EXHIBIT C

INTERIM ACTION PLAN

PORT OF OLYMPIA WEST BAY
BERTHS 2 AND 3

Prepared by
Port of Olympia
915 Washington Street NE
Olympia, WA 98501

Issued by
Washington State Department of Ecology
Toxics Cleanup Program
Southwest Regional Office, Olympia

December 2008

Table of Contents

List of Tables

List of Figures

List of Appendices

1 INTRODUCTION

This *Interim Action Plan* (IAP) is Exhibit C to the Agreed Order (AO) and describes the Interim Cleanup Action Pilot Study proposed by the Port of Olympia (Port) to address sediments adjacent to the Port's Berths 2 and 3 (Figure 1) in South Budd Inlet, Olympia, Washington, and to accomplish maintenance dredging to a minimum of -39 feet below mean lower low water (MLLW). Sediment quality in West Bay and South Budd Inlet is the focus of ongoing investigations by the Washington State Department of Ecology (Ecology; SAIC 2007a, SAIC 2007b, and SAIC 2008; e.g., Budd Inlet Sediments Investigation). The Port and Ecology have decided to enter into an AO for this Interim Action Pilot Study. This IAP was developed using information collected as part of the proposed Olympia Harbor Navigation Channel Maintenance Dredging Project and Ecology's Budd Inlet Sediments Investigation, which has been prepared to satisfy the requirements of Chapter 70.105D Revised Code of Washington (RCW), administered by Ecology under the Model Toxics Control Act (MTCA) Cleanup Regulation, Chapter 173-340 Washington Administrative Code (WAC).

1.1 Scope

The main Washington State law that governs the cleanup of contaminated sites is MTCA. MTCA regulations define the process for the investigation and cleanup of contaminated sites. When contaminated sediments are involved, procedures are regulated by the Sediment Management Standards (SMS), Chapter 173-204 WAC. MTCA regulations specify criteria for the evaluation and conduct of a cleanup action. Under both, the cleanup must protect human health and the environment, meet state environmental standards and standards in other laws that apply, and provide for monitoring to confirm compliance with site cleanup standards.

1.2 Project Description

Under Ecology's oversight, the Port proposes to dredge up to a maximum volume of 22,300 cubic yards (cy) of sediments containing elevated levels of dioxin/furan within a portion of Berths 2 and 3 to an elevation of -39 feet MLLW (plus 2 feet of allowable overdepth). The dredged sediments exceed the screening level guidance for dioxin/furan for disposal at the nearest Dredged Material Management Program (DMMP) unconfined open-water disposal site and, therefore, require removal, transport, and upland disposal. After dredging is completed, a thin layer of clean sand (approximately 6 inches minimum thickness) will be placed in the berth area to ensure that the Interim Action has not increased risks to human health or the environment. Construction will take place all in one construction season (winter 2008 – spring 2009). The Port may also choose to return during the second construction season in order to remove slough material from the under-pier slope that may settle at the toe of the slope.

1.3 Purpose

The purpose of this IAP is to describe the Port's proposed remedial action. Specific objectives include:

1. Remove a significant amount of sediments that have elevated chemical concentrations.
2. Prevent increased risks to human health or the environment.
3. Conduct the Interim Action Pilot Study to collect information on how to investigate and design a more comprehensive cleanup of Port berthing areas in West Bay that will achieve cleanup standards.
4. Remove sediments to maintain a navigational depth of -39 feet MLLW (plus up to an additional 2 feet of allowable overdepth) at Berths 2 and 3.

This remedial action satisfies the requirements of MTCA. Consistent with the requirements of WAC 173-340-430, this document provides the following information:

- A summary of project background and current environmental conditions.
- Cleanup requirements applicable to Berth Areas 2 and 3, including federal, state, and local laws applicable to the cleanup action.
- The rationale for selection of the proposed interim action alternative.
- A description of the cleanup action, consistent with MTCA requirements.

- A description of compliance monitoring and contingency actions.
- A description of the schedule for implementation of the cleanup action.

The AO will be signed by the Port and by Ecology. The Port is in the process of finalizing permitting requirements and the development of construction documents necessary to solicit bids to complete the construction. Construction is expected to begin in early 2009 and will take between 2 and 3 months to complete. Post-dredge monitoring activities will be initiated following completion of construction activities.

2 BACKGROUND

This section summarizes background information relevant to the cleanup of West Bay berthing area sediments and those sediments adjacent to Berths 2 and 3. The Port and Ecology have completed a number of cleanup and investigation activities in South Budd Inlet, including portions of the Port's berthing areas.

2.1 Site History Relevant to Berthing Areas

The Port is located in southern Puget Sound, which is further divided into the East and West Bays in the southernmost point of Budd Inlet (Figure 1). The filling of tidelands in the late 1800s and early 1900s produced the East and West Bays of Budd Inlet, the marine peninsula, and the downtown areas of the City of Olympia (City). At the southern end of West Bay, the Deschutes River drains into Capital Lake. This area was once an estuary where fresh water from the Deschutes River intermingled with salt water from Budd Inlet. The lake was created in 1951 as a reflection pond for the state capital by damming the river under the 5th Avenue Bridge in Olympia. A dredged federal navigation channel extends into West Bay and widens into a turning basin near its southern end, adjacent to the Port's West Bay berths.

The Port peninsula consists of approximately 150 acres, of which, 40 acres are located along West Bay (Figure 1). The construction of the peninsula was the last phase of tideland filling that occurred from the late 1800s through the early 1900s to accommodate the growing city of Olympia. The Port's marine terminal on the peninsula provides approximately 2,500 lineal feet of wharf and 76,000 square feet of warehousing. Three modern ships, or a combination of vessels, can be hosted simultaneously at the marine terminal. Current land use immediately adjacent to the berths and navigation channel include container storage and shipping facilities, log storage yards, and loading docks. Further to the south, there is a boat basin and waterfront shops and restaurants.

The Olympia Harbor federal navigation channel and turning basin, as well as the Port berthing area, are maintained in West Bay. The Port manages the Harbor Area under a Port Management Agreement (PMA) with the Washington State Department of Natural Resources (DNR). Along the Marine Terminal, the Harbor Area is mostly defined as a 54-foot-wide swath that extends from the south end of the Marine Terminal to the north end and beyond (Figure 2). This narrow swath extends from the face of the Marine Terminal pier landward, thus including the under-pier area of the Marine Terminal. Waterward of the Marine Terminal, the berthing areas are within the Federal Turning Basin.

In 2007, the proposed Olympia Harbor Navigation Channel Maintenance Dredging Project included maintenance dredging and minor widening of the federally authorized navigation channel to allow timely and safe passage of ships entering the Port. This project did not include any dredging at the Port berthing areas within the Federal Turning Basin. Though dredged material was initially approved for unconfined open-water disposal at the Anderson-Ketron DMMP disposal site in 1998, the project was reviewed in 2006 following additional sampling required because of concerns about sediment dioxin concentrations. That sampling indicated elevated dioxin concentrations in the navigation channel, which resulted in some units being unsuitable for open-water disposal.

In 2007, Ecology conducted an initial sediments investigation to determine the nature, extent, and possible sources of dioxins/furans in sediments in this area (SAIC 2007a and SAIC 2007b). This investigation showed elevated dioxin/furan contamination in the Port's berthing area, thus triggering a MTCA cleanup process (SAIC 2008).

Additional site characterization studies were then conducted by the Port within the proposed dredge prism for the Olympia Harbor Navigation Channel and West Bay berthing area (Integral 2007). Available sediment quality data from these three studies are summarized in the following section.

2.2 Current Berthing Area Conditions

Sediment quality information in the vicinity of the berthing area is available from several investigations conducted in the vicinity of the Interim Action boundary:

1. Olympia Federal Navigation Channel Sediment Characterization
2. Olympia Federal Navigation Channel and Port of Olympia Berthing Area Dioxin Sediment Characterization (SAIC 2006)
3. Ecology Budd Inlet Sediments Investigation (SAIC 2007a, SAIC 2007b, and SAIC 2008).
4. Port of Olympia West Bay Sediment Characterization Study (Integral 2007)

Summaries of the results of these studies are presented in this section and on several figures and tables. Figure 3 provides locations from previous studies, existing bathymetry, and the Interim Action dredge boundary. Figure 4 summarizes available surface and subsurface chemistry results from each of the studies. Figure 5 presents a plan view of the locations of four cross sections. Figures 6 and 7 show existing chemistry testing results along each cross section, in addition to the proposed dredge prism. Table 1 presents dioxin results from the Olympia Harbor project, Table 2 presents dioxin and SMS exceedances from 2007 sampling by Ecology, and Table 3 presents dioxin results from 2007 sampling by the Port.

2.2.1 1998 Sampling

Previous testing for the Olympia Harbor project included two rounds of testing in 1998: a partial characterization for considering a down-ranking (ranked high at that time), and a full characterization for the original 535,185-cy federal navigation channel/turning basin project. In 1999, the project was expanded to 624,000 cy with the inclusion of the Port's berthing area, and underwent another round of testing. This testing was conducted in accordance with the DMMP guidance to determine the suitability of the dredged material for disposal at the DMMP Anderson-Ketron open-water disposal site. Seventeen Dredged Material Management Units (DMMUs) were tested, and results indicated that all chemicals of concern (COC) were detected below SMS criteria and the

DMMP screening levels, except for tributyltin (TBT) in surface DMMUs collected in the Port's southernmost berthing area (Berth 1) and in the Turning Basin widening area (TBW1), which exceed the bioaccumulation trigger. These results triggered follow-on laboratory bioaccumulation testing of these sediments. The testing results showed that tissue levels of TBT following exposure to West Bay sediments were well below the target tissue levels used by the DMMP to determine suitability for open-water disposal.

In 2005, the results of the 1999 characterization were reviewed by the DMMP agencies due to concerns over lack of dioxin/furan testing at the Port and in the navigation channel. Dioxin testing results from the post-cleanup monitoring of Cascade Pole led the DMMP agencies to require additional testing for dioxin throughout the proposed project area. Further details about the previous investigations and a regulatory timeline are provided in the Suitability Determination (DMMP 2006).

2.2.2 2006 Sampling

A revised project volume of 458,734 cy was subjected to dioxin testing in 2006. The revised project volume was the result of a reduction in the allowed advance maintenance dredging depth in the federal channel. Samples were collected at 21 locations within the joint federal/Port project area (Figures 3 and 4). Surface (0- to 4–foot [0-4ft]), subsurface (4- to 8-foot or greater [4-8+ft]), and Z-samples (samples collected at the bottom of the target dredge depth, intended to represent the new exposed sediment surface following dredging) were collected at each location, for a total of 29 DMMUs. Samples were collected from March 6-10, 2006, and were analyzed for conventionals and dioxin/furans. A subset of the samples was also analyzed for polycyclic aromatic hydrocarbons (PAHs; Appendix A). The emphasis of the Phase 1 analysis was to evaluate the surface DMMUs for dioxin/furans and, in some cases, PAH concentrations. Based on the Phase 1 results, additional analyses were performed in Phase 2 to determine the extent of the dioxin/furan concentrations in surface composited samples, subsurface samples, and Z-samples. Detailed results from both of these phases are provided in the Suitability Determination (DMMP 2006).

Of the 29 total DMMUs sampled in 2006, cores were collected from three locations in the two DMMUs that make up the Port's West Bay Berths 2 and 3 (Figures 3 and 4). A total of six segments from these cores—three surface (0-4ft segments) and three subsurface (greater than 4-foot [>4ft] segments)—were analyzed for dioxins/furans. Results from the three coring stations in Berths 2 and 3 (S2, S3, and S4) are provided in Table 1 and Figures 4, 6, and 7. All 0-4ft samples exceeded the 7.3-picogram per gram (pg/g) DMMP screening level guideline for dioxin[1]. Within Berths 2 and 3, dioxin Toxic Equivalents Quotient (TEQ) concentrations were 52.3 pg/g TEQ at station S2, 37.4 pg/g TEQ at station S3, and 52.6 pg/g TEQ at station S4. Concentrations outside of the Port's berthing area in 0-4ft samples ranged from 0.14 pg/g TEQ to 36.2 pg/g TEQ in the turning basin. All subsurface samples from Berths 2 and 3, as well as samples to the immediate south in Berth 1, showed concentrations well below the 7.3-pg/g level.

The subsurface cores for all stations in the Port's berthing areas (S2, S3, and S4) and in the turning basin, except station S10, were below the screening level, indicating that dioxin concentrations decrease sharply with depth throughout this area. A shallow subsurface core at station S10 slightly exceeded the screening level. A total of 13 DMMUs (S2, S3, S4, S5, S6, S10, S18, S19, S20, S21, S22, S23, and S29), including the surface DMMUs at Berths 2 and 3 (S2, S3, and S4), exceeded the 7.3-pg/g guideline and were determined to be unsuitable for disposal at the Anderson-Ketron Island open-water disposal site. The remaining DMMUs, including those in Berth 1, immediately south of Berth 2, were determined to be suitable for open-water disposal. Finally, limited PAH analyses were conducted at station S4 in the Port's project area

[1] The DMMP screening guideline for dioxin/furans is based on background concentrations currently existing in the vicinity of the Anderson-Ketron Island open-water disposal site. The 7.3-pg/g value is the site-specific ceiling value not to be exceeded. Additional detail on the approach for determining this screening value is provided in DMMP (2006).

(Station S4), and surface and subsurface DMMU results were well below DMMP screening-level guidelines (Appendix A).

2.2.3 2007 Sampling by Ecology

Ecology recently initiated a sediment sampling program as part of its bay-wide investigation of Budd Inlet. As part of this investigation, six sediment cores and two surface samples were collected in the vicinity of Berths 2 and 3 (Table 2 and Figures 4, 6, and 7). Core BI-C4, located along the under-pier slope adjacent to Berth 2, contained a surface dioxin concentration of 29.1 pg/g TEQ and subsurface dioxin concentrations of 41.3 pg/g TEQ and 62.5 pg/g TEQ at 3 to 4 feet and 6 to 7 feet below mudline, respectively. Outside of the dredge area, Core BI-C14, northeast of the area, had an elevated surface dioxin concentration of 13.8 pg/g TEQ, with decreasing concentrations at depth. Core BI-C16, along the west edge of the dredge area, had a surface concentration of 19.20 pg/g TEQ, decreasing with depth. Core BI-C15, south of Berths 2 and 3, had a surface concentration of 19.02 pg/g TEQ, increasing to 33.0 pg/g TEQ from 2 to 3 feet below mudline and to 36.42 pg/g TEQ from 4 to 5 feet below the mudline, and decreasing thereafter. Core BI-C3, located along the under-pier slope south of Berths 2 and 3 contained a concentration of 17.1 pg/g TEQ at the surface, with decreasing concentrations below. Core BI-C5, located north of the dredge area in Berths 2 and 3 along the under-pier slope, had a surface concentration of 21.60 pg/g TEQ, increasing to 231 pg/g TEQ at 3 to 4 feet below mudline, and 4,212.52 pg/g TEQ at 6 to 7 feet below mudline.

PAH concentrations detected above SMS criteria in samples in the vicinity of Berths 2 and 3 were only found in core BI-C5 in the 6-7ft interval below the mudline (Table 2). Mercury was detected at 0.91 milligrams per kilogram (mg/kg), which was above the Cleanup Screening Level (CSL), and acenaphthene was detected at 26.46 mg/kg total organic carbon (TOC), which was above the Sediment Quality Standards (SQS). No other compounds were detected above SMS criteria in samples from the 2007 Ecology study.

2.2.4 2007 Sampling by Port

In 2007, the Port conducted additional sampling to further delineate sediment dioxin concentrations at five surface locations and from 13 core locations. The results of this investigation are described in Integral's 2007 draft data summary report (Integral 2007), as summarized in Table 3 and in Figures 4, 6, and 7. Of the 13 core samples collected by the Port, subsamples were submitted for dioxin/furan testing from selected intervals for eight of the cores: POC- C6, C7, C8, C9, C10, C11, C12, and C13.

Surface sample (0-2ft) concentrations range from 2.5 to 30 pg/g TEQ from the cores, and typically decrease with depth. From within the proposed dredge prism, surface samples from C-11 and C-12 contained dioxin concentrations of 2.5 pg/g TEQ and 30 pg/g TEQ, respectively. Along the slope under the pier and adjacent to the proposed dredge prism, dioxin concentrations in cores POC-C6 and POC-C7 were 20 pg/g TEQ and 28 pg/g TEQ in surface samples, respectively, with lower concentrations at depth.

Outside of the dredge prism, dioxin testing was conducted at POC-C8, C9, C10, and C13. Core POC-C8 contained a surface dioxin concentration of 16 pg/g TEQ, but contained dioxin at 700 pg/g TEQ from the 4-6ft depth interval. Core POC-C9 is located near POC-C8 and contained surface concentration of 21 pg/g TEQ, and less than 1 pg/g TEQ at depth. At location POC-C13, a buried concentration of 63 pg/g TEQ was measured from the 4-5.2ft depth interval. South of the proposed dredge prism, POC-C10 contained a surface concentration of 18 pg/g TEQ.

Each of the five surface samples were collected adjacent to Port outfalls. These samples contained dioxin concentrations of 5.7 pg/g TEQ at Outfall A, 0.71 pg/g at Outfall B, 4.5 pg/g and 45 pg/g at Outfall C (duplicate samples), and 1.6 pg/g at Outfall D.

2.2.5 2008 Sampling by Port

As part of Ecology's review of this IAP, additional information was requested on the condition of the existing sediment surface and estimated post-dredge sediment surface in Berths 2 and 3. This supplemental data collection is described in the Ecology-approved Sampling and Analysis Plan (SAP; Anchor 2008). The supplemental sampling included testing of sediment quality in the proposed berth area prism and the under-pier areas to better characterize existing conditions and the material that may be subject to sloughing during and after dredging. The sediment samples were collected in late September 2008.

Sediment chemistry results are presented in Table 4 and in Figure 4. Existing surface sediment (0 to 10 cm) concentrations in PO-BA-24 through PO-BA-27 range from 21.6 to 23.6 TEQ (average of 22.38), which is consistent with other measurements of surface sediments in this area. Estimated Z-layer samples were collected from the -40 to -41 MLLW elevation. These 1-foot composites had concentrations ranging from 51.1 TEQ to 67.2 TEQ (average of 58.75 TEQ).

Under-pier composite samples were collected from four under-pier cores (PO-UP-20 through PO-UP-23) for the 0- to 2-foot and 2- to 4-foot intervals. PO-UP-23 is located in an under-pier area that is north of the current proposed dredge prism in the berth area. In the four under-pier cores, the upper intervals had concentrations ranging from 32.9 to 57.8 TEQ (average 42.8). Excluding the concentration at PO-UP-23 (north of the dredge area), the average for the upper interval is 37.4 TEQ. The lower interval (2 to 4 feet below the mudline) had concentrations ranging from 28.2 to 250 TEQ. Excluding the concentration at PO-UP-23 (250 TEQ), the average of the other three samples is 42.1 TEQ. The concentration at PO-UP-23 is consistent with existing information further to the north (e.g., C5 and POC-C8 where concentrations ranged from 230 to as high as 4,000 TEQ). The proposed dredge prism was designed to avoid this area of elevated concentrations and limit dredging to areas adjacent to slope sediments that have lower TEQ concentrations (e.g., POC-C7). Additionally, the elevated sediment concentrations found near PO-UP-23 appear to be localized since they are not detected in adjacent samples (i.e., POC-C13, PO-BA-27, POC-C7).

3 INTERIM ACTION REQUIREMENTS

This section describes the interim action requirements that are expected to be met. Consistent with MTCA and SMS requirements, this section addresses point of compliance and applicable local, state, and federal laws. Section 3.1 discusses the point of compliance and Section 3.2 discusses applicable laws and how they will be addressed during implementation of the cleanup action.

3.1 Sediment Point of Compliance

Consistent with the SMS regulations, sediment cleanup levels apply to the sediment bioactive zone (upper 10 centimeters [cm] of the sediment column). The cleanup levels do not directly apply to subsurface sediments, but the SMS require that the potential risks of the current and/or future exposure of deeper sediments be considered and be minimized through the implementation of the cleanup action. No cleanup levels will be defined by Ecology for the Interim Action, but cleanup levels are generally between the SQS and minimum cleanup level (MCUL) criteria (Table 5). The more conservative SQS provide a regulatory goal by identifying surface sediments that have no adverse effects on human health or biological resources. The MCUL (equivalent to the CSL), represents the regulatory level that defines minor adverse effects. The SQS is Ecology's preferred cleanup goal, although Ecology may approve an alternate cleanup level within the range of the SQS and the MCUL if justified by a weighing of environmental benefits, technical feasibility, and cost. Chemical concentrations or confirmatory biological testing data may define compliance with the SQS and MCUL criteria. The primary cleanup levels (long-term goal) for Berth 2 and 3 sediments are assumed to be defined as the SQS, but have yet to be established. Currently, there are no promulgated SMS criteria for dioxin. However, compliance with the state's anti-degradation policy is required (WAC 173-204-120(1)(a)), thereby ensuring the newly exposed surface will not pose greater risk from exposure than the currently exposed surface. Post-dredge confirmational sampling will be the upper 10 cm, consistent with the depth of the biologically active zone.

3.2 Applicable Local, State, and Federal Laws

Cleanup actions must comply with applicable local, state, and federal laws. In certain cases, a permit is required. The following is a list of applicable permits and approvals required for the project:

- **Applicable Permits/Approvals:**
  - Nationwide 38 – Cleanup of Hazardous and Toxic Waste (U.S. Army Corps of Engineers [USACE])
  - Endangered Species Act (ESA) Compliance (National Marine Fisheries Service [NMFS] and U.S. Fish and Wildlife Service [USFWS])
  - National Historic Preservation Act Section 106 (Washington State Department of Archaeology and Historic Preservation [DAHP] under USACE process)

In other cases, the cleanup action must comply with the substantive requirements of the law, but are exempt from the procedural requirements of the law (RCW 70.105D.090 and 90.48.039; WAC 173-340-710). The project must meet the substantive requirements of the permits and approvals listed below. The Port will work with each agency listed for each item below to meet the substantive requirements.

- **Substantive Requirements:**
  - State Environmental Policy Act (SEPA) Determination (Ecology)
  - Shoreline Substantial Development Permit (City of Olympia)
  - Hydraulic Project Approval (Washington Department of Fish and Wildlife [WDFW])
  - 401 Water Quality Certification (Ecology)

4 BASIS FOR INTERIM ACTION

This section describes alternative construction means and methods considered for the interim action to provide a general overview of potential construction alternatives. This section will discuss advantages and disadvantages of the means and methods, and Section 5 will identify the selected means and methods. Central to selection of the preferred action are considerations of net environmental benefits, community acceptance, cost, engineering feasibility, and implementability.

4.1 Dredging Methods

Dredging involves the removal of sediment using a range of possible construction techniques, including the broad categories of mechanical and hydraulic dredges. The overall process to evaluate dredge equipment is based on the approach presented by Palermo et al. (2003) and is focused on evaluating the site-specific characteristics of Berths 2 and 3, the operational attributes of dredge equipment, and a number of selection factors relating to the design requirements.

4.1.1 Mechanical Dredging

Common mechanical dredge types include dragline, clamshell, dipper, and bucket ladder. Dragline and bucket ladder dredges are not found in the Northwest, thus this section will focus on the most common type of mechanical dredge, the clamshell dredge. Mechanical clamshell dredges are typically crane-operated or excavator-operated and located on a barge or pontoons. They can also be operated from land to remove sediment that is close to the shoreline. Recently, dredge buckets are also being mounted on traditional excavators (often termed "instrumented backhoes") that can be operated from either the shoreline or a barge. Bucket sizes of 1 to 10 cy are common; however, buckets up to 40 cy are available on a more limited basis. For dredging Berths 2 and 3, bucket sizes would likely range from 2 to 8 cy.

To remove sediment, the dredge bucket is lowered through the water column with its jaws in the open position, and the bucket is allowed to sink into the sediment. The jaws are then closed around the sediment, the bucket is raised through the water column, and the sediment is typically offloaded to a barge for transport. Hydraulic transport using positive displacement pumps can also be used to transport mechanically dredged sediment. Although mechanical dredges are designed to remove sediment at or near in situ density, a small amount of excess water is typically entrained in the dredge bucket as it closes and is lifted up through the water column; this results in less water at the transport, staging, and disposal end than for hydraulic dredging, discussed below. During dredging operations, debris not identified through a debris survey can easily be removed with a mechanical dredge when encountered by simply grabbing the debris with the bucket. Although a debris survey has not been completed at Berths 2 and 3, debris is expected to be encountered, but it is not expected to be substantial.

Mechanical dredging provides numerous advantages over other alternatives, including the ability to remove sediment in an in-situ state and can also handle removing debris. Mechanical dredging equipment generally has greater availability in the Northwest, and reduces the volume of water that may require treatment during dredging operations. Additional information about the differences between closed buckets and clamshell buckets is included in Section 4.2.3.

4.1.2 Hydraulic Dredging

Hydraulic dredges typically use centrifugal pumps to remove and transport sediment in a slurry form to a local disposal area where the sediment slurry is dewatered over time. Dredges are typically barge- or float-mounted and have a suction device fixed to a moveable arm (or ladder) that is raised or lowered to facilitate sediment removal. The suction end of the dredge is often equipped with a mechanical or hydraulic device to loosen the sediment prior to being drawn into the dredge suction line. The most common types of hydraulic dredges are suction, cutterhead, or horizontal auger.

The size of a hydraulic dredge is based on the diameter of the discharge side of the suction pump. The dredge position is controlled in the field by combinations of spuds, anchors, and cables. These have the potential to affect operations if the dredge is operated in or near the navigational channel. Hydraulic dredges ranging in size from 6 to 14 inches are applicable for this type of environment. Based on other environmental dredging projects, production rates for these dredge sizes vary considerably due to site conditions (presence of debris) and location of the disposal area. While hydraulic dredges are capable of generating slurries with solids concentrations of 10 to 20 percent on a dry-weight basis, using this equipment for environmental dredging typically results in lower solids concentrations. This is because of the additional water that is drawn into the dredge in an effort to minimize resuspension. As a result, the slurry concentrations can be as low as 5 to 10 percent solids. The method of propulsion for this dredge can also present a challenge—the typical hydraulic dredge swings on an arc as it moves from side to side during the dredging process. This action creates windrows where certain sediments targeted for removal may be left behind.

Hydraulic dredging for sediment cleanup sites typically results in slurry concentrations with low solids content, varying between 5 and 20 percent, which requires active on-site dewatering of the slurried sediment. Hydraulic dredging results in generating large volumes of water that require containment and temporary storage, and that may also require treatment. Space requirements to manage the slurry during hydraulic dredging are significant. Hydraulic dredges are less available in the Northwest, and they cannot pick up debris. Debris can clog the pumps and/or dredge pipeline.

4.1.3 Under-Pier Dredging

The feasibility to dredge under-pier is dependent upon the pier design (e.g., piling spacing and deck elevation), presence of debris and broken off piling, under-pier slope conditions, and ability of equipment to access the under-pier area without potentially damaging the existing structure.

The under-pier slope at Berths 2 and 3 is mostly unarmored below approximately elevation -4 feet MLLW. The existing under-pier slope is also fairly steep, at an approximate 2 horizontal to 1 vertical (2H:1V) slope (Figures 6 and 7). Under-pier dredging is difficult at Berths 2 and 3 due to limited access from height limitations at the deckline, narrow pier spacing, the presence of buried pilings, and miscellaneous debris on the under-pier slope. There are few alternatives for removing material in these areas. Berths 2 and 3, with deposits of unconsolidated material on an unstable slope (1.5H:1V near the toe), have the following specific constraints:

- Typically 20-foot opening between pile bents
- The tide range at Budd Inlet is approximately 14.6 feet, which limits vertical access from the barge
- Old piling remains in the under-pier slope areas, mostly buried

Mechanical dredges for this type of dredging are typically operated using a traditional or modified barge-mounted long-reach excavator. The geometry of the excavator and differential global positioning system (DGPS) instrumentation are used to control placement of the dredge bucket. Typical excavator-mounted dredge buckets range in size from 1 to 6 cy, and can be operated in water depths ranging from 3 feet to over 50 feet, depending on the size of the excavator. Under-pier areas can potentially be dredged, provided there is sufficient space between the bottom of the concrete deck and the water surface for the barge (with the appropriate excavator mounted on the deck), and the under-pier dredge area is within the reach of the excavator boom.

Mechanical dredging under-pier cannot directly remove sediment from the sediment bed to the surface in one action, due to the presence of the pier deck. Therefore, under-pier dredging by mechanical methods involves dragging sediment from the under-pier area downslope out into the toe of slope where additional equipment can be used to re-dredge the sediment and lift it to a haul barge. The process of under-pier dredging can create greater resuspension of sediment than traditional mechanical dredging techniques. The presence of broken-off piling and other debris, which could need to be removed prior to dredging, also present limitations for mechanical dredging.

A hydraulic alternative for removing the sediments underneath the pier is the diver-assisted suction dredges. A diver-assisted suction dredge is a commercially certified, umbilically-supported hard-hat diver operation with hand-vacuum stinger dredge units. Diving operations could be deployed from a dive-support platform from the water. Traditional hydraulic dredging methods (e.g., cutterhead and suction) are not considered feasible for under-pier dredging due to how this hydraulic equipment operates.

Hydraulic under-pier dredging is considered to have significant feasibility issues. Diver-assisted dredging of unstable slopes is a significant safety issue, in addition to the issues associated with hydraulic dredging in general, such as managing the quantity of water generated, and potential for debris and broken pilings to clog the dredge. The production rate that could be achieved using diver-assisted hydraulic dredging is very low due to the ability of a diver to handle large hydraulic pipelines.

4.2 Water Quality Controls

Regardless of the means and methods for dredging, temporary water quality impacts from suspended sediment (e.g., turbidity) are expected. Impacts are generally short-term and localized. Best management practices (BMPs), water quality monitoring, and contingency measures will be employed to minimize the potential for unacceptable levels of suspended sediment in the water column and to ensure compliance with state water quality standards.

The following sections briefly discuss potential water quality control methods (i.e., BMPs) that are available to the contractor to comply with project water quality criteria that will be approved by Ecology. These include operational controls, silt curtains, closed buckets, and water quality monitoring. While this section discusses potential water quality controls, the contractor will be required to implement the operational controls described in Section 5. Water quality monitoring will also be required during all dredging activity.

4.2.1 Operational Controls

For dredging projects, operational controls are defined as modifications in the standard operation of the dredging equipment intended to minimize resuspension of materials. Operational controls can be employed with mechanical dredges, hydraulic dredges, hopper dredges, or barges. Operational controls are defined in the specifications portion of the construction bid documents. The contractor will be expected to use the controls listed in Section 5 unless a demonstration can be made that altering them will make a comparable end result and is specifically approved by Ecology. Operational controls discussed in this section but not identified in Section 5 may still be used by the contractor but are not intended to be required.

4.2.1.1 Qualified Contractor

Bidding contractors must meet minimum qualifications that demonstrate experience with projects similar in scope and complexity. Specific requirements will be provided in the bid documents that will be prepared by the Port. Typically, the contractor will need to demonstrate experience with environmental dredging in the Puget Sound area for similar projects within the last 5 to 7 years. In addition, the project superintendent will typically need to demonstrate similar experience. Contractors that cannot demonstrate experience will not be considered responsive to the bid, and thus will not be awarded the work.

4.2.1.2 Increasing Cycle Time

A longer cycle time generally means reducing the velocity of the ascending loaded bucket through the water column, which reduces potential to wash sediment from the bucket. However, limiting the velocity of the descending bucket may reduce the volume of sediment that is picked up by the bucket, thus requiring more total bites to remove the project material and increasing the overall project duration. Sediment resuspension also occurs when the bucket impacts the bottom surface. Sediment resuspension may be reduced by pausing the bucket at the sediment surface before digging and/or pausing the bucket at the waterline during the ascent, both of which increase cycle time, but may reduce resuspension of sediment. This operational control is not a requirement but is available to the contractor to implement if needed.

4.2.1.3 Eliminating Multiple Bites

When the clamshell bucket hits the bottom, an impact wave of suspended sediment travels along the bottom away from the dredge bucket. When the clamshell bucket takes multiple bites before ascending to the surface, the bucket loses sediment as it is reopened for subsequent bites. Sediment is also released higher in the water column, as the bucket is raised, opened, and lowered. Contract specifications will prohibit taking multiple bites.

4.2.1.4 Eliminating Dredging During Peak Tidal Exchange Periods

Dredging during peak tidal exchange periods (i.e., an ebb tide and high river currents) may increase downstream turbidity. The contractor may need to minimize working during these periods to minimize water quality impacts. This operational control is not a requirement but is available to the contractor to implement if needed.

4.2.1.5 Eliminating Underwater Stockpiling

Taking small dredge cuts and temporarily stockpiling material at the mudline creates a pile of loose sediment that could be easily resuspended and impact water quality. The contractor will be required to take complete dredge cuts—from the moment the bucket is closed at the mudline, the contractor will be required to return the bucket to the surface and deposit dredge material onto the barge before returning the bucket back to the mudline.

4.2.1.6 Controlled Cut Thickness Along Toe of Slope

Dredging at the toe of the slope is expected to initiate some sloughing of under-pier sediments, which could be resuspended and cause temporary water quality impacts. The amount of potential resuspension is controlled by the amount of material that sloughs. The contractor will be required to make multiple dredge passes along the toe of the slope using a controlled lift thickness that is intended to minimize sediment resuspension from sloughing.

4.2.1.7 Eliminating Bottom Leveling

Dragging a bucket or beam to level the bottom of the dredge surface (so as to achieve the required dredge elevation) has the potential to resuspend sediment. The contractor will be prohibited from leveling the surface. Instead of leveling to remove high spots, the contractor will be required to make an additional dredging pass to remove any high spots that are identified during the post-dredge survey.

4.2.1.8 Eliminating Bucket Overloading

When the dredge bucket impacts soft sediment, there is the potential for the bucket to penetrate beyond the designed digging depth of the bucket. When this occurs, the bucket returns to the surface with excess material at the bucket surface, which tends to fall back into the water before being placed into the material barge. If bucket overloading is observed, the contractor will be required to control the rate of descent on the bucket to prevent excess penetration of the bucket into the mud.

4.2.1.9 Eliminating Barge Overloading

The contractor will be prohibited from overloading the material barge beyond the top of the side rails. When dredge material is heaped adjacent to and above the side rails, there is the potential for material to ravel off of the heap and over the rail. In addition, overloading the barge can lead to barge listing and instability, which could result in loss of sediment back to the surface water.

4.2.1.10 Contractor Requirements

Because silt curtains and closed buckets have site-specific limitations with respect to their effectiveness, the use of these measures to manage water quality impacts will not be required in the project specifications. However, the contractor may choose to employ these methods as part of their procedure if they determine such measures would be compatible with their operation. The contractor will be expected to comply with Ecology's water quality criteria requirements regardless of whether they choose to use a closed bucket or silt curtain. The contractor may also choose to employ additional methods to further limit turbidity. Additional discussion of silt curtains and closed buckets is included in Sections 4.2.2 and 4.2.3.

4.2.2 Silt Curtains

Silt curtains can be an effective water quality control when used properly and in the right site conditions. However, silt curtains often have been used on dredging projects with limited effectiveness, and may even cause greater water quality impacts than without using them. It is critical to consider their limitations.

The objective when using silt curtains is to create a physical barrier around the dredge equipment to allow the suspended sediments to settle out of the water column in a controlled area. Silt curtains are typically constructed of flexible, reinforced, thermoplastic material with flotation material in the upper hem and ballast material in the lower hem. The curtain is placed in the water surrounding the dredge or disposal area, allowed to unfurl, and then anchored in place using anchor buoys. Silt curtains are most effective on projects where they are not opened and closed to allow equipment access to the dredging or disposal area. Because they are impermeable, silt curtains are easily affected by tides and currents and generally should not be used in areas with greater than 1- to 2-knot currents (Hartman 2001) or large tidal variation. Silt curtains are most effective if they can be deployed so that they extend to the bottom or within a close distance (e.g., 2 feet) of the bottom, but this is seldom practical due to tidal variation, water depth, and current velocities. As such, most projects only use curtains that extend a maximum of 10 to 12 feet below the surface.

A key advantage of silt curtains, if they are properly deployed, is that they can protect the adjacent resources by controlling surface turbidity. The main disadvantages of silt curtains are that they are not effective in high-energy and tidal environments, they have no effect on bottom turbidity, and they limit navigation in the dredging vicinity.

For this project site, silt curtains are not considered to be an effective water quality control method. Due to Berths 2 and 3 deep-water depths (approximately 40 feet), silt curtains would not be able to extend the full length of the water column, limiting their effectiveness. High tidal variation also makes use of the curtain difficult, and it may not be feasible to extend the curtain under the pier to fully enclose the area to be dredged.

4.2.3 Closed Buckets

This technology consists of specially constructed dredging buckets designed to try to reduce turbidity or suspended solids during dredging. In general, these buckets may help to minimize the loss of sediment out of the bucket when used properly. However, minimizing the loss of sediment out of the bucket does not necessarily mean fewer suspended sediments or lower turbidity. As demonstrated in Wang et al. (2002), closed buckets have not been proven to lower suspended sediments in all site conditions. These buckets have been used on dredging projects in the Northwest. Although a debris survey has not been completed for Berths 2 and 3, debris encountered must be removed with the dredge bucket at the time of dredging. A standard clamshell bucket will be more effective at removing debris or dense substrate; closed buckets (without digging teeth) are ineffective at removing debris. Closed buckets are typically lightweight in construction and typically not suitable for digging denser materials. Due to the anticipated presence of debris in Berths 2 and 3, this water quality control is not a requirement but is available to the contractor to implement if the contractor wishes to try using a closed bucket at the site.

4.2.4 Water Quality Monitoring

Water quality monitoring will meet the substantive requirements of the 401 Water Quality Certification and will be detailed in the Water Quality Monitoring and Sediment Sampling Plan, which will be identified as a required deliverable prepared by the Port in the AO. Potential water quality impacts can be minimized by implementing a high-frequency sampling and reporting scheme during water quality monitoring. A tiered water quality monitoring program includes a higher frequency of sampling early in the project, and less frequent monitoring once the contractor has shown consistent compliance with water quality criteria. This methodology provides more timely information to the construction manager when the contractor exceeds water quality criteria. Using a greater sampling frequency allows the construction manager to direct the contractor to modify operations to stay within compliance.

Water quality monitoring is conducted to provide timely input into the construction process to minimize the potential for a water quality exceedance. Due to the long-lead times to obtain results from chemical testing (e.g., standard turnaround time for chemical testing is 2 weeks, minimum), collection of samples to analyze water chemistry is not planned.

It is expected that water quality monitoring will include regular turbidity and dissolved oxygen monitoring, as dictated by Ecology. Dioxins and furans remain bound to sediment particles during dredging, which means very little of these compounds will dissolve in the water column. Operational controls employed by the contractor will serve to limit the amount of sediment (and sediment-bound dioxin) resuspended in the water column during dredging. Additional details of the water quality monitoring are included in Section 6.1.1.

4.3 Sediment Staging

Sediment staging will either employ upland staging or direct transfer to truck/rail. These methods are discussed below.

4.3.1 Temporary Barge Storage

As material is excavated from Berths 2 and 3, it will be placed into a haul barge alongside of the dredge. A flatdeck haul barge is anticipated to be used by the contractor. The haul barge or barges are located alongside of the dredge so that as the dredge digs directly off its bow, it will swing the bucket (filled with dredged material) no more than 90 degrees to the barge along its side. Having the haul barge placed in this position will minimize cycle time and maximize capture of material during barge loading. Dredged material will be placed into the center of the barge and heaped to promote drainage of the sediment. The effluent from the sediment will drain from the barge through scuppers (holes along the rails below the combing). These holes will be covered with geotextile fabric or similar filtering media to remove suspended solids from the effluent before it enters the receiving water. Filter fabric is expected to be anchored with hay bales. The haul barge containing the dredged material will be transported by tug to the offloading area at Berths 2 and 3.

The temporary barge storage method is a standard method used by dredging contractors to minimize water content in the dredged material, and to control potential loss of suspended solids from the barge. This method has been used successfully on many sediment remediation projects throughout the Puget Sound and United States. Temporary barge storage may be used in lieu of upland staging or for transport from the dredge area to the upland staging area, but material will not be stockpiled on inactive barges.

4.3.2 Upland Staging

Dredged material will likely be offloaded utilizing a crane (either floating crane or crane positioned on the dock) and clamshell (or rehandling) bucket and placed either directly into trucks or railcars (boxes or gondolas) or moved to a temporary on-site staging area (Figure 8). If sediment is placed directly into trucks or containers/gondolas for transport, there will be no water management of dredged material required.

If the contractor chooses to use an on-site staging area to either help control transport of sediment offsite, or to further dewater the sediment, the temporary staging area will be constructed with perimeter containment to prevent loss of sediment outside of the temporary staging area. The temporary staging area would be less than 1 acre in size and located on the Marine Terminal, which is paved. Any water that drains from the sediment or from rainfall events will be collected and filtered to remove suspended solids, and then directed back into the site waters within the dredge area. Water from the temporary staging area will comply with water quality criteria approved by Ecology.

Removal of suspended solids may consist of the use of settling tanks and/or sand filters prior to discharge to West Bay. The contractor will develop a Temporary Erosion and Sedimentation Control (TESC) Plan that will utilize All Known, Reasonable, and Available Technologies (AKART) to control water discharge to meet standard conditions normally required in general National Pollution Discharge Elimination System (NPDES) construction permits. The TESC will be reviewed and approved by Ecology.

4.3.3 Direct Transfer to Truck/Rail

Dredged material will be mechanically offloaded utilizing a crane and clamshell (or rehandling) bucket and can be placed directly into various transportation methods. The contractor will decide whether this option is the most effective method for their operations. Dredged material can be placed directly into lined trucks. Because there is a rail spur located along the offloading area, dredged material can be loaded into sealed gondolas and transported by rail to a permitted disposal facility; this would reduce truck traffic through the Port. Dredged material can also be placed directly into sealed containers secured onto a flatdeck haul barge and transported to the offloading area at Berths 2 and 3 (Figure 8). Containers would then be removed by crane and placed directly onto either railcars or trucks for transportation.

4.4 Disposal Alternatives

Disposal options such as beneficial reuse and construction landfills were conceptually evaluated; the Port was unable to identify any reasonable reuse of construction landfill sites that meet the timing objective for this project. Also, because of public concerns around elevated concentration of dioxins/furans, the upland landfill disposal option is the preferred disposal option.

Solid waste landfills in Washington are regulated primarily by the Minimum Functional Standards for Solid Waste Handling (WAC 173-304), Criteria for Municipal Solid Waste Landfills (WAC 173-351), and the Resource Conservation and Recovery Act (RCRA; Subtitle D). These regulations were established by state and federal governments to protect human health and the environment. Dredged material that is not eligible for open-water disposal and not classified as dangerous wastes is categorized as "problem wastes" under the Minimal Functional Standards (WAC 173-304-100). Generally, if sediments are not eligible for open-water disposal, they can be disposed of in a Subtitle D landfill. The landfill will identify testing requirements before or during construction, including the toxicity characteristic leaching procedure (TCLP) test. If required, TCLP will be conducted on stockpiled material (in containers or from the upland staging area) prior to acceptance of the material by the landfill.

4.5 Placing Clean Sand Cover

4.5.1 Purpose

Ecology is requiring placement of a minimum 6-inch-thick layer of clean sand over the dredge area to address potential anti-degradation concerns. The clean sand will ensure the biologically active zone is protected by forming a viable substrate for benthic biota and will further ensure that risks to human health and the environment have not increased until a more comprehensive cleanup of the area is undertaken. This additional post construction action goes above and beyond the needs of the antidegradation rule by further ensuring that all existing beneficial uses in Budd Inlet will continue to be protected and maintained.

The clean sand would likely be placed using one of four different placement methods, or a combination of these methods:

1. Directly placing the sand at the mudline using a dredge rehandling bucket; the rehandling bucket would grab cover material from a haul barge, and lower the material through the water column before opening slightly above the mudline.
2. Placing the sand with a barge-mounted, crane-operated clamshell. The clamshell placement method involves taking a bite of sand from a material barge and slowly releasing the sand from the bucket at the water surface as the operator methodically moves the bucket in a sweeping motion from side to side.
3. Hydraulically spraying the cover material off of the deck of a flatdeck material barge over the removal area.
4. Placing the sand from a material barge into a tremie tube that would extend through the water column to deposit the cover material slightly above the mudline.

In each case, the construction method would minimize disturbance of the in situ sediments because the methods described all entail low-energy placement. A bathymetry survey will be completed following dredging/prior to placement of sand and following placement of sand to confirm that placement of the clean sand layer met the minimum thickness requirements. Additional methods may be required to confirm cover thickness, including sediment profile imaging (SPI) or diver cores. If additional material is needed to achieve minimum cover thickness, it would be added during the same dredging season.

4.5.2 Thin versus Thick Cover

A minimum 6-inch-thick clean sand layer is intended to meet anti-degradation policy and provide a temporary partial isolation and partial mixing layer in order to provide a cleaner surface layer than pre-dredge conditions. Vessel propwash is possible in the berth area, which could scour or mix parts of the cover over time. However, the types of vessels and maneuvering methods used limit this risk. Since this cover is an interim measure to address anti-degradation, placing a thicker clean sand layer will increase the future costs and difficulties in site cleanup should the Port and Ecology decide that the area requires additional cleanup in the future or the Port pursues dredging to the full authorized depth of –40 feet MLLW (plus 2 feet of allowable overdepth). If a true isolation cap were required, it would need to be engineered and would likely include an armoring layer, requiring a fairly thick cap (e.g., greater than 2 to 3 feet).

5 DESCRIPTION OF THE INTERIM ACTION

In the previous section, a general discussion of alternative means and methods to conduct the construction elements was discussed. This section summarizes the selected means and methods for the proposed interim action and provides more detail of the means and methods that will be specified for the contractor.

5.1 Dredging Design

5.1.1 Berth Dredging

5.1.1.1 Dredge Method

Dredging with mechanical equipment using a crane (or other suitable equipment) mounted on a flatdeck barge has been selected as the preferred dredging method, based on an evaluation of Berths 2 and 3 conditions. The mechanical dredge will be equipped with a clamshell bucket. The specific make and model of the bucket to be employed will be determined by the selected contractor based on the material types present and the dredging requirements, but due consideration will be given to the material characteristics and the ability of the selected bucket and associated equipment to keep turbidity to a minimum and within acceptable water quality criteria limits. A closed bucket will not be required, but will be identified to the contractor as an acceptable water quality control BMP if the contractor determines that using a closed bucket is feasible and effective.

Dredged material will be placed into a flatdeck haul barge lined with filter fabric and anchored with hay bales. Water quality monitoring will be conducted as described in Section 6. Once the haul barge is filled to capacity, the haul barge will be transported by tug/tender to the on-site offloading facility. If debris is encountered during dredging, it will be removed with the dredge bucket and placed on the haul barge. Debris will be handled, offloaded, and disposed of with the dredged sediment.

5.1.1.2 Dredge Prism

The required dredge prism has dimensions of 110 feet wide by 800 feet long in the Berths 2 and 3 areas. Additional dredge areas on the sideslopes in the open water, plus some sloughing of material from the under-pier areas, are also within the dredge prism (Figures 6 and 7). The required dredge depth will be -39 feet MLLW (plus 2 feet of allowable overdepth). This dredge depth will provide sufficient clearance to allow placement of a minimum 6-inch clean cover (Section 5.3), and maintain a minimum -38 feet MLLW berthing depth that is required for safe vessel navigation and berthing in Berths 2 and 3.

Under-pier dredging is not considered to be feasible due to the presence of debris and buried piling, limited under-pier access, existing slope stability, concerns with damaging the existing structures, and concern with causing high turbidity associated with under-pier dredging. Some sideslope material from the under-pier area will be removed as it sloughs downslope to the face of the pier during dredging adjacent to the pier face. Dredging will be conducted in lifts at the pier face to minimize the amount of uncontrolled sloughing that occurs. Although some recently deposited sediments may slough, historic dredging to -42 feet MLLW was conducted in 1977 that did not cause slope failure. The final slope following sloughing will vary, but is expected to be approximately 1H:1V, with some areas potentially as flat as 1.5H:1V, and some areas steeper than 1H:1V.

Other methods to minimize slope sloughing are not being considered as part of the Interim Action, but will be considered as part of evaluation and selection of a permanent remedy. One method is the construction of a sheetpile wall at the toe of the slope. A sheetpile wall may support the slope and minimize potential sloughing as material is dredged from the berth area. Because cleanup levels for the site have not been established, significant additional time, effort and costs would be needed for the evaluation and installation of a sheetpile wall, and a sheetpile wall would limit future remedies for under-pier sediment, consideration of this more permanent remedy is considered premature for this interim action.

Post-dredge bathymetric surveys will be conducted as specified in Section 6.1.2. Depending on the degree of sloughing, Ecology and the Port will work to determine if additional dredging during the second construction season is necessary to remove contaminated or excessive materials that slough from the under-pier slope and settles at the toe of slope following the completion of dredging.

Along the under-pier slope, some material is expected to slough during dredging along the edge of the pier. Surface sediment (0-2ft) concentrations along the under-pier slope ranges from 20 to 29 pg/g TEQ, which are lower than most surface dioxin concentrations within the dredge area (Figures 6 and 7). Subsurface concentrations along the under-pier slope decrease with depth in two cores (POC-C6 and POC-C7) and increase in BI-C4. Sediments lower on the slope and closer to the dredge cut will slough more than sediments farther up the slope.

5.1.1.3 Dredge Volumes

Based on the most recent surveys of Berths 2 and 3 (conducted by David Evans and Associates in March 2008), approximately 22,300 cy of dredged material will be removed from Berths 2 and 3. This volume is based on the removal of sediments to a depth of -39 feet MLLW (plus 2 feet of allowable overdepth) including sideslope and under-pier slough volumes. The 22,300 cy represents an anticipated maximum volume that may be removed. The ability of the contractor to minimize allowable overdredging and the amount of sloughing from under-pier material may result in a total dredged volume much less than 22,300 cy.

5.1.1.4 Production Rate

The dredging production rate (i.e., the volume of dredged materials dredged per hour) was estimated for purposes of developing the dredging project schedule. Factors that impact dredging productivity vary with equipment, site characteristics, and weather conditions. Production rates may be higher in some areas of the site and lower in others, depending on sediment type, thickness of sediment removal, water depths, and the presence of debris. Production rates may also be impacted by turbidity control requirements.

The following assumptions were made to estimate the dredge production rate:

- Size of clamshell bucket = 5 cy
- Cycle time (i.e., the time to close the bucket with dredged material, pull it out of the water, place the dredged material into the barge/offloading area, and return the bucket to the water for the next dredge cut) = 90 to 120 seconds per cycle
- Uptime (i.e., the time that the dredge is actually working, excluding routine maintenance, unexpected maintenance, dredge positioning, encountering unexpected debris, and the need to periodically switch out the barges used to transport dredged material) = 70 percent
- Bucket load = 60 percent in situ sediment and 40 percent water by volume

The assumptions listed above were based on engineering judgment, familiarity with the West Bay conditions, and discussions with dredging contractors. It is further assumed that dredging operations would be conducted 6 days per week for 10 hours a day, yielding a production rate of 600 to 850 cy per day. The contractor can work double shifts to increase production; however, some Subtitle D landfills in the Northwest have been limiting daily volume accepted at the facilities to approximately 600 cy (900 tons) per day. Assuming a 22,300-cy maximum volume, this results in a total estimated maximum dredging duration of approximately 26 workdays. The contractor may need to increase their dredging production rate and use temporary storage of sediment on barges or in upland areas in order to complete in-water work within the allowable work window, then dispose of sediment at the lower 600-cy per day rate since the in-water work window does not apply to upland activities. The total project schedule for dredging depends on the additional time required for mobilization and demobilization, and the number of dredges used, among other factors.

5.2 Materials Handling/Disposal

One or more haul barges containing the dredged sediment will be positioned next to the terminal and the material offloaded. These barges will be lined with filter fabric anchored with hay bales. Turbidity monitoring will be performed to ensure compliance with water quality criteria required by Ecology.

A land-based crane or a floating crane on a barge will be used to transfer dredge material from the haul barge into haul trucks or rail containers/gondolas. To contain all excess sediment that may be spilled during this transfer process, a spill-prevention apron (e.g., spill plate) will be installed on the terminal that sufficiently extends out to the haul barge so any spilled material will fall back either into the haul barge or onto the paved dock, and not into the site waters (Figure 8). Any spillage on the apron will be removed as soon as practicable and properly disposed of along with dredged sediments. Additionally, the haul trucks, containers, or gondolas will be lined to prevent release of any sediment or effluent during transport. The anticipated truck haul route is shown on Figure 9.

Direct placement of sediment into haul trucks or rail containers/gondolas is the preferred option. However, depending on the methods proposed by the selected contractor, a staging area designated for sediment transloading and dewatering may be established on the terminal. In this case, the dredged material will be offloaded over the spill prevention apron directly into the temporary staging area. The temporary staging area will be less than 1 acre in size, lined with an impermeable liner, and be surrounded by perimeter containment (e.g., Ecology blocks). The sediment will be heaped by a front-end loader or similar to promote drainage before the sediment is loaded into haul trucks or rail gondolas. The excess water (i.e., effluent) that drains from the sediment or accumulates through rainfall within the temporary staging area will be collected and filtered before being returned to the receiving waters in the dredge area. Site water that receives effluent from the temporary staging area will comply with turbidity criteria approved by Ecology. Should the contractor propose to use a temporary staging area, Ecology would review and approve this method prior to implementation.

Removal of suspended solids may consist of the use of settling tanks and/or sand filters prior to discharge to the bay. The contractor will develop a TESC Plan that will utilize AKART to control water discharge to meet standard conditions normally required in general NPDES construction permits. The TESC will be reviewed and approved by Ecology.

From the terminal, the dredged material will be taken directly to an approved Subtitle D landfill facility. In order for the material to be acceptable for transport, certain moisture content limitations may be required, which often involves passing the Paint Filter Test. Water-absorbent additives such as fly ash, cement, diatomaceous earth, or lime may be added to the sediment prior to off-site transport in order to meet criteria to transport wet sediment. However, some landfills have exemptions from the Paint Filter Test requirement.

5.3 Placement of Clean Sand Cover

The sand cover will be placed during the winter 2008 to spring 2009 construction season following dredging. Ecology is requiring the cover be placed in the first construction season following dredging based on supplemental sediment chemistry results collected in 2008 (Section 2.2.5). Additional details of the cover, including gradation of the sand material and thickness, will be approved by Ecology.

Following dredging, a minimum 6-inch-thick clean sand layer will be placed in the berth area. The anticipated maximum volume of clean sand to be placed is estimated to be approximately 2,600 cy. This volume includes a 6-inch allowable overplacement to account for measurement and placement accuracy (Figure 10). The clean sand will provide a usable substrate for benthic species in the berth area in the interim until the more comprehensive cleanup of the area is undertaken. A barge-mounted, crane-operated clamshell or rehandling bucket is anticipated to be used to place the material. The bucket placement method involves taking a bite of sand from a material barge and slowly releasing the sand from the bucket as the operator methodically moves the bucket in a sweeping motion from side to side. This method ensures a consistent spread of material that will evenly fall through the water column and land in the proper location. Anticipated production rate for placing clean sand cover averages 600 to 850 cy per day, resulting in a placement duration of approximately 4 to 8 workdays. Source sand will be tested to ensure that contaminants are not present and that sand chemistry is below SQS criteria. Sand will contain less than 3 percent fines (clay and silt).

5.4 Water Quality Controls

Section 4 identified water quality controls that may be available to the contractor. This section identifies the water quality controls that will be required in the bid documents. The contractor may choose to use additional water quality controls not discussed in this document. The contractor will be required to identify their plan to meet water quality criteria, which will be reviewed and approved by Ecology, as discussed in Section 5.4. The following water quality controls will be required in the bid documents:

- Qualified Contractor
- Eliminating Multiple Bites
- Eliminating Underwater Stockpiling
- Controlled Cut Thickness Along Toe of Slope
- Eliminating Bottom Leveling

- Eliminating Bucket Overloading
- Eliminating Barge Overloading
- Water Quality Monitoring

5.5 Contractor Submittals

The dredging contractor will be expected to submit several documents for Ecology review and approval prior to initiating in-water work. These submittals are listed below:

- Contractor Construction Workplan – This plan will include the contractor's approach to sediment dredging, offloading, material handling, temporary staging, and sediment disposal. The plan will also include a description of the contractor's quality control organization.
- Spill Prevention, Containment, and Control (SPCC) Plan – This plan will be prepared to describe methods to prevent, contain, and control spills of both sediment and other substances (such as fuel).
- TESC Plan – This plan will be prepared if temporary upland staging is implemented. The estimated total volume of water will be included in this plan, along with planned methods to reduce turbidity in effluent.
- Water Quality Control Plan – This plan will be prepared to describe methods to minimize turbidity during dredging, material handling, and temporary staging. This plan will also identify contractor contingency methods to comply with water quality criteria should there be an exceedance during construction.

5.6 Contractor Quality Control

The Port will provide daily construction inspections and management to ensure the contractor meets bid specification requirements, permit conditions, and adheres to contractor submittals. The contractor shall also be required to conduct daily progress surveys. The Port, in coordination with Ecology, will also conduct a pre-construction meeting prior to construction and conduct weekly construction meetings to ensure contractor compliance.

5.7 Construction Sequencing and Duration

Subject to the selected contractor's means and methods for removal, construction is anticipated to occur in the following sequence:

1. Berth area dredging
2. Sediment dewatering, offloading, and disposal

The overall anticipated duration of construction activities, which includes time for the contractor to implement BMPs if necessary, is identified below:

1. Mobilization (5 workdays)
2. Berth area dredging (26 workdays)
3. Sediment dewatering, offloading, and disposal (26 workdays concurrent with dredging)
4. Demobilization (5 workdays)
5. Clean cover placement (8 workdays)

Total duration = 44 workdays.

6 WATER AND SEDIMENT QUALITY MONITORING

This AO requires the submittal and approval of a Water Quality Monitoring and Sediment Sampling Plan (WQMSSP) prior to beginning work at Berths 2 and 3. As required by the Water Quality Certification and Table 1 of the AO, written approval of this WQMSSP from Ecology is required prior to beginning the work. Water quality sampling will be conducted during construction and sediment sampling will be conducted post-construction.

6.1 Construction Monitoring

Construction monitoring refers to monitoring conducted during or shortly after construction is completed to assess compliance with water quality certification conditions. It will also provide information to assess the implementability, potential environmental impacts, and effectiveness of the dredging to meet water and sediment quality objectives. This information may be used during evaluation of final cleanup alternatives, including selection or prioritization of techniques that were successful for implementing dredging, limiting environmental impacts, and achieving water and sediment quality objectives.

6.1.1 Water Quality Monitoring

Water quality monitoring requirements will be discussed in the WQMSSP that will be prepared in conjunction with Ecology and ultimately approved by Ecology. The WQMSSP will define water sampling and testing protocols to comply with substantive requirements in the Section 401 Water Quality Certification issued by Ecology.

The waters for this project are designated as excellent quality marine waters by the State of Washington (WAC 173-201A). The Port will monitor turbidity as the primary indicator of water quality. The following water quality criteria are expected to be included in the Water Quality Certification issued by Ecology:

- Water quality shall not exceed 5 nephelometric turbidity units (NTUs) over background turbidity when the background turbidity is 50 NTUs or less, or shall not exceed more than 10 percent above background turbidity when background turbidity is more than 50 NTUs.

- Turbidity will be assessed and recorded at a minimum of every 4 hours during periods of active in-water work during the day at multiple water elevations. Monitoring points will be within a 100 foot radius of the work area and at the point of compliance at a 150 foot radius. Monitoring will occur in real time and consist of both turbidity and dissolved oxygen. The WQMSSP will include contingency corrective measures to be implemented if criteria are exceeded at the 100 foot radius that will prevent any exceedances at the 150 foot compliance boundary.

Background turbidity may be affected by releases of water from the Capitol Lake reservoir, causing turbidity levels to exceed 50 NTU. The dam has been opened in the past during the winter months, but the schedule for this opening is unknown and contingent on flows from the Deschutes River and other variables. Turbidity limitations based on background turbidity, as described in the next paragraph, will be implemented regardless of whether the Capitol Lake reservoir is opened during in-water work.

If turbidity exceeds 5 NTU over background turbidity when background turbidity is 50 NTU or less, or there is a more than 10 percent increase in turbidity when the background turbidity is more than 50 NTU, the activity causing the turbidity will be modified and monitoring will continue every 4 hours. If exceedances occur during two consecutive measurements (4 hours apart), the activity causing the turbidity will be stopped, Ecology will be notified, and work will not continue until the problem is resolved.

Water quality monitoring will be conducted by the Port or its designee rather than the dredging contractor. Specific compliance boundaries will be identified in the WQMSSP.

6.1.2 Post-Dredge Monitoring

Post-dredge monitoring will be discussed in the WQMSSP, which will include post-dredge surface sediment sampling and bathymetry monitoring. The WQMSSP will specify collection of the dredged 'Z' surface (upper 10 cm) to define the post-dredge surface dioxin concentrations as well as surface dioxin concentrations on the under-pier slope and outside of the dredge prism (within 150 feet). Additional sampling is expected to include sampling following placement of the sand cover, 3 months after cover placement, and sampling at three 6-month intervals thereafter. Sample results will be provided to Ecology at the conclusion of each sampling event.

Also included in the WQMSSP will be post-dredge bathymetry monitoring. Bathymetry will be collected in the berth areas following dredging to establish baseline conditions. Bathymetry will also be collected at the same time as surface sediment sampling to monitor sloughing of material from the under-pier slope into the berth areas. Bathymetry results will also be provided to Ecology.

Following each monitoring effort, Ecology will review the monitoring results. In the event that the cover is not performing its desired function to decrease surface sediment concentrations, contingency measures will be identified and discussed with Ecology. Similarly, if monitoring indicates greater than expected slope failures, additional evaluations of slope stability will be performed to evaluate potential slope stabilization measures.

7 IMPLEMENTATION OF THE INTERIM CLEANUP ACTION

All permits for sediment cleanup elements will be obtained prior to award of the contract. The Port will request sealed bid proposals for construction from qualified contractors. Contract documents included Contract Plans, Contract Provisions, Contract Specifications, and addenda. All contract documents will be submitted to Ecology to ensure consistency with the IAP and AO. This interim action is scheduled to be completed by March 15, 2009.

8 REFERENCES

Anchor. 2008. Final Sampling and Analysis Plan, Port of Olympia Berths 2 and 3. Prepared for Port of Olympia. Anchor Environmental, L.L.C.

DMMP. 2006. Memorandum for record: Supplemental determination on the suitability of dredged material tested for dioxin/furans within the Olympia Harbor federal/port navigation project evaluated under Section 404 of the Clean Water Act for open-water disposal at the Anderson-Ketron Island non-dispersive disposal site and for beneficial use. CENWS-OD-TS-DM. Dredged Material Management Program, Olympia, WA.

Hartman Consulting Group. 2001. Final LTMS Management Plan for San Francisco Bay. Appendix I: Best Management Practices.

Integral. 2007. Draft Data Summary Report – West Bay Sediment Characterization Study Berths 2 and 3 Interim Action Project. Prepared by Integral Consulting Inc. Olympia, WA. November 14, 2007.

Palermo, M.R., N.R. Francingues, and D.E. Averett. 2003. Equipment Selection Factors for Environmental Dredging. Proceedings of the WEDA XXIII Conference, Chicago, Illinois, June 10-13, 2003.

SAIC. 2006. Olympia Federal Navigation Channel and Port of Olympia Berthing Area Dioxin Sediment Characterization. Prepared for U.S. Army Corps of Engineers, Seattle District. Science Applications International Corporation, Bothell, WA.

SAIC. 2007a. Budd Inlet Summary of Existing Information and Identification of Data Gaps for Sediments, Budd Inlet, WA. Data Report. Prepared for the Washington State Department of Ecology, Lacey, WA. Prepared by Science Applications International Corporation, Bothell, WA. March 30, 2007.

SAIC. 2007b. Sediment Characterization Study, Budd Inlet, Olympia, WA. Sampling and Analysis Plan. Prepared for the Washington State Department of Ecology, Lacey, WA. Prepared by Science Applications International Corporation, Bothell, WA. March 2007.

SAIC. 2008. Sediment Characterization Study, Budd Inlet, Olympia, WA. Final Data Report. Prepared for the Washington State Department of Ecology, Lacey, WA. Prepared by Science Applications International Corporation, Bothell, WA. March 12, 2008.

Wang, T.S., Larm, K., Hotchkiss, D. 2002. Evaluation of Closed Buckets for Remedial Dredging and Case Histories. Proceedings – Third Speciality Conference on Dredging and Dredged Material Disposal, ASCE Dredging '02. Orlando, FL. May 2002.

TABLES

Table 1
2006 Sediment Sampling Results

Analyte	Location / Sample Date / Sample Time / Sample ID / Interval / TEQ	S2		S3		S4	
	Sample Date	3/8/2006	3/8/2006	3/8/2006	3/8/2006	3/8/2006	3/8/2006
	Sample Time	13:51	13:51	13:17	13:17	10:38	10:38
	Sample ID	SAIC_WBBDMCS2	SAIC_WBBDMCS26	SAIC_WBBDMCS3	SAIC_WBBDMCS25	SAIC_WBBDMCS4	SAIC_WBBDMCS24
	Interval	0-4.0 ft	4.0-8.9 ft	0-4.0 ft	4.0-10.1 ft	0-4.0 ft	4.0-9.8 ft
Conventionals (%)							
Total organic carbon		2.94	0.38	3.15	0.46	2.67	0.35
Total solids		40.4	60	39.8	79	46.9	84.5
Total volatile solids		8.86	4.3	9.54	1.9	7.75	1.5
Total fines		89.4	80.6	74.2	2.5	66.2	8.1
Dioxins/Furans (pg/g)							
Dioxin/furan TCDD toxicity equivalent (ND = 0)		52.3	0.0485	37.4	1.83	52.7	4.54
Dioxin/furan TCDD toxicity equivalent (ND = 1/2 DL)		52.3	0.271	37.4	2.02	52.7	4.56

Note: PAH data were tested for both intervals of sample S4. Results are contained in Appendix A.

Table 2
2007 Sediment Sampling by Ecology - Dioxin and Concentrations Exceeding SMS Criteria

		Sample ID	BI-S36			BI-S37			BI-C3																	
		Interval	0-10 cm			0-10 cm			0-1 FT			1-2 FT			2-3 FT			3-4 FT			4-5 FT			6-7 FT		
Analyte		TEF		LQ	VQ		LQ	VQ		LQ	VQ		LQ	VQ		LQ	VQ		LQ	VQ		LQ	VQ		LQ	VQ
Conventionals (%)																										
Total organic carbon			3.48			3.62			2.53			2.11			1.47			1.14			1.19			1.25		
Total solids			32.1			29			11.9		J	8.29		J	6.29		J	5.96		J	5.2		J	4.55		J
Total volatile solids			11.9		J	12.3		J	33.3			49.2			59			66.2			64.2			65.2		
Percent Gravel (>2.0 mm)			1.01			0			23			29.7			20.7			5.48		J	7.45		J	7.02		J
Percent Sand (<2.0 mm - 0.06 mm)			11.68			11.38			26.22			33.11			41.81			45.9			23.16			15.59		
Percent Silt (0.06 mm - 0.004 mm)			63.9			69.8			28.3			21.7			21.3			34.6		J	53.7		J	63.7		J
Percent Fines (<0.06 mm)			88.7			89.3			56.1			41.6			38.4			48.4		J	67.3		J	77.3		J
Percent Clay (<0.004 mm)			24.8			19.5			27.8			19.9			17.1			13.8		J	13.6		J	13.6		J
Dioxins/Furans (pg/g)																										
2,3,7,8-TCDD		1	0.488	J	J	0.424	J	J	0.484	J		0.464	J		0.36	J		0.0489	KJ	U	0.0481	KJ	U	0.0469	KJ	U
1,2,3,7,8-PECDD		1	2.36	J		2.21	J		2.38	J	J	1.99	J		1.74	J		0.599	J	J	0.125	U		0.122	U	
1,2,3,4,7,8-HXCDD		0.1	3.54	J		3.36	J		4.16	J	J	3.59	J		2.69	J		1	J	J	0.183	U		0.178	U	
1,2,3,6,7,8-HXCDD		0.1	23.9			21.9			23.6			22.2		J	19.2		J	6.31		J	0.629	J	J	0.232	J	J
1,2,3,7,8,9-HXCDD		0.1	11.8			10.5			12.1			10.9		J	9.02		J	3.24	J	J	0.423	J	J	0.241	J	J
1,2,3,4,6,7,8-HPCDD		0.01	442			413			535			499		J	385		J	131	B		12.7	B		3.86	BJ	
OCDD		0.0003	3080			2940			4430			3770			2790			966			92.4			31.3		
2,3,7,8-TCDF		0.1	1.31			1.4			1.23			0.101	K	U	0.0667	K	U	0.429	J		0.0481	KJ	U	0.0469	U	
1,2,3,7,8-PECDF		0.03	1.69	J		1.64	J		1.7	J		1.58	J		1.37	J		0.481	J		0.0914	U		0.089	U	
2,3,4,7,8-PECDF		0.3	2.05	J	J	2	J	J	1.87	J		1.68	J		1.68	J		0.519	J		0.0924	U		0.09	U	
1,2,3,4,7,8-HXCDF		0.1	8.61		J	8.23		J	7.79		J	7.5			6.31			2.73	J		0.266	J		0.0853	U	
1,2,3,6,7,8-HXCDF		0.1	3.82	J		3.82	J		3.66	J		3.51	J	J	3	J	J	1.13	J		0.117	J		0.112	U	
1,2,3,7,8,9-HXCDF		0.1	0.35	J		0.373	J		0.309	J		0.356	J		0.294	J		0.0909	KJ	U	0.0895	U		0.0872	U	
2,3,4,6,7,8-HXCDF		0.1	3.82	J	J	3.38	J	J	3.27	J	J	3.13	J		2.56	J		1	J		0.115	U		0.112	U	
1,2,3,4,6,7,8-HPCDF		0.01	137			151			123			114			88.7			33.6	B		0.0953	BJ	U	0.0928	BJ	U
1,2,3,4,7,8,9-HPCDF		0.01	5.36			4.98			5.02	J		4.49	J		3.29	J		1.39	BJ		0.154	BJ		0.0825	U	
OCDF		0.0003	222			221			266			166			122			0.274	B	U	0.269	BJ	U	0.262	BJ	U
Dioxin/furan TCDD toxicity equivalent (ND = 0)			16.06			15.22			17.1			15.5			12.6			4.3			0.4			0.2		
Dioxin/furan TCDD toxicity equivalent (ND = 1/2 DL)			16.06			15.22			17.1			15.5			12.6			4.3			0.3			0.1		
Compounds Exceeding SMS Criteria	**SQS**	**CSL**																								
Metals (mg/kg dw)																										
Mercury	0.41	0.59																								
LPAH (mg/kg TOC)																										
Acenaphthene	16	57																								
Chlorinated Aromatics (mg/kg TOC)																										
1,2,4-Trichlorobenzene	0.81	1.8																								
Hexachlorobenzene	0.38	2.3																								
Phenols (ug/kg dw)																										
2-Methylphenol	63	63																								
2,4-Dimethylphenol	29	29																								
Pentachlorophenol	360	690																								

Table 2
2007 Sediment Sampling by Ecology - Dioxin and Concentrations Exceeding SMS Criteria

Analyte		Sample ID / Interval / TEF	BI-C4 0-1 FT	LQ	VQ	BI-C4 3-4 FT	LQ	VQ	BI-C4 6-7 FT	LQ	VQ	BI-C5 0-10 cm	LQ	VQ	BI-C5 3-4 FT	LQ	VQ	BI-C5 6-7 FT	LQ	VQ
Conventionals (%)																				
Total organic carbon			3.94			4.62			3.71			4.62			8.24			7.56		
Total solids			14		J	14.2		J	10.3		J	23.9			40.2			36.8		
Total volatile solids			23.9			38.4			57.1			14.9		J	13.8		J	15.9		
Percent Gravel (>2.0 mm)			8.4			9.75			11.5			1.51			23.9			68.9		J
Percent Sand (<2.0 mm - 0.06 mm)			15.54			19.84			35.72			16.37			14.58			10.53		
Percent Silt (0.06 mm - 0.004 mm)			51.9			35.5			27			56			30.1			19.4		J
Percent Fines (<0.06 mm)			84.5			72.5			52.5			81.3			66.7			35.8		
Percent Clay (<0.004 mm)			32.6			37			25.5			25.3			36.6			16.4		
Dioxins/Furans (pg/g)																				
2,3,7,8-TCDD		1	0.547	DJ		0.917	DJ		1.81	DJ		0.64	DJ		8.56	DJ		11.6	KDJ	U
1,2,3,7,8-PECDD		1	3.65	DJ	J	4.59	DJ	J	6.01	DJ	J	3.02	DJ		31.6	DJ	J	55.5	DJ	J
1,2,3,4,7,8-HXCDD		0.1	7.62	DJ	J	7.87	DJ	J	8.6	DJ	J	5.6	DJ		32.5	DJ	J	89.8	DJ	J
1,2,3,6,7,8-HXCDD		0.1	36	D		52.1	D		52.9	D		29.6	D	J	267	D		3130	D	
1,2,3,7,8,9-HXCDD		0.1	21.4	D		26.1	D		22	DJ		15.2	D	J	114	D		413	DJ	
1,2,3,4,6,7,8-HPCDD		0.01	944	D		1300	D		1190	D		635	D	J	4800	D		46700	D	
OCDD		0.0003	8360	D		10800	D		8720	D		4500	D		31800	D		402000	D	
2,3,7,8-TCDF		0.1	2.41			3.44			6.26			2			15			280		
1,2,3,7,8-PECDF		0.03	2.5	DJ		4.32	DJ		11.1	DJ		2.4	DJ		60.3	D		925	DJ	
2,3,4,7,8-PECDF		0.3	3.08	DJ		5.37	DJ		14.9	DJ		2.88	DJ		53.6	D		3140	D	
1,2,3,4,7,8-HXCDF		0.1	15.2	D	J	31.9	D	J	112	D	J	11.2	D		335	D	J	14900	D	J
1,2,3,6,7,8-HXCDF		0.1	6.05	DJ		10.9	DJ		28.7	D		4.8	DJ	J	87.9	D		2320	D	
1,2,3,7,8,9-HXCDF		0.1	0.481	DJ		0.777	DJ		0.899	DJ		0.453	DJ		19.9	DJ		170	DJ	
2,3,4,6,7,8-HXCDF		0.1	5.4	DJ	J	7.78	DJ	J	14.4	DJ	J	4.5	DJ		57.5	D	J	976	D	J
1,2,3,4,6,7,8-HPCDF		0.01	220	D		339	D		1020	D		178	D		2020	D		31600	D	
1,2,3,4,7,8,9-HPCDF		0.01	9.71	DJ		11.9	DJ		23.9	D		7.63	DJ		128	D		3730	D	
OCDF		0.0003	535	D		566	D		1250	D		386	D		2240	D		42300	D	
Dioxin/furan TCDD toxicity equivalent (ND = 0)			29.1			41.3			62.5			21.60			230.62			4206.72		
Dioxin/furan TCDD toxicity equivalent (ND = 1/2 DL)			29.1			41.3			62.5			21.60			230.62			4212.52		
Compounds Exceeding SMS Criteria	**SQS**	**CSL**																		
Metals (mg/kg dw)																				
Mercury	0.41	0.59																0.91		
LPAH (mg/kg TOC)																				
Acenaphthene	16	57																26.46		
Chlorinated Aromatics (mg/kg TOC)																				
1,2,4-Trichlorobenzene	0.81	1.8	0.81	U					1.35	U					1.58	U		1.85	U	
Hexachlorobenzene	0.38	2.3	1.12	U					1.35	U					1.58	U		1.85	U	
Phenols (ug/kg dw)																				
2-Methylphenol	63	63	72	U											130	U		140	U	
2,4-Dimethylphenol	29	29	120	U														680	U	
Pentachlorophenol	360	690							500	U					1300	U		1400	U	

Table 2
2007 Sediment Sampling by Ecology - Dioxin and Concentrations Exceeding SMS Criteria

Analyte		Sample ID	BI-C14											
		Interval	0-10 cm			3-4FT			6-7FT			9-10FT		
		TEF		LQ	VQ		LQ	VQ		LQ	VQ		LQ	VQ
Conventionals (%)														
Total organic carbon			4.59			0.39			0.8			1.05		
Total solids			29.6			76.4			68.1			64.6		
Total volatile solids			15.8		J	2.77		J	4.41		J	4.97		J
Percent Gravel (>2.0 mm)			17.6			12.2		J	15.1		J	27.3		J
Percent Sand (<2.0 mm - 0.06 mm)			30.85			75.43			45.26			35.58		
Percent Silt (0.06 mm - 0.004 mm)			41.9			10.5		J	23.5		J	23		J
Percent Fines (<0.06 mm)			58.3			14.24		J	39.3		J	40.5		J
Percent Clay (<0.004 mm)			16.4			3.74		J	15.8		J	17.5		J
Dioxins/Furans (pg/g)														
2,3,7,8-TCDD		1	0.4	J		0.0474	KJ	U	0.0455	U		0.0501	KJ	U
1,2,3,7,8-PECDD		1	1.78	J		0.951	J	J	0.118	U		0.13	U	
1,2,3,4,7,8-HXCDD		0.1	2.96	J		1.61	J	J	0.173	U		0.19	U	
1,2,3,6,7,8-HXCDD		0.1	17.5		J	7.78		J	0.164	U		0.18	U	
1,2,3,7,8,9-HXCDD		0.1	10.2		J	4.24	J	J	0.155	U		0.17	U	
1,2,3,4,6,7,8-HPCDD		0.01	428		J	146	B		0.155	BJ	U	1.02	J	J
OCDD		0.0003	3020		J	903			11.7			11.2		J
2,3,7,8-TCDF		0.1	0.0656	K	U	0.317	J		0.0455	U	UJ	0.0501	U	
1,2,3,7,8-PECDF		0.03	1.27	J		0.709	J		0.0864	U		0.0951	U	
2,3,4,7,8-PECDF		0.3	1.45	J		1.24	J		0.0874	U		0.0961	U	
1,2,3,4,7,8-HXCDF		0.1	6			6.97			0.0828	U		0.0911	U	
1,2,3,6,7,8-HXCDF		0.1	2.83	J	J	2.18	J		0.109	U		0.12	U	
1,2,3,7,8,9-HXCDF		0.1	0.234	J		0.126	J		0.0846	U		0.0931	U	
2,3,4,6,7,8-HXCDF		0.1	2.59	J		1.98	J		0.109	U		0.12	U	
1,2,3,4,6,7,8-HPCDF		0.01	161			92.2	B		0.0901	U		0.0991	KJ	U
1,2,3,4,7,8,9-HPCDF		0.01	3.8	J		3.03	BJ		0.0801	U		0.0881	U	
OCDF		0.0003	245			159	B		0.255	U		0.28	U	
Dioxin/furan TCDD toxicity equivalent (ND = 0)			13.79			6.60			0.00			0.01		
Dioxin/furan TCDD toxicity equivalent (ND = 1/2 DL)			13.80			6.62			0.15			0.17		
Compounds Exceeding SMS Criteria	**SQS**	**CSL**												
Metals (mg/kg dw)														
Mercury	0.41	0.59												
LPAH (mg/kg TOC)														
Acenaphthene	16	57												
Chlorinated Aromatics (mg/kg TOC)														
1,2,4-Trichlorobenzene	0.81	1.8												
Hexachlorobenzene	0.38	2.3												
Phenols (ug/kg dw)														
2-Methylphenol	63	63												
2,4-Dimethylphenol	29	29												
Pentachlorophenol	360	690												

Table 2
2007 Sediment Sampling by Ecology - Dioxin and Concentrations Exceeding SMS Criteria

Analyte		Sample ID	BI-C15															BI-C16								
		Interval	0-10 cm			2-3 FT			4-5 FT			6-7FT			9-10FT			0-10 cm			1-2 FT			2-3 FT		
		TEF		LQ	VQ		LQ	VQ		LQ	VQ		LQ	VQ		LQ	VQ		LQ	VQ		LQ	VQ		LQ	VQ
Conventionals (%)																										
Total organic carbon			3.88			3.37			2.35			0.1			1.14			3.81			0.87			0.08		
Total solids			26.3			33.8			61			87.3			74.9			28.3			75.5			88.6		
Total volatile solids			13.4		J	10.9		J	5.63		J	1.25		J	3.1		J	13.8		J	2.55		J	1.04		J
Percent Gravel (>2.0 mm)			0.08			5.71			25.9			61.6		J	11.9		J	0.11			63			48.1		
Percent Sand (<2.0 mm - 0.06 mm)			13.2			18.51			29.55			42.19			58.18			14.26			25.16			50.67		
Percent Silt (0.06 mm - 0.004 mm)			72.7			41.6			23.9			0.76		J	24.6		J	57.8			10.5			1.14		
Percent Fines (<0.06 mm)			92.3			82.2			44.8			1.38		J	29.84		J	84.8			16.48			1.63		
Percent Clay (<0.004 mm)			19.6			40.6			20.9			0.62		J	5.24		J	27			5.98			0.49		
Dioxins/Furans (pg/g)																										
2,3,7,8-TCDD		1	0.537	J	J	0.788	J		0.878	DJ		0.046	KJ	U	0.0478	U		0.449	J	J	0.174	J		0.0484	U	
1,2,3,7,8-PECDD		1	2.87	J		4.24	J		4	DJ	J	0.12	U		0.124	U		2.77	J		0.541	J	J	0.126	U	UJ
1,2,3,4,7,8-HXCDD		0.1	4.77			8.03			6.14	DJ	J	0.319	J		0.182	U		4.32	J		0.727	J	J	0.184	U	UJ
1,2,3,6,7,8-HXCDD		0.1	25.9			43.3			45.1	D		1.14	J	J	0.172	U		27.3			4.66	J		0.174	U	
1,2,3,7,8,9-HXCDD		0.1	13.8			22.2			18.3	DJ		0.613	J	J	0.163	KJ	U	13.6			1.95	J		0.164	U	
1,2,3,4,6,7,8-HPCDD		0.01	538			954			967	D		51		J	2.92	J	J	558			93.9			1.41	J	
OCDD		0.0003	4220			7190	D		7140	D		490		J	219		J	4110			627			9.6	J	
2,3,7,8-TCDF		0.1	1.57			2.4			2.66			0.046	U		0.0478	U		1.62			0.101	KJ	U	0.0484	U	
1,2,3,7,8-PECDF		0.03	1.91	J		2.93	J		4.65	DJ		0.0874	U		0.0908	U		2.02	J		0.517	J		0.0919	U	
2,3,4,7,8-PECDF		0.3	2.25	J	J	3.48	J		6.66	DJ		0.0883	U		0.0918	U		2.47	J	J	1.01	J		0.0928	U	
1,2,3,4,7,8-HXCDF		0.1	9.48		J	18.5			37.7	D	J	0.361	J		0.087	U		10.2		J	4.67	J	J	0.088	U	UJ
1,2,3,6,7,8-HXCDF		0.1	4.59	J		7.05			11.3	DJ		0.13	J		0.115	U		4.48	J		1.42	J		0.116	U	
1,2,3,7,8,9-HXCDF		0.1	0.423	J		0.611	J		1.16	DJ		0.0856	U		0.0889	U		0.387	J		0.107	U		0.0899	U	
2,3,4,6,7,8-HXCDF		0.1	4.01	J	J	6.56			7.94	DJ	J	0.132	J		0.115	U		4.3	J	J	1.12	J	J	0.116	U	UJ
1,2,3,4,6,7,8-HPCDF		0.01	161			400			414	D		7.23			0.0946	U		160			89.8			0.677	J	
1,2,3,4,7,8,9-HPCDF		0.01	6.88			11.4			18.9	DJ		0.923	J	J	0.0841	U		6.25			2.43	J		0.0851	U	
OCDF		0.0003	340			641			771	D		44.2		J	0.268	U		280			146			0.912	J	
Dioxin/furan TCDD toxicity equivalent (ND = 0)			19.02			33.03			36.42			1.02			0.09			19.20			4.58			0.02		
Dioxin/furan TCDD toxicity equivalent (ND = 1/2 DL)			19.02			33.03			36.42			1.13			0.25			19.20			4.59			0.18		
Compounds Exceeding SMS Criteria	**SQS**	**CSL**																								
Metals (mg/kg dw)																										
Mercury	0.41	0.59																								
LPAH (mg/kg TOC)																										
Acenaphthene	16	57																								
Chlorinated Aromatics (mg/kg TOC)																										
1,2,4-Trichlorobenzene	0.81	1.8																								
Hexachlorobenzene	0.38	2.3																								
Phenols (ug/kg dw)																										
2-Methylphenol	63	63																								
2,4-Dimethylphenol	29	29																								
Pentachlorophenol	360	690																								

B - The analyte was found in the associated method blank at a level that is significant relative to the sample result.
D - The reported result is from a dilution.
U - The compound was analyzed for, but was not detected ("non-detect") at or above the MDL.
J - The result is an estimated concentration that is less than the MRL but greater than or eqaul to the MDL.
i - the MRL/MDL is elevated due to matrix or chromatographic interference.
K – Identifies a target that could not be confirmed by virtue of not satisfying all method required criteria, the reported value may be interpreted as an estimated maximum concentration.

Table 3
2007 Sediment Sampling by Port Results

Chemical Name	CAS No	Method	Outfall Sample ID/in Sample Interval (ft) Sample Date Unit	Outfall A POC-S1 (0-2) (0.0-0.2) 8/27/2007		Outfall B POC-S2 (0-4) (0.0-0.3) 8/28/2007		Outfall C POC-S3 (0-3) (0.0-0.3) 8/27/2007		Outfall C POC-S4 (0-3) (0.0-0.3) 8/27/2007		Outfall D POC-S5 (0-4) (0.0-0.3) 8/27/2007		POC-C6 (0-2) (0.0-2.0) 8/27/2007		POC-C6 (4-5.3) (4.0-5.3) 8/27/2007	
PCDD/F																	
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	EPA 1613B	ng/kg	0.1	U	0.099	U	0.3	U	0.65	J	0.15	U	0.5	J	0.31	U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	EPA 1613B	ng/kg	0.96	J	0.15	J	0.6	J	4.6	J	0.41	J	2.6	J	0.22	U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	EPA 1613B	ng/kg	2.3	J	0.34	J	1	J	11		0.75	J	3.6	J	0.23	U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	EPA 1613B	ng/kg	5.9		0.85	J	4.2	J	43		1.6	J	22		0.56	J
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	EPA 1613B	ng/kg	4.5	J	0.6	J	1.9	J	24		1.4	J	8.1		0.28	U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	EPA 1613B	ng/kg	200		17		97		1300		41		640		14	
Tetrachlorodibenzo-p-dioxin	41903-57-5	EPA 1613B	ng/kg	1.1	J	0.35	J	2.3		74		0.15	U	15		0.31	U
Pentachlorodibenzo-p-dioxin	36088-22-9	EPA 1613B	ng/kg	3.8	J	0.65	J	5.2	J	80		1.9	J	26		0.22	U
Hexachlorodibenzo-p-dioxin	34465-46-8	EPA 1613B	ng/kg	46		4.6	J	26		290		11		250		5.3	J
Heptachlorodibenzo-p-dioxin	37871-00-4	EPA 1613B	ng/kg	530		29		190		2300		79		1600		32	
Octachlorodibenzo-p-dioxin	3268-87-9	EPA 1613B	ng/kg	1800		120		700		11000		320		4800		110	
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	EPA 1613B	ng/kg	0.17	J	0.072	U	0.35	J	1.7		0.12	J	1.7		0.21	U
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	EPA 1613B	ng/kg	0.23	J	0.13	U	0.62	J	3.5	J	0.15	U	1.8	J	0.19	J
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	EPA 1613B	ng/kg	0.43	J	0.13	J	1.9	J	15		0.19	J	4	J	0.31	J
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	EPA 1613B	ng/kg	1.1	J	0.21	J	4.2	J	40		0.21	J	14		0.69	J
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	EPA 1613B	ng/kg	0.76	J	0.063	U	1.3	J	0.51	UJ	0.31	J	5.7	J	0.18	U
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	EPA 1613B	ng/kg	0.44	J	0.059	U	1.4	J	15		0.081	U	4.3	J	0.14	U
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	EPA 1613B	ng/kg	1.3	J	0.18	J	2.1	J	6.8		0.44	J	3.7	J	0.25	J
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	EPA 1613B	ng/kg	35		3.2	J	32		360		6.6		180		4.7	J
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	EPA 1613B	ng/kg	3.2	J	0.11	U	2.4	J	30		0.6	J	8.8		0.35	U
Tetrachlorodibenzofuran	30402-14-3	EPA 1613B	ng/kg	1.8		0.072	U	3.5		27		0.59	J	28		0.31	J
Pentachlorodibenzofuran	30402-15-4	EPA 1613B	ng/kg	2.4	J	0.13	J	7.6		74		0.91	J	13		1.2	J
Hexachlorodibenzofuran	55684-94-1	EPA 1613B	ng/kg	29		3.8	J	61		250		8.6		240		7.4	
Heptachlorodibenzofuran	38998-75-3	EPA 1613B	ng/kg	120		10		130		390		23		190		28	
Octachlorodibenzofuran	39001-02-0	EPA 1613B	ng/kg	200		12		97		1600		27		330		18	
Dioxin/furan TCDD toxicity equivalent (ND = 0)	TEQ_DIOXIN.0	EPA 1613B	ng/kg	5.7	JT	0.65	JT	4.4	JT	45	JT	1.5	JT	20	JT	0.47	JT
Dioxin/furan TCDD toxicity equivalent (ND = 1/2 DL)	TEQ_DIOXIN.5	EPA 1613B	ng/kg	5.8	JT	0.71	JT	4.5	JT	45	JT	1.6	JT	20	JT	0.79	JT
Conventionals																	
Total organic carbon	TOC	Plumb1981	percent	1.26		2.18		4.33		4.46		1.96		3.57		0.86	
Total solids	TSO	E160.3	percent	78		72.1		56.8		31.3		84.3		39.4		78.7	
Gravel	GS_GRAVEL	PSEP	percent	73.2		59.9		24.4		18.2		78.2		11.8		8.3	
Very coarse sand	GS_VCS	PSEP	percent	8.7		13.1		12.2		6.3		3.6		5.9		5.8	
Coarse sand	GS_CS	PSEP	percent	6.3		10.8		14.8		6.7		4.1		3.8		8.4	
Medium sand	GS_MS	PSEP	percent	4.9		8.7		21.6		8.8		4.6		4.4		30.1	
Fine sand	GS_FS	PSEP	percent	1.9		2.3		9.8		8.3		2		3.9		26.9	
Very fine sand	GS_VFS	PSEP	percent	1.1		0.5		2.5		7.9		1.2		3.5		8.6	
Fines	GS_FINES	PSEP	percent	3.9		4.8		14.7		43.8		6.3		66.7		11.8	
Coarse silt	GS_CSILT	PSEP	percent	1.5		2.6		4.8		6.4		1.7		1.9		1.7	
Medium silt	GS_MSILT	PSEP	percent	0.4		0.2		1.3		9.9		1.2		6.3		1.5	
Fine silt	GS_FSILT	PSEP	percent	0.4		0.3		1.5		5.9		0.8		8.8		1.5	
Very fine silt	GS_VFSILT	PSEP	percent	0.5		0.3		1.2		3.8		0.6		10.7		2.2	
8-9 Phi clay	GS_CCLAY	PSEP	percent	0.3		0.1		1.1		2.6		0.5		10		1.8	
9-10 Phi clay	GS_MCLAY	PSEP	percent	0.1		0.1		1.2		3.7		0.4		8.6		1.2	
>10 Phi clay	GS_FCLAY	PSEP	percent	0.8		1.1		3.6		11.5		1.1		20.4		2	

Notes:

PCDD/F data validation in process. Preliminary validation of conventionals data.

POC-S1 through POC-S5 collected below Outfalls A, B, C (proximal), C (distal), D, respectively.

Table 3
2007 Sediment Sampling by Port Results

Chemical Name	CAS No	Method	Outfall Sample ID/in Sample Interval (ft) Sample Date Unit	POC-C6 (6-7.8) (6.0-7.8) 8/27/2007		POC-C7 (0-2) (0.0-2.0) 8/28/2007		POC-C7 (4-6) (4.0-6.0) 8/28/2007		POC-C7 (6.5-7.2) (6.5-7.2) 8/28/2007		POC-C8 (0-2) (0.0-2.0) 8/29/2007		POC-C8 (4-6) (4.0-6.0) 8/29/2007		POC-C8 (8-10) (8.0-10.0) 8/29/2007		POC-C8 (11.5-11.7) (11.5-11.7) 8/29/2007	
PCDD/F																			
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	EPA 1613B	ng/kg	0.16	U	0.78	U	0.15	U	0.12	U	0.34	J	3.6	U	0.21	U	0.06	U
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	EPA 1613B	ng/kg	0.29	U	3.6	J	0.53	J	0.2	U	1.3	J	12		0.22	U	0.12	U
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	EPA 1613B	ng/kg	0.29	U	4.4	J	1.4	J	0.19	U	2.4	J	34		0.15	U	0.15	U
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	EPA 1613B	ng/kg	0.35	U	32		12		0.22	U	14		650		0.13	U	0.16	U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	EPA 1613B	ng/kg	0.28	U	9.5		2.7	J	0.18	U	4.6	J	87		0.17	U	0.19	U
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	EPA 1613B	ng/kg	0.27	U	970		310		0.82	J	500		18000		1.6	J	0.99	J
Tetrachlorodibenzo-p-dioxin	41903-57-5	EPA 1613B	ng/kg	0.16	U	5.6		8.3		0.12	U	33		21		0.21	U	0.06	U
Pentachlorodibenzo-p-dioxin	36088-22-9	EPA 1613B	ng/kg	0.29	U	30		7.3		0.2	U	27		170		0.22	U	0.12	U
Hexachlorodibenzo-p-dioxin	34465-46-8	EPA 1613B	ng/kg	0.3	U	360		80		0.19	U	110		3100		0.15	U	0.17	U
Heptachlorodibenzo-p-dioxin	37871-00-4	EPA 1613B	ng/kg	0.48	J	2700		570		2.1	J	1100		32000		2.5	J	2.2	J
Octachlorodibenzo-p-dioxin	3268-87-9	EPA 1613B	ng/kg	2.7	J	6300		1900		3.4	J	7700		130000		5.1	J	4.1	J
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	EPA 1613B	ng/kg	0.23	J	2.1		0.48	J	0.12	U	1.1		18		0.3	J	0.22	J
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	EPA 1613B	ng/kg	0.23	U	0.69	UJ	7.8		0.34	J	1.3	J	29		0.18	U	0.13	U
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	EPA 1613B	ng/kg	0.25	U	4.4	J	0.15	UJ	0.17	U	4.7	J	290		0.09	U	0.12	U
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	EPA 1613B	ng/kg	0.099	U	24		0.18	UJ	0.11	U	13		1300		0.18	J	0.15	J
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	EPA 1613B	ng/kg	0.12	U	0.56	UJ	2.6	J	0.1	U	1.6	J	410		0.11	U	0.081	U
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	EPA 1613B	ng/kg	0.15	U	5		2.4	J	0.1	U	3.5	J	200		0.1	U	0.078	U
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	EPA 1613B	ng/kg	0.088	U	4.4	J	1.8	J	0.096	U	2.5	J	150		0.098	U	0.062	U
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	EPA 1613B	ng/kg	0.16	J	270		130		0.18	J	110		8600		0.27	U	0.085	U
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	EPA 1613B	ng/kg	0.11	U	12		7.6		0.092	U	7.6		560		0.38	U	0.08	U
Tetrachlorodibenzofuran	30402-14-3	EPA 1613B	ng/kg	0.23	J	29		11		0.12	U	12		130		0.3	J	0.22	J
Pentachlorodibenzofuran	30402-15-4	EPA 1613B	ng/kg	0.24	U	77		9.5		0.34	J	21		1300		0.13	U	0.12	U
Hexachlorodibenzofuran	55684-94-1	EPA 1613B	ng/kg	0.11	U	290		140		0.18	J	85		12000		0.18	J	0.31	J
Heptachlorodibenzofuran	38998-75-3	EPA 1613B	ng/kg	0.16	J	850		590		0.6	J	390		33000		0.97	J	1	J
Octachlorodibenzofuran	39001-02-0	EPA 1613B	ng/kg	0.26	U	580		500		0.15	U	280		19000		1.2	J	1.1	J
Dioxin/furan TCDD toxicity equivalent (ND = 0)	TEQ_DIOXIN.0	EPA 1613B	ng/kg	0.025	JT	28	JT	8.3	JT	0.021	JT	16	JT	700		0.066	JT	0.048	JT
Dioxin/furan TCDD toxicity equivalent (ND = 1/2 DL)	TEQ_DIOXIN.5	EPA 1613B	ng/kg	0.36	JT	28	JT	8.4	JT	0.26	JT	16	JT	700		0.34	JT	0.2	JT
Conventionals																			
Total organic carbon	TOC	Plumb1981	percent	0.213		5.7		3.9		0.513		7.09		3.98		2.05		0.433	
Total solids	TSO	E160.3	percent	84		41.2		56.6		73.6		35.8		40.6		68.1		82.3	
Gravel	GS_GRAVEL	PSEP	percent	0.6		11.4		23.4		1.9		47.9		31		6		3.5	
Very coarse sand	GS_VCS	PSEP	percent	1.7		5		7.2		2.8		9.9		7		3.7		10	
Coarse sand	GS_CS	PSEP	percent	15.8		6.5		5.5		4.3		5.4		3.4		4.1		32	
Medium sand	GS_MS	PSEP	percent	57.1		10.9		12.5		12.2		5.6		3.4		12.6		32	
Fine sand	GS_FS	PSEP	percent	22.6		7.6		10.6		16.7		5.6		2.8		18.4		10.4	
Very fine sand	GS_VFS	PSEP	percent	1.2		4.5		7.5		21		4.2		3		21		4.4	
Fines	GS_FINES	PSEP	percent	1		53.9		33.2		41.1		21.4		49.4		34.3		7.8	
Coarse silt	GS_CSILT	PSEP	percent			4.6		1.8		12.6		1		5.5		10.3		2.8	
Medium silt	GS_MSILT	PSEP	percent			5.5		4.2		7.1		3.3		6.7		6.2		1.2	
Fine silt	GS_FSILT	PSEP	percent			7.4		5.3		5.5		4.2		6.1		4.2		0.9	
Very fine silt	GS_VFSILT	PSEP	percent			8.1		5.5		4.3		3.3		6.6		4.9		1.2	
8-9 Phi clay	GS_CCLAY	PSEP	percent			8.1		4.9		3.2		2.6		6.3		1.5		0.8	
9-10 Phi clay	GS_MCLAY	PSEP	percent			7.3		4.5		2.4		2.5		6.5		2.1		0.4	
>10 Phi clay	GS_FCLAY	PSEP	percent			12.9		7.1		5.9		4.4		11.8		5.2		0.4	

Notes:

PCDD/F data validation in process. Preliminary validation of conventionals data.

POC-S1 through POC-S5 collected below Outfalls A, B, C (proximal), C (distal), D, respectively.

Table 3
2007 Sediment Sampling by Port Results

Chemical Name	CAS No	Method	Outfall Sample ID/in Sample Interval (ft) Sample Date Unit	POC-C9 (0-2) (0.0-2.0) 8/29/2007		POC-C9 (4-6) (4.0-6.0) 8/29/2007		POC-C9 (8-10) (8.0-10.0) 8/29/2007		POC-C10 (0-2) (0.0-2.0) 8/26/2007		POC-C11 (0-2) (0.0-2.0) 8/26/2007		POC-C12 (0-2) (0.0-2.0) 8/26/2007		POC-C13 (0-2) (0.0-2.0) 8/26/2007		POC-C13 (4-5.2) (4.0-5.2) 8/26/2007	
PCDD/F																			
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	EPA 1613B	ng/kg	0.45	J	0.097	U	0.23	U	0.28	U	0.19	U	0.77	J	0.58	J	1.3	
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	EPA 1613B	ng/kg	1.4	J	0.16	U	0.27	U	2.2	J	0.22	U	3.9	J	3.4	J	7.6	
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	EPA 1613B	ng/kg	3.3	J	0.045	U	0.28	U	4.2		0.18	U	8.2		7.9		15	
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	EPA 1613B	ng/kg	23		0.063	U	0.28	U	24.0		2.5	J	40		31		75	
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	EPA 1613B	ng/kg	7.6		0.07	U	0.26	U	10.0		0.97	J	15		14		26	
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	EPA 1613B	ng/kg	550		0.85	J	0.64	J	530.0		63		840		700		1800	
Tetrachlorodibenzo-p-dioxin	41903-57-5	EPA 1613B	ng/kg	8.8		0.21	U	0.23	U	16		0.34		37		27		38	
Pentachlorodibenzo-p-dioxin	36088-22-9	EPA 1613B	ng/kg	16		1	U	0.27	U	31		0.63		55		43		95	
Hexachlorodibenzo-p-dioxin	34465-46-8	EPA 1613B	ng/kg	130		0.08	U	0.27	U	230		15		360		320		620	
Heptachlorodibenzo-p-dioxin	37871-00-4	EPA 1613B	ng/kg	1100		0.85	J	1.3	J	1500		130		2300		2100		3800	
Octachlorodibenzo-p-dioxin	3268-87-9	EPA 1613B	ng/kg	4800		6.5	J	0.26	U	4500		1200		7500		6600		13000	
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	EPA 1613B	ng/kg	1.3		0.22	J	0.2	J	1.9		7.7		3.3		2.5		5.2	
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	EPA 1613B	ng/kg	2.2	J	0.13	J	0.15	U	2.5	J	0.45	BJ	4.9	J	2.3	J	5.5	J
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	EPA 1613B	ng/kg	9.5		0.092	U	0.13	U	4	J	0.81	BJ	6.9		6.4		17	
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	EPA 1613B	ng/kg	25		0.088	J	0.14	U	9.7		0.15	U	16		14		50	
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	EPA 1613B	ng/kg	0.38	UJ	0.045	U	0.18	U	5.2		0.21	U	7.4		5.6	J	16	
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	EPA 1613B	ng/kg	5.7		0.047	U	0.15	U	6.5		0.24	U	3.7	J	3.6	J	12	
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	EPA 1613B	ng/kg	3.5	J	0.049	U	0.14	U	2		0.17	U	11		6.6		13	
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	EPA 1613B	ng/kg	170		0.33	J	0.32	U	140		6.5		220		200		550	
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	EPA 1613B	ng/kg	12		0.11	U	0.51	U	6.3		0.43	U	11		9.7		29	
Tetrachlorodibenzofuran	30402-14-3	EPA 1613B	ng/kg	14		0.22	J	0.2	J	26		22		40		28		46	
Pentachlorodibenzofuran	30402-15-4	EPA 1613B	ng/kg	37		0.13	J	0.14	U	51		5.1		86		44		97	
Hexachlorodibenzofuran	55684-94-1	EPA 1613B	ng/kg	130		0.77	J	0.15	U	210		5.6		340		160		850	
Heptachlorodibenzofuran	38998-75-3	EPA 1613B	ng/kg	630		1.2	J	0.41	U	380		6.5		660		210		580	
Octachlorodibenzofuran	39001-02-0	EPA 1613B	ng/kg	500		1	J	0.56	J	240		33		7500		480		1300	
Dioxin/furan TCDD toxicity equivalent (ND = 0)	TEQ_DIOXIN.0	EPA 1613B	ng/kg	21	JT	0.049	JT	0.027	JT	18	JT	2.5	JT	30	JT	26	JT	63	JT
Dioxin/furan TCDD toxicity equivalent (ND = 1/2 DL)	TEQ_DIOXIN.5	EPA 1613B	ng/kg	21	JT	0.21	JT	0.37	JT	18	JT	2.5	JT	30	JT	26	JT	63	JT
Conventionals																			
Total organic carbon	TOC	Plumb1981	percent	4.19		1.33		0.665								2.64		2.04	
Total solids	TSO	E160.3	percent	50.9		75.5		72.6								29.4		41.5	
Gravel	GS_GRAVEL	PSEP	percent	20.4		6.7		15.5								0.2		0.2	
Very coarse sand	GS_VCS	PSEP	percent	7.9		5.5		7.5								3.6		2	
Coarse sand	GS_CS	PSEP	percent	9.6		8.6		5.7								2.9		1.5	
Medium sand	GS_MS	PSEP	percent	16.9		27.2		7.9								2.6		1.3	
Fine sand	GS_FS	PSEP	percent	13.7		22.5		17.9								2.3		1.7	
Very fine sand	GS_VFS	PSEP	percent	6.9		10.6		19.6								3		4.1	
Fines	GS_FINES	PSEP	percent	24.5		18.8		25.9								85.5		89.2	
Coarse silt	GS_CSILT	PSEP	percent	1.2		3.4		6								2.4		6.4	
Medium silt	GS_MSILT	PSEP	percent	2.9		2.6		3.2								15.2		11	
Fine silt	GS_FSILT	PSEP	percent	3.8		2.4		2.9								14.7		13	
Very fine silt	GS_VFSILT	PSEP	percent	3.7		3.3		4.1								13.1		13.6	
8-9 Phi clay	GS_CCLAY	PSEP	percent	3.9		2.1		3.1								11.4		12.6	
9-10 Phi clay	GS_MCLAY	PSEP	percent	3.6		1.5		2.2								9.3		10.1	
>10 Phi clay	GS_FCLAY	PSEP	percent	5.5		3.5		4.6								19.5		22.4	

Notes:

PCDD/F data validation in process. Preliminary validation of conventionals data.

POC-S1 through POC-S5 collected below Outfalls A, B, C (proximal), C (distal), D, respectively.

Table 4
2008 Berth Area and Under-Pier Results

	PO-BA-24		PO-BA-25		PO-BA-26		PO-BA-27		PO-UP-20		PO-UP-21		PO-UP-22		PO-UP-23	
Sample ID	**A**	**Z**	**A**	**Z**	**A**	**Z**	**A**	**Z**	**A**	**B**	**A**	**B**	**A**	**B**	**A**	**B**
Sample Date	**9/25/08**	**9/26/08**	**9/25/08**	**9/26/08**	**9/25/08**	**9/26/08**	**9/25/08**	**9/26/08**	**9/26/08**	**9/26/08**	**9/26/08**	**9/26/08**	**9/26/08**	**9/26/08**	**9/26/08**	**9/26/08**
Sample Interval (ft)	**0 - 10 cm**	**48 - 60 in**	**0 - 10 cm**	**36 - 45 in**	**0 - 10 cm**	**48 - 60 in**	**0 - 10 cm**	**40 - 50 in**	**0 - 2 ft**	**2 - 4 ft**	**0 - 2 ft**	**2 - 4 ft**	**0 - 2 ft**	**2 - 4 ft**	**0 - 2 ft**	**2 - 4 ft**
Conventional Parameters (pct)																
Total organic carbon	3.7	3.6	3.9	3.4	4.2	3.8	4.4	3.6	8.6	9.5	4.3	4.8	6.3	2.6	5.3	7.1
Conventional Parameters (pct)																
Total solids	23	40	21	40	20	37	21	41	30	37	32	32	40	44	47	38
Grain Size (pct)																
Cobbles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gravel	0.9	0.5	5.7	2.5	0	2.1	0.9	1.9	40	38	23	35	34	32	41	37
Sand	8.4	9	19	14	30	13	18	8.8	18	30	19	14	24	23	36	18
Silt	2.1	4.5	2.5	4.6	2.6	4.3	2.6	4.4	3.6	3	2.7	4.4	1.9	2.2	1.9	3.6
Clay	88.6	86	72.5	79.1	67.1	80.3	79	84.9	37.6	29.4	55.9	46.8	40.1	43.3	21.7	41.7
Fines (Silt + Clay)	90.7	90.5	75	83.7	69.7	84.6	81.6	89.3	41.2	32.4	58.6	51.2	42	45.5	23.6	45.3
Dioxin Furans (ng/kg)																
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	0.711 J	1.44	0.724	1.95	0.921	1.56	0.714 J	1.5	1.03	1.14	0.842	0.985 J	0.518	0.617	1.19	4.77
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	3.21	6.38	3.68	7.82	3.31	6.84	3.16	6.36	6.37	5.94	4.87	5.28	3	3.49	5.48	21.6
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	5.53	9.96	6.27	11.1	5.53	11.5	5.86	10.9	11.9	10.6	9.73	10.1	7.66	6.39	9.22	31.9
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	25.9	67.5	27.5	85.7	25.3	74.7	27.9	73.7	46.7	61.7	34.6	47.9	34.3	33.5	64.1	240
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	11.9	23.6	12.3	26.8	12.1	26.3	11.7	24.7	23.4	22.9	19.8	19.5	12.8	13.1	20.8	74.5
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	586	1520	667	1990	578	1790	609	1770	1170	2020	999	1530	1840	920	1680	6350 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	4600	10900 J	5070	14400 J	4490	13400 J	4490	16600 J	9610	17100 J	8410	14500 J	20700 J	7610	12500 J	46100 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	2.54	4.6	2.6	4.47	2.45	4.74	2.62	5.09	3.46	4.7	2.59	3.42	1.94	2.44	4.21	14.5
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	2.72	5.08	2.52	6.59	2.59	5.71	2.5	5.94	3.91	5.01	3	3.89	2.45 J	2.77	6.68	44.9
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	4.11	10.8	4.22	15.3	4.23	12	4.58	13.1	6.84	9.92	5.18	7.62	4.59	5.31	18.7	91.2
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	10.7	27.8	11.1	44.2	11.1	30.7	11.4	38.4	16.5	21.8	13.9	20.1	11.2	14.3	51.6	291
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	5.09	10.8	5.2	14.8	4.97	11.7	5.28	12.9	7.66	9.12	6.81	7.73	4.61	5.81	14.3	76.6
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	2.38 J	5.92	2.42 J	8.95	2.44 J	6.75	2.65	7.97	3.5	4.55	2.8	3.94	2.47	2.97	10.6	83.7
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	8	17.7	8.79	23.9	8.17	19	8.59	20.8	10.7	13.1	10.2	12.8	7.98	8.73	20.1	104
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	172	434	184	595	173	441	194	485	240	338	267	287	182	202	477	2360
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	6.42	14.8	7.62	22.8	6.56	15.8	6.55	19	9.79	11.4	11.5	10.9	8.96	7.72	20.2	143
1,2,3,4,5,6,7,8-Octachlorodibenzofuran (OCDF)	323	648	403	998	375	673	345	844	555	637	814	564	556	372	857	4950
Total Tetrachlorodibenzo-p-dioxin (TCDD)	32.3 J	48.8 J	30.8 J	38.8 J	31.8	49.9 J	30.5 J	51 J	34 J	44.5 J	27.9 J	34.2 J	21.4 J	23.2 J	37.8 J	95.2 J
Total Pentachlorodibenzo-p-dioxin (PeCDD)	55.7 J	94.1	55.6	97.9	55.3	95.4	58.9	98.5 J	66.1	75.2 J	56.8 J	71.4 J	46.7	49.3	68.9	218
Total Hexachlorodibenzo-p-dioxin (HxCDD)	232	499	249	696	235	578	261 J	537	402	585	310	541	634	325	461	1510
Total Heptachlorodibenzo-p-dioxin (HpCDD)	1440	3510	1670	4900	1350	4580	1400	3860	3460	6870	2680	6370	11100	2950	3920	13100
Total Tetrachlorodibenzofuran (TCDF)	33.1 J	64 J	31.9	78.9	33.7 J	62.6	37.9	67.7	53.5	72.9	37.9	49.6 J	28.8 J	34.5 J	58.6	216
Total Pentachlorodibenzofuran (PeCDF)	50.6 J	118	57.5 J	166 J	52.9 J	124 J	58.7 J	126 J	81.3 J	111 J	63.2 J	85.8	50.1 J	61.6 J	149 J	702 J
Total Hexachlorodibenzofuran (HxCDF)	219	554	238	777	220	596 J	237	644	329	425	294	375	227	271 J	720	4820
Total Heptachlorodibenzofuran (HpCDF)	436	1090	474	1660	471	1130	497	1350	652	948	778	796	626	555	1370	8930
Total Dioxin/Furan TEQ	**21.6**	**51.1**	**23.6**	**67.2**	**21.8**	**57.4**	**22.5**	**59.3**	**39.2**	**54.1**	**32.9**	**44.0**	**40.0**	**28.2**	**57.8**	**250.5**

Notes:
J = Estimated value

Table 5
Sediment Management Standards Criteria

Chemical	Unit	SQS	CSL
Metals in mg/kg dry weight			
Arsenic	mg/kg	57	93
Cadmium	mg/kg	5.1	6.7
Chromium	mg/kg	260	270
Copper	mg/kg	390	390
Lead	mg/kg	450	530
Mercury	mg/kg	0.41	0.59
Silver	mg/kg	6.1	6.1
Zinc	mg/kg	410	960
Organics in µg/kg dry weight (except as noted)			
Total LPAH	µg/kg	370 mg/kg OC	780 mg/kg OC
Naphthalene	µg/kg	99 mg/kg OC	170 mg/kg OC
Acenaphthylene	µg/kg	66 mg/kg OC	66 mg/kg OC
Acenaphthene	µg/kg	16 mg/kg OC	57 mg/kg OC
Fluorene	µg/kg	23 mg/kg OC	79 mg/kg OC
Phenanthrene	µg/kg	100 mg/kg OC	480 mg/kg OC
Anthracene	µg/kg	220 mg/kg OC	1,200 mg/kg OC
2-Methylnaphthalene[a]	µg/kg	38 mg/kg OC	64 mg/kg OC
Total HPAHs	µg/kg	960 mg/kg OC	5,300 mg/kg OC
Fluoranthene	µg/kg	160 mg/kg OC	1200 mg/kg OC
Pyrene	µg/kg	1,000 mg/kg OC	1,400 mg/kg OC
Benzo(a)anthracene	µg/kg	110 mg/kg OC	270 mg/kg OC
Chrysene	µg/kg	110 mg/kg OC	460 mg/kg OC
Total benzo(b+k)fluoranthenes	µg/kg	230 mg/kg OC	450 mg/kg OC
Benzo(a)pyrene	µg/kg	99 mg/kg OC	210 mg/kg OC
Indeno(1,2,3-cd)pyrene	µg/kg	34 mg/kg OC	88 mg/kg OC
Dibenz(a,h)anthracene	µg/kg	12 mg/kg OC	33 mg/kg OC
Benzo(g,h,i)perylene	µg/kg	31 mg/kg OC	78 mg/kg OC
Chlorinated Hydrocarbons			
1,4-Dichlorobenzene	µg/kg	3.1 mg/kg OC	9 mg/kg OC
1,2-Dichlorobenzene	µg/kg	2.3 mg/kg OC	2.3 mg/kg OC
1,2,4-Trichlorobenzene	µg/kg	0.81 mg/kg OC	1.8 mg/kg OC
Hexachlorobenzene	µg/kg	0.38 mg/kg OC	2.3 mg/kg OC
Phthalates			
Dimethyl phthalate	µg/kg	53 mg/kg OC	53 mg/kg OC
Diethyl phthalate	µg/kg	61 mg/kg OC	110 mg/kg OC
Di-n-butyl phthalate	µg/kg	220 mg/kg OC	1,700 mg/kg OC
Butyl benzyl phthalate	µg/kg	4.9 mg/kg OC	64 mg/kg OC
Bis(2-ethylhexyl) phthalate	µg/kg	47 mg/kg OC	78 mg/kg OC
Di-n-octyl phthalate	µg/kg	58 mg/kg OC	4,500 mg/kg OC
Phenols			
Phenol	µg/kg	420	1,200
2-Methylphenol	µg/kg	63	63
4-Methylphenol	µg/kg	670	670
2,4-Dimethylphenol	µg/kg	29	29
Pentachlorophenol	µg/kg	360	690
Miscellaneous Extractables			
Benzyl Alcohol	µg/kg	57	73
Benzoic Acid	µg/kg	650	650
Dibenzofuran	µg/kg	15 mg/kg OC	58 mg/kg OC
Hexachloroethane	µg/kg	--	--
Hexachlorobutadiene	µg/kg	3.9 mg/kg OC	6.2 mg/kg OC
N-Nitrosodiphenylamine	µg/kg	11 mg/kg OC	11 mg/kg OC
PCBs			
Total Aroclor PCBs	mg/kg-OC	12	65

Notes:

SQS = Sediment Quality Standards

CSL = Cleanup Screening Levels

a = 2-Methylnapthalene is not included in the sum of LPAHs

APPENDIX A

OLYMPIA HARBOR NAVIGATION PROJECT PAH RESULTS

Table 5a. Olympia Harbor Navigation Project Phase 1 Sediment non-Dioxin Chemistry Results

DMMU Location Number			4a (0-4 ft)			4b (4-13 ft)			9a + 10a (0-4 ft)			9b (2-3 ft)			10b (2-3 ft)				
Station Number			S4			S24			C3			Z9			Z10				
Lab Number	DMMP	DMMP																	
Collection Date	SL	ML	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ	03/08/2006	LV	VQ	03/08/2006	LQ	VQ	Mean	%RSD
Conventionals																			
Total Organic Carbon (% DW)	–	–	2.67			0.35			3.09			2.4			1.7			2.0	52.5%
Total Sulfides (mg/kg DW)	–	–	575			16.9			650			172			45.1			291.8	102.7%
Ammonia (mg-N/kg DW)	–	–	195			19.2			90			147			113			112.8	58.1%
TVS (%)	–	–	7.75			1.5			9.76			7.48			5.49			6.4	48.9%
Total Solids (%)	–	–	46.9			84.5			37.1			45.3			51.9			53.1	34.5%
Grain Size																			
Percent Gravel (>2.0 mm)	–	–	4.26			51			0			0.38			2.04			11.5	191.8%
Percent Sand (<2.0 mm - 0.06 mm)	–	–	31.63			43.97			10.9			11.31			30.61			25.7	55.7%
Percent Silt (0.06 mm - 0.004 mm)	–	–	36.33			4.98			50.4			57.1			44.17			38.6	52.6%
Percent Fines (<0.06 mm)	–	–	66.18			8.13			89.95			90.72			65.98			64.2	52.4%
Percent Clay (<0.004 mm)	–	–	29.85			3.15			39.55			33.62			21.81			25.6	55.1%
LPAH in ug/kg DW																			
Naphthalene	2100	2400	91			35			16			37			23			40.4	73.2%
Acenaphthylene	560	1300	15			4.5	J		16			11			6.4			10.6	48.1%
Acenaphthene	500	2000	94			39			16			8.4			**3.3**	J		32.1	115.7%
Fluorene	540	3600	93			38			24			16			5.3			35.3	97.6%
Phenanthrene	1500	21000	310			120			320			58			23			166.2	84.4%
Anthracene	960	13000	100			35			36			23			11			41.0	84.2%
2-Methylnaphthalene	670	1900	21			10			4.8	J		11			4.3	J		10.2	65.9%
Total LPAH*	5200	29000	724			281.5			432.8			164.4			76.3			335.8	75.9%
HPAH in ug/kg DW																			
Fluoranthene	1700	30000	540			200			450			62			31			256.6	89.2%
Pyrene	2600	16000	470			170			370			90			42			228.4	80.7%
Benzo(a)anthracene	1300	5100	170			56			73			28			15			68.4	89.5%
Chrysene	1400	21000	260			82			170			36			24			114.4	87.0%
Benzofluoranthenes*	3200	9900	260			70			160			63			22			115.0	83.0%
Benzo(a)pyrene	1600	3600	120			31			63			30			10			50.8	84.8%
Indeno(1,2,3-cd)pyrene	600	4400	64			17			41			21			6.7			29.9	76.0%
Dibenz(a,h)anthracene	230	1900	16			3.2	J		9.2			4.0	J		1.3	J		6.7	88.2%
Benzo(g,h,i)perylene	670	3200	63			17			41			21			9.6			30.3	71.4%
Total HPAH*	12000	69000	1963			646.2			1377.2			355			161.6			900.6	83.5%

Table 5b. TOC Normalized - Olympia Harbor Navigation Project Phase 1 Sediment non-Dioxin Chemistry Results

DMMU Location Number			4a (0-4 ft)			4b (4-13 ft)			9a + 10a (0-4 ft)			9b (2-3 ft)			10b (2-3 ft)		
Station Number	WA SMS	WA SMS	S4			S24			C3			Z9			Z10		
Lab Number	Chem	Max Chm															
Collection Date	Criteria	Criteria	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ	03/08/2006	LQ	VQ
Conventionals																	
Total Organic Carbon (% DW)	–	–	2.67			0.35			3.09			2.67			0.35		
Total Sulfides (mg/kg DW)	–	–	575			16.9			650			575			16.9		
Ammonia (mg-N/kg DW)	–	–	195			19.2			90			195			19.2		
TVS (%)	–	–	7.75			1.5			9.76			7.75			1.5		
Total Solids (%)	–	–	46.9			84.5			37.1			46.9			84.5		
Grain Size																	
Percent Gravel (>2.0 mm)	–	–	4.26			51			0			4.26			51		
Percent Sand (<2.0 mm - 0.06 mm)	–	–	31.63			43.97			10.9			31.63			43.97		
Percent Silt (0.06 mm - 0.004 mm)	–	–	36.33			4.98			50.4			36.33			4.98		
Percent Fines (<0.06 mm)	–	–	66.18			8.13			89.95			66.18			8.13		
Percent Clay (<0.004 mm)	–	–	29.85			3.15			39.55			29.85			3.15		
LPAH in mg/kg TOC																	
Naphthalene	99	170	3.41			10.00			0.52			1.54			1.35		
Acenaphthylene	66	66	0.56	J		1.29			0.52			0.46			0.38		
Acenaphthene	16	57	3.52			11.14			0.52			0.35			0.19	J	
Fluorene	23	79	3.48			10.86			0.78			0.67			0.31		
Phenanthrene	100	480	11.61			34.29			10.36			2.42			1.35		
Anthracene	220	1200	3.75			10.00			1.17			0.96			0.65		
2-Methylnaphthalene	38	64	0.79			2.86	J		0.16			0.46			0.25	J	
Total LPAH*	370	780	27.12			80.43			14.01			6.85			4.49		
HPAH in mg/kg TOC																	
Fluoranthene	160	1200	20.22			57.14			14.56			2.58			1.82		
Pyrene	1000	1400	17.60			48.57			11.97			3.75			2.47		
Benzo(a)anthracene	110	270	6.37			16.00			2.36			1.17			0.88		
Chrysene	110	460	9.74			23.43			5.50			1.50			1.41		
Benzofluoranthenes*	230	450	9.74			20.00			5.18			2.63			1.29		
Benzo(a)pyrene	99	210	4.49			8.86			2.04			1.25			0.59		
Indeno(1,2,3-cd)pyrene	34	88	2.40			4.86			1.33			0.88			0.39		
Dibenz(a,h)anthracene	12	33	0.60	J		0.91			0.30			0.17			0.08	J	
Benzo(g,h,i)perylene	31	78	2.36			4.86			1.33			0.88			0.56		
Total HPAH*	960	5300	73.52			184.63			44.57			14.79			9.51		