< 1	NA	NA	NA	NA	1.4
bis(2-Ethylhexyl)phthalate	9,370 c	< 0.45	NA	NA	NA	NA	0.70
Carbazole	6,560 c	< 0.45	NA	NA	NA	NA	6.3
Dibenzofuran	NV	0.47	NA	NA	NA	NA	15

Notes:

All concentrations are expressed as mg/kg dry weight.
c - Method C cleanup level for industrial soils
a - Method A cleanup level for industrial soils
B - Acetone detected in Method Blank, see Appendix E.
J - Estimated value
UJ - Detection limit estimated
NA - Not analyzed NC - Not calculated

Table 4-2. Chemical Concentrations in Saturated Zone Soils

Parameter	MTCA Direct Contact Soil Cleanup Levels for Industrial Sites (Methods A & C)	B-1	MW-1		MW-2	MW-3	MW-4	MW-5
		6.5 ft. 4/29/1998	10 ft. (dup.) 4/28/1998	10 ft. 4/28/1998	8.5 ft. 4/28/1998	7.5 ft. 4/28/1998	8 ft. 4/28/1998	7.5 ft. 4/29/1998
Heavy Metals								
Antimony	1,400 c	NA	< 5	< 5	< 6	< 5	< 5	< 5
Arsenic	219 c	NA	**7**	**8**	**11**	**6**	**8**	**11**
Beryllium	30.5 c	NA	**0.2**	**0.2**	**0.2**	< 0.1	**0.2**	**0.2**
Cadmium	320 c	NA	< 0.2	< 0.2	**1**	< 0.2	< 0.2	< 0.2
Chromium	17,500 c	NA	**39.6**	**44.1**	**35.4**	**34**	**38.5**	**59.5**
Copper	130,000 c	NA	**18.1**	**18.5**	**114**	**9.2**	**43.1**	**37**
Lead	1,000 a	NA	**4**	**4**	**188**	< 2	**5**	**5**
Mercury	1,500 c	NA	< 0.05	< 0.05	**0.19**	< 0.04	< 0.04	< 0.05
Nickel	70,000 c	NA	**38**	**38**	**32**	**25**	**45**	**64**
Selenium	17,500 c	NA	< 5	< 5	< 6	< 5	< 5	< 5
Silver	17,500 c	NA	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Thallium	245 c	NA	< 5	< 5	< 6	< 5	< 5	< 5
Zinc	1,050,000 c	NA	**32.5**	**31.7**	**281**	**24**	**50.5**	**40**
Purgeable Hydrocarbons (WTPH-g)								
Gasoline (toluene to n-C12)	NV	< 5.2	NA	**34**	**240**	< 5.5	< 5.5	< 5.5
Extractable Hydrocarbons (WTPH-d extended)								
Diesel (n-C12 to n-C24)	NV	**9.7**	**250**	**210**	**13,000**	**6.3**	< 5.5	< 5.6
Motor Oil (n-C24 to n-C32)	NV	**16**	**12**	< 11	**8,000**	< 11	< 11	< 11
Total Diesel & Oil	NV	**26**	**262**	**221**	**21,000**	**12**	< 17	< 17
Volatile Organics: (EPA 8260)								
1,2,4-Trimethylbenzene	NV	< 0.001	NA	**0.087**	**0.016 J**	< 0.001	< 0.0011	< 0.0011
1,3,5-Trimethylbenzene	NV	< 0.001	NA	**0.022**	**0.0075 J**	< 0.001	< 0.0011	< 0.0011
4-Isopropyltoluene	NV	< 0.001	NA	**0.034**	< 0.0045 **UJ**	< 0.001	< 0.0011	< 0.0011
n-Butylbenzene	NV	< 0.0021	NA	**0.027**	< 0.0091 **UJ**	< 0.002	< 0.0022	< 0.0022
n-Propylbenzene	NV	< 0.001	NA	**0.010**	< 0.0045 **UJ**	< 0.001	< 0.0011	< 0.0011
sec-Butylbenzene	NV	< 0.001	NA	**0.014**	< 0.0045 **UJ**	< 0.001	< 0.0011	< 0.0011
1,1,2-Trichlorotrifluoroethane	NV	< 0.0021	NA	< 0.010	< 0.0091 **UJ**	**0.0058** *	< 0.0022	< 0.0022
Acetone	350,000 c	**0.0086 B**	NA	**0.059 B**	**0.066 B**	**0.0081 B**	**0.012 B**	**0.0087 B**
Carbon Disulfide	350,000 c	< 0.001	NA	< 0.0052	**0.012 *UJ**	< 0.001	< 0.0011	< 0.0011
Methylene Chloride	17,500 c	< 0.0021	NA	**0.011** *	< 0.0091 **UJ**	**0.0031** *	< 0.0022	< 0.0022

Notes:

All concentrations are expressed as mg contaminant per kg sample dry weight (ppm).
c - Method C cleanup level for industrial soils
a - Method A cleanup level for industrial soils
* - Methylene chloride, carbon disulfide and 1,1,2-trichlorotrifluoroethane are common laboratory contaminants. See Appendix E for a discussion of these results.
B - Acetone detected in Method Blank, see Appendix E for discussion
J - Estimated value
UJ - Detection limit estimated
NA - Not analyzed   NC - Not calculated

Table 4-3. Summary of Groundwater and Seep Chemistry Data

PARAMETER	REFERENCE VALUES			MW-1-98 5/14/1998		MW-2-98 5/14/1998		MW-3-98 5/14/1998		MW-3-98 (Duplicate) 5/14/1998		MW-4-98 5/14/1998		MW-5-98 5/14/1998		Seep No. 1 (Former Outfall) 5/14/1998		Trip Blank 4/23/1998
	MTCA Groundwater Cleanup Levels (Methods A & B)	Marine Chronic Water Quality Criteria (WAC 173-201A)	Natural Background Seawater (Davis, 1977)	Total (Not Filtered)	Dissolved (Filtered)	Total (Not Filtered)	Dissolved (Filtered)	Total (Not Filtered)	Dissolved (Filtered)	Total (Not Filtered)	Dissolved (Filtered)	Total (Not Filtered)	Dissolved (Filtered)	Total (Not Filtered)	Dissolved (Filtered)	Total (Not Filtered)	Dissolved (Filtered)	Total
Heavy Metals (mg/L)																		
Antimony	0.0064	--	0.005	**0.003 J**	< 0.001	**0.006**	< 0.005	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.005	< 0.005	NA
Arsenic	0.00006	0.0360	0.003	**0.034**	**0.004**	**0.024**	**0.002**	**0.012**	< 0.001	**0.012**	< 0.001	**0.082**	**0.004**	**0.02**	< 0.001	**0.002**	**0.001**	NA
Beryllium	0.00002	--	0.0000006	**0.002**	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	**0.002**	< 0.001	**0.009**	< 0.001	< 0.002	< 0.002	NA
Cadmium	0.0080	0.0093	0.00011	< 0.002	< 0.002	**0.005**	< 0.002	**0.005**	< 0.002	**0.006**	< 0.002	< 0.002	< 0.002	**0.008**	< 0.002	< 0.004	< 0.004	NA
Chromium	0.0800	0.05 VI	0.0005	**0.205**	< 0.005	**0.255**	< 0.005	**0.149**	< 0.005	**0.151**	< 0.005	**0.176**	< 0.005	**2.12**	< 0.005	< 0.01	< 0.01	NA
Copper	0.5920	0.0031	0.003	**0.248**	< 0.002	**0.194**	**0.003**	**0.072**	< 0.002	**0.083**	< 0.002	**0.31**	**0.004**	**1.73**	**0.003**	< 0.004	< 0.004	NA
Lead	0.005 A	0.0081	0.00003	**0.116**	< 0.001	**0.072**	< 0.005	**0.041**	< 0.001	**0.047**	< 0.001	**0.102**	< 0.001	**0.15**	< 0.001	< 0.005	< 0.005	NA
Mercury	0.0048	0.00003	0.00005	**0.0004**	< 0.0001	**0.0003**	< 0.0001	< 0.0001	< 0.0001	**0.0002**	< 0.0001	**0.0006**	< 0.0001	**0.0046**	< 0.0001	< 0.0001	< 0.0001	NA
Nickel	0.3200	0.0082	0.002	**0.28**	< 0.01	**0.25**	< 0.01	**0.12**	< 0.01	**0.12**	< 0.01	**0.33**	**0.03**	**3.81**	< 0.01	< 0.02	< 0.02	NA
Selenium	0.0800	0.0710	0.004	**0.006**	< 0.002	< 0.005	< 0.01	< 0.001	< 0.001	< 0.002	< 0.001	< 0.005	< 0.001	< 0.01	< 0.001	< 0.005	< 0.010	NA
Silver	0.0800	--	0.0001	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.006	< 0.003	< 0.006	< 0.006	NA
Thallium	0.0011	--	<0.00001	< 0.005	< 0.001	< 0.005	< 0.01	< 0.005	< 0.001	< 0.005	< 0.001	< 0.005	< 0.001	< 0.02	< 0.001	< 0.001	< 0.005	NA
Zinc	4.8000	0.0810	0.005	**0.352**	< 0.004	**0.459**	**0.071**	**0.163**	< 0.004	**0.178**	< 0.004	**0.317**	< 0.004	**1.21**	< 0.004	**0.011 B**	< 0.008	NA
Hydrocarbons (mg/L)																		
Gasoline Range	1.0	--	--	**0.58**	NA	< 0.25	NA	< 0.25	NA	< 0.25	NA	< 0.25	NA	< 0.25	NA	NA	NA	< 0.25
Diesel Range	1.0	--	--	**4.6**	NA	**0.4**	NA	< 0.25	NA	< 0.25	NA	**0.73**	NA	< 0.25	NA	NA	NA	NA
Motor Oil	1.0	--	--	< 0.5	NA	< 0.5	NA	< 0.5	NA	< 0.5	NA	< 0.5	NA	< 0.5	NA	NA	NA	NA
Volatile Organics (mg/L)																		
Benzene	0.00151	--	--	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
Toluene	1.6	--	--	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
Ethylbenzene	0.8	--	--	**0.0014**	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
Isopropylbenzene	--	--	--	**0.0034**	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
m,p-Xylene	16	--	--	**0.0066**	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
o-Xylene	16	--	--	**0.0025**	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
1,2,4-Trimethylbenzene	--	--	--	**0.015**	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
1,3,5-Trimethylbenzene	--	--	--	**0.0064**	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
4-Isopropyltoluene	--	--	--	**0.0045**	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
Naphthalene	0.32	--	--	**0.014**	NA	< 0.005	NA	< 0.005	NA	< 0.005	NA	< 0.005	NA	< 0.005	NA	NA	NA	< 0.005
n-Butylbenzene	--	--	--	**0.0015**	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
n-Propylbenzene	--	--	--	**0.0029**	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
sec-Butylbenzene	--	--	--	**0.0018**	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	< 0.001	NA	NA	NA	< 0.001
Acetone	0.8	--	--	**0.009 B**	NA	**0.0059 B**	NA	**0.010 B**	NA	**0.0086 B**	NA	**0.0055 B**	NA	**0.0076 B**	NA	NA	NA	**0.0054 B**

Notes:

All volatile organics which were detected in the Shipyard samples are shown above.
For a complete list of volatile organics which were tested, refer to Appendix D.
Detected concentrations which exceed any of the reference values have been
underlined, as have the reference values which were exceeded.
Site cleanup levels may be based on one or more of these reference values.
Groundwater samples were slightly to moderately turbid.
B - Acetone detected in Method Blank, see Appendix E for discussion
J - Estimated value
NA - Not analyzed NC - Not calculated

Appendix B: Analytical Data Tables from RETEC Phase 2 Sampling of Bellingham Bay Sediments at the Harris Avenue Shipyard, August 6, 1998

Table 2-1. Previous Sediment Sampling Data

Sample Set	SMS Criteria		Ecology Samples (Cubbage, Oct. 1993)			Pier Samples (GeoEngineers, 1996)			Bellingham Bay Sediments (Cubbage & Pebles, June 1993)					Post Point WWTP (Reif, 1988)	
Sampler Notes			Van Veen Sampler included, EPA Manchester Lab used except TOC and PCB by ARI			Van Veen Sampler included, EPA Manchester Lab used except TOC and			Van Veen Sampler included, EPA Manchester Lab						
Sample ID			Bell-20	Bell-40	Bell-41	SS-1	SS-2	SS-3	BEll50	Bell51	Bell52	Bell53	Bell54	RE-01	RE-02
Latitude			NT	NT	NT	NT	NT	NT	48—uo˜45.012'	48—uo˜44.627'	48—uo˜44.631'	48—uo˜44.370'	48—uo˜44.725'		
Longitude			NT	NT	NT	NT	NT	NT	122—uo˜30.380'	122—uo˜30.825'	122—uo˜30.121'	122—uo˜30.230'	122—uo˜30.467'		
Location Notes			Subtidal-Middle	Subtidal-North	Intertidal-Middle	See Map	See Map	See Map	Samples collected in bay between Fairhaven and Downtown Bellingham.					West of Post Point, Near Outfall	
	SQS	**MCUL**													
Percent Solids	NV	NV	60	40	80	53.9	48.8	58.5	43	41	37	38	42	NT	NT
Particle Size Distribution															
% Gravel (> 2000 um)	NV	NV	57	1.0	22	0.7	1.6	2.7	NT	NT	NT	NT	NT	NT	NT
% Sand (> 62.5 um)	NV	NV	30	36	76	53.4	54	53	2	3	4	6	6	NT	NT
%Silt (3.9-62 um)	NV	NV	6.0	29	1.0	23.7	22.6	21.1	64	55	58	59	60	NT	NT
% Clay (< 3.9 um)	NV	NV	7.0	34	1.0	22.1	21.9	23.2	34	42	38	33	34	NT	NT
Total Organic Carbon															
% TOC	NV	NV	3.6	1.9	0.61	3.5	2.8	2.4	NT	NT	NT	NT	NT	NT	NT
Total Metals (mg/kg)															
Arsenic	**57**	93	15	55	78	17	10	8.5	11	13	10	12	9.1	< 35	35
Cadmium	5.1	6.7	1.2 P	1.8 P	1.6 P	0.63	0.51	0.32	0.63 P	0.95 P	0.64	1.24 P	0.92	NV	NV
Chromium	260	270	97	82	32	31	71	48	80	79	81	78	81	80	80
Copper	**390**	**390**	190	**540**	**1400**	190	120	33	57	52	53	53	46	54	55
Lead	**450**	530	**460**	90	220	38	80	34	20	20	21	25	17	22	18
Mercury	0.41	0.59	0.40	0.32	0.04 P	0.23	0.254	0.285	0.31	0.23	**0.58**	**0.74**	0.25	**0.66**	0.38
Nickel	NV	NV	160	130	94.8	NT	NT	NT	130	128	122	117	133	98	110
Silver	6.1	6.1	< 0.30	< 0.30	< 0.30	0.19	0.16	< 0.08	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	NV	NV
Zinc	**410**	**960**	260 E	**900** E	**1700** E	330	120	70	99 E	108 E	103 E	108 E	95 E	120	130
Organotin Compounds (ug Sn/kg)															
Tetrabutyltin	NV	NV	< 20	< 40	< 20	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Tributyltin	NV	NV	**282** [1]	**392** [1]	**173** [1]	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Dibutyltin	NV	NV	< 20	< 40	< 20	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
PCB Aroclors (ppm TOC)															
PCB 1242/1016	NV	NV	< 610	< 50	< 11	< 0.4	< 0.6	< 0.58	NT	NT	NT	NT	NT	NT	NT
PCB 1248	NV	NV	< 2200	< 50	8.9 J	< 0.4	< 0.6	< 0.58	NT	NT	NT	NT	NT	NT	NT
PCB 1254	NV	NV	1,694	17.4 J	10.5 J	< 0.4	< 0.6	< 0.58	NT	NT	NT	NT	NT	NT	NT
PCB 1260	NV	NV	< 830	< 50	< 11	< 0.4	0.71	< 0.58	NT	NT	NT	NT	NT	NT	NT
PCB 1221	NV	NV	< 1200	< 100	< 23	< 1.6	< 2.4	< 2.3	NT	NT	NT	NT	NT	NT	NT
PCB 1232	NV	NV	< 611	< 50	< 11	< 0.4	< 0.6	< 0.58	NT	NT	NT	NT	NT	NT	NT
PCB 1262	NV	NV	< 830	< 50	< 11	< 0.4	< 0.6	< 0.58	NT	NT	NT	NT	NT	NT	NT
PCB-1268	NV	NV	1,556 J	< 50	47.5	< 0.4	< 0.6	< 0.58	NT	NT	NT	NT	NT	NT	NT
Total PCB	**12**	**65**	**3300** J	**17.4** J	**67** J	0.69	0.71	< 2.3	NT	NT	NT	NT	NT	NT	NT

Table 2-1. Previous Sediment Sampling Data

Sample Set			Ecology Samples (Cubbage, Oct. 1993)			Pier Samples (GeoEngineers, 1996)			Bellingham Bay Sediments (Cubbage & Pebles, June 1993)					Post Point WWTP (Reif, 1988)	
Sampler Notes			Van Veen Sampler included, EPA Manchester Lab used except TOC and PCB by ARI			Van Veen Sampler included, EPA Manchester Lab used except TOC and			Van Veen Sampler included, EPA Manchester Lab						
Sample ID			Bell-20	Bell-40	Bell-41	SS-1	SS-2	SS-3	BEll50	Bell51	Bell52	Bell53	Bell54	RE-01	RE-02
Latitude			NT	NT	NT	NT	NT	NT	48—uo˜45.012'	48—uo˜44.627'	48—uo˜44.631'	48—uo˜44.370'	48—uo˜44.725'		
Longitude			NT	NT	NT	NT	NT	NT	122—uo˜30.380'	122—uo˜30.825'	122—uo˜30.121'	122—uo˜30.230'	122—uo˜30.467'		
Location Notes			Subtidal-Middle	Subtidal-North	Intertidal-Middle	See Map	See Map	See Map	Samples collected in bay between Fairhaven and Downtown Bellingham.					West of Post Point, Near Outfall	
	SMS Criteria														
	SQS	MCUL													
Detected Semivolatiles															
Phenol (ug/kg)	**420**	**1200**	**920**	**2400**	< 400	< 28	86	< 27	NT	NT	NT	NT	NT	NT	NT
Dibenzofuran (ppm TOC)	15	58	4 J	15 J	< 66	0.94	< 1.2	< 1.1	NT	NT	NT	NT	NT	NT	NT
Retene (ppm TOC)	NV	NV	4 J	12 J	< 66	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Polynuclear Aromatics (ppm TOC)															
1-Methylnaphthalene	NV	NV	2 J	< 39	< 66	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
2-methylnaphthalene	38	64	2 J	5 J	< 66	< 0.8	< 1.2	< 1.1	NT	NT	NT	NT	NT	NT	NT
Naphthalene	99	170	9 J	34 J	7 J	1	< 1.2	< 1.1	NT	NT	NT	NT	NT	NT	NT
Acenaphthylene	66	66	3 J	7 J	< 66	< 0.8	< 1.2	< 1.1	NT	NT	NT	NT	NT	NT	NT
Acenaphthene	16	57	4 J	6 J	4 J	1.1	< 1.2	< 1.1	NT	NT	NT	NT	NT	NT	NT
Fluorene	23	79	5 J	10 J	4 J	1.1	< 1.2	< 1.1	NT	NT	NT	NT	NT	NT	NT
Phenanthrene	100	480	31	62	< 66	6	7.5	5	NT	NT	NT	NT	NT	NT	NT
Anthracene	220	1200	10 J	21 J	< 66	2.5	2.3	1.4	NT	NT	NT	NT	NT	NT	NT
Sum LPAH	370	780	67 J	150 J	13 J	11.7	9.8	6.4	NT	NT	NT	NT	NT	NT	NT
Fluoranthene	160	1200	47	110	< 66	11	11	6.7	NT	NT	NT	NT	NT	NT	NT
Pyrene	1000	1400	53	< 39	< 66	9.4	9.3	7.9	NT	NT	NT	NT	NT	NT	NT
Benzo(a)anthracene	110	270	23	28 J	< 66	4.9	4.6	4.1	NT	NT	NT	NT	NT	NT	NT
Chrysene	110	460	28	36 J	< 66	7.7	7.9	5.4	NT	NT	NT	NT	NT	NT	NT
Benzo(a)pyrene	99	210	< 66	< 39	< 66	4	3.6	4.2	NT	NT	NT	NT	NT	NT	NT
Benzofluoranthenes	230	450	26	36 J	< 66	8.3	7.9	7.9	NT	NT	NT	NT	NT	NT	NT
Indeno(1,2,3-cd)pyrene	34	88	< 66	< 39	< 66	2.5	2.4	2.7	NT	NT	NT	NT	NT	NT	NT
Dibenzo(a,h)anthracene	12	33	< 66	< 39	< 66	< 0.8	< 1.2	< 1.1	NT	NT	NT	NT	NT	NT	NT
Benzo(g,h,I)perylene	31	78	< 66	< 39	< 66	2.4	2.2	2.7	NT	NT	NT	NT	NT	NT	NT
Sum HPAH	960	5300	177	210 J	< 66	50.2	48.9	41.6	NT	NT	NT	NT	NT	NT	NT
Detected Pesticides (ug/kg)															
4,4'-DDD	NV	NV	< 2200	< 95	3.3 J	< 2200	< 95	3.3 J	NT	NT	NT	NT	NT	NT	NT

Notes:

Contaminant concentrations which exceeded a sediment reference value have been bolded, as were the reference values which were exceeded.

1. Low surrogate recoveries

E: Concentration is an estimate

J: Concentration is an estimate

P: Above DL but below PQL

ND: None detected.

NT: Not tested.

NV: No reference value available

Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Appendix C
Sampling and Analysis Plan/ Quality Assurance Project Plan

FINAL

Table of Contents

List of Tables

List of Abbreviations and Acronyms

Acronym/ Abbreviation	Definition
ALS	ALS Laboratory
ARI	Analytical Resources, Inc.
DO	Dissolved oxygen
EIM	Environmental Information Management
LNAPL	Light non-aqueous phase liquid
MS/MSD	Matrix spike/matrix spike duplicate
MTCA	Model Toxics Control Act
NTU	Nephelometric turbidity unit
PID	Photoionization detector
ppt	Parts per trillion
QA/QC	Quality assurance/quality control
RI/FS	Remedial Investigation/Feasibility Study

Acronym/ Abbreviation	Definition
RPD	Relative percent difference
SAP/QAPP	Sampling and Analysis Plan/Quality Assurance Project Plan
USEPA	U. S. Environmental Protection Agency
VOC	Volatile organic compound
WAC	Washington Administrative Code

1.0 Project Description

This Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the draft Site-Wide Remedial Investigation Feasibility Study (RI/FS) Work Plan activities for the Harris Avenue Shipyard located in Bellingham, Washington.

Specific protocols for sampling, sample handling and storage, chain of custody, and laboratory and field analyses are described. All QA/QC procedures are structured in accordance with the Washington State Model Toxics Control Act (MTCA) Washington Administrative Code (WAC) 173-340.

1.1 INTRODUCTION

This SAP/QAPP has been prepared by Floyd|Snider on behalf of the Port of Bellingham. The Supplemental Site Investigation field activities include the following:

- Groundwater sampling.
- Soil sampling.
- Monitoring Well Installation.
- Tidal study.
- Bank/intertidal sampling.
- Contingency surface sediment sampling.

The rationale for the investigative activities is presented in the associated Final Site-Wide RI/FS Work Plan.

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2.0 Project Organization and Responsibility

Under the authorization of the Port of Bellingham, Floyd|Snider will perform field activities as part of the Supplemental Site Investigation for the Site-Wide RI/FS. ALS Laboratory (ALS) and Analytical Resources, Incorporated (ARI) in Tukwila, Washington are the primary project laboratories providing all environmental laboratory analyses. The various QA field, laboratory, and management responsibilities of key project personnel are defined below.

2.1 MANAGEMENT RESPONSIBILITIES

Mike Stoner—Port of Bellingham

Mike Stoner is the Port's point of contact and control for matters concerning the project. He will perform the following:

- Define project objectives.
- Orient Floyd|Snider as to the project's special considerations.
- Communicate with Ecology and project stakeholders.
- Review and approve all reports (deliverables) before their submission to stakeholders.
- Represent the project team at meetings and public hearings.

Kate Snider—Floyd|Snider Project Manager

Kate Snider, Project Manager, will have overall responsibility for project implementation. As Project Manager she will be responsible for the overall QA on this project to ensure that it meets technical and contractual requirements. The Project Manager will report directly to the Port's Project Manager and is responsible for technical QC and project oversight.

The Project Manager will perform the following:

- Monitor project activity and quality.
- Provide overview of field activities to the Port and its tenants.
- Prepare and review RI/FS reports.
- Provide technical representation of project activities.
- Approve the SAP/QAPP.

2.2 QUALITY ASSURANCE RESPONSIBILITIES

Jessi Massingale—Floyd|Snider QA Manager

The QA Manager reports directly to the Floyd|Snider Project Manager and will be responsible for ensuring that all QA/QC procedures for this project are followed. The QA Manager will be responsible for the data validation of all sample results from the analytical laboratories. Additional responsibilities include the following:

- Overview and review of field QA/QC.
- Coordinate supply of performance evaluation samples and review results from performance audits.
- Review of laboratory QA/QC.
- Advising on data corrective action procedures.
- Preparation and review of reports.
- QA/QC representation of project activities.
- Approval of the SAP/QAPP.

2.3 LABORATORY RESPONSIBILITIES

ALS and ARI will perform all analytical services in support of the Site-Wide RI/FS work activities.

Rick Bagan (ALS Project Manager) and Sue Dunihoo (ARI Project Manager)

The Laboratory Project Managers will report directly to the Floyd|Snider QA Manager and will be responsible for the following:

- Ensuring all resources of the laboratory are available.
- Advising Floyd|Snider's QA Manager of laboratory status.
- Review and approval of final analytical reports.
- Coordinating laboratory analyses.
- Supervising in-house chain-of-custody procedures.
- Scheduling sample analyses.
- Overseeing data review.

2.4 FIELD RESPONSIBILITIES

Lisa Meoli—Floyd|Snider Field QA Officer

The Field QA Officer will be responsible for leading and coordinating the day-to-day activities in the field. The Field QA Officer will report directly to the Floyd|Snider Project Manager.

Specific responsibilities include the following:

- Day-to-day coordination with the Project Manager.
- Developing and implementing work plans, and setting the field schedule.
- Coordinating and managing field staff including sampling and drilling.
- Reviewing technical data provided by the field staff including field measurement data.
- Adhering to work schedule.
- Coordinating and overseeing subcontractors.

- Identifying problems, resolving difficulties in consultation with the Project Manager, implementing and documenting corrective action procedures, and communicating between team and upper management.
- Preparation of the data report.

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3.0 Laboratory Quality Assurance Objectives

The overall QA objective is to specify laboratory procedures for ensuring data quality is maintained for field sampling, chain of custody, laboratory analyses, and reporting.

Specific procedures for sampling, chain of custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventative maintenance of field/laboratory equipment, and corrective action are described in other sections of this SAP/QAPP.

3.1 LABORATORY QUALITY ASSURANCE OBJECTIVES

The quality of analytical data generated is assessed by the frequency and type of internal QC checks developed for analysis type. Laboratory results will be evaluated by reviewing results for analysis of method blanks, matrix spikes, duplicate samples, laboratory control samples, calibrations, performance evaluation samples, and interference checks as specified by the specific analytical methods.

3.2 PRECISION

Precision measures the reproducibility of measurements under a given set of conditions. Specifically, precision is a quantitative measure of the variability of a group of measurements compared to their average values. Analytical precision is measured through matrix spike/matrix spike duplicate (MS/MSD) samples for organic analysis and through laboratory duplicate samples for inorganic analyses.

Analytical precision measurements will be carried out on project-specific samples at a minimum frequency of one per laboratory analysis group or 1 in 20 samples, whichever is more frequent per matrix analyzed, as practical. Laboratory precision will be evaluated against quantitative relative percent difference (RPD) performance criteria.

Field precision will be evaluated by the collection of blind field duplicates at a minimum frequency of one per laboratory analysis group or 1 in 20 samples. Currently, no performance criteria have been established for field duplicates. Field duplicate precision will therefore be screened against a RPD of 75 percent for all samples. However, no data will be qualified based solely on field duplicate precision.

Precision measurements can be affected by the nearness of a chemical concentration to the method detection limit, where the percent error (expressed as RPD) increases. The equations used to express precision are as follows:

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

Where:

RPD = relative percent difference

C_1 = larger of the two observed values

C_2 = smaller of the two observed values

3.3 ACCURACY

Accuracy is an expression of the degree to which a measured or computed value represents the true value. Analytical accuracy may be assessed by analyzing “spiked” samples with known standards (surrogates, laboratory control samples, and/or matrix spike) and measuring the percent recovery. Accuracy measurements on matrix spike samples will be carried out at a minimum frequency of 1 in 20 samples per matrix analyzed. Because MS/MSDs measure the effects of potential matrix interferences of a specific matrix, the laboratory will perform MS/MSDs only on samples from this investigation and not from other projects. Surrogate recoveries will be determined for every sample analyzed for organics.

Laboratory accuracy will be evaluated against quantitative laboratory control sample, matrix spike, and surrogate spike recoveries using limits for each applicable analyte. Accuracy can be expressed as a percentage of the true or reference value, or as a percent recovery in those analyses where reference materials are not available and spiked samples are analyzed. The equation used to express accuracy is as follows:

$$\%R = 100\% \times (S-U)/C_{sa}$$

Where:

- %R = percent recovery
- S = measured concentration in the spiked aliquot
- U = measured concentration in the unspiked aliquot
- C_{sa} = actual concentration of spike added

3.4 REPRESENTATIVENESS

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Care will be taken in the design of the sampling program to ensure sample locations are properly selected, sufficient numbers of samples are collected to accurately reflect conditions at the location(s), and samples are representative of the sampling location(s). A sufficient volume of sample will be collected at each sampling location to minimize bias or errors associated with sample particle size and heterogeneity.

Selected analytes were identified as contaminants of concern based on previous sampling investigations.

3.5 COMPARABILITY

Comparability is a qualitative parameter expressing the confidence with which one dataset can be compared to another. In order to insure results are comparable, samples will be analyzed using standard U.S. Environmental Protection Agency (USEPA) methods and protocols. Calibration and reference standards will be traceable to certified standards and standard data reporting formats will be employed. Data will also be reviewed to verify that precision and accuracy criteria were achieved and, if not, that data were appropriately qualified.

3.6 COMPLETENESS

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

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

The data quality objective for completeness for all components of this project is 95 percent. Data that were qualified as estimated because the QC criteria were not met will be considered valid for the purpose of assessing completeness. Data that were qualified as rejected will not be considered valid for the purpose of assessing completeness.

3.7 QUALITY CONTROL PROCEDURES

Sampling procedures for this investigation are described in detail in Section 4.0.

3.7.1 Field Quality Control Procedures

Trip blanks will be included in each cooler with samples being analyzed for volatile organic compounds (VOCs) to ensure the sample containers do not contribute to any detected analyte concentrations and to identify any artifacts of improper sample handling, storage, or shipping. A rinsate blank QC sample will also be collected for each sampling event on the non-dedicated field equipment (i.e., stainless steel bowl and spoon) to ensure field decontamination procedures are effective. All field QC samples will be documented in the field logbook and verified by the QA Manager or designee. A blind field duplicate will be collected at a frequency of 1 in 20 samples to evaluate the efficiency of field decontamination procedures, variability from sample handling, and site heterogeneity.

3.7.2 Laboratory Quality Control Procedures

Laboratory Quality Control Criteria. 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 whether control limits were exceeded. If control limits are exceeded in the sample group, corrective action (e.g., method modifications followed by reprocessing the affected samples) will be initiated prior to processing a subsequent group of samples.

All primary chemical standards and standard solutions used in this project will be traceable to documented and reliable commercial sources. Standards will be validated to determine their accuracy by comparison with an independent standard. Any impurities identified in the standard will be documented.

The following sections summarize the procedures that will be used to assess data quality throughout sample analysis.

Laboratory Duplicates. Analytical duplicates provide information on the precision of the analysis and are useful in assessing potential sample heterogeneity and matrix effects. Analytical duplicates are subsamples of the original sample that are prepared and analyzed as a separate sample. A minimum of one duplicate will be analyzed per sample group or for every 20 samples, whichever is more frequent.

Matrix Spikes and Matrix Spike Duplicates (MS/MSD). Analysis of MS samples provides information on the extraction efficiency of the method on the sample matrix. By performing MSD analyses, information on the precision of the method is also provided for organic analyses. A minimum of one MS/MSD will be analyzed for every sample group or for every 20 samples, whichever is more frequent. MS/MSD analyses will be performed on project-specific samples (i.e., batch QC using samples from other projects is not permitted).

Laboratory Control Samples. A laboratory control sample (LCS) is a method blank sample carried throughout the same process as the samples to be analyzed, with a known amount of standard added. The blank spike compound recovery assesses analytical accuracy in the absence of any sample heterogeneity or matrix effects.

Surrogate Spikes. All project samples analyzed for organic compounds will be spiked with appropriate surrogate compounds as defined in the analytical methods. Surrogate recoveries will be reported by the laboratories; however, no sample result will be corrected for recovery using these values.

Method Blanks. Method blanks are analyzed to assess possible laboratory contamination at all stages of sample preparation and analysis. A minimum of one method blank will be analyzed for every extraction batch or for every 20 samples whichever is more frequent.

4.0 Sample Handling and Custody Documentation

Sample possession and handling must be traceable from the time of sample collection, through laboratory and data analysis, to the time sample results are reported. A sample log form and field logbook entries will be completed for each location occupied and each sample collected.

4.1 SAMPLE HANDLING

To control the integrity of the samples during transit to the laboratory and during hold prior to analysis, established preservation and storage measures will be taken. Sample containers will be labeled with the client name, survey number, sample number, sampling date and time, required analyses, and initials of the individual processing the sample. The Field QA Officer will check all container labels, custody form entries, and logbook entries for completeness and accuracy at the end of each sampling day.

4.2 SAMPLE CHAIN-OF-CUSTODY

Sample labeling and custody documentation will be performed as described in this document. Custody procedures will be used for all samples at all stages in the analytical or transfer process and for all data and data documentation whether in hard copy or electronic format.

4.3 SAMPLE PRESERVATION

Samples requiring field preservation will be placed into pre-preserved sample jars supplied by the lab (i.e., VOCs and metals depending on media). Immediately after the sample jars are filled with each media, they will be placed in the appropriate cooler with a sufficient number of ice packs (or crushed ice) to keep them cool through the completion of that day's sampling and transport to the laboratory.

4.4 SAMPLE SHIPMENT

Technical field staff will be responsible for all sample tracking and custody procedures in the field. The Field QA Officer will be responsible for final sample inventory and will maintain sample custody documentation. At the end of each day, and prior to transfer, custody form entries will be made for all samples. Each shipment of coolers will be accompanied by custody forms; the forms will be signed at each point of transfer and will include sample numbers. All custody forms will be completed in indelible ink. Copies of all forms will be retained as appropriate and included as appendices to QA/QC reports to management.

Prior to shipping, sample containers will be wrapped and securely packed inside the cooler with ice packs or crushed ice by the field technician or designee. The original, signed custody forms will be transferred with the cooler. The cooler will be secured and appropriately sealed and labeled for immediate shipping. Samples will be delivered to the laboratory under custody following completion of sampling activities.

4.5 SAMPLE RECEIPT

The designated sample custodian at the laboratory will accept custody of the samples and verify that the chain-of-custody form matches the samples received. The laboratory Project Manager will ensure that the custody forms are properly signed upon receipt of the samples and will note questions or observations concerning sample integrity on the custody forms. The laboratory will contact the QA Manager immediately if discrepancies are discovered between the custody forms and the sample shipment upon receipt. The laboratory Project Manager, or designee, will specifically note any coolers that do not contain ice packs or are not sufficiently cold upon receipt.

5.0 Data Reduction, Validation, and Reporting

Initial data reduction, evaluation, and reporting at the laboratory will be carried out as described in the appropriate analytical protocols and the laboratory's QA Manual. QC data resulting from methods and procedures described in this document will also be reported.

5.1 DATA REDUCTION AND REPORTING

The laboratory will be responsible for internal checks on data reporting and will correct errors identified during the QA review. Close contact will be maintained with the laboratories to resolve any QC problems in a timely manner. The analytical laboratories 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 should 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 necessary.
- **Sample IDs.** Records will be produced that clearly match all blind duplicate QA samples with laboratory sample IDs.
- **Chain-of-Custody Records.** Legible copies of the 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.
- **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.
        - Percent moisture in solid samples.
        - Identification of the instrument used for analysis.
        - Method reporting and quantitation limits.
    - Analytical results reported with reporting units identified.
    - All data qualifiers and their definitions.
    - Electronic data deliverables (EDDs).
- **Quality Assurance/Quality Control Summaries.** This section will contain the results of all QA/QC procedures. Each QA/QC sample analysis will be documented with the same information required for the sample results (refer to above). No recovery or blank corrections will be made by the laboratory. The required summaries are listed below; additional information may be requested.

- **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.** All surrogate spike recovery data for organic compounds will be reported. The name and concentration of all compounds added, percent recoveries, and range of recoveries will be listed.
- **Matrix Spike Recovery.** All matrix spike recovery data for metals and organic 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 reported.
- **Matrix Duplicate.** The RPD for all matrix duplicate analyses will be reported.
- **Blind Duplicates.** Blind duplicates will be reported in the same format as any other sample. RPDs will be calculated for duplicate samples and evaluated as part of the data quality review.

5.2 DATA VALIDATION

Once data are received from the laboratory, a number of 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.

A data quality review of the analytical data will follow USEPA National Functional Guidelines in accordance with the QAPP limits (USEPA 1999 and USEPA 2004). All chemical data will be reviewed with regard to the following:

- Chain of custody/documentation.
- Sample preservation and holding times.
- Instrument performance (calibration, tuning, sensitivity).
- Method blanks.
- Reporting limits.
- Surrogate recoveries.
- Matrix spike/matrix spike recoveries.
- Laboratory control sample recoveries.
- Laboratory and field duplicate relative percent differences.

The Data Validation summary report will be presented as an appendix to the data reports. Validated data will be entered into the project database and uploaded to Ecology's EIM system.

6.0 Corrective Actions

Corrective action procedures are described in this section.

Corrective Action for Field Sampling. The Field QA Officer will be responsible for correcting field errors in sampling or documenting equipment malfunctions during the field sampling effort. The QA Manager will be responsible for resolving situations in the field that may result in non-compliance with the SAP/QAPP. All corrective measures will be immediately documented in the field logbook.

Corrective Action for Laboratory Analyses. The laboratory is required to comply with their Standard Operating Procedures (SOPs). The laboratory Project Manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this SAP/QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

If any QC sample exceeds the project-specified control limits, the analyst will identify and correct the anomaly before continuing with the sample analysis. The analyst will document the corrective action taken in a memorandum submitted to the QA Manager. A narrative describing the anomaly, the steps taken to identify and correct the anomaly, and the treatment of the relevant sample batch (i.e., recalculation, reanalysis, and/or re-extraction) will be submitted with the data package.

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7.0 Sampling Procedures

7.1 WELL INSTALLATION AND DEVELOPMENT

Monitoring wells will be installed following the “Minimum Standards for Construction and Maintenance of Wells” in WAC 173-160. Borings will be advanced and wells completed by Cascade Drilling. Well locations are shown in Figure 7.3 of the Final Site-Wide RI/FS Work Plan. The boreholes for the wells will be drilled using standard hollow-stem auger techniques. Auger boreholes will be advanced using a 4-inch ID auger. Split-spoon soil samples will be collected every 2 feet during completion of soil boring activities. Soil samples will be documented on the well installation log form According to protocols described in Section 7.4. The well screen placement will be determined and adjusted in the field as work progresses based on soil samples collected and inferred groundwater elevations at each well location. The objective is to place the well screen within the permeable soils and, if possible, avoid lenses of silt or confining layers.

The monitoring wells will be constructed with 5-foot screens set approximately 10 feet below ground surface (bgs). All wells will be constructed of 2-inch diameter, flush-threaded, Schedule 40 PVC well casings and screens. Well screen assemblies will consist of a 5-foot length of 0.020-inch (20-slot), flush-threaded, machine-slotted, Schedule 40 PVC set in a 10/20 sand or equivalent silica sand filter pack. The well design includes a 0.5-foot long flush-threaded, Schedule 40 PVC sump with a flush-threaded end cap. The sand filter pack will be installed by pouring sand into the space between the well casing and auger as the auger is withdrawn. A weighted tape will be used to monitor filter pack placement and depth during installation. The sand filter pack will extend 3 feet above the top of the screened interval. A minimum 2-foot thick seal of hydrated bentonite chips will be installed in the annular space immediately above the sand filter pack and hydrated with potable water if installed above the water table. The remainder of the annular space will be sealed with bentonite grout or hydrated bentonite chips to within 1 foot of the ground surface.

The monitoring wells will be secured with flush-to-ground locking steel protective monuments with expansion seals on the well casing to minimize the potential for surface water entering the monument.

Well development will be completed by continuous pumping at a steady rate using a whale pump. Wells will be developed using the described methodologies or equivalents at least 48 hours following well installation. Well development equipment will be decontaminated by pumping clean water through the pump and washing to the satisfaction of the field technical staff. Well development will be terminated when the variation in the turbidity NTU readings is less than 10 percent. Installed wells will be labeled with a permanent marker on the well casing on the well cover of flush mounts. All newly installed monitoring wells will be surveyed by a licensed surveyor.

7.2 SEVENTY-TWO (72)-HOUR TIDAL STUDY PROTOCOL

After completing the installation and purging of the new monitoring wells in the monitoring well network, the Site hydrogeologic conditions will be evaluated by completing a 72-hour tidal study. Data collected during the tidal study will be evaluated using the Serfes method of reducing data to successfully determine tidally-influenced groundwater gradient information using all installed shallow monitoring wells.

Water levels in newly installed and existing monitoring wells will be recorded using a combination of pressure transducers with internal data loggers and an electronic water level indicator. The data collection will include continuous (every 15 minutes) transducer-based water level measurements. The data logger will be programmed to automatically convert pressure changes to water levels. If possible, a vented transducer will be used that internally correct for fluctuations in atmospheric pressure.

The general procedure for conducting the 72-hour tidal study and recording water levels in monitoring wells is summarized below:

1. At each monitoring well location, lower a pressure transducer into the well and securely fasten it to the top of the well casing for the duration of the monitoring period.
2. Set the transducers to record the height of the water column above the transducer at 15-minute intervals.
3. Make sure the pressure transducers are rated to a minimum 15 pounds per square inch (psi) range capable of measuring a water level change of 23 feet with a resolution of 0.01 foot.
4. Transducer readings will be taken using a manual depth-to-water level instrument. Readings will be measured to the nearest 0.01 foot.
5. At the end of the monitoring period, upload the water level data to a computer and remove the pressure transducer.

7.3 GROUNDWATER SAMPLING PROTOCOL

Groundwater samples will be collected from all monitoring wells during an initial baseline monitoring event and a subsequent monitoring event 4 to 6 months later. One event will be completed during the wet season (targeting a rain event of 0.5 inches of precipitation or greater). Following the completion of the tidal study, all monitoring wells will be sampled at a low tide cycle to establish baseline groundwater data. Monitoring wells will be purged and sampled low-flow with a peristaltic pump using disposable polyethylene tubing.

Groundwater screening samples will be collected directly from soil boring locations with retractable drop-down type screen samplers made of stainless steel. Once retracted, the screen will be open to the formation. Groundwater that enters the screen will be coarsely filtered. Once the groundwater level has been determined inside the screen, a disposable polyethylene tube will be inserted into the screen and attached to a peristaltic pump. The groundwater sample will be collected as the pumped water begins to clear. After collection, the polyethylene tubing will be discarded and the screen and related equipment decontaminated between uses. At most locations, the sample will be collected between 5 to 10 feet below the groundwater surface. Salinity will be measured at each boring location prior to sample collection. If the salinity is greater than 5,000 parts per trillion (ppt), borings will be advanced deeper until freshwater is encountered.

7.3.1 Measuring Depth to Water in Groundwater Monitoring Wells

1. Open protective casing. Observe and note on the field log the condition of monument/well.
2. Decontaminate well sounder by rinsing with deionized (DI) water.
3. Drop water level indicator into well and determine water level by means of LED or beeper. Measure mark on the probe to the nearest 0.01 foot using a tape measure. Record this value, with date and time, on the field log as the static depth to water.

7.3.2 Purging Groundwater Monitoring Wells and Soil Borings

1. Lower a low-flow peristaltic pump into the well.
2. Begin purging the well. All purge water will be containerized and properly disposed of according to state and federal regulations.
3. Purge the well at low-flow rates not to exceed 0.5 liters per minute. The purge rate can be increased to one liter per minute if the purge water is observed to be generally non-turbid (less than 50 NTU) and the purging creates less than 0.5 foot of drawdown in the well. Because water levels may fluctuate in the monitoring wells with the tide, the drawdown will be measured and compared against this criterion in the first 5 minutes of purging.
4. Adjust the pump controller to achieve an acceptable purge rate.
5. During purging, field parameters (temperature, pH, dissolved oxygen [DO], conductivity, salinity, and turbidity) in the purge water will be recorded at 3- to 5 minute intervals. Record the time and parameter values and purge rate on the field log for each set of readings. If the field measurements for turbidity, DO, and Electrical Conductivity are approximately stable (within 10 percent) for three consecutive readings, the groundwater sample will be collected. If DO is below 5 mg/L, three consecutive readings within 1 mg/L will be considered stable. Should the turbidity readings be negative values, the measurement will be recorded as less than 1 (less than 1). Salinity will be a stabilization parameter; groundwater that has high salinity (above approximately 5,000 ppt) will not be sampled unless verified to be continuously saline during a complete low-tide cycle. Depth to water will be measured and recorded during the first 5 minutes of purging to calculate drawdown, as discussed above. Because these field parameters (particularly turbidity) may not reach these stringent stabilization criteria at a particular well, collection of each groundwater sample will be based on the field personnel's best professional judgment at the time of sampling. The last set of field parameters measured during purging will represent field parameters for the groundwater sample. Field parameters will not be collected at the soil boring locations.
6. Record all field measurements and observations legibly on the field forms.

7.3.3 Sample Collection

1. After purging the well and labeling the bottles, collect the groundwater sample by directly filling the lab-provided bottles from the pump discharge line (maintain same

flow rate as purging). In this way, only dedicated tubing will be used in sampling and there will be no need for equipment decontamination (other than the water level indicator). The specific bottles to be filled for each chemical analysis will be communicated by the laboratory.

2. Immediately place all labeled, filled bottles in coolers packed with ice.
3. Samples collected for dissolved metals analysis will be filtered at the laboratory.

7.3.4 Sample Nomenclature and Handling Procedures

Before or during well purging, label the bottles provided by the laboratory. The sample number format will be “well number-year/month/day of collection.” For example, a sample collected from Well MW-01 on February 1, 2011 would be labeled MW-01-02011. A duplicate sample would be labeled MW-01-02011-B. Every groundwater sample will have a unique identifier, and the collection date will be known from the sample number. Also include the date, time, and initials of sampler on the bottle label.

The samples will be shipped overnight to the laboratory on the day following collection or as soon as possible following collection to ensure that analytical holding times are met.

7.3.5 Laboratory Analysis

The analyses to be performed on groundwater and soil samples collected during the Site-Wide RI/FS are summarized in Table C.1.

7.4 SOIL BORING SAMPLING PROTOCOL

Soil samples will be collected from soil borings advanced using direct-push technology (e.g., Geoprobe™ or Strataprobe™). Soil samples will be collected from the proposed boring locations as shown in Figure 7.3 of the Final Site-Wide RI/FS Work Plan. All borings will be monitored and recorded by a field technician. When using direct-push technology, soil samples will be collected continuously using a 4-foot long sampler. Sampling will start below the ground surface and continue until saturated soils are encountered. If the saturated soils display evidence of hydrocarbons, sampling will continue until no indications of hydrocarbons are noted on the sample.

Soil samples will be screened for organic vapors using a photoionization detector (PID). Selected intervals showing elevated PID response will be analyzed for volatile petroleum-hydrocarbon analysis. These soil intervals will be sampled directly from the open split spoon using USEPA Method 5035A (for VOCs only). This preservation method uses a Teflon corer to collect a sealed sample that minimizes loss of volatiles during sampling and transport. Samples will be placed in a field cooler and packed with ice. Standard chain-of-custody procedures will be implemented for all sampling events.

In addition, the shoreline area will be assessed for the potential presence and thickness of light non-aqueous phase liquid (LNAPL) accumulation during soil boring advancement and well placement. Soil samples will be collected in the smear zone and below the water table, and inspected for LNAPL accumulation using field tests (paper towel, shake test, sheen, etc.). The sample locations presented in the Final RI/FS Work Plan are shown on Figure 7.3 and additional borings will be performed based on field conditions to adequately define the extent of petroleum contamination. If the presence of LNAPL is identified in the field, then up to two petroleum-saturated zoned soil cores will be collected and sent to PTS Laboratory for digital UV imaging to verify field test observations and to assist in the identification of hydrocarbon zones.

Soil borings will be logged in accordance with standard geologic practices for the environmental industry and will include detailed descriptions of materials encountered during drilling, including soil types classified using the USCS (ASTM D-2488-93), the presence of fill, debris, and contamination (visual and/or odors).

7.5 SOIL GAS SAMPLING

Soil gas samples may be collected if indications of LNAPL are observed during field drilling activities to assess if there is a vapor risk. If LNAPL is encountered, Floyd|Snider will collect up to two soil gas samples into a pre-evacuated Summa canister for laboratory analysis. Floyd|Snider will evaluate the potential vapor risk using the MTCA Petroleum Hydrocarbon Vapor Phase Cleanup Levels. The field procedure for collection of soil gas samples includes the following:

1. Advance a shallow probe point with a Retract-a-Tip (based on depth of observed LNAPL) using a Geoprobe™ next to the boring location in which LNAPL has been identified. The retractable tip will be pulled back to expose the sampling screen.
2. Collect a PID reading prior to sample collection.
3. Attach a certified clean, evacuated 6-liter Summa canister via the ¼-inch Teflon tubing.
4. Open the valve on the Summa canister. The soil gas sample will be drawn into the canister by pressure equilibration. The approximate sampling time for a 6-liter canister is 20 minutes.
5. Record the Site name, sample location, sample identifier, and date on a chain-of-custody form and on a tag attached to the canister.
6. Submit samples to Air Toxics Ltd.; samples will be analyzed using the Mass Air Petroleum Hydrocarbon method.

7.6 BANK/INTERTIDAL SEDIMENT SAMPLING PROTOCOL

Bank/intertidal samples will be collected by hand using a hand-held auger where sampling locations are accessible by foot. Bank/intertidal samples will be collected from the proposed sampling locations as shown in Figures 7.3 and 7.7 of the Final Site-Wide RI/FS Work Plan. Bank/intertidal samples will be collected using an auger and/or trowel to scoop the surface 0 to 12 cm of sediment, as measured with a ruler. The sediment sample will be visually classified in accordance with ASTM D 2488. The sediment descriptions will be recorded on a sediment sampling form and photographed. The sediment will be placed in a decontaminated stainless steel bowl and homogenized until the sediment is uniform in color and texture. Appropriate sediment sampling containers will be filled with the homogenized sediment, the sample labels completely filled out, and the containers stored on ice.

In the event that the sample acceptance criteria are not achieved, the sample will be rejected and the location re-sampled. If the required penetration depth or sufficient sample volume cannot be achieved at any of the selected sampling locations, it will be relocated within 5 to 10 feet of the target location. The new sampling location will be recorded in the field logbook.

As part of sample collection, the following information will be recorded on the sediment sampling form:

- Date, time, and name of the person logging the sample.
- Weather conditions.
- Sample location number.
- Depth of water at the location.
- Sediment sample depth and sediment description.
- Sample recovery.
- Biological structures (e.g., shells, tubes, macrophytes, bioturbation).
- Presence of debris (e.g., wood chips, wood fibers, anthropogenic artifacts).
- Presence of oily sheen.
- Odor.

7.6.1 Nearshore Marine Surface Sediment Contingency Sample Collection

Contingency surface sediment samples may be collected from the proposed sampling locations as shown in Figure 7.7 of the Final Site-Wide RI/FS Work Plan. Contingency surface sediment samples, as needed, will be collected from the surface interval (0–12 cm) by a diver using a 7-inch diver-assisted hand corer, commonly referred to as a “cookie cutter.” The diver-assisted hand corer provides a high level of certainty for sample location and penetration.

For all sediment samples, the diver-assisted hand corer will be inserted into the sediment column by the diver and brought to the surface for sample processing. All sediment samples will be visually classified and the total penetration of the sampler measured. The sediment descriptions, along with the sampling time, sampling coordinates, and diver notes will be recorded on sample collection forms. Photographs of each sample will be taken.

The individual sediment samples will be placed in a decontaminated stainless steel bowl and homogenized until the sediment is uniform in color and texture. Appropriate sediment sampling containers will be filled with the homogenized sediment, the sample labels completely filled out, and the containers stored on ice.

7.6.2 Equipment Decontamination

Field sampling equipment, such as the hand auger and the diver-assisted hand corer, will be cleaned between use at each sampling location. Equipment for reuse will be decontaminated according to the procedure below, before each sample interval.

1. Seawater will be sprayed over equipment to dislodge and remove any remaining sediments.
2. Surfaces of equipment contacting sample material will be scrubbed with brushes using an Alconox solution.
3. Scrubbed equipment will be rinsed and scrubbed with DI water.
4. Equipment will undergo a final spray rinse of DI water.

5. A rinsate blank QC sample will be collected following the completion of sample collection.

7.6.3 Laboratory Analyses

The analyses to be performed for bank/intertidal and contingency surface sediment samples are summarized in Table C.2.

It should be noted that gasoline-range hydrocarbon analyses will not be performed on sediment samples as there are no Sediment Management Standard (SMS) criteria for gasoline. However, since they will be analyzed for in the uplands, the sediment diesel-range hydrocarbon chromatographs will be reviewed for the presence of gasoline-range hydrocarbons.

7.7 DATA REPORTING

The Site-Wide RI/FS report will document activities associated with the collection, transportation, and laboratory analysis of groundwater, soil, and sediment samples. The report will include the following:

- A description of the purpose and goals of the investigation.
- A summary of the field sampling and laboratory analytical procedures, referencing this SAP/QAPP and identifying any deviations resulting from field conditions.
- A general vicinity map showing the location of the Site and a sampling location map. Coordinates (i.e., latitude and longitude or state plan coordinates) will be reported in an accompanying table for the sampling locations.
- Data tables for all media summarizing the chemical and conventional analytical results, as well as pertinent QA/QC data. The data tables will include sample location numbers, sample IDs, dates of sample collection, depth of sample collection, and whether the sample was a duplicate.
- Interpretation of the results of this investigation, incorporating the results of previous investigations relative to the nature and extent of contamination on the Site as well as potential contamination sources. All analytical results will be compared to the MTCA and SMS criteria as appropriate.
- QA reports and laboratory data reports as appendices or attachments.
- Copies of field logs and chain-of-custody forms as appendices or attachments.

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8.0 References

U.S. Environmental Protection Agency (USEPA). 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review*. EPA 540/R-99/1008. October 1999.

U.S. Environmental Protection Agency (USEPA). 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*. EPA 540-R-01-008. October 2004.

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Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Appendix C
Tables

FINAL

Table C.1
Upland Soil and Groundwater Sampling Rationale and Analyses

Location ID	Rationale for Sample Collection	Soil Sampling Protocol for Area[1]	Soil Analyses[2]	Geoprobe Groundwater Analyses	Monitoring Well Analyses
Northern Shoreline Area—Geoprobes and Monitoring Wells					
FS-01	Characterize contamination associated with the former Union Oil AST. Anthropogenic material previously identified in the area. Petroleum odor and sheen identified in test pit location in close proximity.	Continuous soil sampling to native layer. Soil sampling at approximately 2 to 4 feet and at native layer.	Two per location: TPH-Gx, TPH-Dx, SVOCs, VOCs, Metals	NA	NA
FS-02	Metals and petroleum-hydrocarbon contamination was previously identified along the shoreline area between the loft and pier shops to the east beyond the dry dock. Borings will be advanced to characterize the extent of TPH and metals contamination in soil and groundwater along the northern shoreline area.				
FS-03					
FS-04					
FS-05					
FS-06					
FS-07				FS-07: TPH-Gx, TPH-Dx, VOCs, Dissolved Metals	
FS-08				NA	
FS-09				FS-09: TPH-Gx, TPH-Dx, VOCs, Dissolved Metals	
MW-02A	Assess groundwater conditions in the shoreline area. This well is a replacement well for the permanently inaccessible Monitoring Well MW-02.		Two per location: TPH-Gx, TPH-Dx, VOCs, SVOCs, PCBs, Metals	NA	TPH-Gx, TPH-Dx, VOCs, SVOCs, PCBs, Dissolved Metals
MW-06	Three new monitoring wells will be installed for a total network of eight monitoring wells to characterize groundwater conditions along the shoreline area.				
MW-07					
MW-08					

Location ID	Rationale for Sample Collection	Soil Sampling Protocol for Area[1]	Soil Analyses[2]	Geoprobe Groundwater Analyses	Monitoring Well Analyses
Marine Railway Area—Geoprobes and Monitoring Wells					
FS-10	The marine railway area is one of the most heavily used areas for upland activities. Borings will be advanced in this area to further characterize subsurface soil. Test pits in this area confirmed two probable source areas.	Continuous soil sampling to native layer. Soil sampling at approximately 2 to 4 feet and at native layer.	Two per location: TPH-Gx, TPH-Dx, SVOCs, VOCs, Metals, PCBs, TBT	NA	NA
FS-11					
Former Union Oil AST Area—Geoprobes and Monitoring Wells					
FS-12	Characterize contamination associated with the former Union Oil AST. Anthropogenic material previously identified in the area. Petroleum odor and sheen identified in test pit location in close proximity.	Continuous soil sampling to native layer. Soil sampling at approximately 2 to 4 feet and at native layer.	Two per location: TPH-Gx, TPH-Dx, SVOCs, VOCs, Metals	NA	NA
FS-13	Assess subsurface conditions near the waste oil drum storage area.				
FS-14	Define contamination associated with the former Union Oil AST and east of the Marine Railway Area. Anthropogenic debris located in previous boring location in close proximity.				
FS-15	Define contamination associated with the former Union Oil AST and east of the Marine Railway Area. Anthropogenic debris located in previous boring location in close proximity. Groundwater screening sample will be collected for general characterization.			FS-15: TPH-Gx, TPH-Dx, VOCs, Dissolved Metals	
MW-01A	Assess groundwater conditions in the former Union Oil AST area. This well is a replacement well for the permanently inaccessible Monitoring Well MW-01.		Two per location: TPH-Gx, TPH-Dx, VOCs, PCBs, SVOCs, Metals	NA	TPH-Gx, TPH-Dx, VOCs, SVOCs, PCBs, Dissolved Metals

Location ID	Rationale for Sample Collection	Soil Sampling Protocol for Area[1]	Soil Analyses[2]	Geoprobe Groundwater Analyses	Monitoring Well Analyses
Paint Shop and Sandblast Shed Area (former Joiner Shop)—Geoprobes and Monitoring Wells					
FS-08	The former joiner shop was formerly located in the area of the current paint shop and sandblast shed and was also heavily used for painting and caulking as well as shipbuilding activities. Anthropogenic debris have been observed in a test pit location. These three borings will characterize lateral and vertical extent of contamination and identify the presence of sandblast grit and debris.	Continuous soil sampling to native layer. Soil sampling at approximately 2 to 4 feet and at native layer.	Two per location: TPH-Gx, TPH-Dx, VOCs, SVOCs, Metals	NA	NA
FS-16					
FS-17				FS-17: TPH-Gx, TPH-Dx, VOCs, Dissolved Metals	
MW-04	Existing monitoring well in the former joiner shop area will be sampled to characterize site groundwater contamination.	NA	NA	NA	TPH-Gx, TPH-Dx, VOCs, SVOCs, PCBs, Dissolved Metals
Main Entrance Area and Fabrication and Maintenance Building—Upgradient Monitoring Wells					
MW-03	Existing upgradient monitoring wells will be sampled to establish baseline groundwater conditions.	NA	NA	NA	TPH-Gx, TPH-Dx, VOCs, SVOCs, PCBs, Dissolved Metals
MW-05					

Notes:

1 Based on observed condition of the soil in the field, additional samples will be collected and archived if additional analytical testing may be needed.

2 Analytical Methods:

NWTPH-Gx	Gasoline-range total petroleum hydrocarbons.
NWTPH-Dx	Diesel-range total petroleum hydrocarbons.
USEPA 6010	Metals (silver, arsenic, calcium, chromium, copper, lead, mercury, nickel, zinc).
USEPA 8270	Semivolatile organic compounds.
USEPA 8260	Volatile organic compounds.
USEPA 8082	Polychlorinated biphenyls.
Krone/8270 SIM	Tributyltin.

Abbreviations:

NA	Not applicable.
PCB	Polychlorinated biphenyl.
SIM	Select ion monitoring.
SVOC	Semivolatile organic compound.
TPH-Dx	Diesel-range total petroleum hydrocarbons.
TPH-Gx	Gasoline-range total petroleum hydrocarbons.
USEPA	U. S. Environmental Protection Agency.
VOC	Volatile organic compound.

Table C.2
Sediment Analyses

Proposed Samples	Proposed Location	Sample Collection Depth	Sampling Method	Analyte(s)	Analytical Method
12	Intertidal/Bank and Nearshore Contingency Samples	0–12 cm	Hand Auger and Diver-assisted Hand Corer	Diesel-range Hydrocarbons	NWTPH-Dx
				Metals (As, Cu, Pb, Hg, Zn)	USEPA 6010/7471
				Tributyltin	PSEP/Krone (1988)
				SVOCs	USEPA 8270
				PCBs	USEPA 8082
				Total Solids	USEPA 160.3
				Total Organic Carbon	Plumb 1981

Abbreviations:

As Arsenic.
BTEX Benzene, toluene, ethylbenzene, xylene.
Cu Copper.
Hg Mercury.
Pb Lead.
PCB Polychlorinated biphenyl.
SVOC Semivolatile organic compound.
USEPA U.S. Environmental Protection Agency.
VOC Volatile organic compound.
Zn Zinc.

Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Appendix D
Health and Safety Plan

FINAL

Table of Contents

List of Figures

List of Attachments

List of Abbreviations and Acronyms

Acronym/ Abbreviation	Definition
AST	Aboveground storage tank
CIH	Certified Industrial Hygienist
CRZ	Contamination reduction zone
DOT	Department of Transportation
EZ	Exclusion zone

Acronym/ Abbreviation	Definition
HASP	Health and Safety Plan
HAS	Hollow-stem auger
HAZWOPER	Hazardous Waste Operations Training
HSO	Health and Safety Officer
L&I	Washington State Department of Labor and Industries
OSHA	Occupational Safety and Health Act
PAF	Pacific American Fisheries
PID	Photoionization detector
PPE	Personal protective equipment
PCB	Polychlorinated biphenyl
PM	Project Manager
Port	Port of Bellingham
Site	Harris Avenue Shipyard Site
SS	Site Supervisor
SSO	Site Safety Officer
Site-Wide RI/FS	Site-Wide Remedial Investigation/Feasibility Study
SZ	Support zone
TWA	Time-weighted average
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Act

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1.0 Plan Objectives and Applicability

This Health and Safety Plan (HASP) has been written to comply with the standards prescribed by the Occupational Safety and Health Act (OSHA) and the Washington Industrial Safety and Health Act (WISHA).

The purpose of this HASP is to establish protection standards and mandatory safe practices and procedures for all personnel involved with investigation activities including soil boring installation; monitoring well installation and development; groundwater monitoring; soil, sediment, groundwater sample collection; and tidal study at the Harris Avenue Shipyard Site (Site). This HASP assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may occur during field work activities. The plan consists of Site descriptions, a summary of work activities, an identification and evaluation of chemical and physical hazards, monitoring procedures, personnel responsibilities, a description of site zones, decontamination and disposal practices, emergency procedures, and administrative requirements.

The provisions and procedures outlined by this HASP apply to all Floyd|Snider personnel on-site. Contractors, subcontractors, other oversight personnel, and all other persons involved with the field work activities described herein are required to develop and comply with their own HASP. All Floyd|Snider staff conducting field activities are required to read this HASP and indicate that they understand its contents by signing the Health and Safety Officer/Site Supervisor's (HSO/SS) copy of this plan.

It should be noted that this HASP is based on information that was available as of the date indicated on the title page. It is possible that additional hazards that are not specifically addressed by this HASP may exist at the work site, or may be created as a result of on-site activities. It is the firm belief of Floyd|Snider that active participation in health and safety procedures and acute awareness of on-site conditions by all workers is crucial to the health and safety of everyone involved. Should project personnel identify a site condition that is not addressed by this HASP or have any questions or concerns about site conditions, they should immediately notify the HSO/SS and an addendum will be provided to this HASP.

The HSO/SS has field responsibility for ensuring that the provisions outlined herein adequately protect worker health and safety and that the procedures outlined by this HASP are properly implemented. In this capacity, the HSO/SS will conduct regular site inspections to ensure that this HASP remains current with potentially changing site conditions. The HSO/SS has the authority to make health and safety decisions that may not be specifically outlined in this HASP should site conditions warrant such actions. In the event that the HSO/SS leaves the Site while work is in progress, an alternate Site Safety Officer (SSO) will be designated. Personnel responsibilities are further described in Section 4.0.

This HASP has been reviewed by the Project Manager (PM) and the HSO/SS prior to commencement of work activities. All Floyd|Snider personnel shall review the plan and be familiar with on-site health and safety procedures. A copy of the HASP will be on-site at all times.

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2.0 Emergency Contacts and Information

2.1 DIAL 911

In the event of any emergency, DIAL 911 to reach fire, police, and first aid.

2.2 HOSPITAL AND POISON CONTROL

Nearest Hospital Location and Telephone: **(Refer to Figure D.1 for map and directions to the hospital.)**	PeaceHealth St. Joseph Medical Center 2901 Squalicum Parkway Bellingham, WA 98225-1581 (360) 734-5400
Washington Poison Control Center:	(800) 222-1222

2.3 PROVIDE INFORMATION TO EMERGENCY PERSONNEL

All Floyd|Snider project personnel should be prepared to give the following information:

Information to give to Emergency Personnel	
Site Location: **(Refer to Figure D.2 for directions and map to the Shipyard.)**	**Fairhaven Shipyard** **201 Harris Avenue** **Bellingham, WA 98225**
Number that you are calling from:	Look on the phone you are calling from.
Describe accident and/or incident and numbers of personnel needing assistance.	Type of Accident Type(s) of Injuries

2.4 FLOYD|SNIDER AND PORT OF BELLINGHAM (PORT) EMERGENCY CONTACTS

After contacting emergency response crews as necessary, contact the Floyd|Snider Project Manager or a Principal to report the emergency. The Principal may then contact the Port or direct the field staff to do so.

Floyd|Snider Emergency Contacts:

Matt Woltman	Office: (206)292-2078	Cell: (206)713-1329
Tom Colligan	Office (206) 292-2078	Cell: (206) 276-8527
Kate Snider	Office: (206)292-2078	Cell: (206)375-0762

Port of Bellingham Emergency Contacts:

Mike Stoner	Office: (360) 676-2500	Direct Line: (360) 715-7365

Ecology Emergency Contacts:

Mary O'Herron Direct Line: (360) 715-5224

3.0 Background Information

3.1 SITE BACKGROUND

Floyd|Snider will conduct field investigation and data collection activities on behalf of the Port of Bellingham at Harris Avenue Shipyard located at 201 Harris Avenue in Bellingham, Washington. The Site consists of approximately 7 acres of upland and over-water operational area. The property is bounded on the north and west sides by Bellingham Bay and on the south by Bellingham Marine Park and the Burlington Northern Rail lines. Industrial properties, owned by the Port, are present to the east and southeast of the Site. The properties to the east include the Bellingham Cruise Terminal, operated by the Port as the southern terminus for the Alaska State ferry, and the former Arrowac Fisheries building, now leased by Puglia Engineering.

The Site has been used by various entities for industrial purposes since the early 1900s. Shipyard activity began at the property in 1915 with Pacific American Fisheries (PAF). In May 1915, PAF leased the property from the State of Washington and then purchased it in 1916. After the purchase, PAF used the shipyard facilities to construct wooden fishing boats and cannery operations were conducted to the east of the shipyard at the present Arrowac Fisheries and Alaska Ferry Terminal properties.

In 1937, significant filling of the shoreline in the west and north portions of the Site was performed, expanding the uplands by approximately 4 acres. Nearly all of the Site property has been utilized at some point in the past for shipbuilding or repair. Maps from the Port's archive files and reports of historical investigations at the Site indicate that shipway structures occupied the western and northern sides of the property in the 1940s. From 1942 to 1945, PAF subleased the property to the Northwestern Shipbuilding Company.

During the 1930s and 1940s, an aboveground storage tank (AST) for ship fuel was located near the main dock and operated by Union Oil (a.k.a. Unocal). The bunker fuel tank had a reported capacity of 100,000 gallons and was removed in the late 1940s or early 1950s. During World War II, PAF constructed wooden ships for use during the war. Salvaging of Liberty Ships was reportedly conducted in the post-war era on the north side of the Site (in the existing Parcel A). In 1966, the PAF property, including the shipyard, was purchased by the Port. Since purchase of the land by the Port, the property has been leased by several different companies for use as a shipyard.

The objective of the Site-Wide Remedial Investigation/Feasibility Study (Site-Wide RI/FS) is to conduct a comprehensive site-wide evaluation, including the upland and in-water properties. This will involve completing a full characterization of soil, groundwater, and sediment quality; determining the compliance status of upland soil and groundwater; and evaluating potential upland-sediment contaminant migration pathways. Remedial actions for upland soil and groundwater will be evaluated and coordinated with updated sediment remedial actions to define site-wide remedial alternatives. Site-wide remedial alternatives will be evaluated against MTCA and SMS criteria and a preferred cleanup alternative will be identified.

3.2 SCOPE OF WORK

The scope of work for this field investigation and data collection activities is described in detail in the Harris Avenue Shipyard Remedial Investigation/Feasibility Study Work Plan (RI/FS Work Plan). Floyd|Snider will conduct the following fieldwork activities:

- Installation of soil borings, including Geoprobe, hollow-stem auger (HSA), and hand-auger borings, and the collection of soil and sediment samples for analytical testing. Geoprobe and HSA borings will be completed in the upland areas. Hand-auger borings will be completed in the bank and intertidal areas.
- Construction of groundwater monitoring wells in boring locations completed with HSA, and collection of soil samples for analytical testing.
- Development of new monitoring wells and development.
- Collection of groundwater samples from new and existing monitoring wells.
- Completion of tidal study.

4.0 Primary Responsibilities and Requirements

4.1 PROJECT MANAGER

The PM will have overall responsibility for the completion of the project, including the implementation and review of this HASP. The PM will review health and safety issues as needed and as consulted, and will have authority to allocate resources and personnel to safely accomplish the field work.

The PM will direct all Floyd|Snider personnel involved in field work at the Site. If the project scope changes, the PM will notify the HSO/SS so that the appropriate addendum can be included in the HASP. The PM will ensure that all Floyd|Snider personnel on-site have received the required training, are familiar with the HASP, and understand the procedures to follow should an accident and/or incident occur on-site.

4.2 HEALTH AND SAFETY OFFICER AND SITE SUPERVISOR

The HSO/SS will approve this HASP and any amendments, thereof, and will ultimately be responsible for full implementation of all elements of the HASP.

The HSO/SS will advise the PM and project personnel on all potential health and safety issues of the field investigation activities to be conducted at the Site. The HSO/SS will specify required exposure monitoring to assess Site health and safety conditions, modify the Site HASP based on field assessment of health and safety accidents and/or incidents, and recommend corrective action if needed. The HSO/SS will report all accidents and/or incidents to the PM. If the HSO/SS observes unsafe working conditions by Floyd|Snider personnel or any contractor personnel, the HSO/SS will suspend all work until the hazard has been addressed.

4.3 SITE SAFETY OFFICER

The SSO may be a person dedicated to this task, to assist the HSO/SS during field work activities. The SSO will ensure that all personnel have appropriate personal protective equipment (PPE) on-site and PPE is properly used. The SSO will assist the HSO/SS in field observation of Floyd|Snider personnel safety. If a health or safety hazard is observed, the SSO shall suspend all work activity. The SSO will conduct on-site safety meetings daily before work commences. All health and safety equipment will be calibrated daily and records kept in the daily field logbook. The SSO may perform exposure monitoring if needed and will ensure that equipment is properly maintained.

4.4 FLOYD|SNIDER PROJECT PERSONNEL

All Floyd|Snider project personnel involved in field work activities will take precautions to prevent accidents and/or incidents from occurring to themselves and others in the work areas. Employees will report all accidents, incidents, and/or other unsafe working conditions to the HSO/SS or SSO immediately. Employees will inform the HSO/SS or SSO of any physical conditions that could impact their ability to perform field work.

4.5 TRAINING REQUIREMENTS

All Floyd|Snider project personnel must comply with applicable regulations specified in the Washington Administrative Code (WAC) Chapter 296-843, Hazardous Waste Operations Training (HAZWOPER), administered by the Washington State Department of Labor and Industries (L&I). Project personnel will be 40-hour HAZWOPER trained and maintain their training with an annual 8-hour refresher. Personnel with limited tasks and minimal exposure potential will be required to have 24-hour training and a site hazard briefing, and be escorted by a trained employee. Personnel with defined tasks that do not include potential contact with disturbed site soils or waste, groundwater, or exposures to visible dust (e.g., surveying) are not required to have any level of hazardous waste training beyond a site emergency briefing and hazard orientation by the HSO/SS. Floyd|Snider project personnel will fulfill the medical surveillance program requirements.

In addition to the 40-hour course and 8-hour refreshers, the HSO/SS will have completed an 8-hour HAZWOPER Supervisor training as required by WAC 296-843-20015. At least one person on-site during field work will have current CPR/First Aid certification. All field personnel must have a minimum of 3 days of hazardous materials field experience under the direction of a skilled supervisor. Documentation of all required training will be maintained on-site in a 3-ring binder or similar device and kept either in the HSO/SS vehicle or equipment storage bin.

Additional site-specific training that covers on-site hazards, PPE requirements, use and limitations, decontamination procedures, and emergency response information as outlined in this HASP will be given by the HSO/SS before on-site work activities begin. Daily health and safety meetings will be documented on the Daily Tailgate Safety Meeting form included in this HASP.

4.6 MEDICAL SURVEILLANCE

All Floyd|Snider field personnel are required to participate in Floyd|Snider's medical surveillance program, which includes biennial audiometric and physical examinations for employees involved in HAZWOPER projects. The program requires medical clearance before respirator use or participating in HAZWOPER activities. Medical examinations must be completed before conducting field work activities and on a biennial basis.

5.0 Hazard Evaluation and Risk Analysis

In general, there are three broad hazard categories that may be encountered during site work: chemical exposure hazards, fire/explosion hazards, and physical hazards. Sections 5.1 through 5.3 discuss the specific hazards that fall within each of these broad categories.

5.1 CHEMICAL EXPOSURE HAZARDS

This section describes potential chemical hazards associated with soil boring installation, monitoring well installation and development, groundwater monitoring, soil and groundwater sample collection, and hydraulic conductivity testing. Based on previous site investigation information, the following chemicals are present at this Site and have been retained as site contaminants of concern (COCs):

- Metals in sediment, soil and groundwater.
- PAHs in soil and groundwater.
- Diesel range and heavy oil range hydrocarbons in soil and groundwater.
- Gasoline range hydrocarbons in soil and groundwater.
- PCBs in sediment and soil.
- VOCs in soil and groundwater.
- SVOCs in sediment.

Human health hazards of these chemicals are discussed in the table below. This information covers potential toxic effects which might occur if relatively significant acute and/or chronic exposure were to happen. This information does not mean that such effects will occur from planned site activities. Potential routes of exposure include inhalation, dermal contact, ingestion, and eye contact. The primary exposure route of concern during site work is ingestion of contaminated water or soil, though such exposure is considered unlikely and highly preventable. In general, the chemicals which may be encountered at this Site are not expected to be present at concentrations which could produce significant exposures. The types of planned work activities and use of monitoring procedures and protective measures will limit potential exposures at this Site. The use of appropriate PPE and decontamination practices will assist in controlling exposure through all pathways to the key contaminants of concern listed in the table below.

Chemical Hazard	Exposure Limits (TWA)	Highest Historic Concentration	Routes of Exposure	Potential Toxic Effects
Arsenic	0.01 mg/m^3 in air	1, 240 mg/kg in soil	Inhalation, skin absorption, ingestion, skin/eye contact	Ulceration of naval septum, dermatitis, GI disturbance, respiratory irritation, hyper-pigmentation of skin

Chemical Hazard	Exposure Limits (TWA)	Highest Historic Concentration	Routes of Exposure	Potential Toxic Effects
Lead	0.1 mg/m^3 in air	1,680 mg/kg in soil	Inhalation, ingestion, skin/eye contact	Weakness, insomnia, facial pallor, weight loss, constipation, abdominal pain, anemia, tremors, eye irritation, hypotension
Copper	0.1 mg/m^3 in air	1,400 mg/kg in sediment	Inhalation, ingestion, skin/eye contact	Eye irritation, respiratory system irritation, cough, dyspnea (breathing difficulty), wheezing
Diesel- and Heavy Oil-range Hydrocarbons	None	4.6 mg/L in groundwater	Inhalation, skin/eye contact	Irritation to eyes, pulmonary function
Gasoline-range Hydrocarbons	None	0.58 mg/L in groundwater	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, skin, mucus membranes; headache; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; liver, kidney damage
Polychlorinated Biphenyl (Aroclor 1254)	0.5 mg/m^3 in air	38.9 mg/kg	Inhalation, skin absorption, ingestion, skin and/or eye contact	Eye irritation, chloracne, liver damage, reproductive effects; potential occupational carcinogen

Abbreviation:
TWA Time-weighted average.

5.2 FIRE AND EXPLOSION HAZARDS

Flammable and combustible liquid hazards may occur from fuels and lubricants brought to the property to support heavy equipment. When on-site storage is necessary, such material will be stored in containers approved by the Department of Transportation (DOT) in a location not exposed to strike hazards and provided with secondary containment. A minimum 2-A:20-B fire extinguisher will be located within 25 feet of the storage location and where refueling occurs. Any subcontractors bringing flammable and combustible liquid hazards to the Site are responsible for providing appropriate material for containment and spill response, and such hazards should be addressed in their respective HASP. Transferring of flammable liquids (e.g., gasoline) will occur only after making positive metal to metal connection between the containers. A bonding strap may be necessary to achieve this. Storage of ignition and combustible materials will be kept away from storage and fueling operations.

5.3 PHYSICAL HAZARDS

When working in or around any hazardous or potentially hazardous substances or situations, all site personnel should plan all activities before starting any task. Site personnel shall identify health and safety hazards involved with the work planned and consult with the HSO/SS as to how the task can be performed in the safest manner. Personnel will also consult the HSO/SS if they have any concerns or uncertainties.

All field personnel will adhere to general safety rules including wearing appropriate PPE, hard hats, steel-toed boots, safety vests, and safety glasses. Eating, drinking, and/or use of tobacco or cosmetics will be restricted in all work areas. Personnel will prevent splashing of liquids containing chemicals and minimize dust emissions.

The following table summarizes a variety of physical hazards that may be encountered on the Site during work activities. For convenience, these hazards have been categorized into several general groupings with recommended preventative measures.

Hazard	Cause	Prevention
Head Strike	Falling and/or sharp objects, bumping hazards.	Hard hats will be worn by all personnel at all times when overhead hazards exist, such as during drilling activities and around large, heavy equipment.
Foot/ankle twist, Crush, Slip/trip/fall	Sharp objects, dropped objects, uneven and/or slippery surfaces.	Steel-toed boots must be worn at all times on-site while heavy equipment is present. Pay attention to footing on uneven or wet terrain and do not run. Keep work areas organized and free from unmarked trip hazards.
Hand Cuts, Splinters, and Chemical Contact	Hands or fingers pinched or crushed, chemical hazards including dermal exposure to nitric acid or sulfuric acid preservative. Cut or splinters from handling sharp/rough objects and tools.	***Nitrile*** safety gloves will be worn to protect the hands from dust and chemicals. Leather or cotton outer gloves will be used when handling sharp-edged rough materials or equipment. Refer to the preventive measures for Mechanical Hazards below.

Hazard	Cause	Prevention
Eye Damage from Flying Materials, or Splash Hazards	Sharp objects, poor lighting, exposure due to flying debris or splashes.	Safety glasses will be worn at all times on-site. If a pressure washer is used to decontaminate heavy equipment, a face shield will be worn over safety glasses or goggles. Care will be taken during decontamination procedures and groundwater sampling to avoid splashing or dropping equipment into decontamination water. Face shields may be worn over safety glasses if splashing is occurring during sampling, decontamination, or well slug testing.
Electrical Hazards	Underground utilities, overhead utilities, electrical cord hazards.	Utility locator service will be used prior to any investigation to locate all underground utilities. Visual inspection of work areas will be conducted prior to starting work. Whenever possible, avoid working under overhead high voltage lines. Make sure that no damage to extension cords occurs. If an extension cord is used, make sure it is the proper size for the load that is being served and rated SJOW or STOW (an "-A" extension is acceptable for either) and inspected prior to use for defects. The plug connection on each end should be of good integrity. Insulation must be intact and extend to the plugs at either end of the cord. All portable power tools will be inspected for defects before use and must either be a double-insulated design or grounded with a ground-fault circuit interrupter (GFCI).
Mechanical Hazards	Heavy equipment such as drill rigs, service trucks, mowing equipment, saws, drills, etc. Conducting work in road right of ways (on the road shoulder).	Ensure the use of competent operators, backup alarms, regular maintenance, daily mechanical checks, and proper guards. Subcontractors will supply their own HASP. All project personnel will make eye contact with operator and obtain a clear OK before approaching or working within swing radius of heavy equipment, staying clear of swing radius. Obey on-site speed limits.

Hazard	Cause	Prevention
Traffic Hazards	Vehicle traffic and hazards when working near public right-of-ways and in/around Shipyard operations.	When working around active Shipyard operations, orange cones and/or flagging will be placed around the work area. Safety vests will be worn at all times while conducting work. Multiple field staff will work together (buddy system) and spot traffic for each other if necessary. Avoid working with your back to traffic whenever possible. **Further details on traffic hazards are provided in Section 5.3.4.**
Hearing Damage due to Noise	Machinery creating more than 85 decibels TWA, less than 115 decibels continuous noise, or peak at less than 140 decibels.	Wear earplugs or protective ear covers when a conversational level of speech is difficult to hear at a distance of 3 feet; when in doubt, a sound level meter may be used on-site to document noise exposure.
Strains from Improper Lifting	Injury due to improper lifting techniques, overreaching/ overextending, or lifting overly heavy objects.	Use proper lifting techniques and mechanical devices where appropriate. The proper lifting procedure first involves testing the weight of the load by tipping it. If in doubt, ask for help. Do not attempt to lift a heavy load alone. Take a good stance and plant your feet firmly with legs apart, one foot farther back than the other. Make sure you stand on a level area with no slick spots or loose gravel. Use as much of your hands as possible, not just your fingers. Keep your back straight, almost vertical. Bend at the hips, holding load close to your body. Keep the weight of your body over your feet for good balance. Use large leg muscles to lift. Push up with one foot positioned in the rear as you start to lift. Avoid quick, jerky movements and twisting motions. Turn the forward foot and point it in the direction of the eventual movement. Never try to lift more than you are accustomed to.
Cold Stress	Cold temperatures and related exposure.	Workers will wear appropriate clothing, stay dry, and take breaks in a heated environment when working in freezing temperatures. **Further details on cold stress are provided in Section 5.3.1.**
Heat Exposure	High temperatures exacerbated by PPE and/or dehydration.	Workers will ensure adequate hydration, shade, and breaks when temperatures are elevated. **Further details on heat stress are provided in Section 5.3.2.**

Hazard	Cause	Prevention
Accidents due to Inadequate Lighting	Improper illumination.	Work will proceed during daylight hours only or under sufficient artificial light.

Abbreviation:
PPE Personal protective equipment.
TWA Time-weighted average.

5.3.1 Cold Stress

Field work is expected to be completed in the spring months; however, if additional phases of work are required or activities are conducted in winter months, exposure to cold temperatures may occur. Exposure to moderate levels of cold can cause the body's internal temperature to drop to a dangerously low level, causing hypothermia. Symptoms of hypothermia include slow, slurred speech; mental confusion; forgetfulness; memory lapses; lack of coordination; and drowsiness.

To prevent hypothermia, site personnel will stay dry and avoid exposure. Site personnel will have access to a warm, dry area, such as a vehicle, to take breaks from the cold weather and warm up. Site personnel will be encouraged to wear sufficient clothing in layers such that outer clothing is wind- and waterproof and inner layers retain warmth (wool or polypropylene), if applicable. Site personnel will keep hands and feet well protected at all times. The signs and symptoms and treatment for hypothermia are summarized below:

Signs and Symptoms

- Mild hypothermia (body temperature of 98–90°F)
  - Shivering.
  - Lack of coordination, stumbling, fumbling hands.
  - Slurred speech.
  - Memory loss.
  - Pale, cold skin.
- Moderate hypothermia (body temperature of 90–86°F)
  - Shivering stops.
  - Unable to walk or stand.
  - Confused and irrational.
- Severe hypothermia (body temperature of 86–78°F)
  - Severe muscle stiffness.
  - Very sleepy or unconscious.
  - Ice-cold skin.
  - Death.

Treatment of Hypothermia (Proper treatment depends on the severity of the hypothermia.)

- Mild hypothermia
  - Move to warm area.
  - Stay active.
  - Remove wet clothes and replace with dry clothes or blankets and cover the head.
  - Drink warm (not hot) sugary drinks.
- Moderate hypothermia
  - All of the above, plus:
    - call 911 for an ambulance,
    - cover all extremities completely, and
    - place very warm objects such as hot packs or water bottles on the victim's head, neck, chest and groin.
- Severe hypothermia
  - Call 911 for an ambulance.
  - Treat the victim very gently.
  - Do not attempt to re-warm—the victim should receive treatment in a hospital.

Frostbite

Frostbite occurs when the skin actually freezes and loses water. In severe cases, amputation of the frostbitten area may be required. While frostbite usually occurs when the temperatures are 30°F or lower, windchill factors can allow frostbite to occur in above-freezing temperatures. Frostbite typically affects the extremities, particularly the feet and hands. Frostbite symptoms include cold, tingling, stinging, or aching feelings in the frostbitten area followed by numbness and skin discoloration from red to purple, then to white or very pale skin. Should any of these symptoms be observed, wrap the area in soft cloth—do not rub the affected area—and seek medical assistance. Call 911 if the condition is severe.

Protective Clothing

Wearing the right clothing is the most important way to avoid cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. The following are recommendations for working in cold environments:

- Wear *at least three layers* of clothing:
  - An outer layer to break the wind and allow some ventilation (like Gortex or nylon).
  - A middle layer of down or wool to absorb sweat and provide insulation even when wet.
  - An inner layer of cotton or synthetic weave to allow ventilation.

- Wear a hat—up to 40 percent of body heat can be lost when the head is left exposed.
- Wear insulated boots or other footwear.
- Keep a change of dry clothing available in case work clothes become wet.
- Do not wear tight clothing—loose clothing allows better ventilation.

Work Practices

- Drinking: Drink plenty of liquids, avoiding caffeine and alcohol. It is easy to become dehydrated in cold weather.
- Work Schedule: If possible, heavy work should be scheduled during the warmer parts of the day. Take breaks out of the cold in heated vehicles.
- Buddy System: Try to work in pairs to keep an eye on each other and watch for signs of cold stress.

5.3.2 Heat Stress

To avoid heat-related illness, current regulations in WAC 296-62-095 through 296-62-09570 will be followed during all outdoor work activities. These regulations apply to any outdoor work environment from May 1 through September 30, annually when workers are exposed to temperatures above 89°F when wearing breathable clothing, above 77°F when wearing double-layered woven clothing such as jackets or coveralls, or above 52°F when wearing non-breathing clothing such as chemical resistant suits or Tyvek. Floyd|Snider will identify and evaluate temperature, humidity, and other environmental factors associated with heat-related illness including but not limited to the provision of rest breaks that are adjusted for environmental factors, and encourage frequent consumption of drinking water. Drinking water will be provided and made readily accessible in sufficient quantity to provide at least 1 quart per employee per hour. All Floyd|Snider personnel will be informed and trained for responding to signs or symptoms of possible heat-related illness and accessing medical aid.

Employees showing signs or demonstrating symptoms of heat-related illness must be relieved from duty and provided with a sufficient means to reduce body temperature, including rest areas or temperature controlled environments (i.e., air conditioned vehicle). Any employee showing signs or demonstrating symptoms of heat-related illness must be carefully evaluated to determine whether it is appropriate to return to work or if medical attention is necessary.

Any incidence of heat-related illness must be immediately reported to the employer directly through the HSO/SS.

The signs, symptoms, and treatment of heat stress are given in the table on the next page.

Condition	Signs/Symptoms	Treatment
Heat Cramps	Painful muscle spasms and heavy sweating.	Increase water intake, rest in shade/cool environment.

Condition	Signs/Symptoms	Treatment
Heat Syncope	Brief fainting and blurred vision.	Increase water intake, rest in shade/cool environment.
Dehydration	Fatigue, reduced movement, headaches.	Increase water intake, rest in shade/cool environment.
Heat Exhaustion	Pale and clammy skin, possible fainting, weakness, fatigue, nausea, dizziness, heaving, sweating, blurred vision, body temperature slightly elevated.	Lie down in cool environment, increase water intake, and loosen clothing; call 911 for ambulance transport if symptoms continue once in cool environment.
Heat Stroke	Cessation of sweating, skin hot and dry, red face, high body temperature, unconsciousness, collapse, convulsions, confusion or erratic behavior, life threatening condition.	**Medical Emergency!! Call 911** for ambulance transport. Move victim to shade and immerse in water.

If site temperatures are forecast to exceed 85°F and physically demanding site work will occur in impermeable clothing, the HSO/SS will promptly consult with a certified industrial hygienist (CIH) and a radial pulse monitoring method will be implemented to ensure that heat stress is properly managed among the affected workers. The following heat index chart indicates the relative risk of heat stress:

Temperature (°F)

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										

<u>**Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity**</u>

Caution Extreme Caution Danger Extreme Danger

5.3.3 Biohazards

Bees and other insects may be encountered during the field work tasks. Persons with allergies to bees will make the HSO/SS aware of their allergies and will avoid areas where bees are identified. Controls such as repellents, hoods, nettings, masks, or other personal protection may be used. Report any insect bites or stings to the HSO/SS and seek first aid if necessary.

Site personnel will maintain a safe distance from any urban wildlife encountered, including raccoons and rodents, to preclude a bite from a sick or injured animal. Personnel will be gloved and will use tools to lift covers from catch basins and monitoring wells.

5.3.4 Traffic Hazards

While work is being performed in the active Shipyard areas, barricades should be utilized. Spotters will be used to ensure traffic is monitored during work activities because signs, signals, and barricades do not always provide appropriate protection. All workers will wear reflective neon/orange vests.

6.0 Site Monitoring

The following sections describe site monitoring techniques and equipment that will be used during site field activities. The HSO/SS, or a designated alternate, is responsible for site control and monitoring activities.

6.1 SITE MONITORING

Since the Shipyard is currently active, and noise generating activities will be conducted within the site boundary, noise levels are expected to be below the allowable levels.

Air monitoring will not be conducted as previous investigations have adequately characterized the type and concentrations of chemicals present at the Site, and the majority of site COCs are non-volatile. Visual monitoring for dust will be conducted by the HSO/SS to ensure inhalation of contaminated soil particles does not occur. It is not anticipated that dust will be generated given that the Site is primarily concrete and asphalt. However, if visible dust is present in the work area, work will cease and the area will be cleared until the dust settles.

Concentrations of VOCs are low and below OSHA standards and all work will be conducted outdoors in an open-air ventilated environment; vapor concentrations are not expected to exceed allowable levels. A photoionization detector (PID) will be used on-site for characterization of soil samples collected. This PID will also be used to monitor vapor concentrations in breathing air of total VOCs in parts per million. Should the PID read a sustained concentration of total VOCs above the lowest action level sustained for 5 minutes, the HSO/SS will stop work and evacuate the area until vapor concentrations return to background levels. As needed, actions may be taken to reduce exposure to vapor concentrations in the work area by covering exposed soil or drilling cuttings, and leaving the work area until odor dissipates.

The HSO/SS will visually inspect the work site at least daily to identify any new potential hazards. If new potential hazards are identified, immediate measures will be taken to eliminate or reduce the risks associated with these hazards.

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7.0 Hazard Analysis by Task

The following section identifies potential hazards associated with each task listed in Section 3.2 of this HASP. Tasks have been grouped according to the types of potential hazard associated with them.

Task	Potential Hazard
Installation of Soil Borings and Wells, Augers, Soil and Sediment Sampling	Exposure to loud noise; overhead hazards; head, foot, ankle, hand, and eye hazards; electrical and mechanical hazards; lifting hazards; dust inhalation hazards; potential dermal or eye exposure to site contaminants in groundwater and soil; fall hazards; traffic hazards; and heat and cold exposure hazards.
Groundwater Sampling from Monitoring Wells, Well Development, Decontamination, and Tidal Study	Chemical hazards include potential dermal or eye exposure to site contaminants in groundwater. Physical hazards include slip, trip, or fall hazards; heat and cold exposure hazards; and biological hazards.

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8.0 Personal Protective Equipment

All work involving heavy equipment, drilling, and well installation will proceed in Level D PPE, which shall include hard hat, steel-toed boots, hearing protection, eye protection, and protective gloves.

All personnel will be properly fitted and trained in the use of PPE. The level of protection will be upgraded by the HSO/SS whenever warranted by conditions present in the work area. The HSO/SS will periodically inspect equipment such as gloves and hard hats for defects.

For all work involving potential exposure to sediment, soil, or groundwater, workers will wear nitrile gloves and Level D PPE.

Safety vests will be worn when working around heavy equipment and in the active shipyard areas.

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9.0 Site Control and Communication

9.1 SITE CONTROL

The Site is active and fenced. Pedestrians and other unauthorized personnel will not be allowed in the work area. Access to the work site will be restricted to designated personnel. The purpose of site control is to minimize the public's potential exposure to site hazards, to prevent vandalism in the work area and access by children and other unauthorized persons, and to provide adequate facilities for workers.

Work area controls and decontamination areas will be provided to limit the potential for chemical exposure associated with site activities, and transfer of contaminated media from one area of the Site to another. The support zone (SZ) for the work area includes all areas outside the work area and decontamination areas. An exclusion zone (EZ), contamination reduction zone (CRZ), and SZ will be set up for work being conducted within the limits of the Shipyard. Only authorized personnel shall be permitted access to the EZ/CRZ. Staff will decontaminate all equipment and gear as necessary prior to exiting the work area.

9.2 COMMUNICATION

All site work will occur in teams and the primary means of communication on-site and with off-site contacts will be via cell phones. An agreed-upon system of alerting via air horns and/or vehicle horns may be used around heavy equipment to signal an emergency if shouting is ineffective.

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10.0 Decontamination

Decontamination procedures will be strictly followed to prevent off-site spread of contaminated sediment, soil, or water. Decontamination effectiveness will be assessed by visual inspection by the HSO/SS. Refer to the Sampling Analysis Plan/Quality Assurance Project Plan (SAP/QAPP; Appendix C of the Site-Wide RI/FS Work Plan) for additional details.

Before eating, drinking, and use of tobacco, hands must be thoroughly washed.

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11.0 Emergency Response and Contingency Plan

This section defines the emergency action plan for the Site. It will be rehearsed with all site personnel and reviewed whenever the plan is modified or the HSO/SS believes that site personnel are unclear about the appropriate emergency actions.

A point of refuge will be identified by the HSO/SS and communicated to the field team each day. This point will be clear of adjacent hazards and preferably upwind or crosswind for the entire day. In an emergency, all site personnel and visitors will evacuate to the point of refuge for roll call. It is important that each person on-site understand their role in an emergency, and that they remain calm and act efficiently to ensure everyone's safety.

After each emergency is resolved, the entire project team will meet and debrief on the incident—the purpose is not to fix blame, but to improve the planning and response to future emergencies. The debriefing will review the sequence of events, what was done well, and what can be improved. The debriefing will be documented in a written format and communicated to the PM. Modifications to the emergency plan will be approved by the PM.

Reasonably foreseeable emergency situations include medical emergencies, accidental release of hazardous materials (such as gasoline or diesel) or hazardous waste, and general emergencies such as vehicle accident, fire, thunderstorm, and earthquake. Expected actions for each potential incident are outlined below.

11.1 MEDICAL EMERGENCIES

In the event of a medical emergency, the following procedures should be used:

1. Stop any imminent hazard if you can safely do so.
2. Remove ill, injured, or exposed person(s) from immediate danger if moving them will clearly not cause them harm and no hazards exist to the rescuers.
3. Evacuate other on-site personnel to a safe place in an upwind or crosswind direction until it is safe for work to resume.

   If serious injury or life-threatening condition exists, call 911 for paramedics, the fire department, and police.

   Clearly describe the location, injury, and conditions to the dispatcher. Designate a person to go to the Site entrance and direct emergency equipment to the injured person(s). Provide the responders with a copy of this HASP to alert them to chemicals of potential concern.
4. Trained personnel may provide first aid/cardiopulmonary resuscitation if it is necessary and safe to do so. Remove contaminated clothing and PPE only if this can be done without endangering the injured person.
5. Call the PM and HSO/SS.
6. Immediately implement steps to prevent recurrence of the accident.

A map showing the nearest hospital location is attached to this HASP (refer to Section 2.0 for number and address).

11.2 ACCIDENTAL RELEASE OF HAZARDOUS MATERIALS OR WASTES

1. Evacuate all on-site personnel to a safe place in an upwind direction until the HSO/SS determines that it is safe for work to resume.
2. Instruct a designated person to contact the PM and confirm a response.
3. Contain the spill, if it is possible and can be done safely.
4. If the release is not stopped, call 911 to alert the fire department.
5. Contact the Washington State Emergency Response Commission at 1-800-258-5990 to report the release.
6. Initiate cleanup.
7. The PM will coordinate follow-up written reporting to the Washington State Department of Ecology in the event of a reportable release of hazardous materials or wastes.

11.3 GENERAL EMERGENCIES

In the case of fire, explosion, earthquake, or imminent hazards, work shall be halted and all on-site personnel will be immediately evacuated to a safe place. The local police/fire department shall be notified if the emergency poses a continuing hazard by calling 911.

In the event of a thunderstorm, outdoor work will be discontinued until the threat of lightning has abated. During the incipient phase of a fire, the available fire extinguisher(s) may be used by persons trained in putting out fires, if it is safe for them to do so. Contact the fire department as soon as feasible.

11.4 EMERGENCY COMMUNICATIONS

In the case of an emergency, an air horn or car horn will be used as needed to signal the emergency. One long (5-second) blast will be given as the emergency/stop work signal. If the air horn is not working, a vehicle horn and/or overhead waving of arms will be used to signal the emergency. In any emergency, all personnel will evacuate to the designated refuge area and await further instruction.

11.5 EMERGENCY EQUIPMENT

The following minimum emergency equipment will be readily available on-site and functional at all times:

- First Aid Kit—contents approved by the HSO/SS.
- Sorbent materials capable of absorbing the volume of liquids/fuels brought to the Site by Floyd|Snider personnel.

- Portable fire extinguisher (2-A:10 B/C min).
- A copy of the current HASP.

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12.0 Administrative

12.1 MEDICAL SURVEILLANCE

Floyd|Snider personnel involved with field activities must be covered under Floyd|Snider's medical surveillance program that includes biennial physical examinations. These medical monitoring programs must be in compliance with all applicable worker health and safety regulations.

12.2 RECORD KEEPING

The HSO/SS, or a designated alternate, will be responsible for keeping attendance lists of personnel present at site health and safety meetings, accident reports, and signatures of all personnel who have read this HASP.

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13.0 Approvals

Project Manager

Date

Project Health & Safety Officer

Date

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14.0 Signature Page

I have read this Heath and Safety Plan and understand its contents. I agree to abide by its provisions and will immediately notify the HSO/SS if site conditions or hazards not specifically designated herein are encountered.

Name (Print)	Signature	Date	Company/Affiliation

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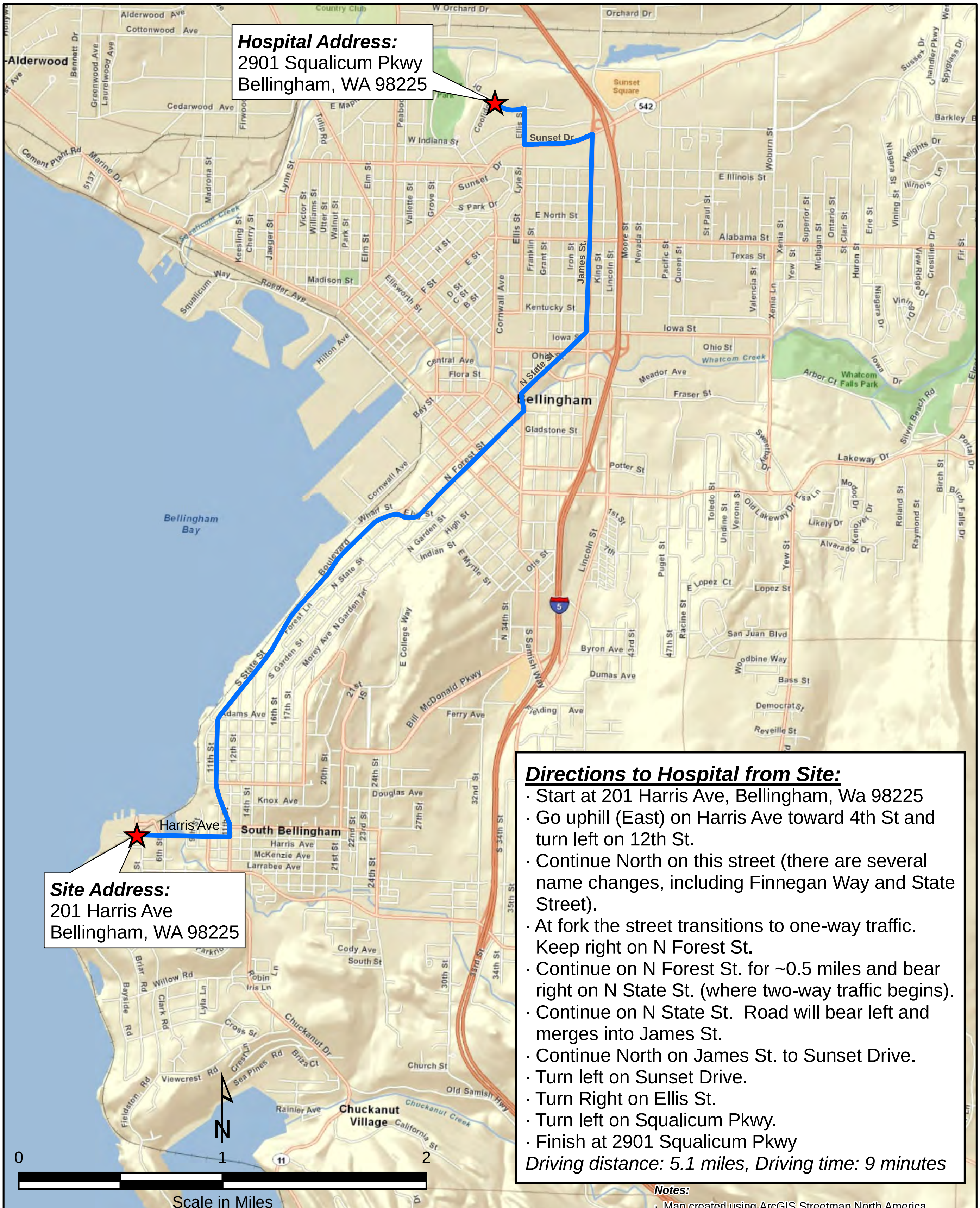
Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Appendix D
Figures

FINAL



FLOYD | SNIDER strategy ▪ science ▪ engineering	**RI/FS Work Plan** **Harris Avenue Shipyard** **Bellingham, Washington**	Figure D.1 Route to Hospital Map

File: F:\projects\POB-HARRIS\GIS\MXD\Figure D.1 (Directions to Hospital Map).mxd
Date: 4/5/2010

FLOYD | SNIDER strategy • science • engineering	**RI/FS Work Plan** **Harris Avenue Shipyard** **Bellingham, Washington**	Figure D.2 Project Location Map

File: F:\projects\POB-HARRIS\GIS\MXD\Figure D.2 (Project Location Map).mxd
Date: 3/29/2010

Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Attachment D.1
Daily Tailgate Safety Meeting Form

FINAL

Daily Tailgate Safety Meeting Form

Date:____________________________ **Time:**__________________________

Project Name: ____

Location: ____

Meeting Conducted By: ____

Topics Discussed:

Physical Hazards:____

Chemical Hazards: ____

Personal Protection: ____

Decontamination:____

Special Site Considerations:____

____

____

On-site Emergency Contact:, Health & Safety Officer/Site Supervisor Emergency Dispatch 911

Hospital: ____

Tailgate Safety Meeting Attendees

Name/Company (printed)	Signature

Conducted by: ____________ ____________ ____________

Name **Signature** **Date**

Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Attachment D.2 Material Safety Data Sheets

(to be included)

Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Appendix E
Memoranda: Response to Comments and Approach to Develop the Final RI/FS Work Plan

FINAL

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strategy ▪ science ▪ engineering

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Seattle, WA 98101
tel: 206.292.2078 fax: 206.682.7867

Memorandum

To: Mary O'Herron, Washington State Department of Ecology

Copies: Mike Stoner, Port of Bellingham

From: Floyd|Snider

Date: October 14, 2010

Project No: POB-Harris

Re: **Harris Avenue Shipyard RI/FS Work Plan**
Response to Comments Dated June 23, 2010

This memorandum provides responses to the Washington State Department of Ecology's (Ecology's) comments to the Draft Remedial Investigation/Feasibility Study (RI/FS) Work Plan dated April 7, 2010 regarding the Harris Avenue Shipyard Site (Site) located at 102 Harris Avenue in Bellingham, Washington. Additionally, this comment response memorandum addresses key Ecology comments that were discussed during conference calls on July 29 and August 8, 2010.

The purpose of this memorandum is to present an approach to Ecology regarding revisions to the Site-Wide RI/FS Work Plan that will help expedite final review and acceptance of the document so that proposed field data collection activities can be completed in early 2011. Following Ecology review and approval of the approach presented in this memorandum, Floyd|Snider will prepare a revised RI/FS Work Plan that will be submitted to Ecology in November 2010. The original text of the compiled Ecology, U.S. Fish and Wildlife Services (USFWS), and Nooksack Tribe comments is included below in *italics* and the response follows each comment.

ECOLOGY COMMENT REGARDING COLLECTION OF DIOXIN/FURANS DATA IN SEDIMENTS (FROM JUNE 23, 2010 E-MAIL TO PORT OF BELLINGHAM)

Ecology has general comments regarding dioxin/furans. This contaminant is present throughout Bellingham Bay and is likely the result of waterfront industrial activities, storm drain inputs, and atmospheric deposition. The Work Plan needs to include provisions for evaluating dioxin/furans in surface and subsurface sediments to determine if they are commingled with the Harris Avenue Shipyard site contaminants. This also includes an evaluation of storm drain inputs and performance of a human health risk assessment. Note that a human health risk assessment is likely to result in cleanup levels which would be below the natural background level for Puget Sound. This means the cleanup level will, by default, be the Puget Sound background level.

Dioxin/furans data is required to ensure that all COC's have been identified, and are addressed by the cleanup of the site. Subsurface information is critical for ensuring that post-dredge surface sediments comply with the SMS.

Ecology will require the evaluation of dioxin/furans at all Bellingham Bay sediment cleanup sites.

In addition to these dioxin/furan cleanup issues, recent core samples are needed to characterize the suitability of dredged materials for disposal at an open-water disposal site. Especially in light of the DMMP proposed dioxin guidelines.

Response to Comments

Floyd|Snider agrees with Ecology that dioxins/furans are present throughout Bellingham Bay and Puget Sound, from multiple sources including atmospheric deposition. Floyd|Snider also acknowledges that human health risk assessments performed recently by organizations such as the Dredged Materials Management Program (DMMP) result in cleanup levels that would be less than the natural background level for Puget Sound.

Per discussions with Ecology on the August 8, 2010 conference call, dioxin is not assumed to be a contaminant of concern (COC) generated by past or current operations at the Harris Avenue Shipyard Site. Due to their ubiquitous presence, it is assumed that dioxins are comingled with contamination associated with the Harris Avenue Shipyard Site. Therefore, sampling and analysis for dioxins in sediments will not be performed during the RI/FS process to define site cleanup boundaries, and a site-specific human health risk assessment for dioxins will not be performed.

It is recognized, however, that sampling and analysis for dioxins will be required if open-water disposal of dredged material is considered as a component of a cleanup alternative. If a DMMP evaluation for disposal of dredged material is performed, dioxin characterization would be performed during the Cleanup Action Plan and remedial design phases of the project to support dredged material disposal options. This approach would allow the dioxin characterization to be focused on those areas targeted for dredging, and will ensure that the collected data meet the DMMP requirements for data recency. In the Feasibility Study evaluating Harris Avenue Shipyard sediment cleanup alternatives, cost ranges will be presented for sediment handling and disposal with the understanding that dioxin concentrations in dredged material could likely be unsuitable for open-water disposal.

Regarding the Ecology comment requesting evaluation of storm drain inputs, additional evaluation will be conducted during the RI/FS process to verify that all shipyard stormwater is collected, treated, and re-routed to the sanitary sewer for treatment and discharge. Further evaluation of stormwater inputs from the Harris Avenue Shipyard Site will be completed during the RI/FS process and requirements for additional sampling and analysis of stormwater that may be discharged to Bellingham Bay from the Harris Avenue Shipyard Site will be discussed with Ecology as necessary.

Additional language regarding the requirements and schedules for collecting this additional information relative to dioxin contamination in sediments and stormwater will be provided in the revised Site-Wide RI/FS Work Plan document.

COMBINED ECOLOGY AND BELLINGHAM BAY ACTION TEAM COMMENTS PROVIDED TO THE PORT OF BELLINGHAM ON JUNE 23, 2010

Section 2.1.2 Current Site Ownership (Page 10, paragraph 5):

Ecology: *Is there secondary containment? Has there always been secondary containment? Is this an area that needs to be tested? Where is this in relation to areas that we have sampled or will be sampling?*

Response to Comment

All American Marine personnel have confirmed that there is, and always has been, secondary containment within the area of the limited paint and oil storage shed located in the northwest corner of the property outside of their fabrication and maintenance building. Currently, one boring location (FS-18) is proposed adjacent to the main All American Marine facility. Due to the limited volume of used paints and oil stored at the site, no additional sampling is proposed for this area of the All American Marine lease area.

2.2.2 Potential Infrastructure Upgrades (Page 14, paragraph 1)

USFWS: *If pier replacement is necessary -- it may require a formal ESA Section 7 consultation if impact pile driving or proofing of steels piles is required. This is due to the adverse effects of elevated underwater sound on marbled murrelets.*

Response to Comment

Pier replacement activities are not planned at this time; however, it is understood that formal Endangered Species Act Section 7 consultation would be required for these types of construction activities.

Section 3.2 Agreed Order and MTCA Requirements (Page 18, paragraph 4)

Ecology: *Insert space.*

Response to Comment

A space will be inserted into this sentence to correct the error.

Section 3.3 ARARs, Screening Levels, and Cleanup Standards (Page 18)

USFWS: *US Fish and Wildlife suggested possibly lower cleanup numbers. Recommended using the screening levels and target tissue levels for the protection of aquatic life and aquatic dependent species from the Sediment Evaluation Framework (SEF) for the Pacific Northwest as an ARAR for this project if the SLs are lower that the SMS benchmarks.*

Ecology: *In response to this F&W suggestion and the comments noted on page 25, 30 and 41, Ecology considered the need to use the SEF in determining cleanup levels for the site and if additional tissue sampling would be needed.*

Typically, Ecology has conducted tissue analysis with a focus on human health risk assessment, analyzing for bioaccumulative contaminants in species most highly consumed by local residents. Analysis of prey species is atypical for this purpose. However, the current SMS rule (WAC 173-204) requires that we consider non-benthic ecological effects. Because no Site-specific ecological risk assessment has been performed, Ecology believes that one should be *conducted. The current tissue data collected for the human health risk assessment should be appropriate for use in an ecological risk assessment modeling effort.*

As a result, in considering the F&W comments, we have concluded that a non-benthic ecological risk assessment would be the preferable approach. A similar approach was conducted at the ALCOA Vancouver, WA Site. Existing tissue values are used to model risk in higher trophic levels.

It should be noted, that SEF is not an official ARAR itself, but the context of the comment is understood. Ecology believes that rather than using the SEF values directly, a more defensible approach would be to develop a site specific ecological risk assessment. If the resulting values are higher or lower than the SEF, we would use them because they are site specific.

It should also be noted, however, that certain input parameters of the human health risk assessment will need to be updated because of knowledge gained since the initial risk assessment was performed. This may drive the sediment cleanup values associated with tissue risk below those of the site specific ecological risk assessment. (Also see the comment re: BSL development on page 30.)

Response to Comments

A site-specific, non-benthic ecological risk assessment has already been performed by RETEC as part of the Sediments RI/FS for the Harris Avenue Shipyard Site (RETEC 2006). While briefly mentioned in the main text of the RI/FS, this non-benthic ecological risk assessment is described in detail in Section 5 of Appendix N (prepared in 2002) of the RI/FS document, titled "Evaluation of Site-Specific BSL Protectiveness for Ecological Receptors." This section uses the polychlorinated biphenyl (PCB) bioaccumulation screening level (BSL) that was calculated to be protective of human health to determine if it is also protective of shore birds and marine mammals in Bellingham Bay. As part of this evaluation, PCB bioaccumulation modeling was conducted for shore birds, who consume both benthic and non-benthic food sources, at and around the Harris Avenue Shipyard Site. A discussion of the potential for PCB bioaccumulation risks to marine mammals from site sediments is also included as part of the RETEC 2002 non-benthic risk evaluation. The conclusion from this evaluation was that the current PCB BSL would be protective of ecological receptors at the Harris Avenue Shipyard Site. The modeling approach used for assessing shore bird protectiveness was similar to the approach used for the Alcoa/Evergreen Vancouver Site (Anchor Environmental 2008).

The site-specific non-benthic ecological risk assessment prepared by RETEC in 2002 should be adequate. However, it is recommended that Ecology review this risk assessment appendix in concurrence with review of this response to comment memorandum, and coordinate with Floyd|Snider and the Port of Bellingham (Port) regarding requirements for further evaluation of ecological risk. When the PCB BSL for human health risk is revisited as part of the Site-Wide RI/FS process (response to comment of PCB BSL included below), the results of both human health and ecological risk assessments will be compared to ensure that site ecological receptors remain protected. Based on the current conclusions, if the PCB BSL were to be lowered at the Harris Avenue Shipyard Site based on updated calculations, then ecological receptors at the Site would still be protected. If the PCB BSL were to be elevated, then the ecological risk assessment would be reviewed to ensure ecological receptors remain protected at that level.

Section 5.0 Site-Wide RI/FS Objectives (Page 25 bullet 2)

USFWS: *US Fish and Wildlife suggested collecting tissue samples to utilize the SEF criteria.*

Ecology: *Refer to the combined comment regarding SEF and Bioaccumulation on Page 18.*

Response to Comments

Additional tissue data will not be collected as part of the proposed Site-Wide RI/FS investigation effort. Refer to the response to comment above regarding the non-benthic, site-specific ecological risk assessment (Section 3.3 ARARs, Screening Levels, and Cleanup Standards).

Section 5.0 Site-Wide RI/FS Objectives (Page 26 bullet 1)

USFWS: *US Fish and Wildlife suggested additional phrasing -- that the action be protective of aquatic species (e.g., salmonids) and aquatic dependent species (piscivorous species such as marbled murrelets).*

Response to Comments

Comment noted. Phrasing will be added to the first bullet of this section to indicate that the action will be protective of both aquatic and aquatic-dependent species.

Section 6.1 Preliminary CSM, COCs, and Exposure Pathways (Page 30, paragraph 2)

USFWS: *US Fish and Wildlife suggested additional tissue sampling. They suggested collecting tissues of various prey items in order to determine the risk to these species from consumption of bioaccumulative contaminants at the site.*

Ecology: *Refer to the combined comment regarding SEF and Bioaccumulation on Page 18.*

Response to Comments

Additional tissue data will not be collected as part of the proposed Site-Wide RI/FS investigation effort. Refer to the response to comment above regarding the non-benthic, site-specific ecological risk assessment (Section 3.3 ARARs, Screening Levels, and Cleanup Standards).

Section 6.1 (Page 30, paragraph 4)

USFWS: *US Fish and Wildlife wants to review the method for developing the BSL. It is their opinion that - although bioaccumulation triggers have not been developed as part of the SEF (the process for conducting a bioaccumulation analysis is outlined) -- a BSL of 6.0 mg/kg TOC seems elevated for the protection of sensitive species.*

Ecology: *In considering our response to this question, the age of the earlier sediment work was noted. About 8 years have passed since the numbers were last calculated and old assumptions need to be updated re: ingestion, exposure frequency, diet fractions, etc. The previous Appendix N, Table 2-1 re: human health risk assessment must be updated and a new BSL calculated.*

Response to Comments

As requested by Ecology, input parameters for consumption in the human health risk assessment will be updated and used for the recalculation of the site-specific sediment BSL for PCBs. The same methodology used by RETEC in 2002 (refer to Appendix N of the Sediment RI/FS) will be used to calculate the updated PCB BSL.

The human health risk assessment input parameters used by RETEC in 2002 to calculate safe seafood PCB tissue concentrations (Appendix N, Table 2-1) will be revisited and updated. A new site-specific sediment BSL for PCBs will be determined (based on the updated input parameters) during development of the Site-Wide RI/FS Report.

The input parameters and safe PCB tissue concentration calculations will be updated for shellfish consumption only, consistent with the previous RETEC evaluation that determined that only the consumption of on-site clams may pose a risk to human health (currently there are no on-site clam tissue data available). This conclusion is based on existing tissue data from Bellingham Bay, which indicates that there is currently no evidence of PCB bioaccumulation in fish, crabs, or off-site clams (tissue data are consistently non-detect for PCBs).

The following updated input parameters relative to consumption will be used for the new calculations of safe shellfish PCB tissue concentrations:

- Ingestion Rate: 38.5 g/day. This number is the 90th percentile Tulalip Tribe clams and mussels consumption rate (this number was calculated from data in Toy et al. (1996) and was presented in the human health risk assessment from the Whatcom Waterway Remedial Investigation & Feasibility Study).
- Diet Fraction: 10 to 100 percent. A range of diet fraction values will be used in the new safe tissue calculations. The Whatcom Waterway human health risk assessment used a diet fraction of 100 percent. However, a significantly lower diet fraction for shellfish is likely more appropriate for the Harris Avenue Shipyard Site due to the small size of this site.
- Exposure Frequency: 365 days/year.
- Fraction Remaining After Preparation: 100 percent.
- Body Weight: 70 kg.
- Averaging Time: 70 years.
- Exposure Duration: 30 years.

Following the revised calculations of safe shellfish PCB tissue concentrations, the same methodology used by RETEC in 2002 for determining the site-specific BSL will be used to determine the updated BSL.

Section 6.1 (Page 30, paragraph 5)

USFWS: *US Fish and Wildlife would like to review this draft CSM. We should determine if there are any additional agencies that should be included in the review process.*

Response to Comment

Comment noted. The Conceptual Site Model (CSM) will be revised and presented in the Site-Wide RI/FS report following collection of additional data proposed as part of this RI/FS

Work Plan. Interested agencies will have the opportunity to review the CSM during review of the Site-Wide RI/FS Report.

Section 6.2.3 Offshore Sediment (Page 32)

Nooksack Tribe: *The Nooksack Tribe commented that a small fraction of the previously completed sediment analyses have included methods to detect Tributyl Tin. They are concerned that the presence and distribution of this contaminant has not been adequately characterized, and as such will not be adequately addressed in the cleanup plans. They suggested that TBT be added to the analytes listed in Appendix C for sediment and groundwater samples.*

Ecology: *We need to add TBT as an additional analyte when testing the 4 sediment samples (the proposed sampling stations along and near the shoreline).*

We will need to take additional samples to delineate the lateral extent of TBT contamination only if a) very high concentrations of TBT are found and/or b) the follow-up bioassay(s) fail. Like the copper situation, the delineation would be conducted because we would need to calculate the volume of removal.

Response to Comments

Tributyltin (TBT) will be added as an additional analyte to be tested for at the Intertidal/Bank hand-auger sample locations (HA-1 through HA-8) as shown on Figure 7.8 in the existing Draft Site-Wide RI/FS Work Plan. TBT has been analyzed at approximately 15 select sample locations within the sediment, intertidal, and upland areas at the Harris Avenue Shipyard Site. TBT sediment data can be found in Tables 4-4 and 4-5 of the 2004 RETEC Sediments RI/FS document, and results of this testing indicate that all surface sediments tested for TBTs had either non-detect concentrations or concentrations that are less than the Puget Sound Dredged Disposal Analysis (PSDDA) screening level of 0.073 mg/kg bulk TBT. Results of TBT testing completed in the intertidal and upland areas within and adjacent to the Marine Railway, as part of supplemental RI/FS sampling in 2005, indicate that TBT concentrations in that area exceed the PSDDA screening criteria in surface and shallow subsurface intertidal bank sediments (refer to Figure 1 and Table 2 of the RETEC 2006 Supplemental Sediments RI/FS deliverable).

There are currently six Intertidal/Bank sample locations (HA-02 through HA-07), plus two additional contingency locations (HA-1 and HA-8), proposed for data collection and analysis of intertidal bank sediments for site COCs. TBT will be added as an additional analyte at these locations. Analysis of TBT at these locations will supplement the results of the 2005 sampling completed by RETEC and will assist in determining the need for additional sampling and analysis for TBT in the site sediments.

Following receipt of results of chemical analyses conducted on the Intertidal/Bank sediment samples, the Port will coordinate with Ecology regarding the need to collect the four contingency surface sediment samples and further analysis of TBT. The existing Site-Wide RI/FS Work Plan does not propose biological testing of sediments at this time. The need for additional biological testing will be discussed with Ecology following receipt of the supplemental RI data.

Section 6.2.3 (Page 32)

Nooksack Tribe: *The Nooksack Tribe noted that at relatively low concentrations, copper is toxic to fish. They are particularly concerned with the delineation of the extent of copper in sediment, and its removal during the cleanup.*

Ecology: *It is a good idea to expand sampling around HG-10/38, HG-39, and HG-42 where bioassays failed (Figure 7.4) in order to determine the lateral extent of copper contamination. We know that the copper is there and that the bioassays failed. We need to delineate the area likely to need removal and this additional sampling will allow calculations of volume needed in the FS. (We just need to test for copper and do not need to conduct additional bioassays.)*

Response to Comments

Floyd|Snider has reviewed the results of copper testing completed for all samples tested as part of the 2004 RI/FS and supplemental sampling efforts. Results of analytical testing for copper in surface sediments, completed at approximately 45 locations within the sediment area of the Harris Avenue Shipyard Site, indicate that the extent of contamination is well bounded with the current data set. Results of copper analyses in surface and shallow subsurface sediments are presented in Table 2-1 and Tables 4-3 through 4-5 of the 2004 RI/FS; copper data for the supplemental sampling effort completed in 2005 are presented in Table 2 of that study.

Review of the copper data collected within the sediment area of the Harris Avenue Shipyard Site indicates that the area around sampling locations HG-10/38, HG-39, and HG-42 is adequately bounded by surface sediment concentrations of copper that are less than the Sediment Management Standards screening level of 390 mg/kg. Therefore, the current extent of sediment analysis for copper is appropriate and additional testing is not necessary at this time.

Section 7.1 Soil and Groundwater (Page 33)

Nooksack Tribe: *The Nooksack Tribe suggested that groundwater sample collection should be scheduled to follow a precipitation event of at least 0.5 inches in order to characterize the groundwater transport processes likely to lead to detection of contaminants in groundwater.*

Ecology: *Ecology concurs that a wet season (a day with > 0.5 inches) ground water sampling event is appropriate. Ecology has done that for the GP West site. Charles San Juan would recommend November, January or March. (He has daily rainfall data for last 5 years in Bellingham.)*

Response to Comments

With the current schedule to submit the next Site-Wide RI/FS Work Plan document to Ecology in November 2010 and the anticipated Ecology approval, groundwater sampling should be conducted during the wet season in early 2011 and will attempt to target a rain event that produces greater than 0.5 inches of rainfall.

Section 7.2 Bank/Intertidal and Nearshore Marine Sediment (Page 36)

Nooksack Tribe: *The Nooksack Tribe commented that the extent of contamination appears to have been determined using 1996 and 1998 data and that the current RI/FS proposes data collection only in the near shore environment. They suggested that sampling should be expanded to include locations for sediment sample collection that define extent of contamination* *in the benthic area, including locations further from the shoreline at the outermost extent of the Pier, the drydock and along the outer harbor line.*

Ecology: *When reviewing Figure 7.5 in the drafted RI/FS, the data points obtained from the previous studies are adequate. Particularly, there were sampling stations located outside all the copper exceeding stations (HG10/38, HG-30, HG-33, HG-39 and HG-42). It is not necessary to expand the sampling locations further from the shoreline.*

Response to Comments

Comment noted. No additional sediment sampling locations are proposed for this data collection effort.

Section 7.2 (Page 36)

Nooksack Tribe: *The Nooksack Tribe commented that the presence and distribution of Tributyl Tin had not been adequately characterized and suggested that TBT be added to the analytes listed in Appendix C for sediment and groundwater samples.*

Ecology: *The SW shoreline area needs to be thoroughly checked for metals, including TBT. It is unclear what has happened in this area, e.g. if this was former sandblast, etc. The sediments are enriched in TBT, and upland soils have significant Cu, Zn, etc. TBT should be added as an Appendix C target analyte / chemical of concern. Per the RIFS work plan, TBT was detected under the railway pavement area (up to 6 ppm in soil) an in intertidal areas (~ 3 ppm). See also figure attached to cover memo (sediments).*

Response to Comment

TBT has been added as a target analyte for the Intertidal/Bank samples that will be collected along the shoreline of the Harris Avenue Shipyard Site. Refer to the response to comment above regarding analysis of TBT at these sample locations (Section 6.2.3 Offshore Sediment (Page 32)).

Section 7.2 (Page 36, paragraph 7)

USFWS: *US Fish and Wildlife questioned if there an ongoing source of gasoline-range hydrocarbons.*

Response to Comment

The data collected at the Harris Avenue Shipyard Site to date do not indicate that there is an ongoing source of gasoline-range hydrocarbons. Data from supplemental upland soil and groundwater samples that have been proposed to be collected as part of the Site-Wide RI/FS Work Plan will provide more information regarding this question.

Section 7.3 Supplemental Investigation Project Plans (Page 37, paragraph 5)

USFWS: *US Fish and Wildlife suggested some additional sediment sampling. There are four surface sediment grab samples are proposed (about 200 ft apart) for the near shore and -- because of limited grab samples in 2006 and depending on the heterogeneity of the site -- it may be necessary to collect more than four samples.*

Ecology: *Four samples are sufficient at this time. (This is a supplemental sampling event. We have more datum points at the area.) It might be necessary to collect more samples at a later date if the initial results show it is needed.*

Response to Comment

The four surface sediment samples proposed as part of the Site-Wide RI/FS Work Plan are contingency samples that will not be collected until analytical results of the Intertidal/Bank samples have been received and evaluated. The need for collection and analysis of these four surface sediment samples will be coordinated with Ecology following receipt of the Intertidal/Bank data.

Section 8.0 Source Control Evaluation (Page 39)

Nooksack Tribe: *The Nooksack Tribe suggested additional characterization of site stormwater. They felt that there is not enough information presented to assess whether stormwater generated on all portions of the site will be captured and treated. They suggested that all potential stormwater runoff pathways should be comprehensively evaluated and any runoff pathways that are found should be characterized and contaminants discharged via those pathways delineated. There are no plans to evaluate stormwater recontamination pathways in the work plan and this transport pathway should be evaluated.*

Ecology: *The work plan only proposes a review of stormwater management systems (with All American and Puglia). Ecology also recommends a check of any unknown or historical stormwater lines, catch basins, etc. Recommended action – have F|S identify the stormwater outfall that was plugged (circa 1994-97). If all site stormwater gets pumped to holding tanks, then we're good to go; however, this is something that should be double-checked.*

Charles checked the City of Bellingham stormwater layer and didn't see anything directly across the site. The discharge to the SW is the City sewer outfall (NPDES permit). It is less clear re: the storm line to the east (it's off property).

Section 2.2 of the RIFS work plan references a stormwater outfall that was plugged between 1994-1997; however, a location as not referenced. Also, per the work plan (Section 8.0), site stormwater has been improved to meet Fairhaven Shipyard stormwater management standards.

Response to Comment

Source control evaluations will be completed as part of the RI/FS process. These evaluations will include inspecting for unknown stormwater lines and investigating the stormwater outfall that was plugged between 1994–1997. Additional text will be added to the Site-Wide RI/FS Work Plan to clarify that these source control evaluations will be completed as part of the RI/FS process.

Page 39, paragraph 2

Ecology: *Charles San Juan was able to find a City stormwater system map. If site stormwater has been improved, shouldn't that pipe be on the map? Or is the section on the Port's property not technically part of the City's network till it meets the main pipe?*

On looking at the map, it appears that it is ~ 600 ft. south of that area with high TBT in sediments and high upland soil metals concentrations. It is unclear if there's any connection between the city sewer and metals (probably not). It's more likely that TBT is result of shipyard activities.

Are there any remnant storm drains that we don't know about? Have they all been plugged (e.g. the 1994-97 drain)? There are a lot of utilities across this site. The stormwater issue is worthy of some further discussion with Port. Perhaps we could do it in a brief telecon.

Response to Comment

Refer to the response to comment above regarding source control evaluations that will be completed as part of the RI/FS process (Section 8.0 Source Control Evaluation (Page 39)). If the results of these evaluations indicate that additional sampling and analysis is necessary, then the scope of those efforts will be coordinated with Ecology.

Section 9.1.2 Feasibility Study Tasks (Page 41, paragraph 5)

USFWS: *Recommends the use of the SEF SL's where lower that MTCA and SMS for the protection of sensitive aquatic species.*

Ecology: *Refer to the combined comment regarding SEF and Bioaccumulation on Page 18.*

Response to Comment

Refer to the responses to previous comments regarding bioaccumulation, and the ecological and human health risk assessments.

Section 9.1.2 (Page 41, paragraph 6)

USFWS: US Fish and Wildlife requests early involvement in the cleanup alternative selection. It should be determined if any additional agencies should be considered for early participation in the process.

Response to Comment

Comment noted. The Port will coordinate with Ecology regarding the process for trustee review of the RI/FS documents for the Harris Avenue Shipyard Project.

Section 9.3 Schedule (Page 42)

Ecology: *Seem to have missed steps for delivery of draft RI and FS. We can't have Ecology comments on draft RI/FS if document(s) not first delivered to Ecology. The AO's SOW has schedule for this as: Draft RI/FS Report 180 days from Ecology approval of the Final RI/FS Data Report.*

Response to Comment

Comment noted. The schedule will be corrected in the subsequent Work Plan draft to address this error.

Section 9.3 (Page 42)

Ecology: *The AO's SOW says: 90 days from Ecology approval of the Final RI/FS Report.*

Response to Comment

Comment noted. The schedule will be corrected in the subsequent Work Plan draft to address this error.

Appendix B Data Tables from Previous Environmental Reports (Page 69, footer)

Ecology: *Can we get some sort of footer on all of the Appendix B pages? Also, some sort of numbering system? For example, page 5 of 7 for table 2.1 is really only numbered for a portion of the Appendix B pages. Appendix B has somewhere around 45 pages. "page 5 of 7, Table 2.1"*

*In any case, all should have: RI/FS Work Plan
Appendix B
Table 2.1*

*In Appendix C, the tables are marked: RI/FS Work Plan
Appendix C
Table C.1*

Response to Comment

Comment noted. The footers in Appendix B will be updated, with the acknowledgement that material included in the appendix not generated by Floyd|Snider will have a custom footer to reflect this change.

Appendix C Table of Contents (Page 115, title)

Ecology: *Insert a title (Appendix C) here. Best to be uniform and to duplicate formatting you used for first page of Appendix B.*

Response to Comment

Comment noted. Floyd|Snider proposes that the edit to be made should be to remove "Appendix B" from the title of the first page of Appendix B. The first pages of Appendices B and C are different because Appendix B is a collection of tables taken from other consultants' reports and Appendix C is a complete document (SAP/QAPP) comprising text, tables, figures, and attachments. Because Appendix B is a collection of data tables from different sources, the first page performs multiple functions—it contains introductory text that explains why these tables are included, shows the documents they were pulled from, and lists the tables. The table of contents pages for Appendix C follows Floyd|Snider's standard style for reports, which is to list the contents of the report.

Section 2.2 Hospital and Poison Control (Page 154)

Ecology: *Name change as of May 2010: "PeaceHealth St. Joseph Medical Center".*

Comment Response

Comment noted. The Health and Safety Plan (HASP) will be updated to reflect this change.

Section 2.3 Provide Information to Emergency Personnel (Page 154)

Ecology: *This (Harris Avenue Shipyard) is a name created for use by Ecology and the Port. There is no such "real" location and the emergency responder will not be able to find it in their directory. Better to use the Puglia facility name (Fairhaven Shipyard) when calling for assistance.*

Response to Comment

Comment noted. The HASP will be updated to reflect this change.

Section 2.4 Floyd|Snider and Port ER Contacts (Page 154)

Ecology: *Also notify Ecology site manager, Mary O'Herron, Direct line (360) 715-5224.*

Response to Comment

Comment noted. The HASP will be updated to reflect this change.

Figure D.1 Route to Hospital (Page 190)

Ecology: *Not sure that the fastest way to the hospital is via downtown roads. Also, odd route from Forrest to Holly to Cornwall to Kentucky to Ellis to Squalicum.*

Suggestion -- Go uphill on Harris to 12th. Turn left. Stay on this street and go north (there are several name changes, including State Street). Road makes a Y and becomes a 1-way street (Forrest). If you take Forrest, it merges into James- (and starts 2-way traffic). Go north on James to Sunset. Turn left on Sunset, then right on Ellis. Then left on Squalicum Parkway.

Response to Comment

Figure D.1 Route to Hospital will be updated to reflect this change.

FLOYD | SNIDER
strategy ▪ science ▪ engineering

Two Union Square
601 Union Street, Suite 600
Seattle, WA 98101
tel: 206.292.2078 fax: 206.682.7867

Memorandum

To: Mary O'Herron, Washington State Department of Ecology

Copies: Mike Stoner, Port of Bellingham

From: Floyd|Snider

Date: December 10, 2010

Project No: POB-Harris

Re: **Harris Avenue Shipyard RI/FS Work Plan**
Summary of December 6, 2010 Ecology Meeting and Approach for Development of Final RI/FS Work Plan

This memorandum provides summary of the meeting held on December 6, 2010 to discuss November 2010 Washington State Department of Ecology (Ecology) comments regarding approach for development of the Final Harris Avenue Shipyard Site Wide RI/FS Work Plan document. This meeting was held in order to facilitate reaching an acceptable approach for final revisions to the work plan document, given Ecology comments that were provided following the Bellingham Bay Action Team (BBAT) review in June 2010, and following Ecology review and comment to the October 23, 2010 Harris Avenue Shipyard RI/FS Work Plan Response to Comments memorandum (Floyd|Snider 2010). Meeting attendees include the following Ecology, Port of Bellingham and Floyd|Snider staff:

- Ecology – Mary O'Herron, Lucy McInerney, Pete Adolphson and Grant Yang
- Port of Bellingham – Mike Stoner
- Floyd|Snider – Kate Snider and Matt Woltman

Comments to the October 23, 2010 Harris Avenue Shipyard RI/FS Work Plan Response to Comments memorandum were provided by Ecology in e-mail format (Attachment 1) on November 20, 2010, and are addressed below as a summary of the December 6, 2010 project meeting. Following discussion of these recent comments, this memorandum also makes recommendation for process and schedule regarding development, review and implementation of the Final Harris Avenue Shipyard Site Wide RI/FS Work Plan document.

NOVEMBER 2010 ECOLOGY COMMENTS

Ecology Comment Regarding Collection of Dioxin/Furan Data in Surface and Subsurface Sediments

Ecology: *While dioxins/furans are not assumed to originate from past or current shipyard operations, if they are comingled with the contaminants defining the Harris Avenue Shipyard Site, they are a COC and must be included in the site characterization work.*

Ecology expects to define a MTCA/SMS approach to addressing dioxins/furans in Bellingham Bay over the next few months. This means that the D/F data generated by the remedial investigation work can be included and addressed in a clear and straight forward way in the RI/FS report.

In addition, analysis of subsurface dioxins/furans is important not only to dredge disposal decisions but also to ensure that the post-dredge surface sediment will comply with cleanup standards for all contaminants including D/Fs.

Ecology is willing to discuss this with you further but it is not clear how an RI/FS can be completed without the collection of dioxins/furans data. This information is required in order to describe the COC's for the site, ensure that remedial alternatives considered for the site address all COC's, and to enable the evaluation of dredged material disposal options.

Response to Comment and Proposed Approach

Considerations associated with how to best address the presence of dioxin/furans in sediment include the following: 1) the remediation boundary at the site will be determined by other site-generated COCs; 2) dioxin/furans are assumed to be present throughout the area (as they are an area-wide contaminant throughout Bellingham Bay and Puget Sound) - they need to be characterized before final selection of a cleanup approach and addressed appropriately by the remedy; 3) sediment dioxin characterization is very expensive, and would be most cost-effective if thoughtfully targeted to locations which will have the most relevance to cleanup decision-making.

Based on these considerations, the following approach has been determined by Ecology and the Port to be appropriate. Targeted dioxin/furan sediment sampling will be conducted following Ecology review of the Draft Site-Wide RI/FS, and before preparation of the Final RI/FS. Dioxin/furan sampling will be focused on those locations determined by the Port and Ecology to be most appropriate to assist in the final determination and refinement of a preferred remedial alternative for the site. The targeted dioxin/furan sampling results will be documented in a technical memorandum that will be included in the Final RI/FS document. Text will be added to the RI/FS Work Plan document to clarify this approach.

Ecology Comment Regarding Collection of Additional TBT Sediment Data

Ecology: *The plan to collect 6 samples is adequate in order to fill the data gap re: TBT contamination from the 2005 sediment sampling event. The contingency plan is acceptable (four more samples will be collected, if exceedance is found).*

Response to Comment and Proposed Approach

The Final Harris Avenue Shipyard RI/FS Plan includes collection of the 6 intertidal bank samples with analysis for TBT and a contingency for collection of up to four additional surface sediment samples for TBT analysis if exceedences are identified in the intertidal bank samples. No additional revisions will be made to the work plan document.

Ecology Comment Regarding Collection of Additional Copper Sediment Data

Ecology: *Bioassay failure overrules the low level of copper contamination (at or below the SMS's cleanup/screening level). Thus, our request for delineating the copper contamination in areas that failed the bioassay is appropriate.*

Response to Comment and Proposed Approach

Floyd|Snider has reviewed the results of copper testing completed for all samples tested as part of the 2004 RI/FS and supplemental sampling efforts. Results of analytical testing for copper in surface sediments, completed at approximately 45 locations within the sediment area of the Harris Avenue Shipyard Site, indicate that the extent of contamination is well bounded with the current data set. Graphical results of copper analyses in surface and shallow subsurface sediments are presented in Attachment 2; green circles indicate locations where surface sediment copper concentrations are below the Sediment Management Standards (SMS) screening level of 390 mg/kg and yellow circles indicate locations where surface sediment copper concentrations exceed the SMS screening level. Analytical data for copper testing is also provided in Table 2-1 and Tables 4-3 through 4-5 of the 2004 RI/FS; copper data for the supplemental sampling effort completed in 2005 are presented in Table 2 of that study.

Review of the copper data collected within the sediment area of the Harris Avenue Shipyard Site indicates that the area around sampling locations HG-10/38, HG-36, and HG-42 (locations where samples failed biological toxicity testing) is adequately bounded by surface sediment concentrations of copper that are less than the SMS screening level. Given this distribution, additional copper contamination delineation is not necessary to support development of the RI/FS report.

Ecology Comment Regarding Bioaccumulation and Ecological and Human Health Risk Assessment

Ecology: *Ecology will make a final determination regarding bioaccumulation after the sampling results are obtained. We would base this decision on which contaminants are found and at what levels they are characterized.*

Ecology will also wait for completion of the sampling event to determine if the Port needs to conduct a Risk Assessment. This would be based on the contaminants found, contamination level determined, the size of the site compared with the nearby site where an assessment had been done.

Response to Comment and Proposed Approach

Per the recommended approach regarding timing for collection and analysis of sediment samples for dioxin/furan analysis, the Port will not conduct additional sediment sampling activities until the end of the RI/FS process (see response to Ecology comment above). As part of the RI/FS, the Port will present the non-benthic ecological risk assessment completed as part of the existing sediments RI/FS per the process described in the October 23, 2010 Harris Avenue Shipyard RI/FS Work Plan Response to Comments memorandum (Floyd|Snider 2010). This ecological risk assessment is anticipated to meet Ecology's requirement to address ecological risk at the Harris Avenue Shipyard Site.

Additionally, the Port will revisit the existing human health risk assessment and recalculate the site-specific sediment biological screening level (BSL) for PCB contamination using updated input parameters and process described in the October 23, 2010 Harris Avenue Shipyard RI/FS Work Plan Response to Comments memorandum (Floyd|Snider 2010). The updated input parameters will be consistent with those used at the Whatcom Waterway site for human health risk assessment regarding mercury contamination. Following recalculation of the site-specific BSL, the new BSL will be checked with the ecological risk assessment results to ensure that it is also protective of ecological receptors. Additional detail regarding the process for recalculation of the BSL is presented in the October 23, 2010 Harris Avenue Shipyard RI/FS Work Plan Response to Comments memorandum (Floyd|Snider 2010).

Completion of additional risk assessment work for other potential contaminants of concern (COCs) will not be completed during development of the RI/FS report. The need for completion of additional ecological or human health risk assessment work will be coordinated with Ecology following collection and analysis of sediment samples for dioxin/furan contamination as necessary.

Ecology Comment Regarding Source Control

Ecology: *The Work Plan states that the Port will inspect for unknown stormwater lines and investigate the plugged line (circa 1994-97). However, the Port does not commit to anything beyond that. For example, if they find a remnant stormwater outfall, then they need to collect sediment samples and undertake the appropriate analysis. This need to be clarified (" collecting and analyzing samples for metals / petroleum, e.g. sediments, etc. as necessary… ").*

Response to Comment and Proposed Approach

The Port will conduct a source control investigation as part of the RI/FS process and as described in the RI/FS Work Plan document. Pending results of the source control investigation, the Port will coordinate with Ecology to determine if additional data collection is necessary. Text will be added to the work plan document to clarify that the Port will coordinate with Ecology following completion of the source control investigation to determine the need for additional data collection or source control activities.

PROCESS FOR FINAL WORK PLAN DEVELOPMENT

Following the December 6, 2010 meeting with Ecology, the following process and schedule was proposed by the Port in order to develop and Final Harris Avenue Shipyard RI/FS Work Plan and move forward with completion of the proposed field investigation effort in 2011:

- Port and Floyd|Snider prepare and submit this memorandum summarizing the 12/6/10 meeting with supporting attachments on December 10, 2010.
- Ecology provides concurrence with the meeting summary memorandum content by December 31, 2010.
- Port and Floyd|Snider submit the Final Harris Avenue Shipyard Work Plan on January 15, 2011, incorporating the 2010 Ecology comments and RI/FS approach information, for review and final approval.
- Ecology provides approval to the Final Work Plan document by January 31, 2011.

- Port and Floyd|Snider begin field work preparation activities in January 2011 and conduct the field investigation program in February 2011.

REFERENCES

Floyd|Snider 2010. *Harris Avenue Shipyard RI/FS Work Plan, Response to Comments Dated June 23, 2010* memorandum. Prepared for the Port of Bellingham. October.

ATTACHMENT 1 – NOVEMBER 30, 2010 ECOLOGY COMMENT E-MAIL

Matt Woltman

From: O'Herron, Mary (ECY) [MOHE461@ECY.WA.GOV]
Sent: Tuesday, November 30, 2010 4:39 PM
To: Stoner, Mike; Gouran, Brian
Cc: Matt Woltman
Subject: Harris RI/FS WP

Mike and Brian -

Thank you for providing Ecology with a very well-considered Response to Ecology Comments re: the Draft Harris RI/FS Work Plan.

Reading through the October 14th Floyd/Snider Memorandum, Ecology has identified only a few items that still need to be revised. The remainder of the draft document -- if changes are made as described in the Response to Comments – appears complete.

Here (below) are the final Ecology comments with reference to the corresponding Memorandum page/paragraph.

If you have questions or would like to propose some draft language, we can provide you with a quick turn-around via e-mail.

Matt called me and asked about a possible meeting while he was in town. If you think that would be necessary or useful, I can set one up. (Depending on the subject, I'll want to get my people on the line so we'll need a few days notice.)

If you would like to move directly to a near-final draft, I'd suggest the Port provide us with an electronic copy with changes highlighted in red-line/strike-out format. Again, we can provide you with a quick turn-around via e-mail.

Overall, I think that this is an excellent document and I'm looking forward to the site assessment work starting up.

Mary K. O'Herron
Environmental Specialist
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<u>Harris draft Work Plan – Ecology feedback on Response to Comments – November 2010</u>

(1) Collection of dioxin/furan data -- Pages 1 and 2

Ecology comment:

While dioxins/furans are not assumed to originate from past or current shipyard operations, if they are comingled with the contaminants defining the Harris Avenue Shipyard Site, they are a COC and must be included in the site characterization work.

Ecology expects to define a MTCA/SMS approach to addressing dioxins/furans in Bellingham Bay over the next few months. This means that the D/F data generated by the remedial investigation work can be included and addressed in a clear and straight forward way in the RI/FS report.

In addition, analysis of subsurface dioxins/furans is important not only to dredge disposal decisions but also to ensure that the post-dredge surface sediment will comply with cleanup standards for all contaminants including D/Fs.

Ecology is willing to discuss this with you further but it is not clear how an RI/FS can be completed without the collection of dioxins/furans data. This information is required in order to describe the COC's for the site, ensure that remedial alternatives considered for the site address all COC's, and to enable the evaluation of dredged material disposal options.

(2) TBT -- in the last two paragraphs on Page 7

Ecology comment:

The plan to collect 6 samples is adequate in order to fill the data gap re: TBT contamination from the 2005 sediment sampling event. The contingency plan is acceptable (four more samples will be collected, if exceedance is found).

(3) Copper -- in the 2nd and 3rd paragraphs on Page 8

Ecology comment:

Bioassay failure overrules the low level of copper contamination (at or below the SMS's cleanup/screening level). Thus, our request for delineating the copper contamination in areas that failed the bioassay is appropriate.

(4) Bioaccumulation, ecological and human health and risk assessment -- in the 4th and 5th paragraphs on Page 4

Ecology comment:

Ecology will make a final determination regarding bioaccumulation after the sampling results are obtained. We would base this decision on which contaminants are found and at what levels they are characterized.

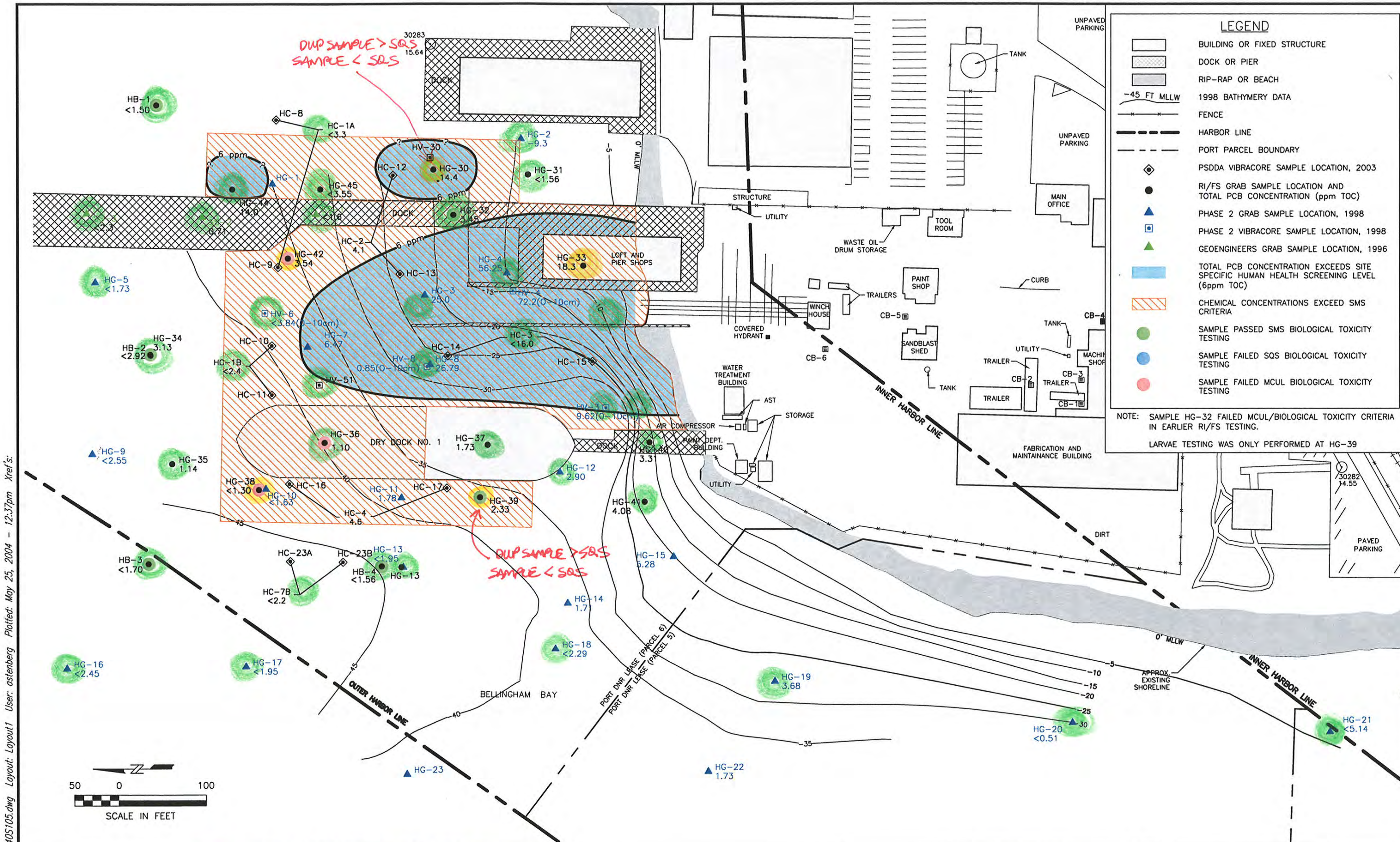
Ecology will also wait for completion of the sampling event to determine if the Port needs to conduct a Risk Assessment. This would be based on the contaminants found, contamination level determined, the size of the site compared with the nearby site where an assessment had been done.

(5) Source control – in the 6th paragraph on page 10

Ecology comment:

The Work Plan states that the Port will inspect for unknown stormwater lines and investigate the plugged line (circa 1994-97). However, the Port does not commit to anything beyond that. For example, if they find a remnant stormwater outfall, then they need to collect sediment samples and undertake the appropriate analysis. This need to be clarified (" collecting and analyzing samples for metals / petroleum, e.g. sediments, etc. as necessary… ").

ATTACHMENT 2 – SURFACE SEDIMENT COPPER CONCENTRATION FIGURE



RETEC

SURFACE SEDIMENT SAMPLE LOCATION WHERE COPPER CONCENTRATIONS ARE < SQS

SURFACE SEDIMENT SAMPLE LOCATION WHERE COPPER CONCENTRATIONS > SQS

HARRIS AVENUE SHIPYARD SEDIMENTS RI/FS PORTB-04140-430	SMS CHEMICAL AND BIOLOGICAL CRITERIA EXCEEDANCES
DATE: 05/07/04 DRWN: A.S./SEA	FIGURE 4-6

File: H:\4140\4140S105.dwg Layout: Layout1 User: ostenberg Plotted: May 25, 2004 - 12:37pm Xref's:

Port of Bellingham
Harris Avenue Shipyard

Remedial Investigation/ Feasibility Study Work Plan

Appendix F
Annotated Outline for Bellingham Bay RI/FS Documents

FINAL

Annotated Outline for RI/FS Documents

Overview: The annotated outline presented below has been developed to assist with the preparation of Remedial Investigation / Feasibility Study (RI/FS) reports as required under project specific Agreed Orders. The format is based on Model Toxics Control Act (MTCA) regulatory requirements listed in WAC 173-340-350 (which are not explicit to document format) and on the format used in the Whatcom Waterway 2006 Supplemental RI/FS. In addition, the disproportionate cost analysis example included in Attachment A to this outline is excerpted from Exhibit B of the Whatcom Waterway 2007 Consent Decree. Both of these Whatcom Waterway documents can be found at
http://www.ecy.wa.gov/programs/tcp/sites/whatcom/ww.htm
Because the specifics of each site are different, deviations from this standard outline may be warranted, but these should be discussed with the Ecology site manager prior to using an alternative structure. This will help minimize the potential for delays during the RI/FS review and finalization process.

Some of the sections listed below are optional, depending on the needs of the site. Section numbering should be adjusted as appropriate.

1. Introduction

- **a. Site Description and Background**
- **b. Document Organization**

2. Project Background

- **a. Site History**
- **b. Objectives of the RI/FS**
- **c. Relationship of RI/FS to Other Documents (if applicable)**

Site history should provide a concise summary of site discovery, identified sources, previous studies and/or cleanup actions as applicable. For MTCA Interim Cleanup Actions, 2-a should discuss the timing and nature of the cleanup action as well as its performance based upon the results of compliance monitoring.

Use 2-c to discuss how the RI/FS relates to other applicable environmental documents. These could include RI/FS or cleanup work at adjacent/nearby sites, or could include separate SEPA documents relating to the cleanup action. This section should provide context, with any detailed analysis addressed in subsequent portions of the document (see Section 15).

3. Optional Section: RI Methods

RI investigation methods can either be included in the RI document as a section, or they can be attached as an appendix to the document. Placing them as an appendix is generally preferred to enhance readability of the final document. However, this should be decided on a case-by-case basis by the PLP and the Ecology site manager. Quality assurance should be addressed as part of the methods section.

4. Environmental Setting

a. Physical Conditions
b. Geology and Hydrogeology (include for upland sites)
c. Natural Resources
d. Historical and Cultural Resources
e. Land and Navigation Uses (as applicable)

Use 4-a to describe bathymetry, topography, surface water and circulation patterns (where applicable), sea level rise, and other physical characteristics of the site.

For upland sites, geology and hydrogeology (4-b) will typically be broken out into separate subsections. For sediment sites, they may be addressed under 4-a, depending on the level of detail required.

Section 4-c will typically be more detailed for sediment sites, to comply with requirements of SMS and address factors that may influence site unit designations. For upland sites this section will typically be used to assess the need for an ecological assessment as part of cleanup levels development.

Use 4-d to generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known or suspected to be on or near the site.

In 4-e, describe land ownership, zoning, current and expected land uses. For sediments, include a discussion of current and anticipated navigation uses including mooring, storage, and boat launch or access uses.

5. Site Screening Levels

a. Exposure Pathways and Receptors
b. Screening Levels (by media and/or receptor)

Present (using subsections as necessary) potentially applicable screening levels for each media if available. This will typically include summary tables documenting the criteria that will be used to evaluate the contaminant data for the site in subsequent sections. For contaminants or media for which screening levels do not exist, derivation of site specific screening levels will likely be necessary as identified in rule as "case by case".

6. Nature and Extent of Contamination

a. Constituents of Concern

b. Nature & Extent – Describe by Media (Use subsections as appropriate)

Example 1: Surface Sediment, Subsurface Sediment, Surface Water
Example 2: Soil Impacts, Groundwater Impacts, Surface Water, Soil Vapor, etc.

In Section 6-a, the constituents of concern (contaminants that may represent MTCA "indicator hazardous substances") should be introduced based on exceedances of screening levels, which may include both chemical or biological impact data correlated with the associated chemical data. Where these screening levels are later modified significantly through risk assessment or other cleanup levels development (e.g., screening against SQS, with some sites ultimately using the CSL; or screening of groundwater against surface water criteria, with later development of location-specific cleanup levels for the site), this section should reference the different considerations applicable.

Section 6-b should provide a description of the type, concentration and extent of contamination. All data used to define the nature and extent of contamination should be presented. The data should be discussed by media, using additional subsections as appropriate. Sources should be discussed where known. Areas of co-mingled or off-site source contamination relevant to the project should be discussed as applicable.

7. Optional Section – Risk Assessment

For some sites a risk assessment (human health or ecological) may be required. If required, these should be summarized or included in this section. Where documentation associated with these studies is extensive, they may be attached as appendices or incorporated by reference with sufficient description to familiarize the reader with their key findings.

8. Contaminant Fate & Transport

a. Source Control

b. Attenuation/Transport Processes – (Organize as Applicable)

The RI needs to include a statement about whether the original source has been controlled. If the source has not been controlled, then this must be considered as part of the Feasibility Study (e.g., removal of buried tank) and potentially as part of coordinated actions under other authorities (e.g., surface water quality work under separate CSO control programs). For sediment sites, applicable subsections may include analyses of other potential sources of contamination (stormwater & industrial discharges, and adjacent contaminated sites), sediment deposition, sediment disturbance, and sediment transport properties. For upland *sites, potential groundwater or vapor transport, or potential anthropogenic soil/groundwater disturbances should be discussed. For sites with both a sediment and upland component, the RI must identify soil and groundwater contaminant concentrations that provide compliance with sediment screening levels If extensive modeling or transport studies are conducted, these may require separate sections, or this section may be used to summarize work attached as appendices or provided as a separate document.*

9. Optional Section – Pre-Design or Engineering Testing (Include when Applicable)

In some cases, extensive pre-design testing may be collected to support the feasibility study process, or provide information needed for site-specific decision-making. For example, treatability testing used to support technology screening could be described in this section.

10. Conceptual Site Model

a. Contaminants & Sources
b. Nature & Extent of Contamination
c. Fate & Transport Processes
d. Exposure Pathways and Receptors
e. RI Conclusions

The Conceptual Site Model should include one or more graphics illustrating the four elements (10-a through 10-d above). These graphics should be concise and are intended to help communicate the conclusions of the RI study to the public and to project stakeholders.

RI conclusions should state whether data gaps necessary for an RI/FS have been filled, and should differentiate between RI/FS data gaps and pre-design data gaps relevant to subsequent project phases.

For 2-volume RI/FS documents, terminate the RI at this point and include a References Cited section. Provide a transition section in the second volume to introduce the FS (Introduction, recap of Conceptual Site Model etc.). For single-volume RI/FS documents, continue with Section 11.

11. Cleanup Requirements

a. Site Cleanup Levels
b. Remedial Action Objectives
c. Potentially Applicable Laws

Site cleanup levels should be defined, along with potentially applicable points of compliance in Section 11-a. Where alternative points of compliance are proposed, the rationale for consideration of these must be provided. Ecology will approve final cleanup levels and points of compliance as part of the Cleanup Action Plan for the site.

Remedial action objectives should be provided in 11-b. These are intended to be simple statements of what the remedy needs to accomplish in order to address issues defined in the Conceptual Site Model. The RAOs are communication tools that help the reader assess what needs to be accomplished. RAOs are not evaluation criteria under MTCA regulations.

ARARs should be presented using tables as appropriate.

12. Optional Section -- Site Units (if applicable)

Describe for Each Site Unit

- *Physical Factors*
- *Land Use and Navigation*
- *Natural Resources*
- *Contaminant Distribution*

Some sites may not require definition of site units. However, larger upland site and most sediment sites will require site unit definition. Site unit definition should be discussed with your Ecology site manager during initial development of the feasibility study.

13. Screening of Remedial Technologies

This section should be used to introduce potential technologies that were considered prior to development of the remedial alternatives. While not explicitly required by MTCA, this section is important to communicate the completeness of the evaluation conducted. Technologies should be described along with potential site-specific limitations. They should then be screened for effectiveness, implementability and cost. A table should be provided summarizing technologies retained for use in developing remedial alternatives.

14. Description of Remedial Alternatives

Develop and describe a reasonable number of cleanup alternatives for the upland portion of the site as well as a separate set of cleanup alternatives for the sediment portion of the site (where applicable). The number of alternatives considered will vary from site to site. Describe for each alternative

- *Actions*
- *Costs and Schedule*
- *Other Considerations (e.g. Habitat, Land Use and/or Navigation)*

All alternatives evaluated must be capable of achieving MTCA threshold criteria. Alternatives that do not should not be considered, unless there are no alternatives considered capable of achieving such cleanup levels.

This section should not evaluate the alternatives. This should be a description, with appropriate tables and figures. Alternatives should be described apples-to-apples, with the subsequent section addressing significant differences between the alternatives and their appropriateness under MTCA regulatory criteria. Cost estimates for each alternative should contain the same line items (i.e. one alternative may include excavation with no capping and the other no excavation and all capping-both should have excavation and capping line items).

Other Considerations should be identified through a review of a blank SEPA checklist. Where such review identifies issues that could affect the evaluation of alternatives, concise factual information on these issues should be presented.

Where a MTCA interim cleanup action has previously been implemented, the remedial alternatives should contain a concise summary of the interim action and a statement about the performance of the interim action based upon the results of compliance monitoring. Any impact each alternative may have upon the previously conducted interim action should also be described.

15. Detailed Evaluation of Alternatives

- **a. MTCA (and SMS) Evaluation Criteria**
  - **i. MTCA Threshold Requirements**
  - **ii. Other MTCA Requirements**
  - **iii. MTCA Disproportionate Cost Analysis**
  - **iv. SMS Evaluation Criteria (Sediment sites only)**
- **b. Evaluation of Alternatives**
- **c. MTCA Disproportionate Cost Analysis (see Attachment A)**
  - **i. Comparative Evaluation of Alternatives**
  - **ii. MTCA Disproportionate Cost Analysis**

This section should begin with a presentation of the regulatory criteria under MTCA (and SMS for sediment sites) used to evaluate the remedial alternatives.

The alternatives evaluation should include appropriate summary tables summarizing the evaluation against the MTCA criteria. The evaluation criteria and process is specified in MTCA. However, the number of alternatives, the specific format of the analysis, and the specific factors considered in evaluating alternatives (i.e., what factors contribute to overall protectiveness rating for an alternative) will vary from site to site and need to be discussed with the Ecology site manager. See Attachment A for detailed DCA information and an example DCA.

SMS criteria are similar to MTCA criteria and are mostly covered in the MTCA analysis with the exception of environmental impacts and net environmental effects. While these are not explicit criterion under MTCA, Ecology expects integration/coordination of MTCA and SEPA in accordance with Policy 130A. As a result, review of a blank SEPA checklist is to be performed at various steps leading up to the completion of an RI/FS. If such review ultimately results in a SEPA *determination of significance, a draft EIS must be prepared and issued concurrent with (or integrated into) the draft RI/FS. In this situation both the RI/FS and the EIS are used by Ecology to select a remedy. If through such review a SEPA determination of non-significance appears likely then the "Other Considerations" section in number 14 above is used to identify environmental impacts that could appreciably affect the evaluation of alternatives. The detailed alternatives analysis in this section would then include an evaluation of Net Environmental Effects as a criterion.*

16. Optional – Coordination with Other Environmental Documents

This section should be used where necessary to discuss environmental reviews conducted under separate documents (e.g., SEPA EIS), to discuss coordination with other cleanup sites, or coordination with other source control or land use activities. This section is provided for information only.

17. Summary and Conclusions

a. Description of the Preferred Alternative
b. Basis for Alternative Identification
c. Implementation of Site Cleanup

The preferred alternative should be identified, along with a short summary of how it was identified and how it will be implemented. This section should recognize the role of subsequent documents (e.g., Cleanup Action Plan, project engineering design, project permits) in finalizing cleanup decisions and project design details.

18. References Cited

19. Tables

20. Figures

Separate figures should be prepared for each impacted media. Separate figures should be prepared for each COC. All data being used to delineate the nature and extent of contamination should be depicted on figures with analytical results. Based upon the complexity of the graphics consider color to help differentiate information.

21. Appendices