Sediment Characterization Study
Budd Inlet, Olympia, WA

Final Data Report

Prepared for

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March 12, 2008

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List of Acronyms

AET	apparent effects threshold
BSAF	biota sediment accumulation factor
CSL	cleanup screening level
cy	cubic yards
DGPS	differential global positioning system
DMMP	Dredged Material Management Program
dw	dry weight
Ecology	Washington State Department of Ecology
HPAH	high molecular polycyclic aromatic hydrocarbon
LOTT	Lacey, Olympia, Tumwater, and Thurston County
MLLW	mean lower low water
MTCA	Model Toxics Control Act
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzodioxin
PCDF	polychlorinated dibenzofuran
PCP	pentachlorophenol
pg	picogram
PSAMP	Puget Sound Ambient Monitoring Program
PSEP	Puget Sound Estuary Program
QA/QC	quality assurance/quality control
RI/FS	remedial investigation/feasibility study
SAIC	Science Applications International Corporation
SMARM	Sediment Management Annual Review Meetings
SMS	Sediment Management Standards
SQS	Sediment Quality Standard
SVOC	semi-volatile organic compound
TEF	toxic equivalent factor
TEQ	toxic equivalent quotient
TOC	total organic carbon
USEPA	U.S. Environmental Protection Agency
WAC	Washington Administrative Code
WHO	World Health Organization
ww	wet weight

1.0 Introduction

This report summarizes the results of an investigation conducted for the Washington State Department of Ecology (Ecology) to determine the nature, extent, and possible sources of dioxins/furans in sediments in Budd Inlet, Olympia, Washington. A recent sediment characterization study of the Olympia Harbor Navigation Channel and Port of Olympia berthing area, located in Budd Inlet, found elevated dioxin/furan contamination in an area scheduled for routine maintenance dredging (DMMP 2006). The elevated concentrations of dioxins/furans have raised concerns regarding the overall extent of dioxin/furan sediment contamination in Budd Inlet and the potential for increased risk to human health and the environment.

The focus of this Budd Inlet Sediment Characterization Study was to determine the nature and extent of dioxin/furan sediment contamination in Budd Inlet, evaluate potential sources, delineate the extent of dioxins/furans (vertically and spatially) in sediments from proposed dredging areas in the navigation channel and berthing area, and measure the uptake of dioxin/furan in ecological receptors by analyzing the tissue of fish and benthic organisms (the specific study objectives are described in Section 2.0). A subset of sediment samples collected for this study were also analyzed for the Sediment Management Standards (SMS) chemicals of concern to provide additional information regarding sediment quality and to evaluate potential source areas in Budd Inlet. The results of these analyses are included in this report.

1.1 Site Description

Budd Inlet is a small embayment located in southern Puget Sound, near the city of Olympia, WA (Figure 1-1). The southern portion of Budd Inlet has historically supported wood product industries, recreational marinas, and boat industries, and is home to the Port of Olympia. A small peninsula extends from the southern point in Budd Inlet, which divides the inlet into the East and West Bays. The Olympia Harbor federal navigation channel and turning basin are maintained in inner West Bay. The northern portion of the inlet (North Inlet) is lined with residential properties. Additional information regarding the site use history of Budd Inlet is provided in Section 2.0.

1.2 Dioxins/Furans

Polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are a group of chlorinated organic compounds identified as human carcinogens. Dioxins and furans may cause cancer, disrupt the endocrine system, and cause reproductive and developmental effects. They are unintentionally produced by natural and industrial activities. Natural activities include forest fires or volcanic activity. Industrial processes include incomplete combustion of materials in the presence of chloride, such as burning of fuels, municipal and domestic waste incineration, as well as chlorine bleaching of pulp and paper, and chlorinated pesticide manufacturing. Dioxin/furan contamination is also present in certain chlorinated organic products (e.g., pentachlorophenol [PCP] – a wood preservative) (Ecology 1998).

1.3 Document Organization

This Data Report summarizes and evaluates the results of the Budd Inlet Sediment Characterization within the context of the study objectives. Section 2.0 of this document describes the background of the project, including the study objectives and site history. Field sampling and analytical methodologies are summarized in Section 3.0. The spatial extent of the sediment contamination (including SMS analytes and dioxins/furans) is presented in Section 4.0 along with the results of the tissue chemistry for dioxins/furans. Also included in Section 4.0 are the results of the sedimentation rates and dating from the radioisotope analysis. The fate and transport of the chemical analytes is the focus of Section 5.0, which includes the evaluation of dioxin/furan sources and the bioavailability of sediment contaminants. Section 6.0 provides a summary of the findings and a list of the data gaps that have been identified. References are provided in Section 7.0.

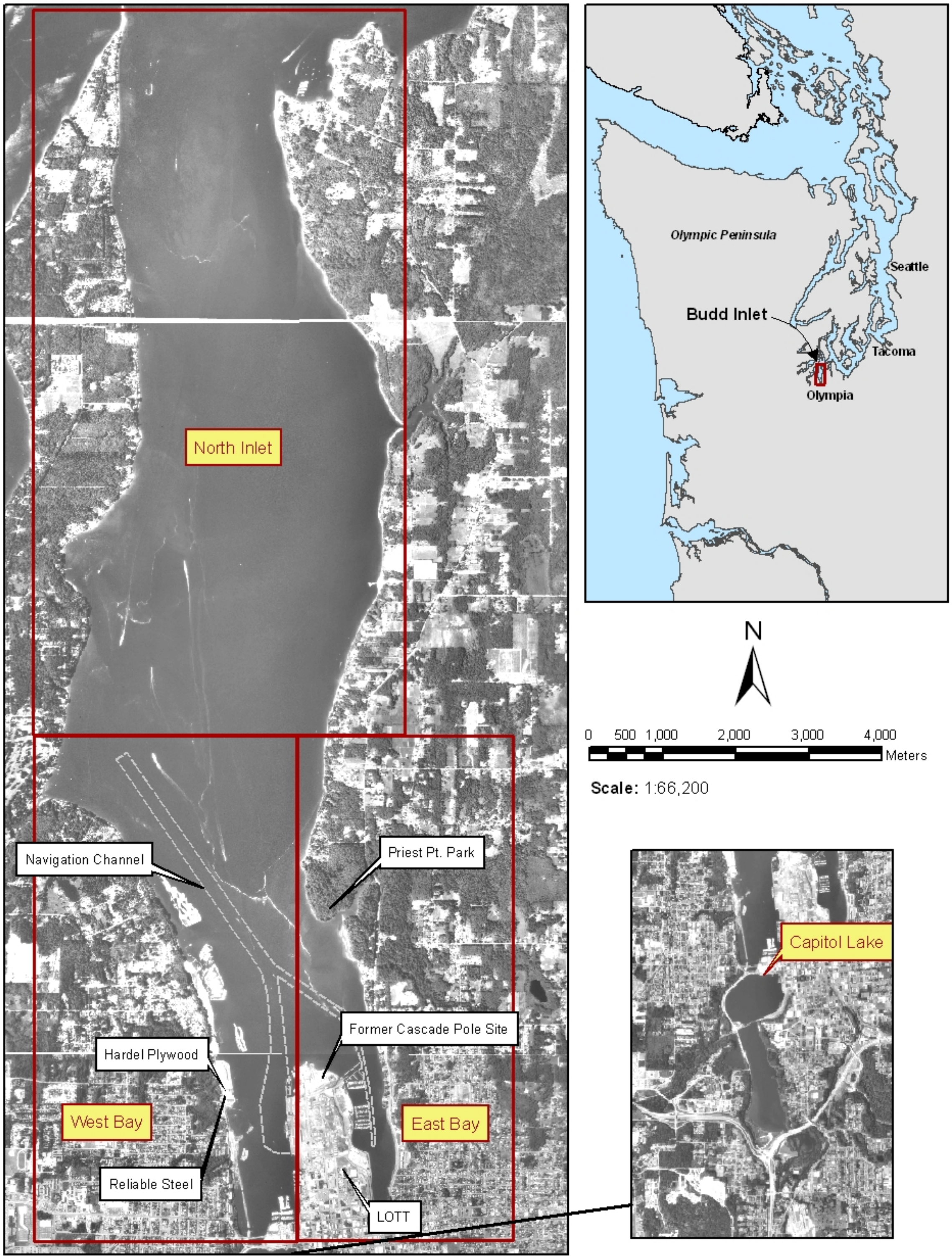

Figure 1-1. Budd Inlet Site Overview

2.0 Project Background

2.1 Study Objectives

The Budd Inlet Sediment Characterization program objectives are summarized below:

- Conduct an intensive sampling and analysis effort in Budd Inlet to characterize the overall extent of dioxin/furan sediment contamination.
- Collect, process, and analyze representative surface sediment grab, subsurface sediment core, and tissue samples to characterize Budd Inlet in accordance with protocols and quality assurance/quality control (QA/QC) requirements outlined by Washington State SMS guidance provided in the Sampling and Analysis Plan Appendix (Ecology 2003), Puget Sound Estuary Program (PSEP) protocols, and subsequent Sediment Management Annual Review Meetings (SMARM) updates.
- Evaluate dioxin/furan concentrations in Budd Inlet sediments relative to human health and ecological health concerns. Analysis will follow U.S. Environmental Protection Agency (USEPA) Method 1613B for 2,3,7,8-substituted chlorinated dioxin/furan congeners.
- Analyze for metals, semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), sediment conventional parameters, and sedimentation rate and biological surface mixed layer in Budd Inlet.
- Delineate the extent of dioxin/furan contamination (vertically and spatially) in sediments from proposed dredging areas in the navigation channel and turning basin, and identify priority areas for remediation based on potential for disturbance due to navigation access to the Port of Olympia.
- Conduct tissue collection and analysis to assess the uptake of dioxin/furan congeners in ecological receptors.
- Measure the sedimentation rate and surface mixed layer in inner Budd Inlet through radioisotope analysis.

2.2 Environmental Setting

Budd Inlet is a narrow-body embayment approximately 1.5 miles (2.5 km) wide by 7 miles (11.5 km) long, situated in southern Puget Sound (Figure 2-1). The inlet is shallow with water depths generally less than 35 feet in the southern inlet and depths from 60 to 90 feet in the northern portion of the inlet (North Inlet). Tides are semi-diurnal, with a range of 14.4 feet (4.4 meters). A small peninsula extends from the southern point in Budd Inlet, which divides the inlet into the East and West Bays. The Olympia Harbor federal navigation channel and the Port of Olympia's turning basin are maintained in the West Bay. The entrance channel is maintained at a depth of –31 feet mean lower low water (MLLW), and the turning basin is maintained at a depth of –42 feet MLLW. The 60-acre marine terminal for the Port of Olympia is located on the west side of the peninsula. The Cascade Pole Model Toxics Control Act (MTCA) cleanup site is located on the northern end of the peninsula.

Budd Inlet has the largest tributary of any of the inlets in southern Puget Sound: the Deschutes River, which flows through Capitol Lake before reaching the West Bay of the inlet (URS 1986). Capitol Lake was created in 1951 to provide a freshwater reflecting pool below the Washington State Capitol campus in Olympia. An earthen dam and 25-meter wide tide gate with concrete spillways was constructed to create the freshwater lake (USGS 2006). Flow of fresh water into West Bay is controlled by gated discharges from Capitol Lake. Moxlie Creek, which originates as an artesian spring in Watershed Park (approximately 1.5 miles south of Budd Inlet), flows into the southern end of East Bay. In 1909, the arm of East Bay that Moxlie Creek flowed into was filled to create more space for downtown Olympia. The Creek was diverted into a mile-long pipe underneath the new city land, which daylights at the southern end of East Bay (Thurston County 2007).

2.2.1 Water Circulation / Quality

Water circulation in Budd Inlet follows a counter-clockwise pattern, with a flushing time of approximately 10 days for the whole inlet (Ebbesmeyer et al. 1998). Cold and dense marine water enters the inlet near the bottom along the western shore, and warmer, less saline water leaves the inlet near the surface along the eastern shore. Net current speeds are relatively low, with historical measurements ranging from 2 to 13 cm/second (URS 1986). The water column in Budd Inlet is generally well mixed in the winter with stratification of the water column most pronounced in the summer months. The central portion of the inlet contains a counterclockwise gyre that recirculates approximately 16 percent of the outgoing water back into the incoming water (Ebbesmeyer et al. 1998).

Low near-bottom dissolved oxygen concentrations have been a persistent problem in the inner bay of Budd Inlet and have been attributed to decay of large phytoplankton blooms in combination with stratification of the water column during summer and early fall. Ammonia, nitrate, and nitrite are the dissolved inorganic nutrients limiting plankton growth in Budd Inlet (Ecology 1997).

2.2.2 Geology / Sediments

The southern portion of Budd Inlet was originally a tidal flat that was filled to create land for the City and Port of Olympia. Moxlie Creek flowed into the arm of East Bay that was filled to create more space for downtown Olympia in the early 1900s (Thurston County 2007). Deep-water loading docks were constructed for the Port of Olympia along the western side of the peninsula. Tide flats along the eastern and southeastern border of the peninsula were filled in the early 1980s and a marina was established in East Bay (Ecology 1989). A geological investigation at the Cascade Pole cleanup site indicated that the fill materials consisted generally of loose, fine-to-coarse interlayered sand, silty sand, and silt (Ecology 1989).

The surface sediments in the southern portion of Budd Inlet are very fine-grained, consisting of silts and clays in most subtidal areas of Budd Inlet. Historically, the major source of sediments to Budd Inlet was the Deschutes River, but following construction of Capitol Lake in 1951, input of sediments to Budd Inlet was significantly reduced, and sediments have proceeded to accumulate in Capitol Lake. As a management plan to maintain Capitol Lake, an estuary restoration plan is under consideration. It would remove the dam retaining Capitol Lake and restore sediment input from the Deschutes River into Budd Inlet (USGS 2006).

2.3 Site History

Home to the Port of Olympia, inner Budd Inlet has historically supported wood product industries, recreational marinas, and boat construction/repair facilities. A detailed environmental site history of Budd Inlet can be found in the *Summary of Existing Information and Identification of Data Gaps for Sediments* report (SAIC 2007a). This report was prepared to summarize the available existing information on relevant environmental investigations and cleanups on properties associated with Budd Inlet. The evaluation covered the East Bay, West Bay, and North Inlet areas (Figure 1-1). In addition, the Cascade Pole site and the Olympia Harbor navigation channel and turning basin were identified as areas of interest based on intensive environmental investigations conducted in these areas (Landau 1993; DMMP 2006). The Cascade Pole cleanup site is described in Section 2.4 Source Control.

2.3.1 East Bay

The primary industry in the East Bay of Budd Inlet is the Swantown Marina and Boatworks located on the eastern side of the peninsula (Figure 2-2). A federal navigation channel is maintained in the East Bay to a depth of –15 feet MLLW. The Cascade Pole cleanup site is located on the north end of the peninsula (see Section 2.4).

The Swantown Marina, in operation since 1983, is owned and operated by the Port of Olympia and maintains slips for approximately 700 vessels. The Swantown Boatworks provides vessel service, haul out, and a vessel storage facility. A stormwater outfall study in 2006 identified zinc, copper, and lead in stormwater runoff and outfall sediments from Swantown Boatworks (Ecology 2006). PCB Aroclors 1260 and 1254, dibenzofuran, benzoic acid, and polycyclic aromatic hydrocarbons (PAHs) were detected in outfall sediments, and dibenzofuran exceeded the Sediment Quality Standard (SQS) criteria.

Water from Moxlie Creek flows through a culvert that discharges into the southern end of East Bay. East Bay was placed on the 1998 303(d) impaired water list for PCBs based on a single composite sample of mussel tissue collected from the culvert at the mouth of Moxlie Creek (Ecology 2003). The sample had a total PCB concentration of 21 µg/kg wet weight (ww), which exceeded the 303(d) listing criterion of 5.3 µg/kg ww. Additional sampling of mussel tissues in 2002 found PCB concentrations ranging from 7.0 to 9.6 µg/kg ww, which confirmed that the 303(d) listing continues to be warranted (Ecology 2003).

2.3.2 West Bay

Industries along the shoreline of West Bay include the Port of Olympia marine terminal, recreational marinas (Fiddlehead and West Bay marinas, Olympia Yacht Club), Hardel Mutual Plywood, and Reliable Steel (Figure 2-3). The Olympia Harbor navigation entrance channel and turning basin are maintained in the West Bay, and the Lacey, Olympia, Tumwater, and Thurston

County (LOTT) outfall and diffuser discharge into Budd Inlet from the northern tip of the peninsula.

The Hardel Mutual Plywood site is 17.8 acres and is located along the western shore of Budd Inlet. Hardel operated as a plywood manufacturing business from 1951 until 1996 and ceased operations after a fire severely damaged buildings on site. Historical site activities resulted in the release of petroleum products to soil and groundwater and surrounding sediments. Hardel is under an agreed order with Ecology to conduct a remedial investigation and feasibility study (RI/FS) at this site to guide the selection of a cleanup remedy (Ecology 2007a).

The Reliable Steel site is about 4.25 acres and is located to the south of Hardel Mutual Plywood along the western shore of Budd Inlet. The site was originally developed as a lumber mill and since 1941 the site has been used for boat building, welding, and steel fabrication. In 1993, arsenic and copper were identified above SQS criteria nearshore sediments. In 2006, total petroleum hydrocarbons and heavy metals were found above MTCA cleanup levels in soil and groundwater on the site. One of the potentially liable parties is under an agreed order with Ecology to conduct an RI/FS at this site to guide the selection of a cleanup remedy (Ecology 2007b).

Sediment characterization studies have been conducted in support of maintenance dredging and minor widening of the Olympia harbor federal navigation channel and the Port of Olympia's berthing area. The entrance channel and turning basin are maintained at a depth of –30 feet MLLW, and the berthing area is maintained at a depth of –40 feet MLLW. In 1988, a sediment characterization of 535,185 cubic yards (cy) of material in the navigation channel was conducted. In 1999, the project was expanded to 624,000 cy with the inclusion of the Port of Olympia's berthing area and underwent another round of sediment characterization testing. In 2006, due to dioxin/furan concerns in the Olympia Harbor/Budd Inlet area, additional sediment testing was conducted to evaluate dioxin/furan concentrations in the proposed project area. Approximately 238,234 cy of material exceeded the interim background-based interpretive guideline maximum level (7.3 pg/g toxic equivalent quotient [TEQ]) and mean concentration level (3.8 pg/g TEQ) for the Anderson/Ketron Island dredged material disposal site (Wakeman and Hoffman 2006).

2.3.3 North Inlet

The North Inlet area extends north of the Olympia Harbor navigation channel entrance to the mouth of Budd Inlet (see Figure 2-4). The east and west shorelines of the North Inlet consist primarily of residential properties. The Puget Sound Ambient Monitoring Program (PSAMP) has monitored one sediment station annually from 2000 to 2005 (near the north end of the navigation channel) as part of a temporal study (PSAMP 2007). The SMS criteria were exceeded for benzoic acid and dibenzofuran in 2000 and 2005 and cadmium in 2005.

2.4 Source Control – Cascade Pole

From 1957 until 1986, the Cascade Pole Company operated a wood-treating facility on property leased from the Port of Olympia (Figure 2-2). Other wood-treating businesses also operated at the site prior to 1957. During numerous investigations of the site, many toxic chemicals related to wood preserving substances (PAHs, PCPs, and dioxins/furans) were found at elevated concentrations in soils, groundwater, surface water, intertidal sediments, and marine organisms adjacent to the site (Ecology 2004). PCP is contaminated with low concentrations of dioxins, and many cleanup sites with confirmed dioxin contamination are former PCP wood-treating facilities (Ecology 1998).

Upland cleanup actions in 1990 included installation of a dense non-aqueous phase liquid recovery trench and a subsurface containment wall along a 350-foot portion of the site shoreline to reduce the potential for liquid creosote to move offshore (Ecology 2004). In early 1992, a groundwater and light non-aqueous phase liquid extraction and treatment system was installed in the upland side to control offsite groundwater flow migration and recover floating product. Later, a slurry wall was installed around the entire site to further contain contaminants on site. In 1998, the Port of Olympia paved 5.8 acres of the site within the containment wall to reduce infiltration of rainwater into the highly contaminated area of the site (Ecology 2004).

In 2001, the Port of Olympia, under an agreed order with Ecology, removed 35,000 cy of intertidal dioxin/furan and PAH contaminated sediment and placed it in an upland containment cell constructed over the hot-spot area of the uplands portion of the site. Post construction monitoring in 2002 measured dioxins/furans in surface sediments ranging from 3.2 to 61.4 pg/g TEQ in the cleanup area and 8.9 to 21.8 pg/g TEQ in areas outside of the cleanup area (Landau 2004).

2.5 Regulatory Framework

The Budd Inlet Sediment Investigation was conducted in accordance with the MTCA cleanup regulations (Washington Administrative Code [WAC] 173-340-350) and followed procedures specified by the Washington State SMS for chemicals of concern. Dioxin/furan congeners do not have numerical criteria under the Washington State SMS for marine or freshwater sediments, but fall under the SMS narrative criteria, which include “other toxic or deleterious substances” (WAC 173-204-320) and are subject to evaluation by Ecology. Managing dioxin/furan contamination in sediments is done on a case-by-case basis, looking at the risk it poses to human or ecological health due to its potential to bioaccumulate.

For data presentation and evaluation purposes, the concentration of dioxin/furan congeners were normalized to the toxicity of 2,3,7,8-TCDD using toxic equivalent factors (TEFs) updated by the World Health Organization (WHO) in 2005 and published in 2006 (Van den Berg et al. 2006). The TEQ is equivalent to the sum of the concentrations of individual congeners multiplied by their TEF (potency relative to 2,3,7,8-TCDD). Non-detected values were assessed as half of the method detection limit for data evaluation purposes.

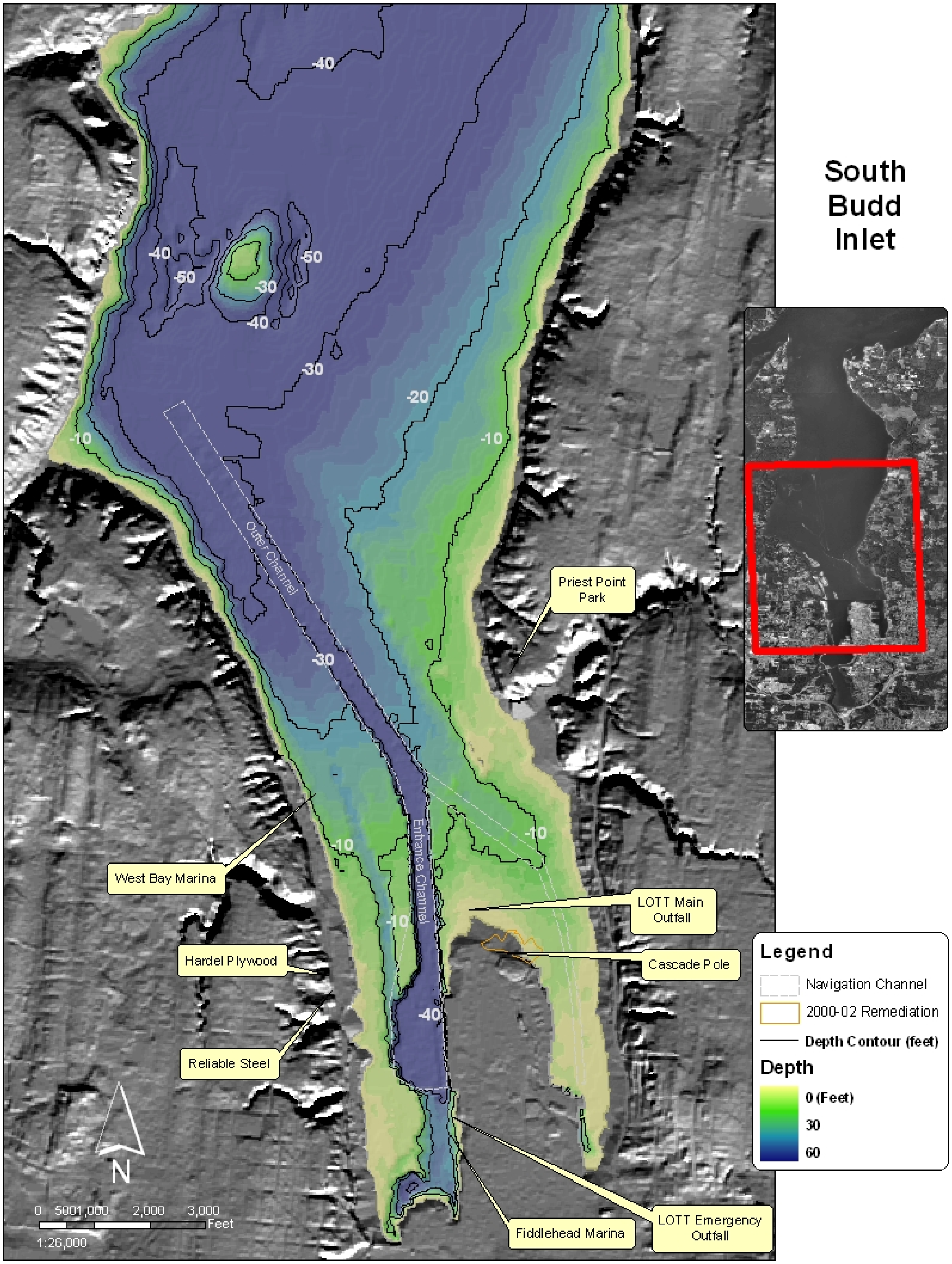

Figure 2-1. Budd Inlet Bathymetry

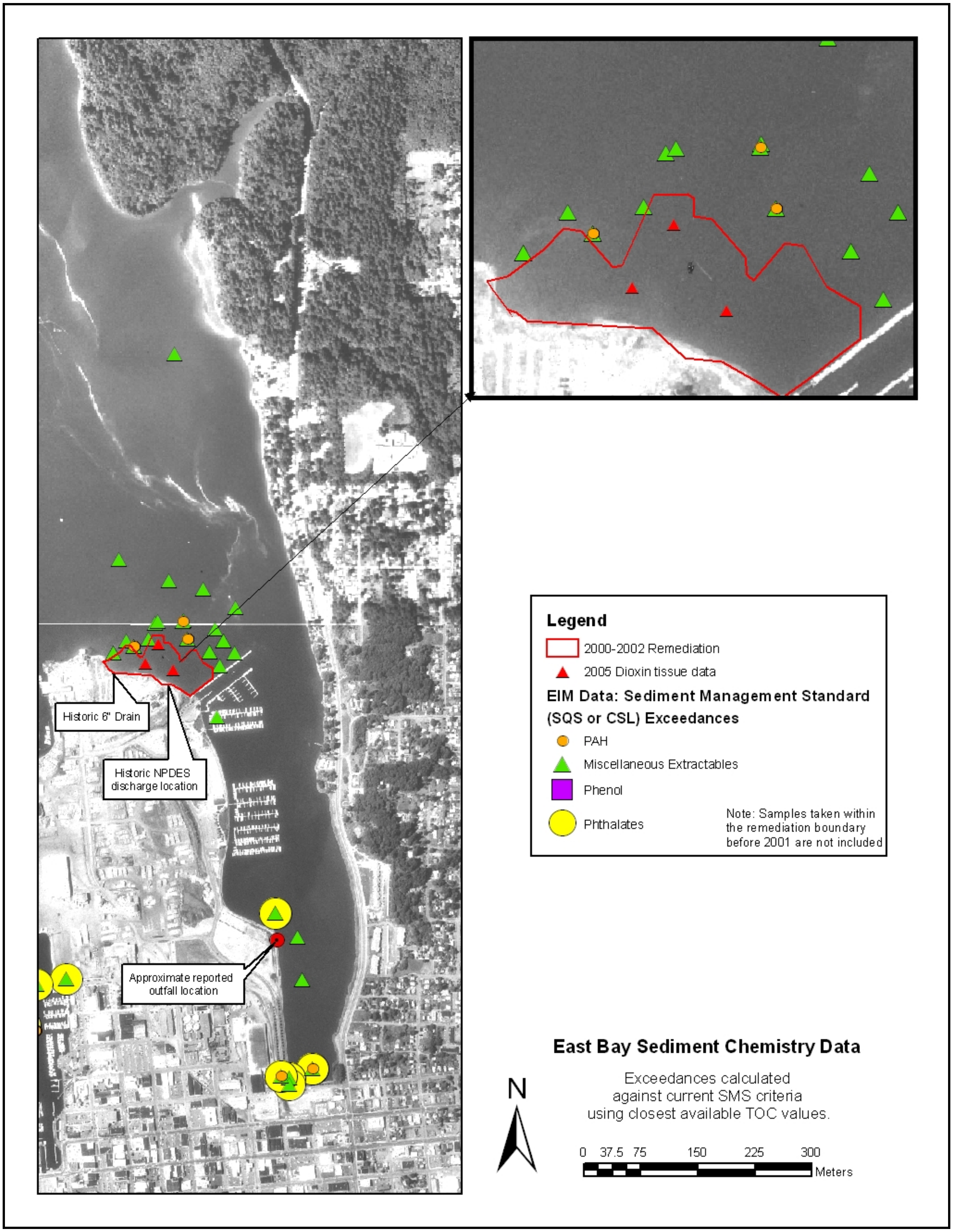

Figure 2-2. Budd Inlet East Bay

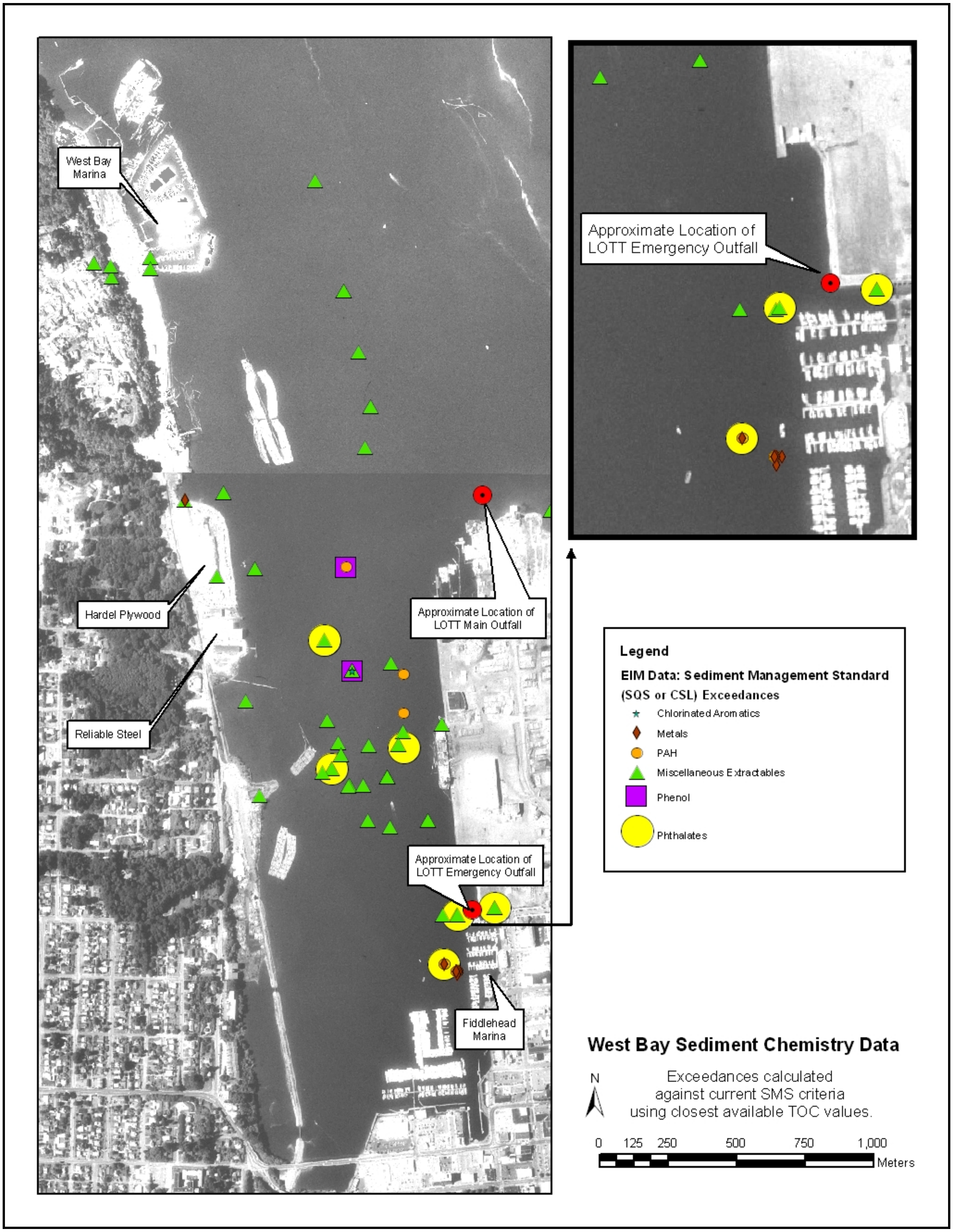

Figure 2-3. Budd Inlet West Bay

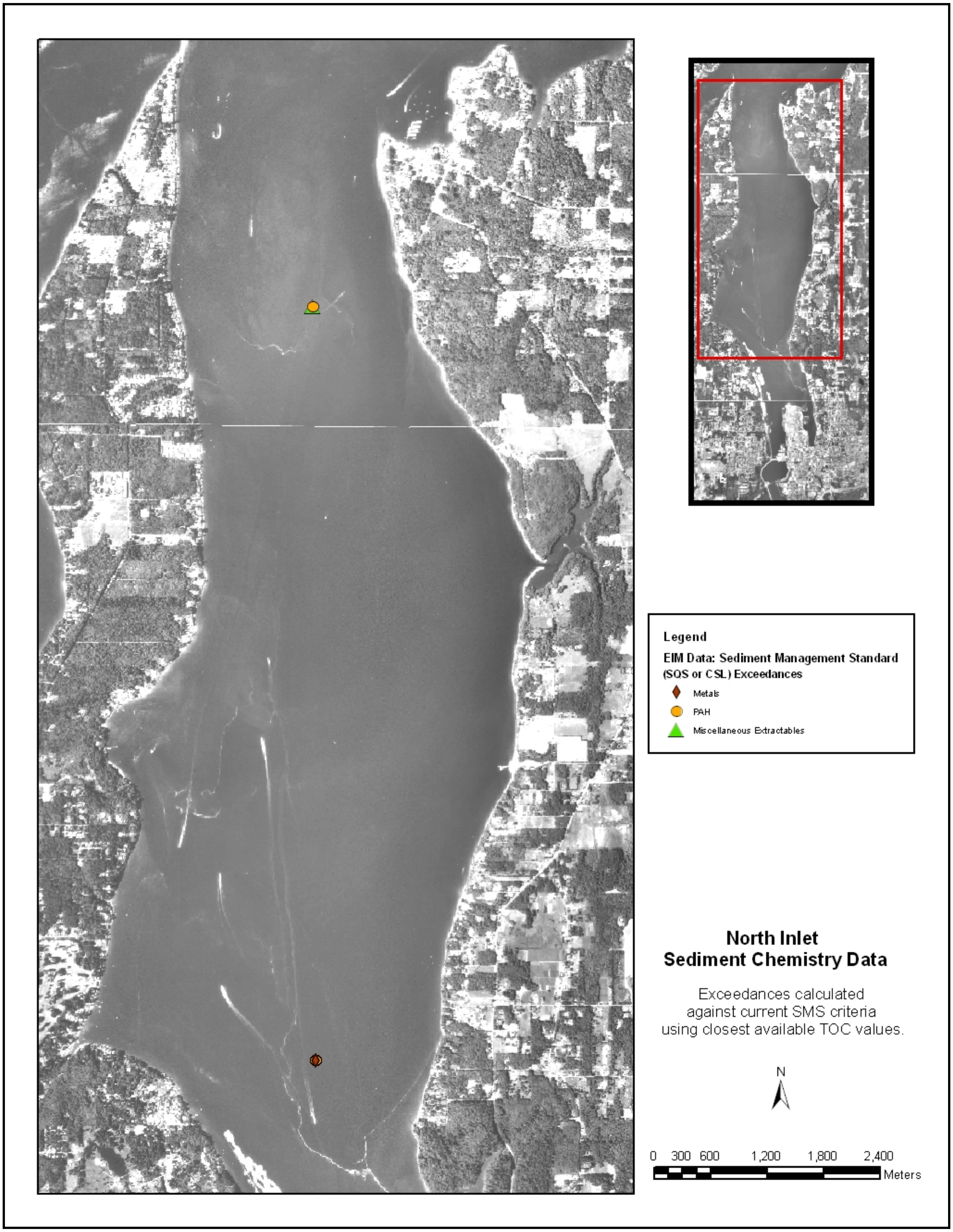

Figure 2-4. North Inlet of Budd Inlet

3.0 Field Sampling Summary – Methods

This section provides a summary of the sampling design and field sampling methods used in support of the Budd Inlet Sediment Characterization Study. The field program included sampling at Capitol Lake to evaluate the quality of the lake surface sediments (Section 3.1.2). Detailed sampling and analysis procedures for this program are documented in the Sampling and Analysis Plan (SAIC 2007b).

3.1 Sample Design

The sample design for dioxin/furan testing in the Budd Inlet project area was guided by the literature review and data gaps identification for Budd Inlet (SAIC 2007a) and was intended to supplement and expand upon existing environmental studies (Section 2.3).

3.1.1 Budd Inlet

Sampling included surface and subsurface sediment sample collection to characterize the vertical and spatial distribution of dioxin/furan contamination, and it included the collection of tissue samples to evaluate the uptake of dioxins/furans in ecological receptors. The first phase of chemical analysis included a total of 64 sediment samples and 15 tissues samples. Following a preliminary data review of the first phase, several archived samples (30 sediment and 28 tissue samples) were analyzed to better delineate the extent of dioxin/furan contamination in the inlet.

Sediment Chemical Characterization

Sediment samples were collected from the surface (0–10 cm) and subsurface (core samples) to delineate the vertical and spatial distribution of dioxins/furans throughout Budd Inlet. Sediment samples were also analyzed for the SMS chemicals of concern in areas of potential sources or where historical contamination was reported. A summary of all samples collected is provided in Table 3-1.

A total of 18 coring locations and 38 surface sediment grab locations were sampled in the Budd Inlet project area (Figures 3-1 and 3-2). Geographic coordinates for all sampling locations are provided in Appendix A. Of the 38 surface sediment samples collected, 31 were analyzed for dioxin/furan congeners and sediment conventional parameters (grain size, total organic carbon, total solids, total volatile solids). Fifteen of these samples were analyzed for the SMS chemical parameters. In addition, four intertidal sediment samples (from three locations) were collected and analyzed. These intertidal sediment samples were co-located with tissue samples.

Sediment cores were collected to a depth of 10 feet and were processed at 1-foot intervals for a maximum of 10 samples per core. Due to access constraints beneath the Port of Olympia pier facilities, three core locations under the pier (C3, C4, and C5) were collected to a depth of 7 feet. Two to six intervals per core were selected for analysis of dioxin/furan congeners after consultation with Ecology. The surface interval (0–1 foot) was archived for all cores, with the exception of cores C3 and C4 (under-pier core locations). Surface grab samples (0–10 cm) were collected at all remaining core sampling locations to maintain a consistent depth interval for all surface sediment chemistry results. However, it should be noted that the surface grab samples were collected on a different date and may not be from the exact locations of the core samples (Appendix A). All samples were collected within 50 feet of the target sampling coordinates.

Forty-three core intervals were analyzed for dioxin/furan congeners and conventionals. Four core intervals were analyzed for the SMS chemical parameters. Of the surface grab samples at the coring locations, 15 were analyzed for dioxin/furan congeners and conventionals and eight were analyzed for the SMS chemical parameters. The analytical chemistry results are presented in Appendix B. All remaining surface and core samples were archived for potential future analysis.

Three cores were collected to determine sedimentation rate and surface mixed layer (Figure 3-1). A total of 31 samples from each of three cores were analyzed. The analysis for each core included five samples for beryllium-7 (Be-7) analysis, 16 samples for lead-210 (Pb-210) analysis, and ten samples for cesium-137 (Cs-137) analysis.

Tissue Chemistry

Ecological receptors (i.e., fish and benthic organisms) targeted for collection and dioxin/furan congener analysis included starry flounder (*Platichthys stellatus*), which was the most abundant flat fish observed in Budd Inlet, English sole (*Parophrys vetula*), littleneck clam (*Protothaca staminea*), manila clam (*Venerupis philippinarum*), bent nose clam (*Macoma nasuta*), and ghost shrimp (*Neotrypaea californiensis*) (Table 3-1). Starry flounder and English sole were collected for tissue analysis using an Otter trawl. Trawling was conducted in three areas of Budd Inlet: the inner part of the inlet (Set 1), the northern end of the navigation channel (Set 2), and the North Inlet (Set 3) (Figures 3-3 and 3-4).

Littleneck, manila, bent nose clams, and ghost shrimp were collected by hand for tissue residue analysis. Littleneck and manila clams were combined for analysis purposes. Triplicate samples were collected at two locations for littleneck/manila clams, three for ghost shrimp, and four for bent nose clams (Table 3-1). Co-located sediment samples were collected at each intertidal tissue sampling location.

3.1.2 Capitol Lake

Surface sediment samples were collected in Capitol Lake to determine the chemical character of sediments that could be transported into Budd Inlet if the estuary restoration plan for Budd Inlet (i.e., dam removal) is implemented (Figure 3-1). A total of six surface grab samples (three in the North Basin, three in the Middle Basin) were collected in areas of expected erosion as identified in Scenario A (dam removal only) of the Deschutes River Estuary Feasibility Study (USGS 2006). Two samples were analyzed for dioxin/furan congeners and conventional parameters, and one sample was analyzed for the SMS chemicals of concern (Table 3-1). The remaining samples were archived for future analyses. Geographic coordinates for the Capitol Lake surface sediment samples are provided in Appendix A.

Table 3-1. Summary of Samples Collected and Analyzed

Parameter	Samples Collected	Samples Analyzed
Budd Inlet		
Core Samples for Analytical Chemistry (18 Cores – 10 Samples per Core, 7 samples for C3, C4, C5)		
Dioxin/Furan Congeners	171	43
Metals	171	4
SVOCs	171	4
PCB Aroclors®	171	4
Conventionals (Total Solids, Total Volatile Solids, Total Organic Carbon, and Grain Size)	171	43
Surface Grab Samples (0–10 cm, 38 Stations + 18 surface grabs at core locations)		
Dioxin/Furan Congeners	56	46
Metals	56	17
SVOCs	56	21
Butyltins	56	4
PCB Aroclors®	56	21
Conventionals (Total Solids, Total Volatile Solids, Total Organic Carbon, and Grain Size)	56	46
Intertidal Beach Samples (0–10 cm, 4 Stations)		
Dioxin/Furan Congeners	4	4
Metals	4	4
SVOCs	4	4
PCB Aroclors®	4	4
Conventionals (Total Solids, Total Volatile Solids, Total Organic Carbon, and Grain Size)	4	4
Sedimentation Core Samples (3 Cores)		
Sedimentation Rate/Mixed Layer Analysis	3	3
Tissue Samples		
Starry Flounder (Dioxin/Furan Congeners, % Lipids, % Moisture)	13	13
English Sole (Dioxin/Furan Congeners, % Lipids, % Moisture)	3	3
Ghost Shrimp (Dioxin/Furan Congeners, % Lipids, % Moisture)	9	9
Littleneck and Manila Clams (Dioxin/Furan Congeners, % Lipids, % Moisture)	19	18
Capitol Lake		
Surface Grab Samples (0–10 cm, 6 Stations)		
Dioxin/Furan Congeners	6	2
Metals	6	1
SVOCs	6	1
PCB Aroclors®	6	1
Conventionals (Total Solids, Total Volatile Solids, Total Organic Carbon, and Grain Size)	6	2

3.2 Navigation and Station Positioning

Vessel navigation and station positioning were accomplished using a differential global positioning system (DGPS) integrated with a computerized navigation system. A U.S. Coast Guard differential correction signal was used to obtain a minimum positional accuracy of ± 3 meters. The R/V *Kittiwake,* owned and operated by Bio-Marine Enterprises, was used for the collection of surface sediment samples and for trawl sampling to collect starry flounder and English sole. The R/V *Nancy Anne*, owned and operated by Marine Sampling Systems, was used for the collection of sediment core samples.

The DGPS antenna was placed above the block on the sampling device deployment boom to accurately record the position of the sampling device. Geographic coordinates for the Budd Inlet sampling sediment and tissue sampling locations are provided in Appendix A. Horizontal coordinates reference the North American Datum of 1983. At sediment grab locations, water depths were measured using the winch meter wheel, verified by the ship's echo sounder, and converted to mudline elevations referencing the MLLW elevation. At coring locations, water depths were measured directly by lead-line and converted to mudline elevations referencing MLLW.

3.3 Decontamination Procedures

The core and grab samplers, compositing pans, and sampling utensils were thoroughly decontaminated prior to use in accordance with PSEP (1997a, 1997b) protocols (i.e., washed with Liquinox™ soap and water, rinsed with fresh water, and rinsed with distilled water). All hand work was conducted with disposable nitrile gloves, which were changed after handling each individual sample, as appropriate, and between sampling locations to prevent cross contamination between samples and composites.

3.4 Sediment Collection Procedures

Sample collection efforts were conducted in April 2007. Sediment core collection was conducted using a vibracore sampler deployed from Marine Sampling System's R/V *Nancy Anne*. Grab sampling was conducted using a 0.2 m^2 stainless steel dual van Veen grab sampler deployed from Bio-Marine Enterprise's R/V *Kittiwake*. In addition, biological sampling for fish tissue was completed using an Otter trawl net deployed from the R/V *Kittiwake* (Section 3.5). The collection of clam and ghost shrimp tissue samples and co-located surface sediment samples was conducted on foot during low tide. Surface grab samples in Capitol Lake were collected using a 0.025 m^2 stainless van Veen grab sampler deployed from a small motorized skiff.

3.4.1 Subsurface Sediment Cores

Subsurface sediment cores were collected using a vibracore sampler deployed from the R/V *Nancy Anne*. The vibracore was equipped with 4-inch diameter pre-cleaned aluminum tubes, and the vibracore quadrupod was mechanically lowered into position on the seafloor, activated, and allowed to penetrate to the target sampling depth (10 feet) or until refusal. An acoustic transducer mounted on the quadrupod was used to measure penetration depth of the core tube. When sampling was completed, the vibracore quadrupod was retrieved and the core tube was removed. A tape measure was used to determine the length of the recovered sediment core in the aluminum tube. Any excess core tube was removed, and both ends of the core were capped and sealed with duct tape. The core was then labeled with station ID, date, time, and orientation of the core. The core was taken to a shore-side area for processing.

The length of the recovered sediment core was divided by the depth of penetration to calculate the decimal percent recovery. This recovery factor was applied uniformly to the entire core to account for sediment compaction. The tube was then cut open lengthwise using a circular saw. A vacuum hose was attached to the circular saw to collect aluminum shavings. Cuts were made on opposite sides of the tube, and then the top of the tube was removed. Decontaminated stainless steel spoons were used to remove any aluminum shavings prior to collection of samples for analysis. Once the core tube was opened, each core section was inspected and described. If the core sample was deemed acceptable, a visual description was recorded on a core log (Appendix C).

Sediment chemistry samples were retained at 1-foot intervals, but only two to six intervals from within each core were analyzed. Intervals were selected to represent different periods of deposition, generally from the top, center, and bottom sections of the core. Core intervals with unusual deposition patterns (i.e., organic matter or sediment type) were also targeted for analysis. All remaining intervals were archived.

Radioisotope cores collected for sedimentation rate and mixed layer analysis were not composited. Rather, the core was opened and sectioned in 2 cm intervals (0–50 cm), 5 cm intervals (50–120 cm), and 10 cm intervals (>120 cm). The intervals were placed in the appropriate containers obtained from the analytical laboratory.

3.4.2 Surface Sediment Grab Samples

Surface samples (0–10 cm) were collected using a 0.02 m^2 stainless steel dual van Veen grab sampler. Established deployment and recovery procedures for the sampling gear, as described in PSEP, were followed to ensure that the best possible samples were recovered and risks to personnel and equipment were minimized. Once a grab sample was retrieved, the overlying water was carefully siphoned off one side of the sampler. If the sample was judged to be acceptable according to PSEP specifications, the penetration depth was measured with a decontaminated stainless steel ruler, and sample quality and texture was described in the sample log (Appendix C).

3.5 Tissue Collection Procedures

Tissue samples were collected from a sampling vessel and by hand as described in the following sections. SAIC coordinated with Ecology, and other agencies as necessary, to obtain the necessary scientific collection permits for the collection of all marine organisms.

3.5.1 Bottom Trawl Sampling

A 7.6-meter Otter trawl was used to target collection of starry flounder and English sole. Flounder and sole with a minimum length of 20 cm were targeted for collection, if possible. However, the majority of starry flounder captured in southern Budd Inlet were juveniles with lengths between 9 and 15 cm (see the tissue collection logs, Appendix C).

Four adult starry flounder were captured. Each adult fish was retained as an individual sample (whole body was homogenized). For starry flounder samples with multiple fish, all fish were homogenized together (whole body) to create a single composite sample for dioxin/furan analysis. English sole were caught only in the North Inlet. Each English sole sample consisted of five fish and each fish was homogenized separately (whole body). Equal volumes of fish homogenate were then combined to create a single composite sample for dioxin/furan analysis. Table 4-3 lists the number of fish composited in each sample and their mean length. The laboratory archived the remaining tissue from each fish.

Trawling at the inner part of the inlet (Set 1) produced three starry flounder samples, the northern end of the navigation channel (Set 2) produced five starry flounder samples, and the North Inlet (Set 3) produced five starry flounder and three English sole samples (see Table 4-3).

3.5.2 Clam and Ghost Shrimp Samples

Small shovels and trowels were used to collect littleneck (*Protothaca staminea*), manila (*Venerupis philippinarum*), and bent nose (*Macoma nasuta*) clams at low tide from publicly accessible beaches in the vicinity of Budd Inlet. Ghost shrimp (*Neotrypaea californiensis*) were also collected at these beaches. A minimum tissue volume of 30 grams ww (shucked) were collected for dioxin/furan analysis. Triplicate samples were collected at each location. The length and weight of each clam were recorded in the tissue collection logs (Appendix C). Ghost shrimp were collected at three beaches. Three replicates were collected at each beach, and the total weight of each replicate was also recorded.

3.6 Chain-of-Custody Procedures

Chain-of-custody forms were initiated at the time of sample collection to ensure that all collected samples were properly documented and traceable through storage, transport, and analysis (Appendix D). Samples were retained at all times in the field crew’s custody until delivery to the appropriate laboratory by contractor personnel or relinquishing to a courier for overnight shipping. All samples were held and transported in coolers with ice or frozen gel-packs at approximately 4ºC. Chain-of-custody seals were attached to sealed coolers sent by overnight courier to verify that the coolers were not tampered with prior to delivery to the analytical laboratories.

3.7 Analytical Methods

All of the chemical analytical procedures used in this program were performed in accordance with the most current SMS and PSEP documentation. Analysis was conducted in two phases.

Dioxins and furans were analyzed by AXYS Analytical Services Ltd. of Sidney, British Columbia, using USEPA Method 1613B (tetra- through octachlorinated dioxins and furans by isotope dilution high resolution gas chromatography/mass spectrophotometry).

Analysis of SMS chemistry and conventional parameters was conducted by Columbia Analytical Services, Inc. of Kelso, WA. The analysis for SVOCs and PCBs was carried out by USEPA methods 8270 and 8081, respectively. The analysis for most of the metals was carried out using EPA method 6010, while mercury was analyzed using USEPA method 7041. Sediment conventional parameters, including grain size, total organic carbon (TOC), and total solids, were analyzed using methods Plumb, PSEP, and USEPA method 9060, respectively. The specific analyses and conventional parameters measured, sediment, analytical methods, and target detection limits are provided in the Sampling and Analysis Plan (SAIC 2007b). The data results are provided in Appendix B, and QA/QC data validation are provided in Appendix E.

Radioisotope analysis for sedimentation rates and dating were conducted by Battelle Marine Sciences Laboratory, Sequim, WA. Be-7 and Cs-137 were dried and counted by gamma spectroscopy, and Pb-210 was counted by alpha spectroscopy (Appendix F).

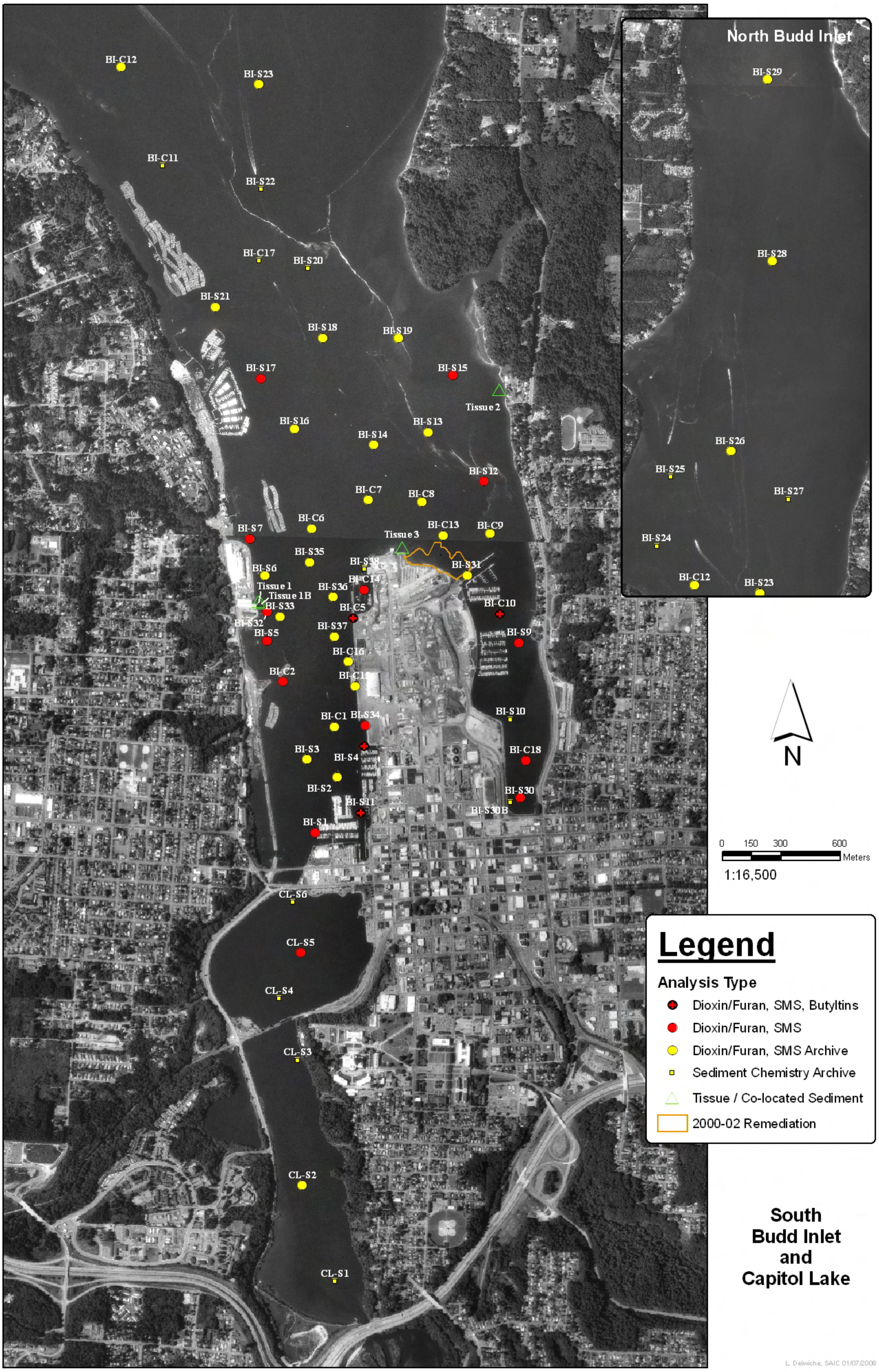

Figure 3-1. Surface Sediment Sample Locations in Budd Inlet

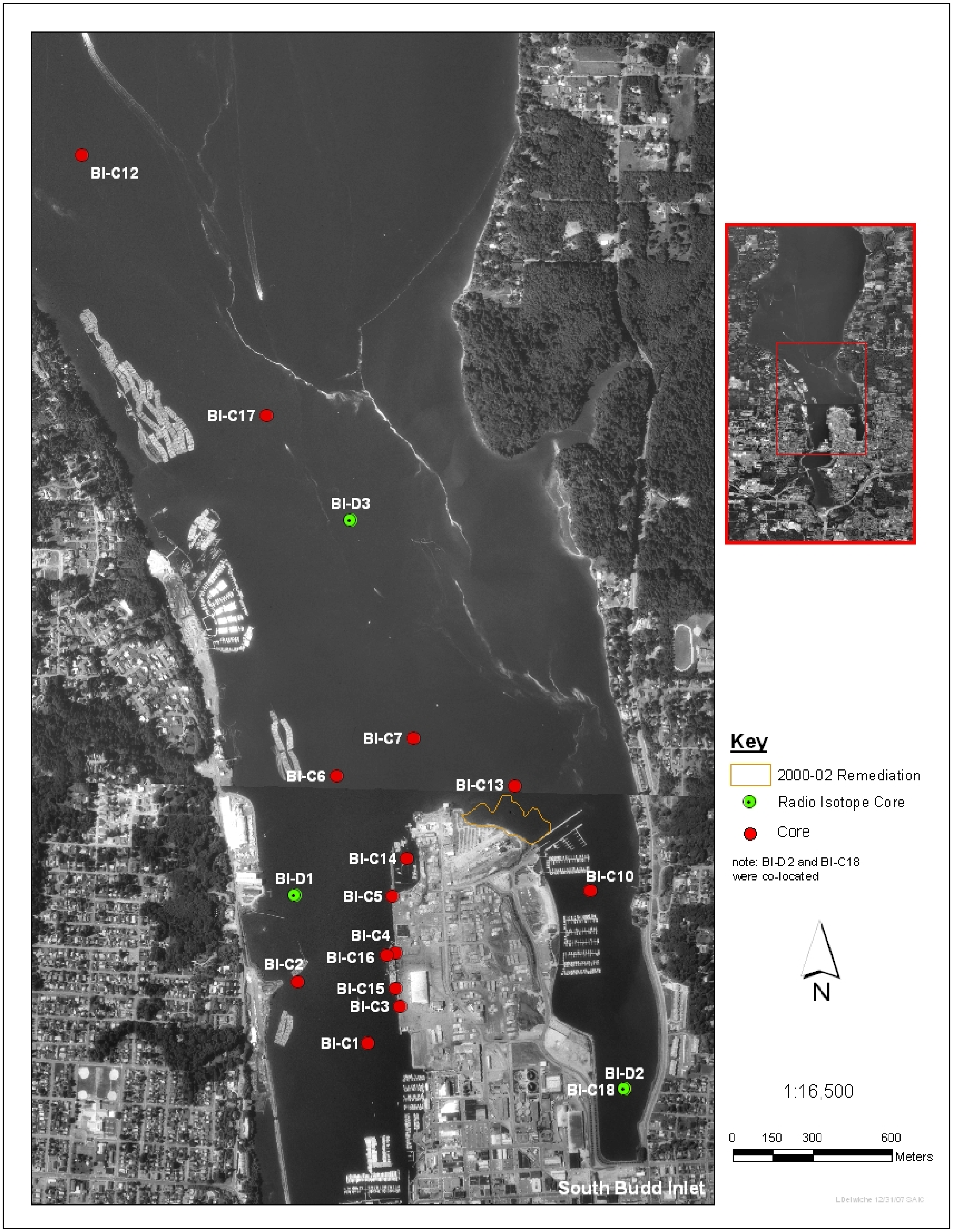

Figure 3-2. Sediment Core Locations for Budd Inlet

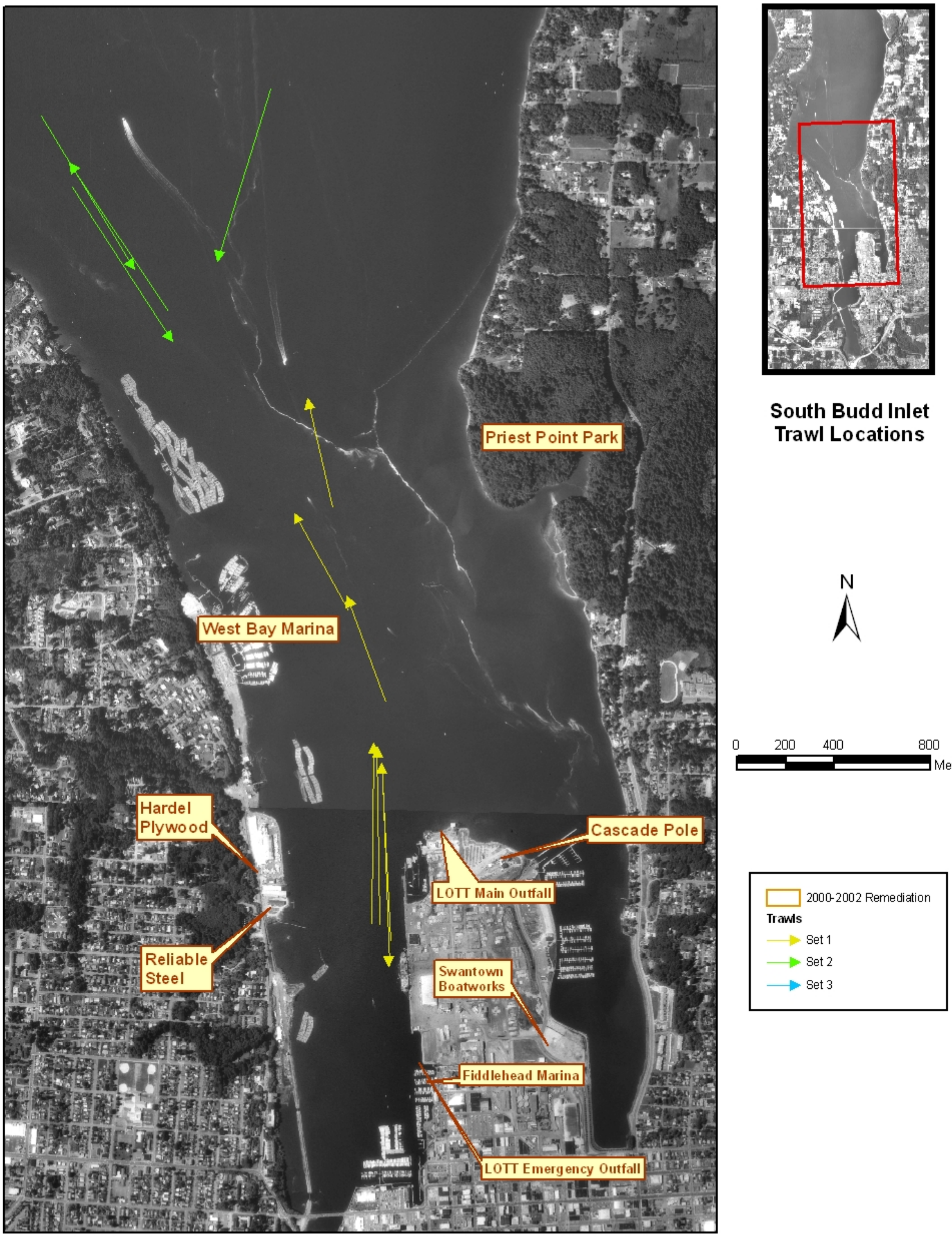

Figure 3-3. Southern Budd Inlet Trawl Locations

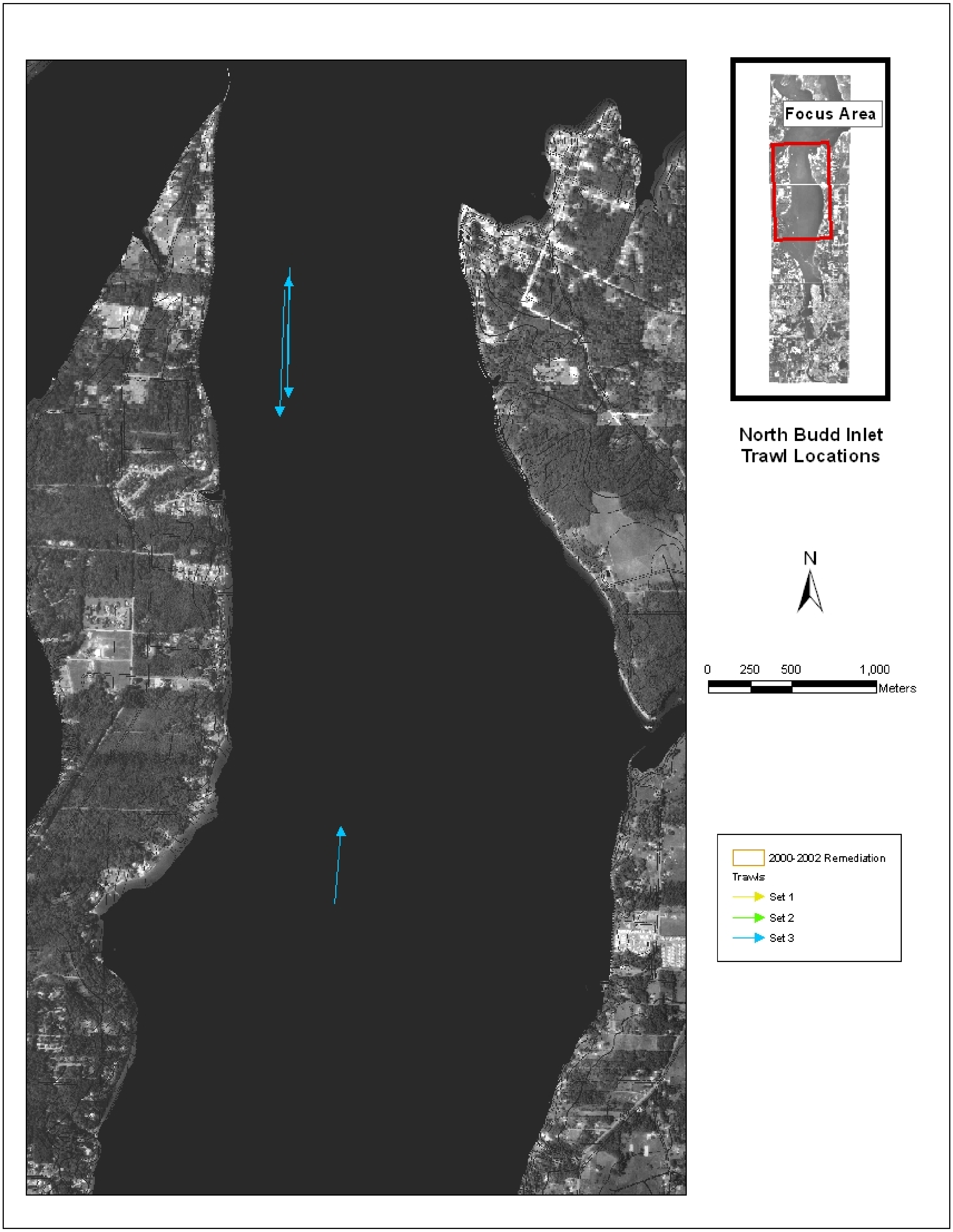

Figure 3-4. Northern Budd Inlet Trawl Locations

4.0 Nature and Extent

This chapter describes the results of the dioxin/furan, SMS chemistry, conventional parameter analysis, and the dioxin/furan results of the tissue and trawl samples as well as the results of the sediment rates and dating analysis.

4.1 Surface Sediment Quality

The following sections describe the surface sediment quality and the general nature and extent of contamination.

4.1.1 Dioxins/Furans

Dioxin/furan congeners were measured in 46 surface sediment samples (grab and core locations) in Budd Inlet. An additional four surface sediment samples from intertidal beaches and two surface sediment samples from Capitol Lake were also analyzed. Concentrations for dioxin/furan congeners in surface sediment samples are presented in Appendix B. For discussion purposes in the text, all data presented in these tables has been converted to total TEQs based on the WHO 2005 mammalian TEF (Van den Berg et al. 2006).

Dioxin/furan concentrations for the Budd Inlet surface sediment samples ranged from 2.9 to 60.3 pg/g TEQ, with a mean concentration of 19.1 pg/g TEQ. When broken down by area, the three samples of the North Inlet had the lowest mean TEQ concentration at 14.6 pg/g. East Bay and West Bay had similar mean concentrations of 20.2 and 19.0 pg/g TEQ, respectively. The highest concentrations were in the vicinity of the Hardel Mutual Plywood/Reliable Steel on the West Bay and at site BI-S30 at the discharge of Moxlie Creek in the East Bay (Figure 4-1). The lowest dioxin/furan concentrations were offshore of Priest Point Park in an area of sandy substrate (Figure 4-2). Dioxin/furan concentrations do not have numerical criteria under SMS for marine sediments. However, a comparison to the Method B soil criterion for protection of human health (14 pg/g TEQ at most soil sites for unrestricted land use) shows that 34 of 50 samples (68 percent) are above this criterion. A total of 41 samples (82 percent) are above the proposed freshwater sediment AET for benthic infauna (8.8 pg/g TEQ).

Capitol Lake sediment samples had substantially lower dioxin/furan TEQs than Budd Inlet with CL-S2 at 2.0 pg/g, and CL-S5 at 3.9 pg/g. Though the sample size for Capitol Lake is much smaller than that for Budd Inlet, the fact that the dioxin/furan TEQs in Capitol Lake are up to an order of magnitude lower suggests that Capitol Lake did not have a direct source of dioxin/furan contamination.

4.1.2 Conventional Parameters

Conventional parameters (grain size, TOC, total solids, and total volatile solids) were measured at all of the surface chemistry locations and the results are summarized in Appendix B. TOC content in the surface sediments was high, averaging 3.2 percent and ranging from 0.6 percent to 9.3 percent (Figure 4-2).

When evaluating sediment contamination by SMS organics, concentrations of nonpolar SVOCs are normalized to TOC. This is because SVOCs partition strongly to organic carbon. A correlation (r^2=0.38) exists between TOC and surface sediment TEQ (compare Figure 4-1 and 4-2). However, dioxin/furan concentrations have not been TOC normalized in this report. The absolute toxicity, or TEQ, of sediment is more important for purposes of comparison and regulation than a TOC adjusted value.

4.1.3 SMS Chemistry

A total of 21 surface sediment samples in Budd Inlet, four intertidal beach samples, and one sample in Capitol Lake were analyzed for the SMS chemical parameters (Appendix B). Contaminant concentrations were below the SQS criteria for all but two samples.

BI-Tissue1-Sediment (T1-Sed) and BI-Tissue1B-Sediment (T1B-Sed) are located near the Hardel Mutual Plywood and Reliable Steel sites (Figure 3-1). Sample T1-Sed exceeded SQS for indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, and buytlbenzylphthalate. The cleanup screening level (CSL) was exceeded for bis(2-ethylhexyl)phthalate. Sample T1B-Sed exceeded the SQS for bis(2-ethylhexyl)phthalate (Table 4-1).

Several samples exceeded the SQS or CSL because of high detection limits (Table 4-1). The most common compounds that exceeded the SMS criteria were the phenols (including pentachlorophenol) and hexachlorobenzene.

Table 4-1. Budd Inlet Sediment Chemistry Exceeding SMS Criteria

Station Number	SQS	CSL	BI-S5	BI-S7	BI-S15	BI-S30	BI-S34	BI-C10	BI-C14	BI-C18	CL-S5	BI-T1-SED	BI-T1B-SED	BI-C4-0-1 FT	BI-C4-6-7 FT	BI-C5-3-4 FT	BI-C5-6-7 FT
Metals in mg/kg DW																	
Mercury	0.41	0.59															**0.91**
LPAH in mg/kg TOC																	
Acenaphthene	16	57															26.46
HPAH in mg/kg TOC																	
Indeno(1,2,3-cd)pyrene	34	88										40.26					
Benzo(g,h,i)perylene	31	78										37.66					
Cl Aromatics in mg/kg TOC																	
1,2,4-Trichlorobenzene	0.81	1.8			1.41 U	1.95 U								0.81 U	1.35 U	1.58 U	1.85 U
Hexachlorobenzene	0.38	2.3			1.41 U	1.95 U	0.44 U	0.99 U	0.78 U	0.82 U	1.01 U			1.12 U	1.35 U	1.58 U	1.85 U
Phthalate Esters in mg/kg TOC																	
Butylbenzylphthalate	4.9	64										5.45					
bis(2-Ethylhexyl)phthalate	47	78										**181.82**	56.7				
Phenols in ug/kg DW																	
2-Methylphenol	63	63												72 U		130 U	140 U
2,4-Dimethylphenol	29	29	62 U	69 U	50 U	250 U		92 U	93 U	53 U	88 U		52 U	120 U			680 U
Pentachlorophenol	360	690				500 U									500 U	1300 U	1400 U
Miscellaneous in ug/kg DW																	
Benzyl Alcohol	57	73						62 U	63 U								
Benzoic Acid	650	650						1600 U	1700 U	920 U							

U indicates non-detected compounds
Normal text indicates detection limit exceeds SQS

Detected value exceeds SQS
Boldface indicates detected value exceeds CSL

4.2 Subsurface Sediment Quality

The following sections describe the subsurface sediment quality and the general nature and extent of contamination.

4.2.1 Dioxin/Furan Congeners

Subsurface cores were collected at 18 locations and sectioned into 1-foot intervals. A total of 43 intervals from 15 different cores were analyzed for dioxin/furan congeners. Concentrations for all samples and congeners are presented in Appendix B. As with the surface samples, all dioxin/furan congener concentrations have been converted to total TEQ. Subsurface data are presented in Figure 4-3 by depth interval. The co-located surface samples (0–10 cm) are plotted separately from the cores to clearly indicate the actual sampling locations of the surface grabs.

Whereas the lowest TEQ in the surface grabs was 2.89 pg/g, there were 23 subsurface intervals under 2.0 pg/g TEQ. Seventeen of these intervals were under 1.0 pg/g TEQ. Many of these low concentrations are close to the TEQ derived from the mean sediment method detection limits: 0.30 pg/g TEQ (calculated using MDL, not ½ MDL).

A gradient of decreasing TEQ with depth is evident (Figure 4-3). This is consistent with the sampling and analysis plan for subsurface sediment, in which the core intervals selected for analysis were chosen to confirm the shallowest depth at which dioxins were absent or present at very low concentrations. This required phased analyses, when the deepest interval analyzed still showed elevated dioxin/furan levels. The decreasing TEQ gradient can be seen in core BI-C3, where concentrations decrease with depth over six intervals, and in core BI-C13, where concentrations decrease with depth over five intervals. For example, concentrations in BI-C13 are as follows: 26.2 pg/g for the surface sample (0–10 cm), 14.8 pg/g for the 1–2-foot interval, 12.1 pg/g for the 2–3-foot interval, 0.43 pg/g for the 4–5-foot interval, and 0.41 pg/g for the 6–7-foot interval.

Dioxin/furan concentrations decrease with depth in 10 of the 15 cores, and most cores show a sharp drop in concentration similar to that of BI-C13, though the transition typically was measured within the 1–2-foot or 2–3-foot intervals. A review of the sediment core logs indicate that the transition frequently occurs when the amount of fine organics in the sediment (typically consisting of highly organic silt) visually decreased with depth (Appendix C). This pattern is consistent with TOC concentrations measured in the core intervals (see Section 4.2.2).

Two cores that did not demonstrate decreasing TEQ with depth were stations BI-C4 and BI-C5. TEQ concentrations in BI-C4 increased from 29.1 pg/g in the 0–1-foot interval, 41.3 pg/g in the 3–4-foot interval, to 62.5 pg/g in the 6–7-foot interval. TEQ concentrations in BI-C5 increased from 230.6 pg/g in the 3–4-foot interval to 4212.5 pg/g in the 6–7-foot interval. Both BI-C4 and BI-C5 locations are adjacent to each other and near an outfall from the former Cascade Pole site, which discharges underneath the Port of Olympia marine terminal facility. Dioxin/furan TEQ concentrations from cores C4 and C5 are of the same order of magnitude as the surface sediment from the Cascade Pole site prior to remediation (Landau 1993).

Cores collected to the immediate north and south of BI-C4 and BI-C5 had much lower TEQ concentrations, suggesting a localized accumulation of dioxin/furan contamination buried in the sediment under the pier of the Port of Olympia marine terminal facility.

4.2.2 Conventional Parameters

Similar to the surface samples, a correlation exists between TOC and dioxin/furan TEQ in the subsurface samples. TOC concentrations decrease with depth for 8 of the 15 cores collected in Budd Inlet (Figure 4-2). However, correlations between percent sand and percent fines are weak. There are no consistent trends between the conventional parameters and core depth.

4.2.3 SMS Chemistry

Four subsurface samples were analyzed for the SMS chemical parameters. The samples analyzed were from cores BI-C4 and BI-C5, the same cores with the high dioxin/furan TEQ. Mercury exceeded the CSL and acenaphthene exceeded the SQS for sample BI-C5-6–7FT (Table 4-1).

There were several analytes for which the detection limits exceeded their respective SQS and CSL (Table 4-1). The most notable instances were for PCP at the BI-C4 and BI-C5 sites. Concentrations were reported as non-detects with detection limit values ranging from 500–1,400 µg/kg dry weight (dw) at these sites. Because PCP was used in wood treatment, and is a presumed source of dioxin/furan contamination to Budd Inlet, better detection limits for PCP would have provided more useful chemical data.

4.3 Uptake by Ecological Receptors – Tissue Chemistry

Benthic invertebrate sampling was conducted at five intertidal collocated surface sediment sites. Starry flounder and English sole were collected via bottom trawls in the north inlet and the West Bay. The following sections describe the dioxin/furan concentrations in the tissue and fish samples and the general nature and extent of contamination in comparison to the sediment.

4.3.1 Dioxin/Furan Concentrations

Tissue samples were collected from five intertidal locations in Budd Inlet: SI-30 near the inlet of Moxlie Creek in the East Bay, BI-Tissue1 and BI-Tissue1B in the West Bay between the Hardel Mutual Plywood and Reliable Steel sites, BI-Tissue2 just south of Priest Point Park in the East Bay, and BI-Tissue3 adjacent to the Cascade Pole site (Figure 3-1). Littleneck/manila clams were collected at BI-Tissue1B and BI-Tissue2: ghost shrimp were collected at BI-Tissue1, BI-Tissue2 and BI-Tissue3; and bent nose clams were collected at BI-S30, BI-Tissue1, BI-Tissue2, and BI-Tissue3 (Table 4-2). At each of the tissue sampling locations, an intertidal sediment sample was also collected and analyzed.

Bottom trawls for flatfish were conducted at three locations (Figures 3-3 and 3-4) including: one trawl set in the North Inlet; one set to the north of the navigation channel; and one set in the West Bay. Flatfish species caught in the trawls included starry flounder and English sole.

As with the sediment concentrations, many of the calculated TEQs for the tissue samples are close to the values derived using the MDLs in the TEQ calculation. Detection limits for tissue samples are lower than sediment, resulting in an mean TEQ of 0.12 pg/g (calculated using MDLs, not ½ MDL). The TEQ for several tissue samples, such as littleneck/manila clams at BI-Tissue-1B and BI-Tissue-2, are within a factor of 2 to 3 of the MDL TEQ.

In the same manner that dioxin/furan congeners partition to TOC in sediment, they also partition to lipids in tissue samples. For the shrimp and clams, there is a correlation (r^2=0.64) between TEQ and percent lipids. Ghost shrimp have the highest lipid content of the tissue samples, and the highest TEQ. The mean concentration for ghost shrimp was 4.2 pg/g TEQ ww versus 1.1 pg/g TEQ ww for all clam species (Table 4-2).

Table 4-2. Dioxin/Furan TEQ and Lipid Concentrations for Benthic Invertebrate Samples and Paired Sediment Samples

			Dioxin/Furan TEQ (pg/g)		**Tissue**
Location	**Tissue**	**Replicate**	**Tissue (ww)**	**Sediment (dw)**	**Lipids (%)**
BI-S30	Bent Nose Clam	1	2.37	60.3	0.77
(Moxlie Creek discharge)	Bent Nose Clam	2	2.26	60.3	0.68
	Bent Nose Clam	3	2.55	60.3	0.71
BI-Tissue1	Ghost Shrimp	1	3.8	4.3	2.28
(Reliable Steel Intertidal)	Ghost Shrimp	2	2.59	4.3	0.68
	Ghost Shrimp	3	2.86	4.3	0.98
	Bent Nose Clam	1	0.87	4.3	0.63
	Bent Nose Clam	2	0.98	4.3	0.51
	Bent Nose Clam	3	0.97	4.3	0.48
BI-Tissue1B	Littleneck/Manila Clam	1	0.31	25.1	0.97
(Reliable Steel Intertidal)	Littleneck/Manila Clam	2	0.27	25.1	0.89
	Littleneck/Manila Clam	3	0.31	25.1	0.73
BI-Tissue2	Ghost Shrimp	1	3.68	4.2	1.75
(South of Priest Pt Park)	Ghost Shrimp	2	5.64	4.2	1.72
	Ghost Shrimp	3	4.86	4.2	1.47
	Littleneck/Manila Clam	1	0.2	4.2	0.89
	Littleneck/Manila Clam	2	1.58	4.2	0.66
	Littleneck/Manila Clam	3	0.26	4.2	0.64
	Bent Nose Clam	1	0.77	4.2	0.8
	Bent Nose Clam	2	0.74	4.2	0.39
	Bent Nose Clam	3	0.78	4.2	0.35
BI-Tissue3	Ghost Shrimp	1	5.47	9.5	2.19
(Cascade Pole Intertidal)	Ghost Shrimp	2	4.37	9.5	1.85
	Ghost Shrimp	3	4.85	9.5	1.89
	Bent Nose Clam	1	1.08	9.5	0.79
	Bent Nose Clam	2	2.25	9.5	0.36
	Bent Nose Clam	3	1.79	9.5	0.59

dw	dry weight
ww	wet weight

With only three paired sediment and benthic samples per species, it is difficult to determine whether a correlation exists between sediment and invertebrate dioxin/furan concentrations. At station BI-S30, only bent nose clams were present and sampled for chemical analysis. Dioxin/furan sediment concentrations were high at station BI-S30, as were the bent nose clam tissue concentrations (Table 4-2). Similarly, of the ghost shrimp sampling locations, BI-Tissue-3 had the highest sediment concentration and the highest mean TEQ for ghost shrimp. The same is not true for littleneck/manila clams.

Comparing contaminant concentrations between sediment and fish is challenging since fish have a large home range. A comparison of fish tissue residue to a single sediment location is not relevant. Therefore, dioxin/furan concentrations in fish were compared to the mean TEQ for all surface sediment data in Budd Inlet. From Section 4.1.1, the mean sediment concentration was 19.1 pg/g TEQ. The mean concentration for fish was 0.66 pg/g TEQ, with a range of 0.16 to 1.23 pg/g TEQ (Table 4-3). Little variation was observed between tissue replicates or species type.

The mean tissue concentrations from each intertidal site or each bottom trawl are plotted against sediment concentrations in Figure 4-4. Ghost shrimp had the highest tissue dioxin/furan concentrations, but some of the lowest sediment concentrations. This is due to the higher lipid content of the shrimp compared to other species. Bent nose clams were the only species where tissue concentrations were consistent with sediment concentrations; as the sediment concentrations increased, tissue concentrations increased. For the fish, both starry flounder and English sole had similar dioxin/furan concentrations.

Table 4-3. Fish Species and Number Collected during Bottom Trawls and the Dioxin/Furan TEQ and Lipid Concentrations for Fish Samples

Location	Rep	Tissue	Number of Fish	Mean Length (cm)	Dioxin/Furan TEQ (pg/g ww)	Lipids (%)
Trawl Set 1	1	Starry Flounder	10	10.8	0.51	1.04
(West Bay)	2	Starry Flounder	10	9.8	0.28	1.19
	3	Starry Flounder	10	8.5	0.32	1.37
Trawl Set 2	1	Starry Flounder	6	12.8	0.68	1.19
(North Navigation	2	Starry Flounder	7	10.5	0.28	1.14
Channel)	3	Starry Flounder	7	10.3	0.72	1.36
	4	Starry Flounder	1	26.7	0.48	0.75
	5	Starry Flounder	1	27.6	0.16	2.13
Trawl Set 3	1	Starry Flounder	1	34	0.6	1.22
(North Inlet)	2	Starry Flounder	1	34.1	1.18	1.01
	3	Starry Flounder	5	15.2	0.96	0.76
	4	Starry Flounder	5	15.5	0.81	0.75
	5	Starry Flounder	5	14.3	0.5	0.71
	1	English Sole	5	22.2	0.92	0.79
	2	English Sole	5	22.9	0.8	1.09
	3	English Sole	5	21.3	0.89	0.74

4.4 Sediment Dating and Biological Surface Mixed Layer

Three sediment cores were collected for sediment dating using radioisotopes. The top 120 cm of each core were analyzed. The cores were BI-D1, BI-D2, and BI-D3 (see Figure 3-2). BI-D1 was located off the south end of the Hardel Mutual Plywood facility, BI-D2 was in the south end of the east bay near the outlet of Moxlie Creek, and BI-D3 in the center of Budd Inlet between Priest Point Park and West Bay Marina. Despite its close proximity to the dredged navigational channel, BI-D3 had a depositional record with the expected exponential decline in Pb-210 counts. A discontinuity in this decline would indicate a disturbance of the sediment.

Although the sediment dating locations were selected to be representative of Budd Inlet, not all the surface grabs and subsurface cores are expected to match the radioisotope dating profiles. Areas that have been dredged, remediated, or located near industrial outfalls may have had different depositional rates. In particular, the samples collected near the pier in the west bay have high dioxin/furan concentrations deeper than what would be expected by the sedimentation rates measured in the radioisotope cores. This discrepancy is likely due to a Cascade Pole outfall under the pier and the history of deposition and disturbance from construction and vessel activity in this area.

4.4.1 Sedimentation Rates and Dating

Dating sediment cores makes use of radioisotopes Pb-210 and Cs-137. Pb-210 is formed by the decay of gaseous radon-222 and has a half-life of 22.3 years. Binding strongly to sediment, sedimentation dates are determined by the decrease in Pb-210 activity. Cs-137 owes its presences in the atmosphere to anthropogenic thermonuclear activities. Cs-137 deposition began around 1952 and peaked around 1963–1964. In marine system, deposition of Cs-137 occurs slowly.

One important event that likely influenced sediment deposition in Budd Inlet was the creation of Capitol Lake in 1951. Historically, the Deschutes River flowed into the east bay of Budd Inlet where it deposited its sediment load. In 1951, an earthen dam was constructed to create a freshwater lake. Shortly after construction, the lake began to act as a settling pond for suspended sediment in the Deschutes River, reducing deposition to Budd Inlet. This event was factored into the calculation of the sedimentation rates for the core locations that would have been most influenced by the Deschutes River.

The radioisotope results were modeled to date the cores and provide sedimentation rates. Core D2 was not expected to be impacted by the dam at Capitol Lake and was modeled as a single core. A change in Pb-210 was noted with depth in cores D1 and D3. The time corresponding to this depth was believed to be when the dam was constructed. The fill used to create the dam would have had lower amounts of Pb-210 (soil dug from the ground is older). During construction, some of this fill would have spread throughout Budd Inlet and settled to the bottom, creating an artificially old layer in the sediment core. Therefore, sedimentation rates were calculated in two sections for D1 and D3: one section for the years prior to 1951 (based on lead-210 discontinuity) and another rate for deposition after 1951.

Core D1 was the site with apparent depositional rates most affected by the dam as evidenced by the large break in continuity between the mid-1930s and 1950. Core D3 depositional rates were also affected, but not to the same extent as core D1 (Figure 4-5). For both cores, there are overlapping dates between the top (post-1951) and bottom (pre-1951) core sections. This is due partly to the statistics of modeling the core in two sections and partly due to the mixing of upland fill and native sediment during construction of the dam.

The sedimentation rates vary between the core locations and between the two sections of cores D1 and D3. Core D3 has the lowest sedimentation rates: 0.29 $g/cm^2/yr$ before 1951 and 0.24 $g/cm^2/yr$ after 1951. Core D1 exhibited a large shift in sedimentation rates after construction of the dam, from 0.68 $g/cm^2/yr$ to 0.45 $g/cm^2/yr$. Lastly, core D2 indicated a consistent sedimentation rate of 0.60 $g/cm^2/yr$.

As stated above, these sedimentation rates may not apply to all locations in Budd Inlet, but in general it can be assumed that the surface samples (0–10 cm) consisted of sediment deposited within the past 10–20 years. Cascade Pole operated from 1957 through 1986, corresponding to sediment depths ranging from 16–37 cm (6–15 inches) in cores D1 and D2 and 12–26 cm (4–10 inches) in core D3.

4.4.2 Biological Surface Mixed Layer

Be-7 is a naturally occurring radioisotope in the earth's atmosphere. Through precipitation, it reaches the surface and is bound to soil or sediment. Owing to a short half-life of 53 days, measuring Be-7 in a core is an effective method for determining whether sediment has recently been in contact with the surface. Detection of this isotope beneath the surface of the sediment is a means of determining the depth of the surface mixed layer.

The top 10 cm of each radioisotope core was analyzed for Be-7 in 2-cm increments for a total of 15 samples. Cores were collected on April 10, 2007, but they were not analyzed within 53 days (June 2, 2007). Although one half-life had elapsed prior to analysis, half of the Be-7 in each sample would still be present and detectable. Be-7 was undetected in all 15 samples. With such low sedimentation rates, this result is not surprising. Be-7 can only be detected in sediments deposited within the previous year. Given the low sedimentation rates, one year worth of sediment represents a small portion of the top 10 cm. Therefore, the biological mixed layer could not be determined by Be-7 in the cores collected.

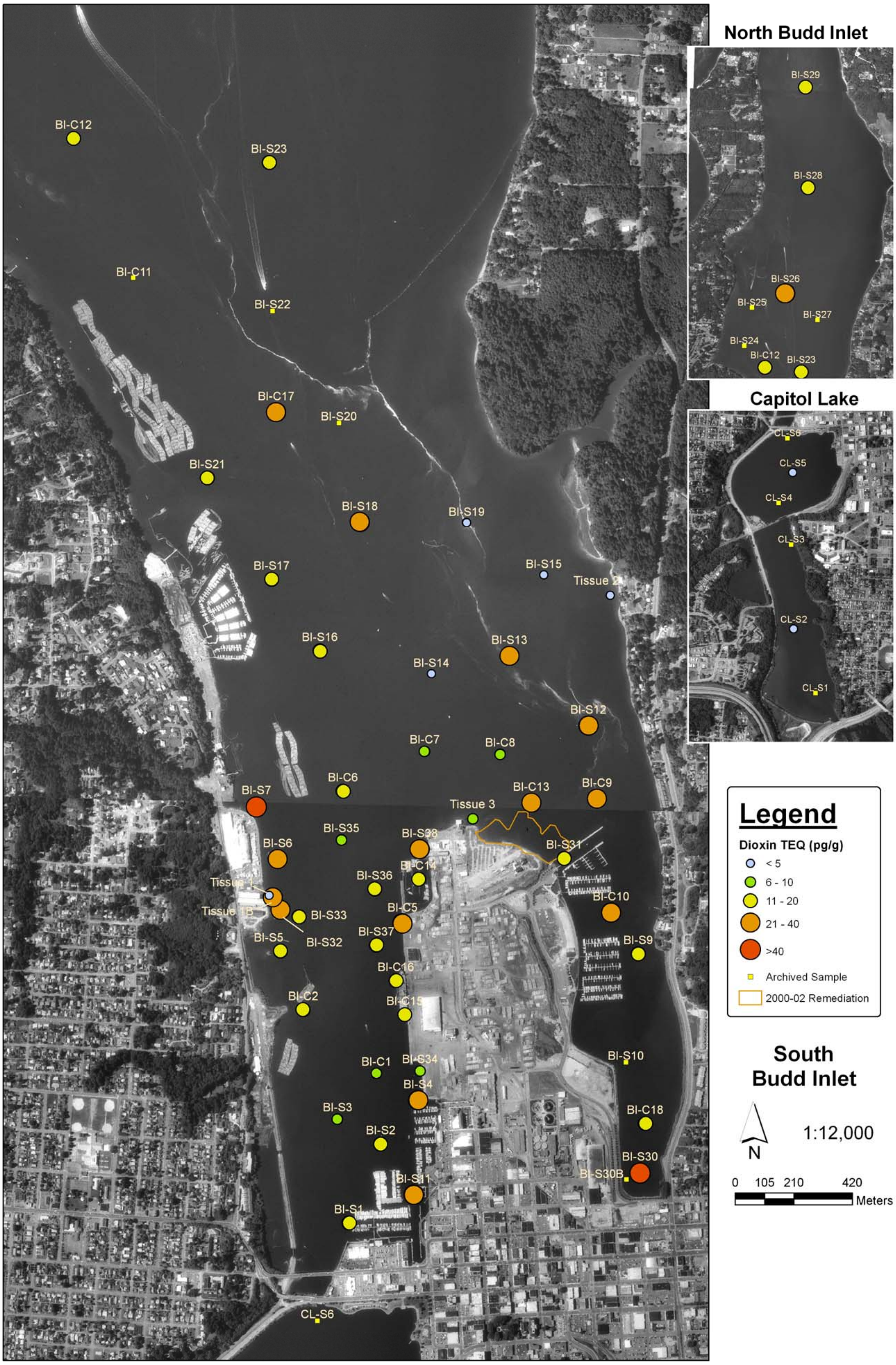

Figure 4-1. Surface Sediment Dioxin/Furan TEQs in Budd Inlet and Capitol Lake

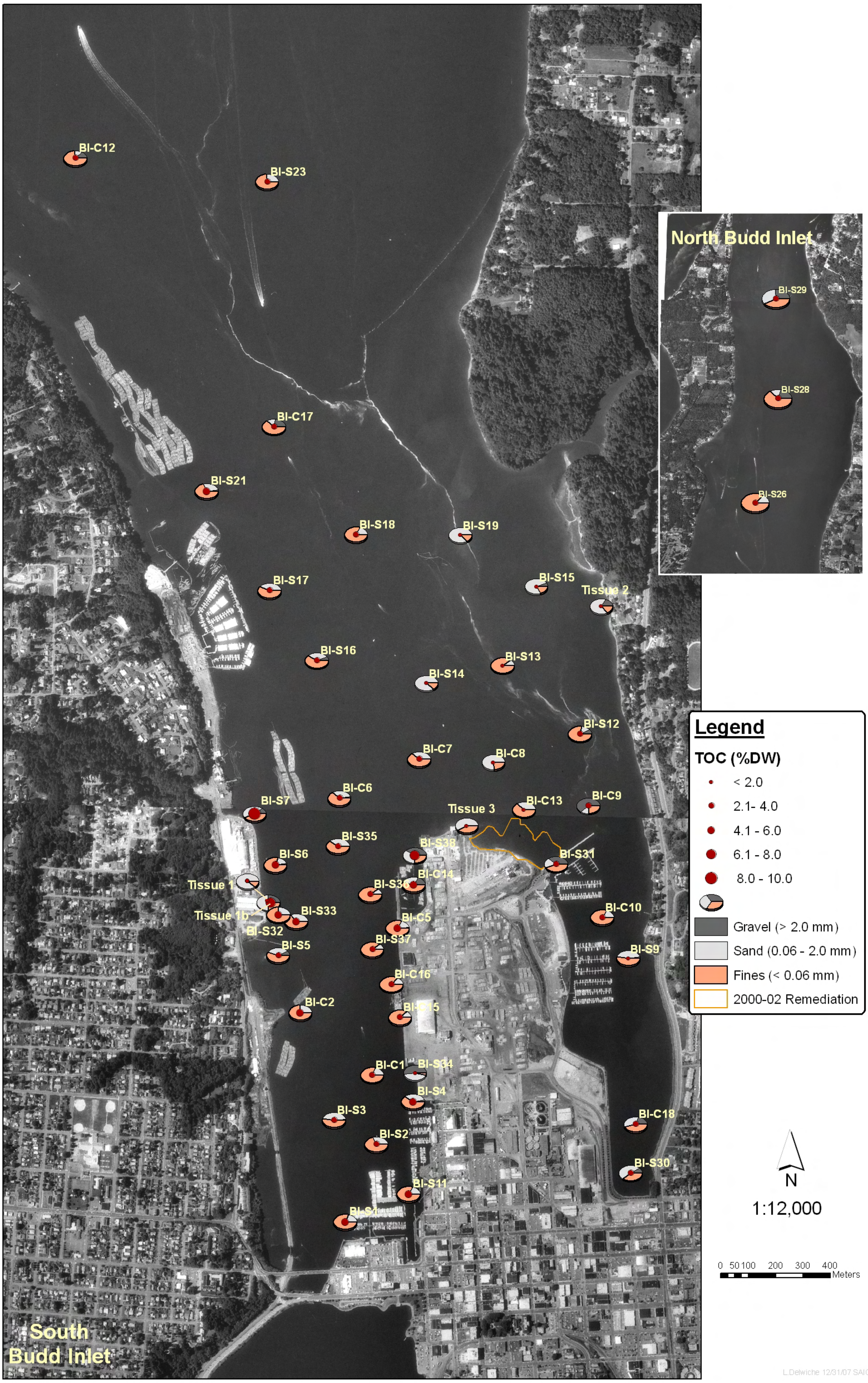

Figure 4-2. Percent Grain Size and TOC in Surface Sediments

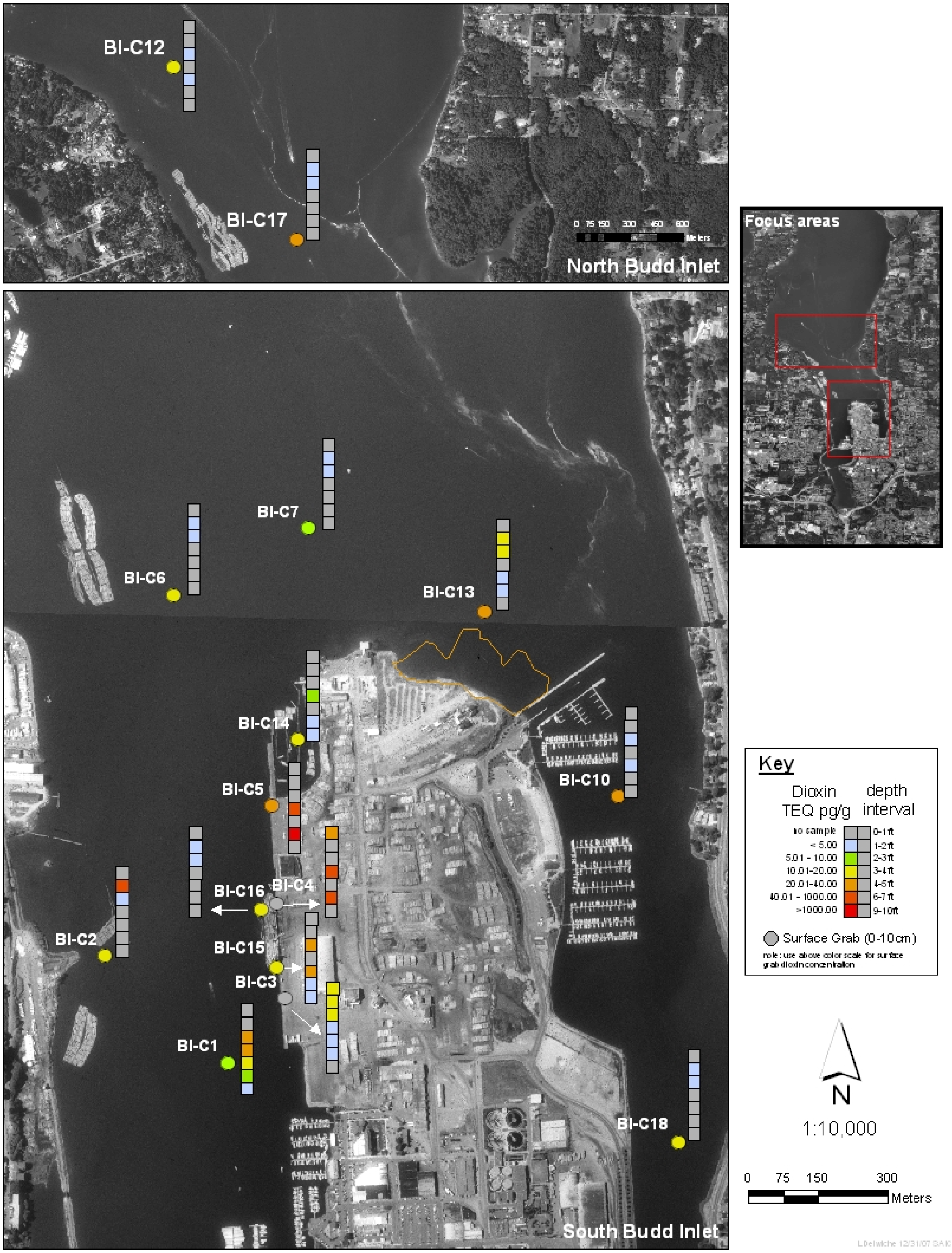

Figure 4-3. Change in TEQ with Depth of Core Interval
Point Data represent the TEQ from the co-located Surface Grab (0–10 cm) at each Coring Location.

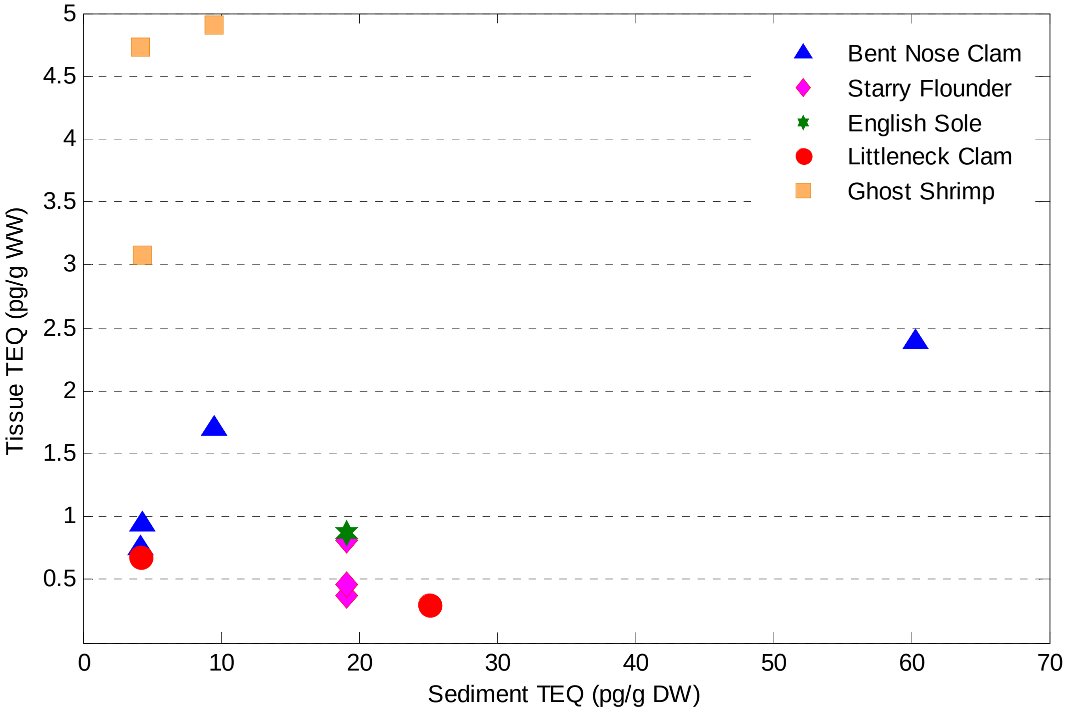

Figure 4-4. Mean Tissue Concentrations at for Each Species Versus Sediment Concentration The mean sediment concentration of all surface samples in Budd Inlet was used for the starry flounder and English sole.

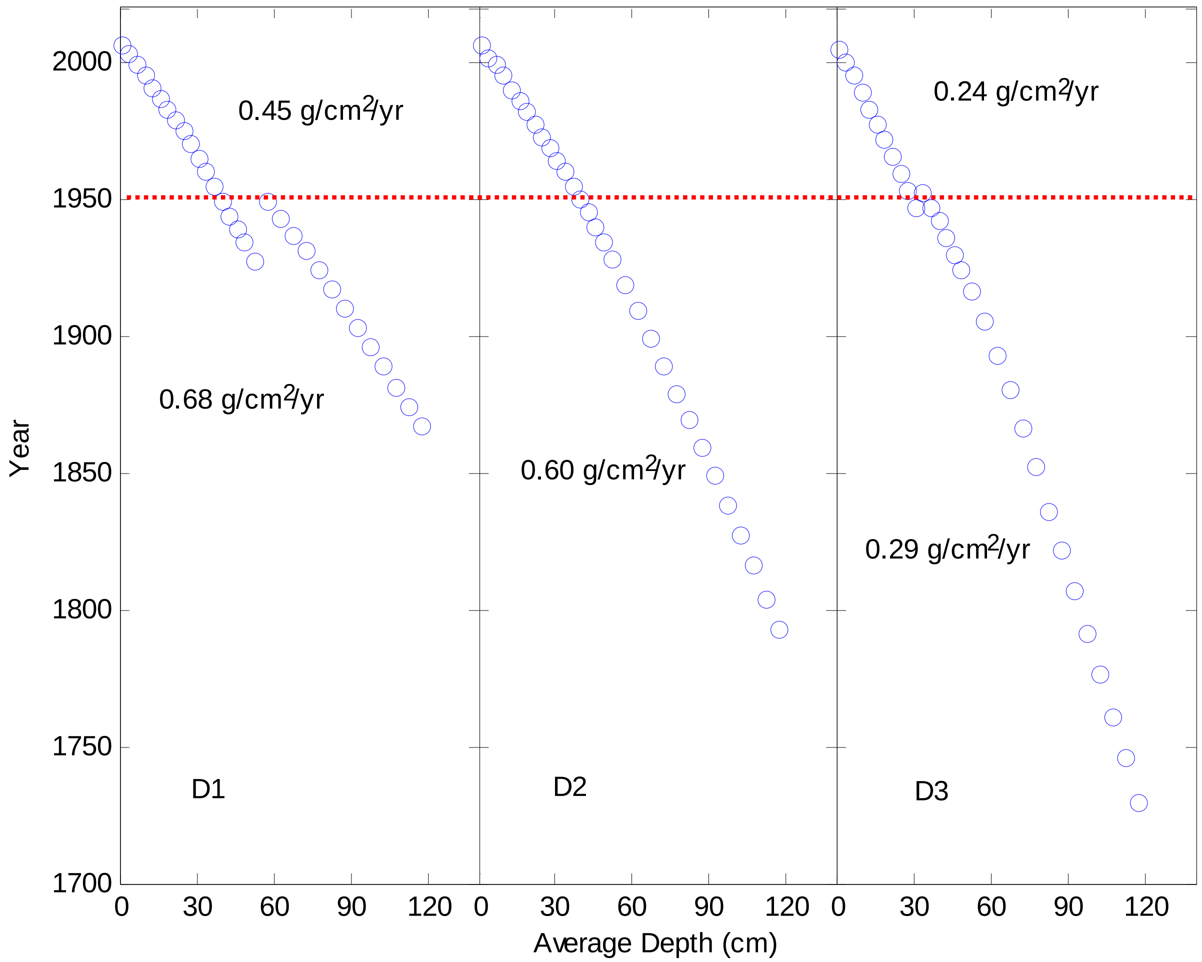

Figure 4-5. Year versus Depth of the Sediment Core for Radioisotope Locations D1, D2, and D3 Sedimentation rates by mass are included for all cores. The two sedimentation rates for cores D1 and D3 represent the periods before and after damming of the Deschutes River in 1951 (red dashed line).

5.0 Contaminant Fate and Transport

This section describes the congener profiles, or fingerprints, of the dioxin/furan results for the surface and subsurface sediment samples. The congener profile results are compared to known source profiles as well as the congener profile of the Cascade Pole intertidal sediments prior to remediation. The congener profiles of the tissue and trawl samples are also compared to the sediment profiles. In addition, biota sediment accumulation factors are calculated for the tissue and trawl samples to determine the uptake of dioxin/furan congeners by species and sampling location.

5.1 Sediment Partitioning

Dioxin/furan congeners partition between the sediment water interface, binding more strongly to sediments high in percent fines and TOC, and less so to sediments composed of the larger grain sizes. Over time, equilibrium conditions are reached based on the grain size distribution of the sediment.

For the majority of Budd Inlet surface samples, dioxin/furan TEQ concentrations show a positive correlation with TOC and percent fines, and a negative correlation with percent sand (Figure 5-1). There are two exceptions in each of these correlations: BI-S7 near Hardel Mutual Plywood, with a concentration of 59.8 pg/g TEQ, and BI-S30 in the south end of East Bay near the discharge of Moxlie Creek, with a concentration of 60.3 pg/g TEQ. Both of these locations have concentrations higher than would be predicted by their respective amounts of TOC, percent fines, and percent sand.

For all three correlations in Figure 5-1, the r^2 values are improved by removing these two outliers. With BI-S7 and BI-S30 included, the r^2 values are 0.384, 0.123, and 0.095 for percent TOC, percent fines, and percent sand, respectively. Excluding these two locations in the correlations results in r^2 values of 0.411, 0.423, and 0.297.

5.2 Dioxin/Furan Congener Profiles

The dioxin/furan congener profile (i.e., fingerprint) is an informative method for evaluating the relative combination of the different congeners measured in a given matrix. To calculate the profiles, the concentration of each individual congener (not adjusted to TEQ) was divided by the sum of the total dioxin/furan concentration in a given sample. In the case of non-detects, concentrations were estimated at one-half the detection limit. The resulting profile illustrates the relative amount of each dioxin/furan congener observed in the sample.

Each source of dioxins such as incinerators, paper pulp, and wood treatment facilities has a unique congener profile. The USEPA tracks environmental releases of dioxin/furan contamination and has created congener profiles for 18 well known sources (Cleverly et al. 1997). In ideal situations, a comparison of the sediment congener profile with the known USEPA source profiles is enough to determine the source of dioxin/furan contamination. More complex situations arise when the sediment has been contaminated by multiple sources. In such instances, statistical un-mixing models must be used to parse out and identify individual source profiles. An advantage of carrying out congener analysis at Budd Inlet is the historic data record from sampling the intertidal zone at Cascade Pole prior to its remediation. This existing source profile can be compared to that of the 2007 dioxin/furan sampling campaign in Budd Inlet.

Congener profiles were calculated for each of the surface and subsurface sediment samples. Samples with low concentrations and frequent non-detected congeners had profiles that were more representative of the method detection limits than potential sources of dioxin/furan contamination. For this reason, all samples where seven or more of the 17 congeners were non-detects were excluded from congener profile analysis. None of the surface samples were excluded, but 15 of the 43 subsurface samples met this criterion (the mean TEQ of these 15 samples was 0.25 pg/g) and were excluded from the analysis.

All congener profiles for the surface grabs, subsurface core samples, and Capitol Lake sediment are plotted in Figure 5-1. Individual samples in these plots are represented by the blue circles, whereas the red boxes represent the mean profile plus or minus one standard deviation. The mean profiles are all similar, indicating a common source. For the surface grabs, the individual samples had a small standard deviation with no outliers. More variability existed for the subsurface core samples.

Interval BI-C13-2-3FT was a notable outlier for the subsurface cores, with a lower percentage of OCDD, and a higher percentage of 1,2,3,4,6,7,8-HpCDF. Three other intervals were analyzed from BI-C13. Of these, BI-C13-4-5FT and BI-C13-6-7FT had greater than seven non-detects and were excluded from fingerprinting analysis. The remaining interval, BI-C13-1-2FT, is compared to BI-C13-2-3FT in Figure 5-2. The two congener profiles are dissimilar, with BI-C13-1-2FT matching the profile of the other subsurface samples in Budd Inlet. Given that the profile of BI-C13-2-3FT does not match that of any of the other samples in Budd Inlet, including BI-C13-1-2FT of the same core, it has been excluded from subsequent fingerprinting analysis.

OCDD is present at much higher concentrations than the other congeners, dominating the profile (Figure 5-1). Excluding OCDD when calculating congener profiles is one method that has been used to allow for a closer examination of congener distribution (Barabas et al. 2004). All congener profiles for the surface grabs, subsurface core samples, and Capitol Lake sediments were recalculated, leaving out OCDD. The profiles are plotted in Figure 5-3.

In the absence of OCDD, 1,2,3,4,6,7,8-HpCDD dominates the congener profile, comprising 52.8 ± 6.5% of the surface samples and 47.2 ± 10.7% of the subsurface samples. The mean amount of OCDF is similar between the surface and subsurface samples (24.9% versus 24.3%, respectively), but the variability is greater in the subsurface. Mean values of 1,2,3,4,6,7,8-HpCDF are more comparable between the surface and subsurface data after exclusion of BI-C13-2-3FT. However, the subsurface core samples have a higher mean and increased variability of this congener. Similarly, the penta- and hexa- chlorinated congeners are more variable in the subsurface, with some samples having up to 5% PeCDF.

The small differences of the mean congener profiles between the subsurface and surface samples combined with the increased variability in the subsurface sample profiles are an indication that dechlorination has played a role in the deeper, older subsurface samples. Various studies have demonstrated a disappearance of higher chlorinated congeners of dioxin, correlated to increasing proportions of lower chlorinated congeners (Field 2007; Barabas et al. 2004). The time scale of dechlorination varied widely in these studies, from months to a year in laboratory studies, to several years for field sediment (Field 2007).

To serve as a comparison, the means and standard deviations of the congener profiles of the surface grab, subsurface core, and Capitol Lake samples are plotted with the 15 surface (0–10 cm) samples from the 1990–1991 sampling of the Cascade Pole intertidal beach (Figure 5-5). Although several chemicals were used as wood preservatives at the Cascade Pole site (Section 2.2), PCP contains dioxin/furan congeners as impurities. As evident in Figure 5-5, the congener profiles for all the sediment samples collected in Budd Inlet match the pre-remediation profile from Cascade Pole. All profiles are a match to the USEPA's profile for PCP (Cleverly et al. 1997). In Budd Inlet, wood treatment using PCP is the source of dioxin/furan to the sediment. However, all wood treatment facilities using PCP would have the same congener profile. If multiple treatment facilities were present, narrowing the source of contamination down to a single treatment facility would be difficult.

5.2.1 Capitol Lake Sediments

Dioxin/furan congener profiles of the two sediment samples collected in Capitol Lake were similar to the surface and subsurface samples in Budd Inlet, as well as the PCP profile (Figures 5-1 and 5-2). The absolute concentrations were much lower. The source of the dioxin/furan contamination in Capitol Lake is not known. However, Capitol Lake may have been influenced by past activities that included periodic flushing of the lake by marine waters, possibly introducing dioxins from lower East Bay.

5.2.2 Uptake by Ecological Receptors

The congener profiles of the fish tissue replicates were averaged from each trawl and species. The congener profile of the fish was compared to the mean profile of all surface sediment samples in Budd Inlet. Congener profiles were averaged for the replicate samples of ghost shrimp, littleneck/manila clams, and bent nose clams at each of the invertebrate sampling locations, and they were compared to the profile of each co-located sediment sample. As with the sediment, tissue samples that with greater than seven non-detected congeners per sample were excluded from the congener profile analysis. Three samples met this criterion: BI-Tissue1B-L2, BI-Trawl-SF2, and BI-Trawl2-SF5 and were excluded from further analysis.

Figure 5-6 shows the congener profiles for Budd Inlet surface sediment, starry flounder, and English sole. Figure 5-7 shows the congener profiles for BI-Tissue2. The congener profiles are similar for BI-Tissue1, BI-Tissue-1B, BI-Tissue3, and BI-S30.

The relative amount of OCDD in the sediment samples ranges from a minimum of 72.5 percent to a maximum of 85.2 percent. OCDD in the fish ranges from 31.1 percent for flounder in Trawl-1 to 49.1 percent in Trawl-2. 1,2,3,4,6,7,8-HpCDD has a trend opposite that of OCDD, in which the relative abundance is greater in the fish than in the sediment. Similarly, 1,2,3,6,7,8-HxCDD represents only 0.6 percent of the congener profile in sediment, but ranges from 5.7

percent to 15.2 percent in fish. Most noticeable is the relatively increased relative presence of the lesser chlorinated (and more toxic) dioxins and furans in the fish samples.

The congener profile of the ghost shrimp matches that of the fish. OCDD is relatively lower in the shrimp and 1,2,3,4,6,7,8-HpCDD is higher. However, lesser chlorinated congeners of dioxins and furans are not as abundant in the shrimp as they are in the fish. Of the tissue samples, the congener profile of the clams is the closest to matching the sediment cogener profile.

The congener profiles for the ghost shrimp and fish samples are not a clear match to PCP or other known source profiles. Differential uptake of dioxin/furan congeners by the fish and ghost shrimp may be responsible for these differences. Biota sediment accumulation factors (BSAFs) were calculated for all tissue samples to better understand this uptake of dioxin/furan contamination from the sediment.

BSAF is the ratio of the lipid normalized concentration of each dioxin/furan congener divided by the TOC normalized concentration of that congener in the sediment (Equation 1).

$$BSAF = \frac{C_t / f_l}{C_s / f_{oc}} \qquad \text{(Equation 1)}$$

C_t is the tissue concentration (pg/g ww), f_l is the fraction by weight lipid concentration, C_s is the sediment concentration (pg/g dw), and f_{oc} is the fraction of organic carbon (TOC) in the sediment (EPA 2000).

The BSAF is based on equilibrium partitioning between the organic carbon in the tissue and sediment. Using laboratory derived partitioning coefficients for SVOCs, theoretical BSAF values ranging from one to four have been calculated for equilibrium conditions. Deviations from this range serve as an indicator that a system is not at equilibrium (USEPA 2000). Reasons may include: metabolism or dechlorination of dioxin/furan congeners by the organism, mass transfer resistance from the sediment, differential biotic uptake, or uptake from an unquantified source (Wong 2000).

BSAF values were calculated for each detected congener in the replicate ghost shrimp, littleneck/manila, and bent nose clam samples. The replicates from each site were then averaged. Table 5-1 contains the BSAF values for bent nose clams collected at SI-30, BI-TISSUE1, BI-TISSUE2, and BI-TISSUE3. BI-S30 has the lowest range of BSAF values. For the clams at this location, the octa- and hepta- dioxin/furan congeners were not accumulated at the same rate as the other congeners. BI-TISSUE3 has the highest BSAF values of the bent nose clams, and nearly all congeners accumulated at an equal rate. BI-TISSUE1 and BI-TISSUE2 also have similar BSAF values for all congeners. Equal accumulation of all congeners by biota means the congener profile of the tissue will match that of the sediment. This can be seen in Figure 5-7.

There is more variability between sites and replicates for the littleneck/manila clams, with BI-Tissue2 having greater uptake than BI-Tissue1B. The standard deviations between the replicates at BI-TISSUE2 are 100 percent of the BSAF values (Table 5-1), demonstrating that even for a single species within a small area, uptake of contaminants can vary.

Table 5-1. Mean BSAF Values and Standard Deviations for Bent Nose and Littleneck/Manila Clams Replicates at each location are averaged. Units are kg TOC per kg lipid

Congener	BI-S30	BI-TISSUE1	BI-TISSUE2	BI-TISSUE3	Mean
kg TOC per kg lipid	**Bent Nose Clams**				**N=12**
2,3,7,8-TCDD	0.44 ± 0.07	0.37 ± 0.19		0.45	0.42 ± 0.10
1,2,3,7,8-PeCDD	0.35 ± 0.02	0.43 ± 0.11	0.40 ± 0.16	0.55 ± 0.40	0.43 ± 0.20
1,2,3,4,7,8-HxCDD	0.28 ± 0.01	0.42 ± 0.11	0.46 ± 0.19	0.67 ± 0.49	0.46 ± 0.27
1,2,3,6,7,8-HxCDD	0.15 ± 0.00	0.37 ± 0.07	0.41 ± 0.16	0.64 ± 0.44	0.39 ± 0.27
1,2,3,7,8,9-HxCDD	0.23 ± 0.02	0.39 ± 0.10	0.41 ± 0.18	0.65 ± 0.49	0.42 ± 0.28
1,2,3,4,6,7,8-HpCDD	0.08 ± 0.01	0.24 ± 0.05	0.33 ± 0.12	0.58 ± 0.42	0.31 ± 0.27
OCDD	0.06 ± 0.01	0.18 ± 0.05	0.30 ± 0.12	0.50 ± 0.39	0.26 ± 0.24
2,3,7,8-TCDF	0.41 ± 0.04			0.33 ± 0.21	0.37 ± 0.14
1,2,3,7,8-PeCDF	0.32 ± 0.01	0.41 ± 0.06	0.29 ± 0.18	0.46 ± 0.31	0.38 ± 0.17
2,3,4,7,8-PeCDF	0.29 ± 0.02	0.38 ± 0.07	0.35 ± 0.12	0.41 ± 0.26	0.36 ± 0.14
1,2,3,4,7,8-HxCDF	0.20 ± 0.01	0.46 ± 0.11	0.40 ± 0.17	0.67 ± 0.49	0.43 ± 0.28
1,2,3,6,7,8-HxCDF	0.26 ± 0.01	0.39 ± 0.08	0.33 ± 0.11	0.37 ± 0.18	0.33 ± 0.10
1,2,3,7,8,9-HxCDF	0.36		0.82	0.97	0.72 ± 0.32
2,3,4,6,7,8-HxCDF	0.27 ± 0.01	0.35 ± 0.08	0.39 ± 0.15	0.56 ± 0.40	0.39 ± 0.22
1,2,3,4,6,7,8-HpCDF	0.19 ± 0.01	0.35 ± 0.06	0.35 ± 0.13	0.65 ± 0.49	0.38 ± 0.28
1,2,3,4,7,8,9-HpCDF	0.09 ± 0.01	0.27 ± 0.05	0.43 ± 0.06	0.63 ± 0.47	0.35 ± 0.30
OCDF	0.10 ± 0.01	0.23 ± 0.04	0.29 ± 0.10	0.59 ± 0.45	0.30 ± 0.27
Congener		**BI-TISSUE1B**	**BI-TISSUE2**		**Mean**
kg TOC per kg lipid	**Littleneck/Manila Clams**				**N=6**
2,3,7,8-TCDD					
1,2,3,7,8-PeCDD		0.15 ± 0.03	0.27 ± 0.22		0.20 ± 0.13
1,2,3,4,7,8-HxCDD		0.10 ± 0.02	0.35 ± 0.34		0.22 ± 0.24
1,2,3,6,7,8-HxCDD		0.12 ± 0.02	0.24 ± 0.26		0.18 ± 0.18
1,2,3,7,8,9-HxCDD		0.10 ± 0.02	0.26 ± 0.33		0.18 ± 0.22
1,2,3,4,6,7,8-HpCDD		0.04 ± 0.01	0.22 ± 0.30		0.13 ± 0.22
OCDD		0.02 ± 0.01	0.21 ± 0.32		0.12 ± 0.23
2,3,7,8-TCDF		0.51			0.51
1,2,3,7,8-PeCDF			0.23 ± 0.19		0.23 ± 0.19
2,3,4,7,8-PeCDF		0.25 ± 0.03	0.19 ± 0.15		0.21 ± 0.11
1,2,3,4,7,8-HxCDF		0.20 ± 0.07	0.25 ± 0.29		0.23 ± 0.19
1,2,3,6,7,8-HxCDF		0.17 ± 0.03	0.22 ± 0.25		0.20 ± 0.18
1,2,3,7,8,9-HxCDF					
2,3,4,6,7,8-HxCDF		0.19 ± 0.05	0.22 ± 0.25		0.21 ± 0.17
1,2,3,4,6,7,8-HpCDF		0.08 ± 0.02	0.22 ± 0.30		0.15 ± 0.20
1,2,3,4,7,8,9-HpCDF		0.07	0.32 ± 0.38		0.24 ± 0.30
OCDF		0.03 ± 0.01	0.20 ± 0.28		0.11 ± 0.20

The BSAF values for starry flounder and English sole were calculated using the mean TOC and congener concentrations for all surface sediment samples. BSAFs for ghost shrimp, starry flounder, and English sole do not have similar values for all congeners (Table 5-2). The octa- and hepta- chlorinated congeners have low BSAF values, while the tetra- and penta- congeners have the highest BSAF values.

For ghost shrimp, the highest uptake was for 1,2,3,7,8-PeCDD at all three tissue sampling locations. The preferential uptake of 1,2,3,7,8-PeCDD and other lesser chlorinated congeners can be seen in the congener profile for ghost shrimp in Figure 5-4.

Table 5-2. Mean BSAF Values and Standard Deviations for Ghost Shrimp, Starry Flounder, and English Sole
Replicates at each location are averaged. Units are kg TOC per kg lipid.

Congener	**BI-30**	**BI-TISSUE1**	**BI-TISSUE2**	**BI-TISSUE3**	**Mean**
kg TOC per kg lipid	**Ghost Shrimp**				**N=9**
2,3,7,8-TCDD		0.72 ± 0.24	0.59 ± 0.13	0.39 ± 0.02	0.57 ± 0.20
1,2,3,7,8-PeCDD		1.29 ± 0.40	1.15 ± 0.28	0.76 ± 0.03	1.07 ± 0.34
1,2,3,4,7,8-HxCDD		0.61 ± 0.19	0.89 ± 0.29	0.56 ± 0.02	0.68 ± 0.23
1,2,3,6,7,8-HxCDD		0.66 ± 0.18	1.00 ± 0.23	0.67 ± 0.06	0.78 ± 0.22
1,2,3,7,8,9-HxCDD		0.37 ± 0.11	0.53 ± 0.15	0.36 ± 0.02	0.42 ± 0.12
1,2,3,4,6,7,8-HpCDD		0.07 ± 0.02	0.14 ± 0.04	0.10 ± 0.01	0.11 ± 0.04
OCDD		0.04 ± 0.02	0.05 ± 0.01	0.03 ± 0.01	0.04 ± 0.02
2,3,7,8-TCDF			0.67 ± 0.20	0.45 ± 0.06	0.56 ± 0.18
1,2,3,7,8-PeCDF		0.84 ± 0.21	0.77 ± 0.12	0.54 ± 0.01	0.72 ± 0.18
2,3,4,7,8-PeCDF		0.99 ± 0.26	0.94 ± 0.17	0.57 ± 0.02	0.83 ± 0.25
1,2,3,4,7,8-HxCDF		0.63 ± 0.19	0.74 ± 0.18	0.49 ± 0.01	0.62 ± 0.17
1,2,3,6,7,8-HxCDF		0.48 ± 0.11	0.57 ± 0.14	0.43 ± 0.02	0.49 ± 0.11
1,2,3,7,8,9-HxCDF			0.33 ± 0.02	0.23	0.30 ± 0.06
2,3,4,6,7,8-HxCDF		0.26 ± 0.09	0.33 ± 0.07	0.26 ± 0.01	0.28 ± 0.07
1,2,3,4,6,7,8-HpCDF		0.11 ± 0.03	0.15 ± 0.03	0.11 ± 0.01	0.12 ± 0.03
1,2,3,4,7,8,9-HpCDF		0.07 ± 0.04	0.10 ± 0.02	0.06 ± 0.01	0.08 ± 0.03
OCDF		0.04 ± 0.01	0.06 ± 0.03	0.03 ± 0.01	0.04 ± 0.02
Congener	**BI-TR1-SF**	**BI-TR2-SF**	**BI-TR3-SF**	**BI-TR3-E**	**SF Mean**
kg TOC per kg lipid	**Starry Flounder and English Sole**				**N=9**
2,3,7,8-TCDD	0.47	0.63	0.75 ± 0.18	0.67	0.67 ± 0.18
1,2,3,7,8-PeCDD	0.17 ± 0.05	0.22 ± 0.13	0.48 ± 0.19	0.56 ± 0.13	0.32 ± 0.20
1,2,3,4,7,8-HxCDD			0.10	0.12 ± 0.02	0.10
1,2,3,6,7,8-HxCDD	0.05 ± 0.03	0.08 ± 0.04	0.15 ± 0.06	0.12 ± 0.03	0.10 ± 0.06
1,2,3,7,8,9-HxCDD	0.02 ± 0.00	0.02 ± 0.02	0.05 ± 0.01	0.04 ± 0.00	0.03 ± 0.02
1,2,3,4,6,7,8-HpCDD	0.00 ± 0.00	0.00 ± 0.00	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00
OCDD	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
2,3,7,8-TCDF	0.45 ± 0.13	0.79 ± 0.45	1.32 ± 0.32	1.83 ± 0.18	0.95 ± 0.48
1,2,3,7,8-PeCDF	0.08 ± 0.02	0.14 ± 0.05	0.24 ± 0.12	0.25 ± 0.06	0.17 ± 0.11
2,3,4,7,8-PeCDF	0.20 ± 0.06	0.28 ± 0.15	0.59 ± 0.20	0.87 ± 0.23	0.38 ± 0.23
1,2,3,4,7,8-HxCDF	0.04 ± 0.02	0.06 ± 0.04	0.13 ± 0.06	0.10 ± 0.02	0.08 ± 0.06
1,2,3,6,7,8-HxCDF	0.04 ± 0.02	0.07 ± 0.03	0.11 ± 0.05	0.08 ± 0.02	0.08 ± 0.05
1,2,3,7,8,9-HxCDF					
2,3,4,6,7,8-HxCDF	0.03 ± 0.00	0.06 ± 0.02	0.08 ± 0.02	0.09 ± 0.02	0.06 ± 0.02
1,2,3,4,6,7,8-HpCDF	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00
1,2,3,4,7,8,9-HpCDF					
OCDF	0.00 ± 0.00		0.01	0.01 ± 0.00	0.00 ± 0.00

TCDD and TCDF (and to a lesser extent PeCDD and PeCDF) have the highest BSAF for starry flounder and English sole (Table 5-2). Uptake of 2,3,7,8-TCDD in fish represents a shift towards a more toxic congener profile. Dioxin/furan uptake was similar between the starry flounder and English sole.

With the exception of the tetra- and penta- congeners, fish had the lowest BSAF for the organisms collected for this investigation. A direct linkage between fish tissue residue and sediment is difficult to ascertain due to the uncertainty of habitat range, residence time, and preferential feeding areas. Establishing an correlation between the tightly bound dioxin/furan congeners in sediment and the fish lipids is difficult. Preferential congener uptake plays a role, but the mechanism is unknown.

Fish and ghost shrimp have the most inconsistent BSAF between congeners. One possibility is that the congener profile (and differing BSAF values) of the fish and shrimp is a reflection of their diet, including potential different dioxin/furan sources from the water column or areas outside Budd Inlet (Bonn 1998).

The water column may have a different congener profile than the sediment, but since flounder and sole are bottom feeders, their potential uptake from the water column is not known relative to their dietary uptake. Typically, starry flounder have a limited range. Although juvenile and adult flounder have been recorded moving up rivers as far as 200 km, tagging studies have show that flounder rarely move more than 8 km (FWIE 1996). This is comparable to the distance between the southernmost and northernmost samples in the 2007 study, all of which had the same congener profile.

It is also possible that the fish and shrimp selectively absorb the lesser chlorinated congeners, or the higher chlorinated congeners are not as bioavailable. No BSAF literature values for starry flounder, English sole, or ghost shrimp were available, making a comparison difficult. BSAF values were available for several species including polychaetes, miscellaneous molluscs, and freshwater carp and trout. In all cases, these species had lower BSAF values for the octa- and hepta- chlorinated congeners than the tetra- and penta- congeners (USACE 2007).

Congener specific BSAF values were calculated for a paired bent nose clam/sediment sample that was collected at the DMMP Anderson-Ketron Disposal site in 2005 (Wakeman and Hoffman 2006). In this same report, BSAF values from Yunker and Cretney (2000) Dungeness crab hepatopancreas were reported. The Dungeness crab had BSAF values similar in magnitude to those of the ghost shrimp, while the bent nose clams from Anderson-Ketron had higher BSAF values for the octa- and hepta- dioxin/furan congeners than the crabs. This is similar to what was observed in the Budd Inlet samples (Table 5-1 and 5-2).

Unlike the differential uptake of the congener profiles for fish and shrimp, the congener profiles of the littleneck/manila and bent nose clams match that of the sediment, and the BSAF values for all congeners are similar for the clams. This is likely an issue of limited range, diet, and a reduced ability to metabolize chlorinated dioxins. Intertidal littleneck/manila and bent nose clams are exposed subjected to sediments that are resuspended by wave action during tidal changes. Also, bent nose clams are facultative deposit feeders that use their separate incurrent siphon to feed directly on organic matter that comes to rest on the sediment surface. Whether feeding by filtering resuspended fines or deposited organic matter, clams are directly exposed to the dioxin/furan congeners that are bound to these fractions of the sediments, explaining in part, why the congener profile of the clams is more similar to that of the sediment (Figure 5-4).

5.3 SMS Chemistry

Four samples exceeded the SMS criteria (Table 4-1). Two of these locations sites were intertidal beaches near Hardel Mutual Plywood/Reliable Steel, while the other two were the under-pier sediment core locations BI-C4 and BI-C5 near an outfall that discharges from the Cascade Pole site. These samples had the highest PAH concentrations measured as part of this investigation. Sample T1-Sed had the highest high molecular polycyclic aromatic hydrocarbon (HPAH) concentration of all sites at 617 mg/kg TOC. The under-pier cores had concentrations of 234 mg/kg TOC, 366 mg/kg TOC, and 400 mg/kg TOC for HPAH in samples BI-C4-3–4ft, BI-C4-6–7ft, and BI-C5-6–7ft, respectively. Prior to remediation, Cascade Pole surface sediment had high concentrations of PAHs (mean of 1,392 mg/kg TOC for low molecular PAH, 794 mg/kg TOC for high molecular PAH) (Landau 1993).

The same three under-pier samples with HPAH concentrations had elevated concentrations of mercury at 0.39, 0.32, and 0.91 mg/kg for samples BI-C4-3–4ft, BI-C4-6–7ft, and BI-C5-6–7ft, respectively. BI-S4, located in Fiddlehead Marina near the approximate location of the LOTT emergency outfall, also had a high concentration of mercury at 0.395 mg/kg. The only other location with mercury over 0.30 mg/kg was BI-TISSUE1B-Sediment near Hardel Mutual Plywood.

Given the elevated concentrations of PAHs and mercury in these areas of East Bay, more extensive sampling may be needed to delineate the extent of contamination.

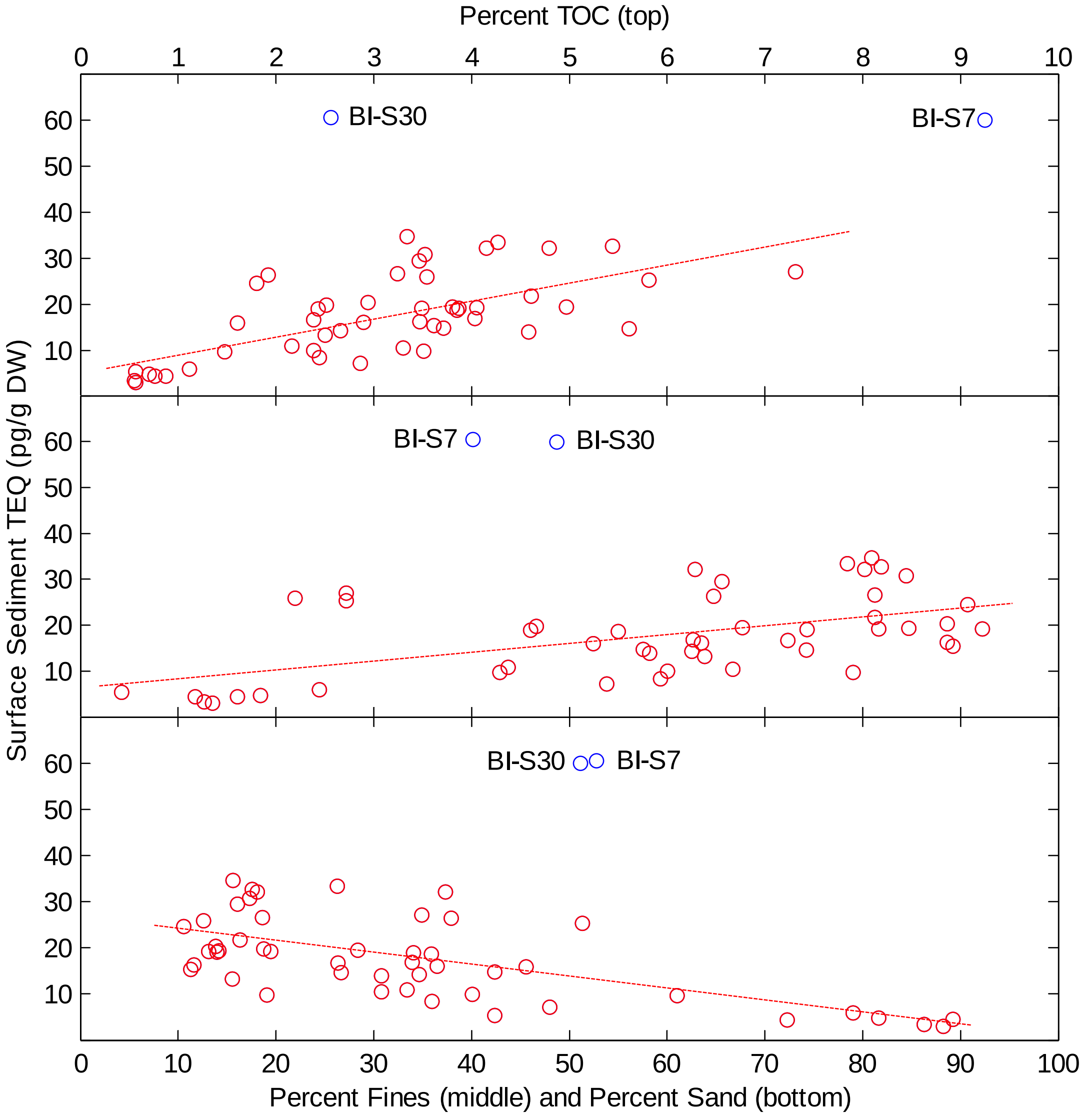

Figure 5-1. Correlations between TEQ and TOC, percent fines, and percent sand Outliers are marked in blue. Regression lines were calculated excluding the outliers.

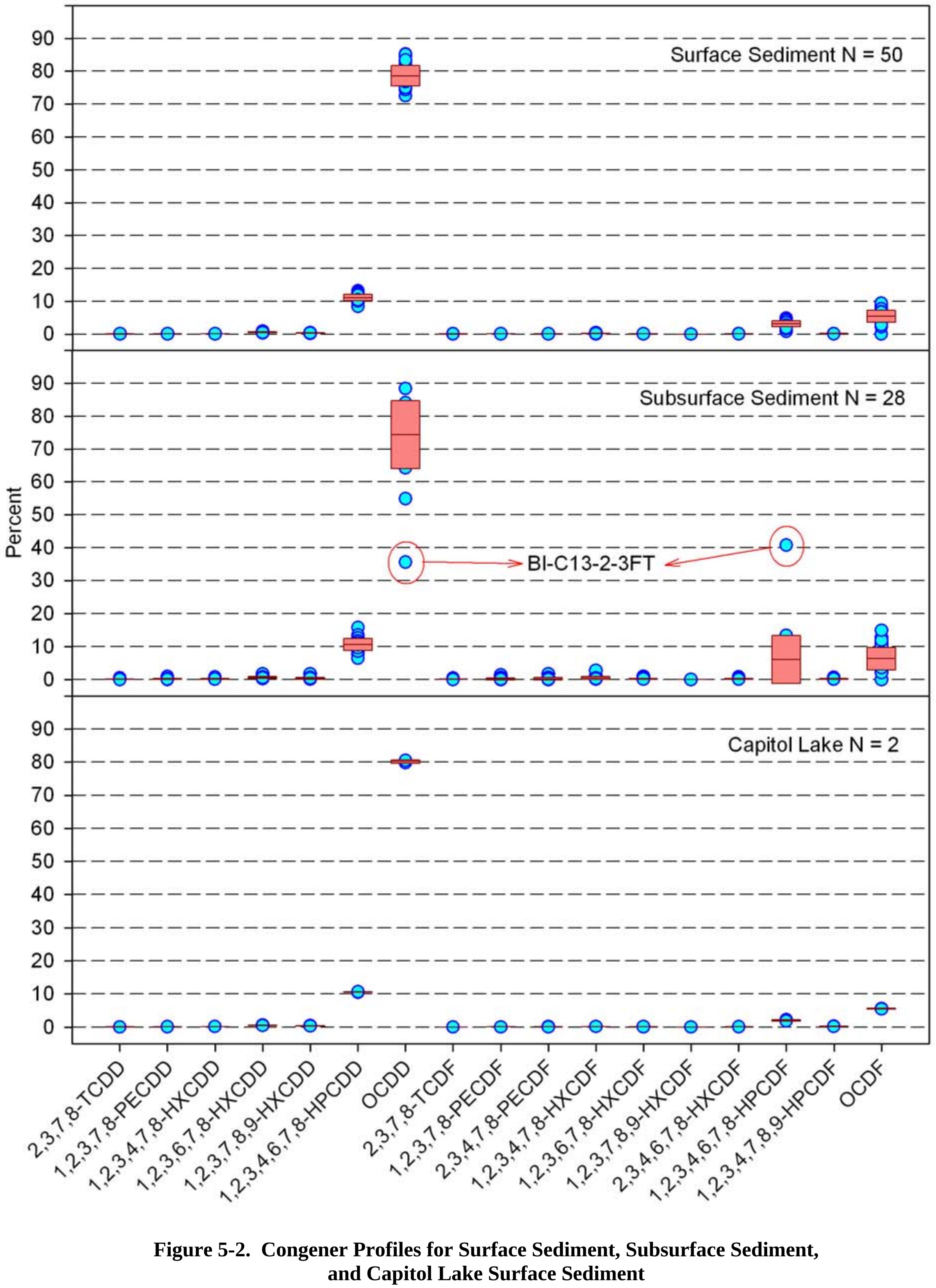

Figure 5-2. Congener Profiles for Surface Sediment, Subsurface Sediment, and Capitol Lake Surface Sediment
Individual samples are represented by the blue dots. Red boxes represent the mean and plus or minus one standard deviation.

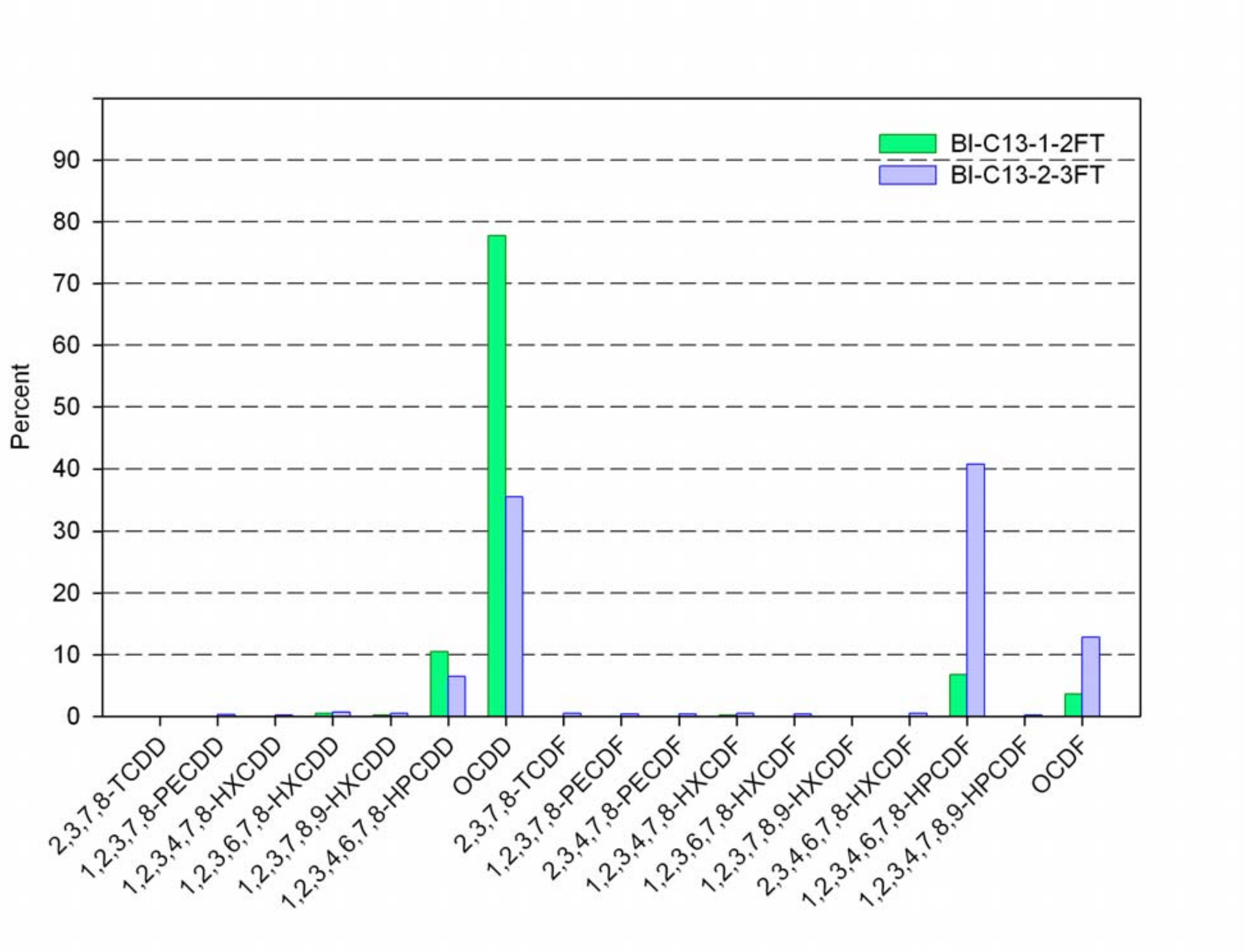

Figure 5-3. Comparison of BI-C13-1-2FT and BIC13-2-3FT

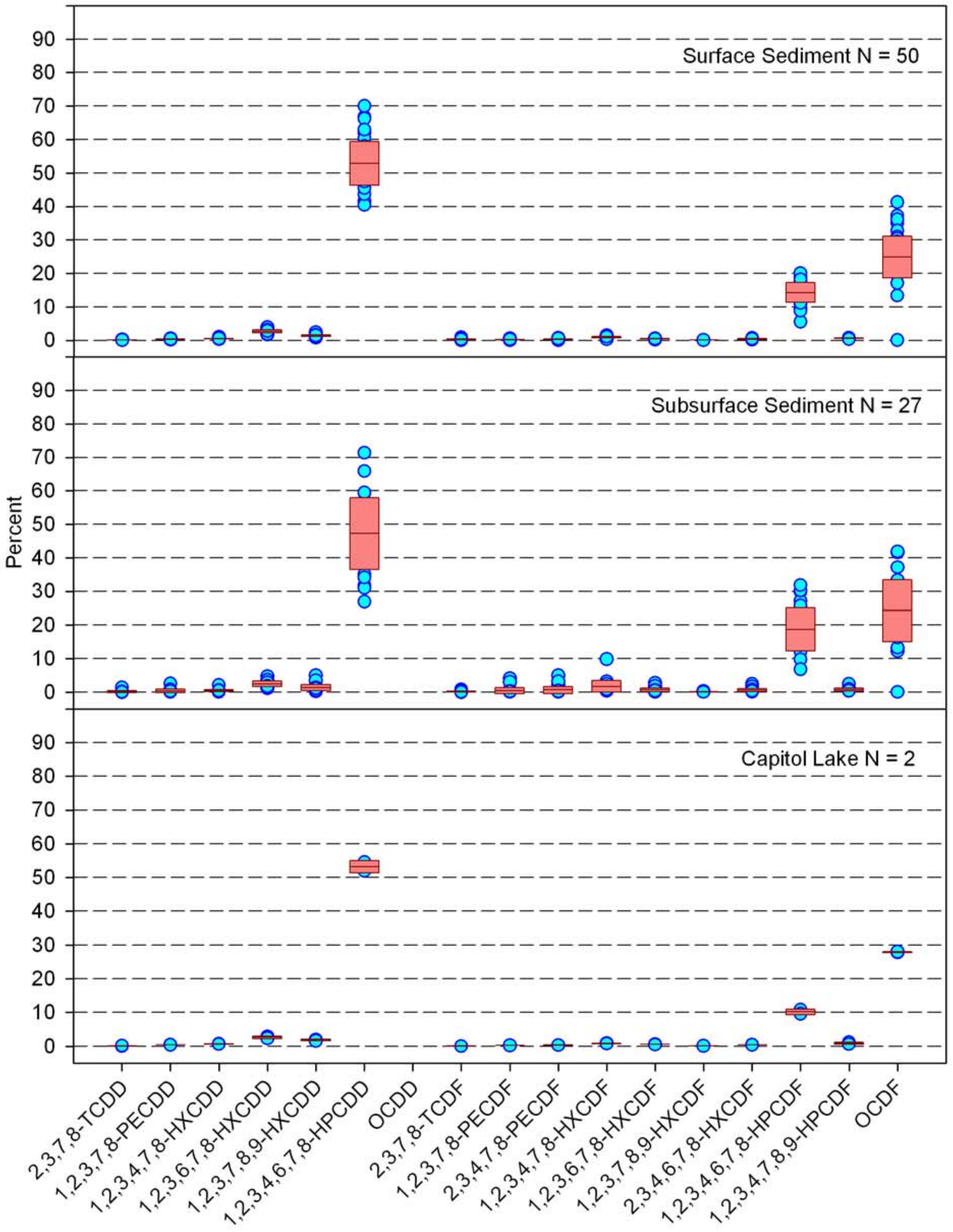

Figure 5-4. Congener Profiles for Surface Sediment, Subsurface Sediment, and Capitol Lake Surface Sediment excluding OCDD Individual samples are represented by the blue dots. Red boxes represent the mean and plus or minus one standard deviation.

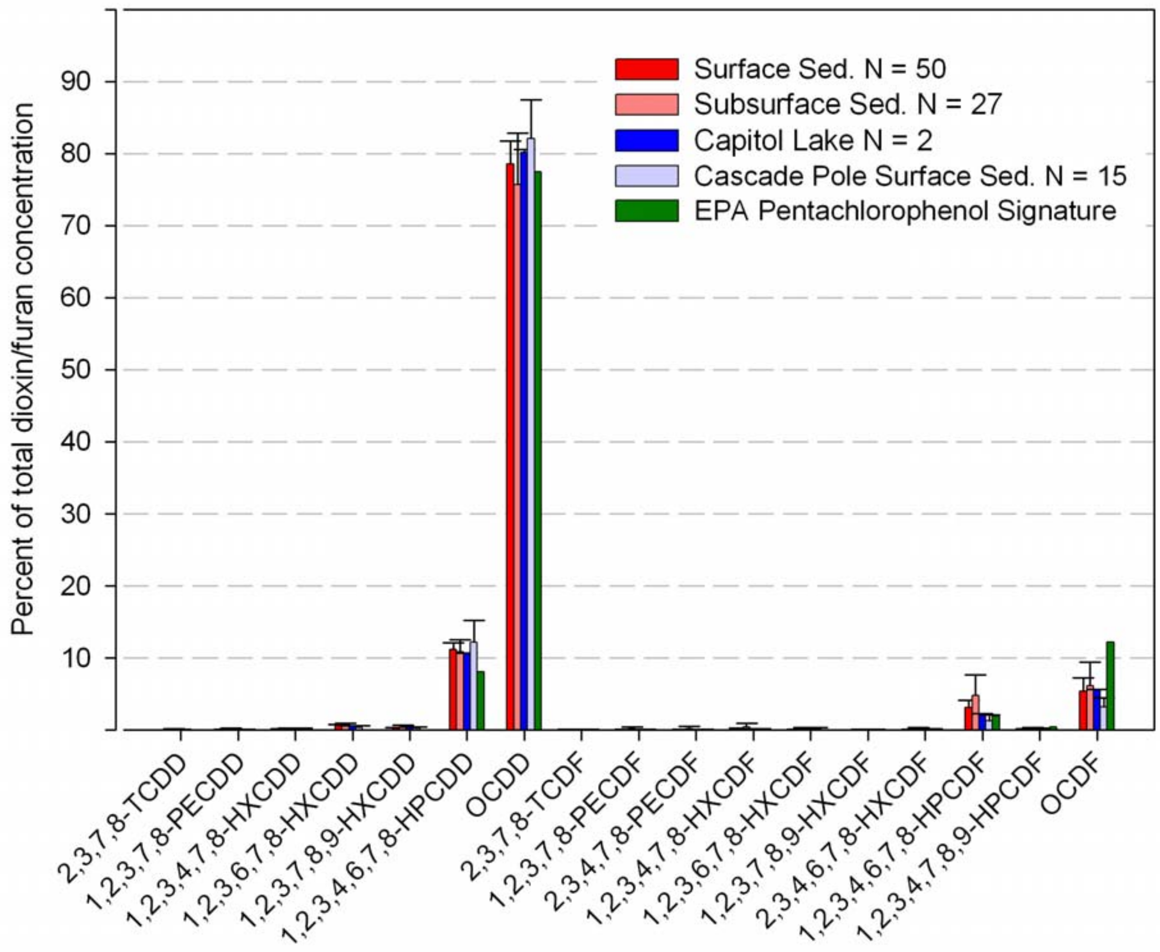

Figure 5-5. Mean Congener Profiles for Surface, Subsurface, and Capitol Lake Sediment Also included are the Cascade Pole intertidal surface samples and the USEPA PCP source profile. Error bars are the standard deviation.

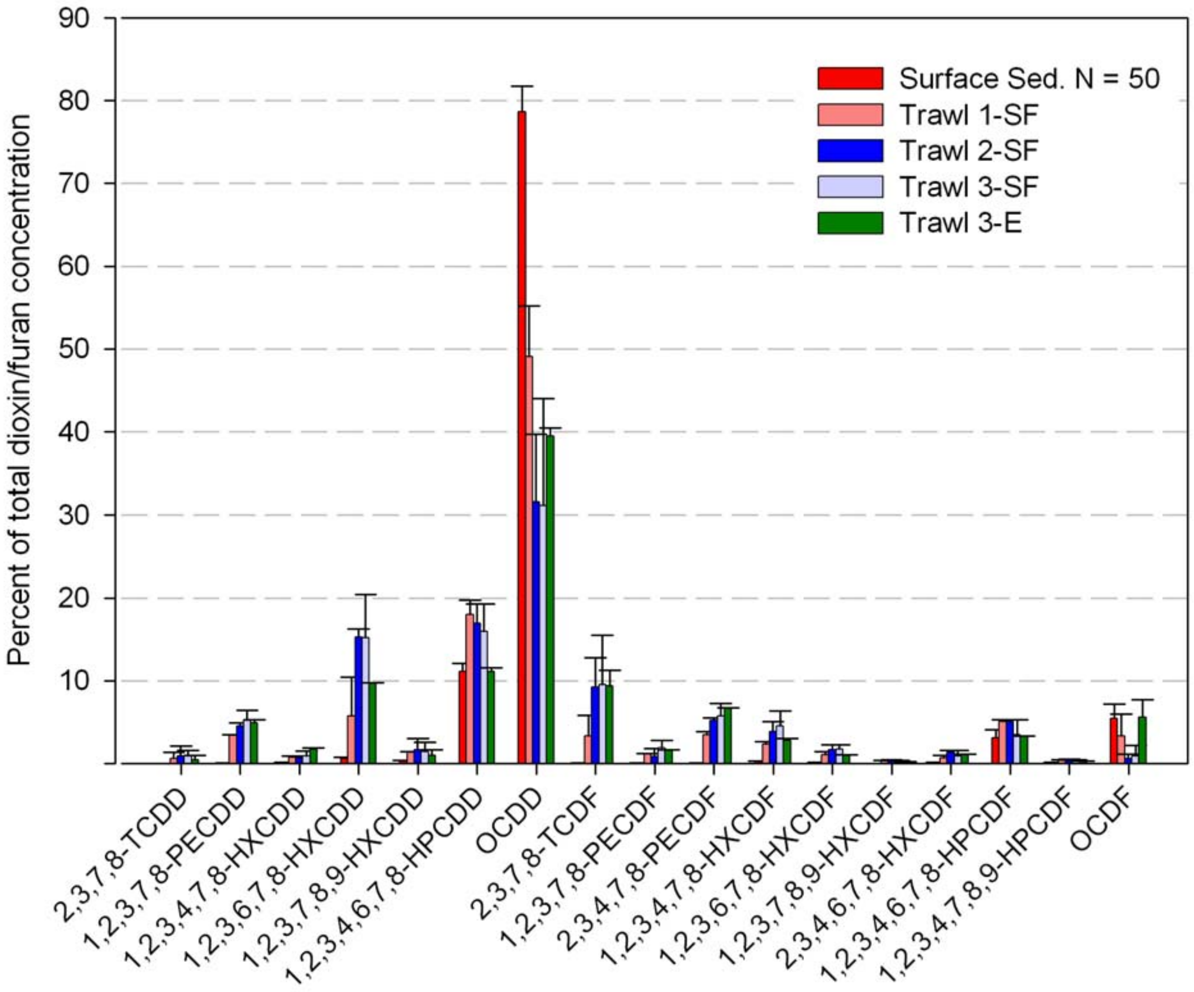

Figure 5-6. Congener Profiles for Budd Inlet Sediment, Starry Flounder (SF), and English Sole (E) Error bars represent the standard deviation.

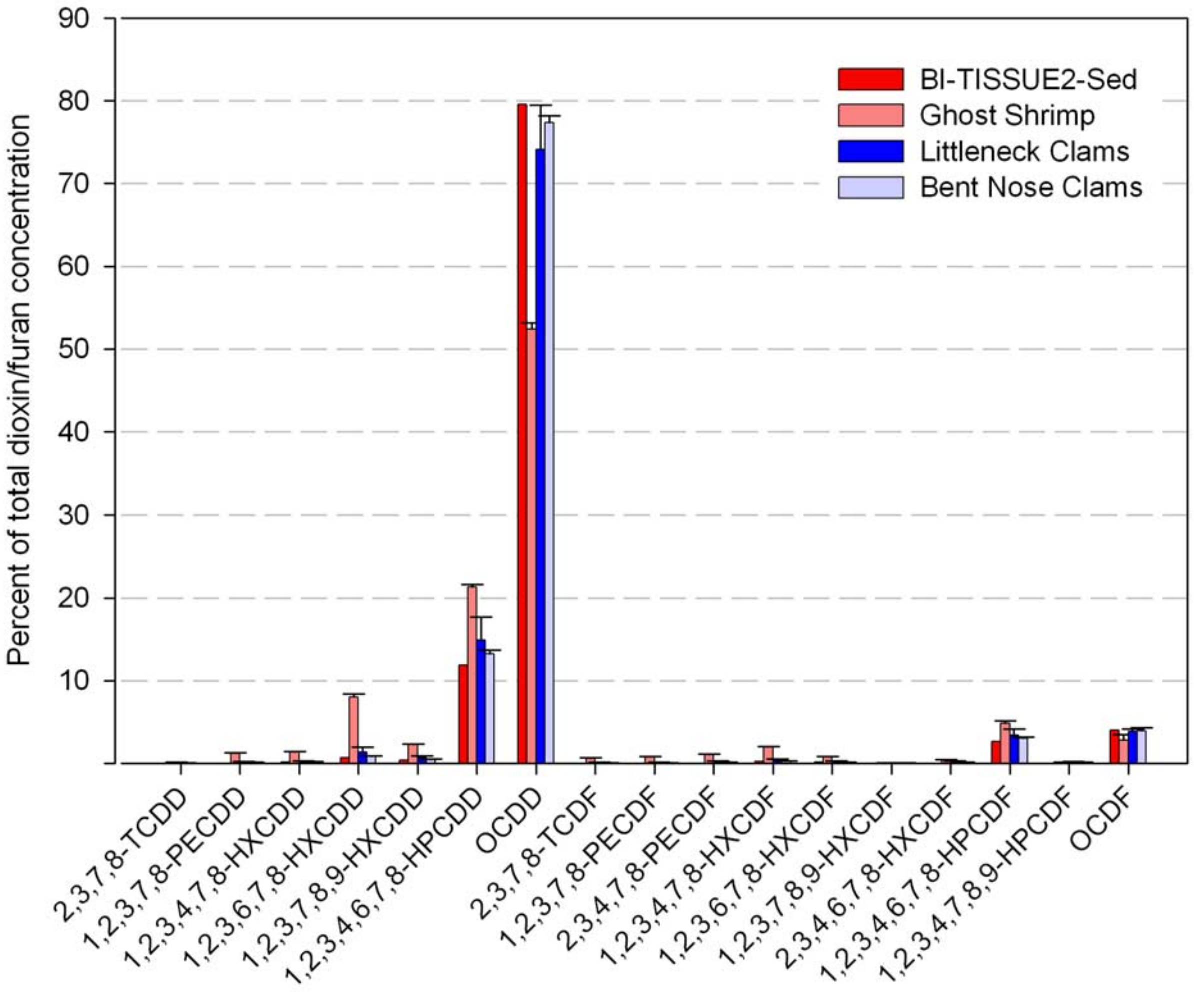

Figure 5-7. Congener Profile for Sediment, Ghost Shrimp, Littleneck/Manila Clams, and Bent Nose Clams at Site BI-Tissue2
Error bars represent the standard deviation.

6.0 Summary and Identification of Data Gaps

6.1 Summary

Dioxin/furan contaminated sediments are dispersed throughout Budd Inlet, with TEQ concentrations ranging from 2.9 to 60.3 pg/g and averaging 19.1 pg/g in surface (0–10 cm) sediments. The highest concentrations were found in areas with high TOC and percent fines (near Hardel Mutual Plywood and beneath the pier at the Port of Olympia marine terminal facility), and the lowest concentrations were found in areas of high sand content (offshore of Priest Point Park). Concentrations for the two samples collected in Capitol Lake were 2.0 and 3.9 pg/g TEQ (Figures 4-1 and 4-2). A background dioxin/furan concentration was not identified in the northern portion of Budd Inlet to bound the spatial distribution of contamination.

Subsurface sediment samples had a wider range of dioxin/furan concentrations. In most cases, the dioxin/furan TEQ decreased with depth. The two primary exceptions were cores BI-C4 and BI-C5, both of which are located beneath the Port of Olympia pier. In both cases, TEQ concentrations were high and increased with depth. The 6–7-foot interval at BI-C5 had a TEQ of 4,213 pg/g, the highest measured in this study (Figure 4-3). Both cores also had elevated concentrations of PAHs. Prior to remediation, the ranges of dioxin/furan and PAH concentrations at the Cascade Pole site were the same order of magnitude as those measured in cores BI-C4 and BI-C5, implying a common source.

All sediment samples in Budd Inlet had a similar dioxin/furan congener profile, or fingerprint. The congener profiles of the 2007 Budd Inlet sediment samples were comparable to that of the Cascade Pole MTCA site prior to remediation. Both profiles were a clear visual match with the known profile of congeners in PCP (Figure 5-5). PCP was used as a wood preservative at Cascade Pole. Elevated dioxin/furan concentrations near the Hardel Mutual Plywood (BI-S7) site and the Moxlie Creek discharge (BI-S30) also showed a congener profile similar to PCP. TEQ concentrations at both of these sites did not display the same relationship to TOC, percent fines, and percent sand as the other surface sediment samples (Figure 5-1). Additional source and sediment evaluations may be needed at these sites to determine whether they have significant sources of dioxin/furan contamination through the use of PCP. Additional current studies in inner Budd Inlet may also be needed to determine whether circulation patterns could result in the transport and accumulation of dioxins/furans (originating from Cascade Pole sources) to these areas.

For the tissue samples collected, only the littleneck/manila and bent nose clams matched the dioxin/furan congener profile of the sediment. The profile for the fish and ghost shrimp had fewer of the octa-chlorinated dioxins/furans and more of the lesser chlorinated congeners. BSAF values were calculated for all fish and benthic invertebrates to evaluate the uptake of dioxin/furan congeners (Tables 5-1 and 5-2). While no direct literature comparisons existed for the species sampled at Budd Inlet, BSAF values for other marine organisms show the same trend of preferential uptake of lesser chlorinated dioxin/furan congeners, suggesting that uptake, not different sources, are responsible for the congener profile of the fish and ghost shrimp.

Three cores were collected for the purpose of radioisotope dating. Due to dredging or remediation within Budd Inlet, the sedimentation rates calculated from these cores are not necessarily representative of all samples. Two of the cores, D1 and D3, show a change in sedimentation rate in the early 1950s that correspond with the creation of Capitol Lake (Figure 4-4). However, sedimentation rates were low before and after that time, ranging from 0.24 to 0.68 g/cm^2/yr. If the estuary restoration plan (i.e., dam removal) is implemented in Budd Inlet, the sedimentation rate history suggests that the return of the Deschutes River sediment load to southern Budd Inlet may not significantly increase sedimentation rates in areas unaltered by human activity.

6.2 Data Gaps

The following data gaps were identified based on the results of the 2007 Budd Inlet Sediment Characterization Study:

- The spatial distribution of dioxin/furan contamination in Budd Inlet surface sediments was not bounded in the northern portion of the inlet. Additional dioxin/furan testing in the North Inlet would be required to determine this boundary.

- Sediment cores collected under the pier of the Port of Olympia marine terminal facility identified a localized accumulation of dioxin/furan contamination. Additional evaluation is needed to better delineate the vertical and spatial extent of this contamination.

- Additional evaluation is needed at the Hardel Mutual Plywood site and the Moxlie Creek discharge to determine whether these sites are significant sources of dioxin/furan contamination through the use of PCP as a wood preservative, or if Cascade Pole was the source of accumulation to these areas based on water circulation patterns in inner Budd Inlet.

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APPENDIX A

Geographic Coordinates of Sampling Locations

Table A-1. Budd Inlet Surface Grab Sample Locations – R/V Kittiwake

Station No.	Sample Rep.	Date	GPS Time	Meter Block Depth m.	Meter Block Depth ft.	Predicted Nearest Tide ft.	Predicted Mudline Depth, ft. (MLLW)	Station Target NAD 1983 / Wash. South Easting (X)	Station Target NAD 1983 / Wash. South Northing (Y)	Sample Location DGPS, Trimble NT300D NAD 1983, Wash. South Easting (X)	Sample Location DGPS, Trimble NT300D NAD 1983, Wash. South Northing (Y)	Sample Location DGPS, Trimble NT300D NAD 1983, Decimal Minutes Latitude	Sample Location DGPS, Trimble NT300D NAD 1983, Decimal Minutes Longitude	Distance to Target (m.)	GPS Status HDOP	Comments
BI-C01	1	12-Apr	0923	5.5	18.0	7.2	-10.8	1040461.7	635422.4	1040462.0	635422.6	47 03.0406	122 54.4286	0.1	1.0	
BI-C01	2		0931	5.5	18.0	7.2	-10.8	1040461.7	635422.4	1040462.9	635425.6	47 03.0411	122 54.4284	1.1	1.1	
BI-C02	1	12-Apr	0948	2.7	8.9	7.3	-1.6	1039601.9	636175.4	1039601.7	636172.6	47 03.1596	122 54.6411	0.9	1.0	
BI-C02	2		0957	2.6	8.5	7.4	-1.1	1039601.9	636175.4	1039600.1	636175.7	47 03.1601	122 54.6415	0.6	1.1	
BI-C05	1	14-Apr	1644	14.0	45.9	11.7	-34.2	1040924.5	637174.0	1040767.2	637183.6	47 03.3317	122 54.3681	48.0	1.8	Tied to dock
BI-C05	2		1650	13.8	45.3	11.6	-33.7	1040924.5	637174.0	1040766.1	637187.9	47 03.3324	122 54.3684	48.5	1.6	west of
BI-C05	3		1655	13.8	45.3	11.5	-33.8	1040924.5	637174.0	1040768.8	637181.7	47 03.3314	122 54.3677	47.5	1.8	station
BI-C06	1	12-Apr	1151	4.3	14.1	9.6	-4.5	1040071.9	638741.0	1040069.2	638741.7	47 03.5844	122 54.5475	0.9	0.9	
BI-C06	2		1201	4.3	14.1	9.8	-4.3	1040071.9	638741.0	1040074.6	638739.7	47 03.5841	122 54.5462	0.9	0.9	
BI-C07	1	12-Apr	1414	4.6	15.1	10.2	-4.9	1041025.2	639208.5	1041027.3	639208.7	47 03.6660	122 54.3204	0.6	1.1	
BI-C07	2		1424	4.2	13.8	10.1	-3.7	1041025.2	639208.5	1041025.6	639207.6	47 03.6658	122 54.3208	0.3	1.1	
BI-C08	1	12-Apr	1352	3.9	12.8	10.5	-2.3	1041914.4	639173.5	1041915.5	639174.3	47 03.6648	122 54.1064	0.4	1.3	
BI-C08	2		1403	3.8	12.5	10.4	-2.1	1041914.4	639173.5	1041915.4	639171.3	47 03.6643	122 54.1064	0.7	1.3	
BI-C09	1	11-Apr	1704	5.8	19.0	3.2	-15.8	1043052.8	638649.1	1043052.0	638651.4	47 03.5845	122 53.8291	0.8	1.7	
BI-C09	2		1712	5.4	17.7	3.0	-14.7	1043052.8	638649.1	1043052.8	638650.8	47 03.5844	1224 53.8289	0.5	1.8	
BI-C10	1	13-Apr	1224	6.9	22.6	8.4	-14.2	1043222.1	637336.4	1043219.2	637313.9	47 03.3654	122 53.7791	6.9	1.0	Moved sta.
BI-C10	2		1231	7.2	23.6	8.4	-15.2	1043222.1	637336.4	1043219.9	637312.0	47 03.3651	122 53.7789	7.5	1.0	dock
BI-C11	1	14-Apr	0953	11.8	38.7	4.3	-34.4	1037613.3	644766.9	1037616.0	644767.6	47 04.5629	122 55.1823	0.8	1.1	
BI-C11	2		1001	12.0	39.4	4.2	-35.2	1037613.3	644766.9	1037612.6	644767.1	47 04.5628	122 55.1831	0.2	1.1	
BI-C12	1	13-Apr	1607	13.0	42.7	10.1	-32.6	1036905.1	646414.4	1036905.4	646413.8	47 04.8300	122 55.3655	0.2	1.4	
BI-C12	2		1612	13.1	43.0	10.0	-33.0	1036905.1	646414.4	1036905.0	646413.2	47 04.8299	122 55.3656	0.4	1.4	
BI-C13	1	13-Apr	1516	3.3	10.8	10.9	0.1	1042283.5	638605.8	1042282.6	638604.3	47 03.5729	122 54.0139	0.5	1.5	
BI-C13	2		1523	3.5	11.5	10.9	-0.6	1042283.5	638605.8	1042282.3	638606.7	47 03.5733	122 54.0140	0.5	1.5	
BI-C14	1	13-Apr	1150	5.0	16.4	7.6	-8.8	1040959.4	637705.5	1040957.7	637706.3	47 03.4186	122 54.3261	0.6	0.9	
BI-C14	2		1157	5.0	16.4	7.7	-8.7	1040959.4	637705.5	1040959.0	637706.2	47 03.4186	122 54.3258	0.3	0.9	

Table A-1. Budd Inlet Surface Grab Sample Locations – R/V Kittiwake (continued)

Station No.	Sample Rep.	Date	GPS Time	Meter Block Depth m.	Meter Block Depth ft.	Predicted Nearest Tide ft.	Predicted Mudline Depth, ft. (MLLW)	Station Target NAD 1983 / Wash. South		Sample Location DGPS, Trimble NT300D NAD 1983, Wash. South		Sample Location DGPS, Trimble NT300D NAD 1983, Decimal Minutes		Distance to Target No.	GPS Status Rep.	Station
								Easting (X)	Northing (Y)	Easting (X)	Northing (Y)	Latitude	Longitude			
BI-C15	1	12-Apr	1010	15.6	51.2	7.6	-43.6	1040795.3	636116.2	1040795.3	636114.9	47 03.1561	122 54.3535	0.4	1.2	
BI-C15	2		1018	15.6	51.2	7.7	-43.5	1040795.3	636116.2	1040794.9	636114.9	47 03.1561	122 54.3536	0.4	1.2	
BI-C16	1	12-Apr	1029	13.3	43.6	7.9	-35.7	1040693.8	636511.9	1040691.9	636511.5	47 03.2208	122 54.3813	0.6	1.1	
BI-C16	2		1036	13.3	43.6	8.0	-35.6	1040693.8	636511.9	1040694.3	636510.8	47 03.2207	122 54.3807	0.4	1.1	
BI-C17	1	14-Apr	1013	8.0	26.2	4.1	-22.1	1039282.9	643193.9	1039284.5	643194.3	47 04.3126	122 54.7691	0.5	1.2	
BI-C17	2		1018	8.0	26.2	4.1	-22.1	1039282.9	643193.9	1039283.3	643195.5	47 04.3128	122 54.7694	0.5	1.1	
BI-C18	1	13-Apr	1404	2.8	9.2	10.9	1.7	1043622.2	634834.2	1043618.9	634834.5	47 02.9597	122 53.6648	1.0	1.1	
BI-C18	2		1410	2.6	8.5	11.0	2.5	1043622.2	634834.2	1043623.9	634835.0	47 02.9598	122 53.6636	0.6	1.1	
BI-C18	3		1419	2.5	8.2	11.0	2.8	1043622.2	634834.2	1043624.8	634836.2	47 02.9600	122 53.6634	1.0	1.1	
BI-S01	1	11-Apr	1435	8.9	29.2	8.9	-20.3	1040140.7	633665.2	1040139.9	633665.8	47 02.7501	122 54.4932	0.3	1.0	Moved sta.
BI-S01	2		1453	9.0	29.5	7.5	-22.0	1040140.7	633665.2	1040144.4	633665.1	47 02.7500	122 54.4921	1.1	0.9	east
BI-S02	1	12-Apr	0900	5.2	17.1	7.2	-9.9	1040511.3	634591.6	1040511.9	634593.4	47 02.9045	122 54.4105	0.6	1.0	
BI-S02	2		0911	5.1	16.7	7.2	-9.5	1040511.3	634591.6	1040512.7	634591.0	47 02.9041	122 54.4103	0.5	1.2	
BI-S03	1	12-Apr	1222	2.9	9.5	10.2	0.7	1040002.5	634884.7	1040005.8	634885.0	47 02.9499	122 54.5344	1.0	1.4	
BI-S03	2		1232	3.2	10.5	10.3	-0.2	1040002.5	634884.7	1040003.4	634885.7	47 02.9500	122 54.5350	0.4	1.0	
BI-S04	1	13-Apr	0922	4.9	16.1	5.9	-10.2	1040698.6	635045.6	1040952.0	635106.0	47 02.9910	122 54.3084	79.4	1.0	Moved 80 m.
BI-S04	2		0929	4.9	16.1	5.8	-10.3	1040698.6	635045.6	1040953.4	635110.2	47 02.9917	122 54.3081	80.1	1.0	east, ne
BI-S04	3		0936	4.9	16.1	5.8	-10.3	1040698.6	635045.6	1040954.1	635107.8	47 02.9913	122 54.3079	80.1	1.0	
BI-S05	1	12-Apr	1244	2.5	8.2	10.5	2.3	1039172.8	636848.3	1039335.5	636860.0	47 03.2713	122 54.7102	49.7	1.0	Moved sta.
BI-S05	2		1254	2.7	8.9	10.6	1.7	1039172.8	636848.3	1039333.9	636860.7	47 03.2714	122 54.7106	49.2	1.2	east
BI-S06	1	12-Apr	1304	3.1	10.2	10.6	0.4	1039301.5	637942.6	1039302.1	637942.3	47 03.4491	122 54.7262	0.2	1.2	
BI-S06	2		1313	3.1	10.2	10.6	0.4	1039301.5	637942.6	1039301.3	637942.4	47 03.4491	122 54.7264	0.1	1.2	
BI-S07	1	12-Apr	1328	2.5	8.2	10.6	2.4	1039051.2	638557.7	1039051.6	638556.3	47 03.5488	122 54.7910	0.4	1.3	
BI-S07	2		1335	2.5	8.2	10.6	2.4	1039051.2	638557.7	1039051.2	638556.3	47 03.5488	122 54.7911	0.4	1.2	
BI-S09	1	13-Apr	1449	2.9	9.5	11.1	1.6	1043538.6	636828.2	1043535.6	636826.9	47 03.2869	122 53.6994	1.0	0.9	
BI-S09	2		1457	3.1	10.2	11.1	0.9	1043538.6	636828.2	1043538.2	636829.2	47 03.2873	122 53.6988	0.3	0.9	

Table A-1. Budd Inlet Surface Grab Sample Locations – R/V Kittiwake (continued)

								Station Target NAD 1983 / Wash. South		Sample Location DGPS, Trimble NT300D NAD 1983, Wash. South		Sample Location DGPS, Trimble NT300D NAD 1983, Decimal Minutes				
Station No.	Sample Rep.	Date	GPS Time	Meter Block Depth m.	Meter Block Depth ft.	Predicted Nearest Tide ft.	Predicted Mudline Depth, ft. (MLLW)	Easting (X)	Northing (Y)	Easting (X)	Northing (Y)	Latitude	Longitude	Distance to Target No.	GPS Status Rep.	Station
BI-S09	3		1502	3.0	9.8	11.0	1.2	1043538.6	636828.2	1043538.5	636826.8	47 03.2869	122 53.6987	0.4	1.4	
BI-S10	1	13-Apr	1429	4.0	13.1	11.1	-2.0	1043392.8	635555.3	1043393.1	635555.3	47 03.0771	122 53.7244	0.1	0.9	
BI-S10	2		1437	4.0	13.1	11.1	-2.0	1043392.8	635555.3	1043393.5	635554.7	47 03.0770	122 53.7243	0.3	0.9	
BI-S11	1	13-Apr	0843	7.4	24.3	6.5	-17.8	1040902.6	633996.0	1040899.0	633997.2	47 02.8084	122 54.3130	1.1	1.0	
BI-S11	2		0851	7.0	23.0	6.3	-16.7	1040902.6	633996.0	1040903.1	633995.2	47 02.8081	122 54.3120	0.3	1.0	
BI-S12	1	13-Apr	1533	4.6	15.1	10.7	-4.4	1042953.0	639512.4	1042953.5	639512.5	47 03.7256	122 53.8591	0.2	1.4	
BI-S12	2		1543	4.8	15.7	10.6	-5.1	1042953.0	639512.4	1042956.5	639513.6	47 03.7258	122 53.8584	1.1	1.2	
BI-S13	1	11-Apr	1643	4.0	13.1	3.9	-9.2	1042020.6	640332.9	1042024.8	640332.0	47 03.8557	122 54.0886	1.3	1.6	
BI-S13	2		1652	3.9	12.8	3.6	-9.2	1042020.6	640332.9	1042024.8	640332.0	47 03.8557	122 54.0886	1.3	1.6	
BI-S14	1	11-Apr	1620	3.0	9.8	4.7	-5.1	1041110.1	640121.0	1041110.4	640122.7	47 03.8167	122 54.3071	0.5	1.4	
BI-S14	2		1628	2.9	9.5	4.4	-5.1	1041110.1	640121.0	1041110.0	640123.3	47 03.8168	122 54.3072	0.7	1.4	
BI-S15	1	14-Apr	1320	3.2	10.5	8.2	-2.3	1042430.2	641281.1	1042430.6	641282.3	47 04.0140	122 53.9979	0.4	1.6	
BI-S15	2		1324	3.2	10.5	8.3	-2.2	1042430.2	641281.1	1042430.6	641282.9	47 04.0141	122 53.9979	0.6	1.5	
BI-S16	1	13-Apr	1003	4.3	14.1	5.7	-8.4	1039798.0	640389.0	1039798.0	640391.4	47 03.8543	122 54.6249	0.7	1.1	
BI-S16	2		1012	4.7	15.4	5.8	-9.6	1039798.0	640389.0	1039800.7	640386.4	47 03.8535	122 54.6242	1.1	1.1	
BI-S17	1	13-Apr	1023	5.9	19.4	5.8	-13.6	1039233.5	641229.9	1039231.9	641230.3	47 03.9894	122 54.7673	0.5	1.1	
BI-S17	2		1030	5.9	19.4	5.9	-13.5	1039233.5	641229.9	1039233.2	641230.9	47 03.9895	122 54.7670	0.3	1.1	
BI-S18	1	14-Apr	1029	5.4	17.7	4.0	-13.7	1040265.9	641902.8	1040268.4	641902.9	47 04.1052	122 54.5228	0.8	1.1	
BI-S18	2		1038	5.8	19.0	4.0	-15.0	1040265.9	641902.8	1040266.0	641904.8	47 04.1055	122 54.5234	0.6	1.1	
BI-S19	1	14-Apr	1452	3.8	12.5	11.3	-1.2	1041518.4	641896.6	1041521.4	641896.9	47 04.1105	122 54.2212	0.9	0.9	
BI-S19	2		1459	3.8	12.5	11.4	-1.1	1041518.4	641896.6	1041519.8	641898.1	47 04.1107	122 54.2216	0.6	1.2	
BI-S19	3		1507	3.8	12.5	11.6	-0.9	1041518.4	641896.6	1041522.7	641896.8	47 04.1105	122 54.2209	1.3	1.2	
BI-S20	1	12-Apr	1757	5.7	18.7	4.0	-14.7	1040022.5	643067.4	1040022.7	643067.7	47 04.2955	122 54.5905	0.1	1.1	
BI-S20	2		1803	5.6	18.4	3.8	-14.6	1040022.5	643067.4	1040026.4	643065.7	47 04.2952	122 54.5896	1.3	1.1	
BI-S21	1	13-Apr	1039	7.9	25.9	6.0	-19.9	1038477.8	642421.6	1038478.0	642421.1	47 04.1814	122 54.9575	0.2	1.1	
BI-S21	2		1045	7.8	25.6	6.1	-19.5	1038477.8	642421.6	1038476.4	642422.3	47 04.1816	122 54.9579	0.5	1.1	
BI-S22	1	12-Apr	1742	6.2	20.3	4.5	-15.8	1039241.1	644383.9	1039240.8	644385.7	47 04.5083	122 54.7884	0.6	1.5	
BI-S22	2		1748	6.1	20.0	4.3	-15.7	1039241.1	644383.9	1039240.0	644386.4	47 04.5084	122 54.7886	0.8	1.1	

Table A-1. Budd Inlet Surface Grab Sample Locations – R/V Kittiwake (continued)

Station No.	Sample Rep.	Date	GPS Time	Meter Block Depth m.	Meter Block Depth ft.	Predicted Nearest Tide ft.	Predicted Mudline Depth, ft. (MLLW)	Station Target NAD 1983 / Wash. South Easting (X)	Northing (Y)	Sample Location DGPS, Trimble NT300D NAD 1983, Wash. South Easting (X)	Northing (Y)	Sample Location DGPS, Trimble NT300D NAD 1983, Decimal Minutes Latitude	Longitude	Distance to Target No.	GPS Status Rep.	Station
BI-S23	1	12-Apr	1725	6.2	20.3	5.1	-15.2	1039203.1	646129.1	1039202.0	646130.5	47 04.7950	122 54.8106	0.6	1.3	
BI-S23	2		1732	6.0	19.7	4.8	-14.9	1039203.1	646129.1	1039204.0	646129.2	47 04.7948	122 54.8101	0.3	1.3	
BI-S24	1	12-Apr	1708	11.9	39.0	5.6	-33.4	1035594.4	647789.1	1035594.7	647790.2	47 05.0497	122 55.6912	0.4	1.9	
BI-S24	2		1714	11.5	37.7	5.5	-32.2	1035594.4	647789.1	1035594.0	647792.1	47 05.0500	122 55.6914	0.9	1.3	
BI-S25	1	12-Apr	1652	19.0	62.3	6.2	-56.1	1036079.3	650223.3	1036080.8	650221.3	47 05.4519	122 55.5922	0.8	1.8	
BI-S25	2		1658	19.0	62.3	6.0	-56.3	1036079.3	650223.3	1036080.0	650221.9	47 05.4520	122 55.5924	0.5	1.8	
BI-S26	1	12-Apr	1631	14.0	45.9	6.9	-39.0	1038183.6	651117.2	1038187.4	651115.0	47 05.6095	122 55.0916	1.3	1.9	
BI-S26	2		1642	14.0	45.9	6.5	-39.4	1038183.6	651117.2	1038186.6	651115.0	47 05.6095	122 55.0918	1.1	1.9	
BI-S27	1	12-Apr	1608	9.2	30.2	7.6	-22.6	1040223.8	649442.6	1040225.4	649441.0	47 05.3445	122 54.5886	0.7	1.6	
BI-S27	2		1615	9.1	29.9	7.4	-22.5	1040223.8	649442.6	1040222.5	649441.1	47 05.3445	122 54.5893	0.6	1.6	
BI-S28	1	12-Apr	1543	16.1	52.8	8.3	-44.5	1039639.1	657802.1	1039642.5	657798.5	47 06.7158	122 54.7905	1.5	1.5	
BI-S28	2		1550	16.1	52.8	8.1	-44.7	1039639.1	657802.1	1039641.3	657799.1	47 06.7159	122 54.7908	1.1	1.2	
BI-S29	1	12-Apr	1522	13.9	45.6	8.9	-36.7	1039480.1	664186.0	1039481.1	664186.7	47 07.7654	122 54.8765	0.4	1.5	
BI-S29	2		1529	14.0	45.9	8.7	-37.2	1039480.1	664186.0	1039480.7	664187.3	47 07.7655	122 54.8766	0.4	1.5	
BI-S31	1	14-Apr	1107	3.4	11.2	4.2	-7.0	1042594.1	637881.6	1042667.9	637951.6	47 03.4675	122 53.9164	31.0	1.0	
BI-S31	2		1115	3.4	11.2	4.3	-6.9	1042594.1	637881.6	1042669.5	637947.9	47 03.4669	122 53.9160	30.6	1.0	
BI-S32	1	14-Apr	1402	3.8	12.5	9.8	-2.7	1039335.4	637345.1	1039336.2	637344.7	47 03.3510	122 54.7136	0.3	1.9	
BI-S32	2		1407	3.4	11.2	10.0	-1.2	1039335.4	637345.1	1039334.5	637344.8	47 03.3510	122 54.7140	0.3	1.1	
BI-S32	3		1413	3.6	11.8	10.1	-1.7	1039335.4	637345.1	1039335.8	637346.5	47 03.3513	122 54.7137	0.5	1.1	
BI-S33	1	12-Apr	1112	3.6	11.8	8.8	-3.0	1039554.8	637264.5	1039552.8	637265.7	47 03.3391	122 54.6609	0.7	1.0	
BI-S33	2		1119	3.4	11.2	8.9	-2.3	1039554.8	637264.5	1039556.9	637263.2	47 03.3387	122 54.6599	0.8	1.0	
BI-S35	1	12-Apr	1130	4.2	13.8	9.2	-4.6	1040051.9	638168.3	1040051.7	638167.6	47 03.4899	122 54.5475	0.2	0.9	
BI-S35	2		1140	4.6	15.1	9.4	-5.7	1040051.9	638168.3	1040051.6	638165.1	47 03.4895	122 54.5475	1.0	0.9	
BI-S36	1	11-Apr	1537	11.8	38.7	6.1	-32.6	1040440.3	637590.7	1040440.5	637588.9	47 03.3967	122 54.4497	0.6	1.2	
BI-S36	2		1547	11.6	38.1	5.7	-32.4	1040440.3	637590.7	1040442.2	637591.3	47 03.3971	122 54.4493	0.6	1.4	
BI-S37	1	11-Apr	1516	12.1	39.7	6.8	-32.9	1040464.5	636926.3	1040462.3	636928.4	47 03.2882	122 54.4396	0.9	1.2	

Table A-1. Budd Inlet Surface Grab Sample Locations – R/V Kittiwake (continued)

Station No.	Sample Rep.	Date	GPS Time	Meter Block Depth m.	Meter Block Depth ft.	Predicted Nearest Tide ft.	Predicted Mudline Depth, ft. (MLLW)	Station Target NAD 1983 / Wash. South		Sample Location DGPS, Trimble NT300D NAD 1983, Wash. South		Sample Location DGPS, Trimble NT300D NAD 1983, Decimal Minutes		Distance to Target No.	GPS Status Rep.	Station
								Easting (X)	Northing (Y)	Easting (X)	Northing (Y)	Latitude	Longitude			
BI-S37	2		1524	12.1	39.7	6.5	-33.2	1040464.5	636926.3	1040466.5	636931.3	47 03.2887	122 54.4386	1.6	1.2	
BI-S38	1	13-Apr	1129	3.9	12.8	7.0	-5.8	1040971.4	638057.1	1040971.0	638058.6	47 03.4766	122 54.3255	0.5	0.9	
BI-S38	2		1138	4.1	13.5	7.2	-6.3	1040971.4	638057.1	1040969.7	638058.0	47 03.4765	122 54.3258	0.6	0.9	
CR-24	1	15-Apr	0823	16.0	52.5	6.5	-46.0	1101498.9	736769.7	1101496.8	736768.3	47 19.9968	122 40.4155	0.8	1.1	Reference
60% fines																sediment

Table A-2. Budd Inlet Core Sample Locations – R/V Nancy Anne

Station	Date	Time	Lat (N)	Long (W)	Phase I Status	Notes:
BI-C1	4/2/2007	1457	47 03.0414	122 54.4293	Analyze 4-5, 9-10ft	
BI-C2	4/2/2007	1527	47 03.1612	122 54.6420	Analyze 1-2, 2-3ft	
BI-C3	4/4/2007	1410	47 03.1187	122 54.3300	Analyze 0-1, 1-2, 2-3ft	
BI-C4	4/4/2007	1301	47 03.2280	122 54.3478	Analyze 0-1, 3-4, 6-7ft	
BI-C5	4/3/2007	1429	47 03.3415	122 54.3623	Analyze 3-4, 6-7ft	
BI-C6	4/2/2007	1404	47 03.5830	122 54.5449	Analyze 1-2, 2-3ft	
BI-C7	4/3/2007	815	47 03.6651	122 54.3205	Analyze 1-2, 2-3ft	
BI-C8	4/2/2007	1504	47 03.6665	122 54.1066	Archive all	
BI-C9	4/2/2007	1114	47 03.5856	122 53.8283	Archive all	
BI-C10	4/2/2007	1039	47 03.3650	122 53.7798	Analyze 2-3, 4-5ft	
BI-C11	4/2/2007	1236	47 04.5640	122 55.1853	Archive all	
BI-C12	4/2/2007	1300	47 04.8306	122 55.3623	Archive all	
BI-C13	4/2/2007	1607	47 03.5748	122 54.0156	Analyze 1-2, 2-3ft	
BI-C14	4/2/2007	1431	47 03.4194	122 54.3277	Archive all	
BI-C15	4/3/2007	1006	47 03.1548	122 54.3518	Analyze 2-3, 4-5ft	
BI-C16	4/3/2007	922	47 03.2212	122 54.3809	Analyze 1-2, 2-3ft	
BI-C17	4/2/2007	1210	47 04.3121	122 54.7873	Archive all	
BI-C18	4/2/2007	940	47 02.9650	122 53.6585	Analyze 1-2, 2-3ft	
BI-D1	4/3/2007	850	47 03.3392	122 54.6577	Analyze	Dating core
BI-D2	4/2/2007	1632	47 02.9651	122 53.6580	Analyze	Dating core co-located with C18
BI-D3	4/3/2007	1047	47 04.1058	122 54.5253	Analyze	Dating core

Table A-3. Budd Inlet Intertidal Sediment and Tissue Collection Coordinates

Station	Date	Time	Lat (N)	Long (W)	Notes:
TISSUE3	4/5/2007	1415	47 03.5383	122 54.1779	Location for tissues and co-located sediment samples
TISSUE2	4/6/2007	1330	47 03.9787	122 53.8086	middle of transect where tissues and sediments collected
TISSUE1	4/6/2007	1300	47 03.3790	122 54.7470	lower intertidal location where Macoma, ghost shrimp and sed sample collected
TISSUE1B	4/6/2007	1600	47 03.3750	122 54.7370	upper intertidal where littlenecks and sed sample collected
BI-S34	4/6/2007	1515	47 03.048	122 54.305	middle of transect where sediments collected
BI-S30	6/15/2007	1030	47 02.863	122 53.678	Primary BI-S30 location, to the east of the Moxlie Creek channel
BI-S30B	6/15/2007	1130	47 02.850	122 53.712	Secondary BI-S30 location, along the lower west area of the Moxlie Creek channel

Table A-4. Budd Inlet Fish Trawls – R/V Kittiwake

Standard 7.6-meter SCCWRP Trawl								Ordered by Date and Time		
Station Name	Date		Time	Depth (feet)	Predicted Tide	Mudline Depth (feet)	Wire Out (feet)	Northstar DGPS (NAD 83) Latitude decimal min.	Longitude decimal min.	Trawl Distance & Time Comments
1-A	10-Apr-07	**Start Set**	1409	38	6.7	-31		47 04.093	122 54.631	0.25 nm
		Start Tow	1410	38	6.7	-31	300	47 04.036	122 54.588	6 min.
		End	1416	37	6.5	-31		47 03.803	122 54.452	158º true
					ebb					
1-B	10-Apr-07	**Start Set**	1429	39	6.0	-33		47 03.945	122 54.523	.25 nm
		Start Tow	1430	37	6.0	-31	300	47 04.003	122 54.580	6 min.
		End	1436	39	5.8	-33		47 04.218	122 54.768	329º true
					ebb					
1-C	10-Apr-07	**Start Set**	1453	22	5.2	-17		47 04.186	122 54.643	.25 nm
		Start Tow	1454	21	5.2	-16	180	47 04.233	122 54.643	6 min.
		End	1500	19	4.9	-14		47 04.476	122 54.738	345º true
					ebb					
3-A	10-Apr-07	**Start Set**	1525	40	4.0	-36		NA	NA	.25 nm
		Start Tow	1526	42	4.0	-38	300	47 06.174	122 54.930	6 min.
		End	1532	49	3.8	-45		47 06.425	122 54.910	003º true
					ebb					
3-B	10-Apr-07	**Start Set**	1555	86	3.0	-83		NA	NA	.30 nm
		Start Tow	1557	89	3.0	-86	550	47 07.879	122 55.224	7 min.
		End	1604	93	2.8	-90		47 08.180	122 55.232	359º true
					ebb					

Table A-4. Budd Inlet Fish Trawls – R/V Kittiwake (continued)

Station Name	Date		Time	Depth (feet)	Predicted Tide	Mudline Depth (feet)	Wire Out (feet)	Northstar DGPS (NAD 83)		Trawl Distance & Time Comments
								Latitude decimal min.	Longitude decimal min.	
3-C	10-Apr-07	**Start Set**	1627	89	2.1	-87		47 08.340	122 55.223	.42 nm
		Start Tow	1630	91	2.0	-89	550	47 08.211	122 55.230	10 min.
		End	1640	83	1.8	-81		47 07.795	122 55.220	179º true
					ebb					
3-D	10-Apr-07	**Start Set**	1658	90	1.4	-89		47 08.275	122 55.260	.40 nm
		Start Tow	1702	91	1.3	-90	550	47 08.136	122 55.255	10 min.
		End	1712	86	1.1	-85		47 07.735	122 55.256	180º true
					ebb					
2-A	10-Apr-07	**Start Set**	1752	25	0.5	-25		47 05.219	122 54.880	.40 nm
		Start Tow	1754	25	0.5	-25	225	47 05.167	122 54.888	10 min.
		End	1804	25	0.5	-25		47 04.777	122 55.046	196º true
					low ebb					
1-D	11-Apr-07	**Start Set**	0841	42	8.3	-34		47 03.195	122 54.412	.40 nm
		Start Tow	0842	43	8.3	-35	300	47 03.267	122 54.411	10 min.
		End	0852	43	8.4	-35		47 03.666	122 54.458	355º true
					flood					
1-E	11-Apr-07	**Start Set**	0908	40	8.6	-31		47 03.236	122 54.450	.40 nm
		Start Tow	0909	42	8.7	-33	300	47 03.302	122 54.448	10 min.
		End	0919	41	8.8	-32		47 03.700	122 54.474	357º true
					flood					
1-F	11-Apr-07	**Start Set**	0938	43	9.1	-34		47 03.697	122 54.458	.41 nm
		Start Tow	0939	43	9.2	-34	300	47 03.625	122 54.451	10 min.
		End	0949	43	9.3	-34		47 03.211	122 54.412	176º true
					flood					

Table A-4. Budd Inlet Fish Trawls – R/V Kittiwake (continued)

Station Name	Date		Time	Depth (feet)	Predicted Tide	Mudline Depth (feet)	Wire Out (feet)	Northstar DGPS (NAD 83)		Trawl Distance & Time Comments
								Latitude decimal min.	Longitude decimal min.	
1-G	11-Apr-07	**Start Set**	1002	41	9.6	-31		47 03.233	122 54.464	.41 nm
		Start Tow	1003	42	9.6	-32	300	47 03.303	122 54.473	10 min.
		End	1013	41	9.8	-31		47 03.709	122 54.487	359º true
					flood					
2-B	11-Apr-07	**Start Set**	1041	43	10.3	-33		47 05.158	122 55.668	.40 nm
		Start Tow	1043	45	10.3	-35	300	47 05.090	122 55.639	10 min.
		End	1053	43	10.5	-33		47 04.753	122 55.319	147º true
					flood					
2-C	11-Apr-07	**Start Set**	1113	43	10.7	-32		47 04.995	122 55.575	.41 nm
		Start Tow	1115	43	10.7	-32	300	47 04.932	122 55.528	10 min.
		End	1125	43	10.7	-32		47 04.595	122 55.185	145º true
					high					
2-D	11-Apr-07	**Start Set**	1137	42	10.8	-31		47 04.600	122 55.145	.40 nm
		Start Tow	1139	43	10.8	-32	300	47 04.661	122 55.203	10 min.
		End	1149	43	10.7	-32		47 04.987	122 55.540	325º true
					high					

Table A-5. Capitol Lake Sample Coordinates

Station	Date	Time	Lat (N)	Long (W)	Notes:
CL-S1	4/13/2007	1103	47 01.524	122 54.359	
CL-S2	4/13/2007	1134	47 01.783	122 54.501	
CL-S3	4/13/2007	1220	47 02.126	122 54.533	
CL-S4	4/13/2007	1308	47 02.294	122 54.615	
CL-S5	4/13/2007	1338	47 02.420	122 54.536	
CL-S6	4/13/2007	1422	47 02.559	122 54.574	

APPENDIX B

Analytical Chemistry Results–Summary Table

Table B-1. Conventional parameters and individual dioxin/furan congener concentrations for all surface (0-10cm) sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

Congener (pg/g)	**TEF**	**BI-S1**	**LQ**	**VQ**	**BI-S2**	**LQ**	**VQ**	**BI-S3**	**LQ**	**VQ**	**BI-S4**	**LQ**	**VQ**	**BI-S5**	**LQ**	**VQ**	**BI-S6**	**LQ**	**VQ**	**BI-S7**	**LQ**	**VQ**	**BI-S9**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.456	J	J	0.317	J	J	0.326	J		1.12			1.04	J		1.05			1.69			0.738	J	
1,2,3,7,8-PECDD	1	2.5	J		1.48	J		1.22	J	J	4.57	J		3.99	J		5.81			11.8		J	2.92	J	
1,2,3,4,7,8-HXCDD	0.1	4.61	J		2.64	J		2.07	J	J	7.03			5.1	J		9.29			14.5		J	4.41	J	
1,2,3,6,7,8-HXCDD	0.1	26.7			14.2			9.9			43.2		J	27.7		J	48		J	101			20.4		J
1,2,3,7,8,9-HXCDD	0.1	13.7			7.42			5.24			21.8		J	13.1		J	23		J	39.8			11.7		J
1,2,3,4,6,7,8-HPCDD	0.01	619			309			179			1060		J	370		J	838		J	1530			393		J
OCDD	0.0003	5410			2420			1210			8150	D	J	2410		J	5770	D	J	8480	D		2310		
2,3,7,8-TCDF	0.1	0.0488	K	U	0.897	J		0.0478	KJ	U	2.61			3.04			2.3			3.11			2.37		
1,2,3,7,8-PECDF	0.03	1.83	J		1.12	J		0.782	J		2.71	J		2.47	J		2.58	J		4.79			2.45	J	
2,3,4,7,8-PECDF	0.3	2.17	J	J	1.34	J	J	1.02	J		3.89	J		3.11	J		3.04	J		6.03			3.45	J	
1,2,3,4,7,8-HXCDF	0.1	8.38		J	4.94	J	J	3.03	J		14.3			8.05			12.3			19.4			7.3		
1,2,3,6,7,8-HXCDF	0.1	4.04	J		2.38	J		1.74	J		6.55		J	4.64	J		7.39			14			3.76	J	J
1,2,3,7,8,9-HXCDF	0.1	0.38	J		0.23	J		0.171	J		0.549	J		0.37	J		0.606	J		1.3	J		0.339	J	
2,3,4,6,7,8-HXCDF	0.1	3.88	J	J	2.09	J	J	1.8	J	J	5.88			4.98	J		8.09			15.2		J	3.8	J	
1,2,3,4,6,7,8-HPCDF	0.01	133			73.5			52.3			164			122			270			525			87.5		
1,2,3,4,7,8,9-HPCDF	0.01	6.02			3.49	J		2.04	J		9.22			4.14	J	J	8.36		J	18.9			4.01	J	
OCDF	0.0003	258			142			80.7			351			166		J	431		J	910			137		
TEQ 1/2 DL		19.11			10.34			6.99			32.01			18.47			31.97			59.83			15.75		
TEQ 0 DL		19.11			10.34			6.99			32.01			18.47			31.97			59.83			15.75		
Conventionals																									
Total Organic Carbon (% DW)		4.06			3.31			2.87			4.16			3.86			4.8			9.26			1.61		
TVS (%)		12.7		J	11.5		J	9.82		J	14.3		J	11.3		J	11.4		J	0			5.55		J
Total Solids (%)		33.2			34.8			44			31.5			40.8			40.7			36.7			54.5		
<u>Grain Size</u>																									
Percent Gravel (>2.0 mm)		0.04			0			1.48			3.45			8.07		J	3.15		J	12.6		J	2.09		
Percent Sand (<2.0 mm - 0.06 mm)		19.56			30.83			48.08			37.4			35.99			18.16			51.19			45.68		
Percent Silt (0.06 mm - 0.004 mm)		57.8			54.6			42.1			41.4			46.5		J	69.7		J	38.6		J	46.6		
Percent Fines (<0.06 mm)		81.7			66.8			53.9			62.9			55.1		J	80.3			48.8			52.54		
Percent Clay (<0.004 mm)		23.9			12.2			11.8			21.5			8.6		J	10.6			10.2			5.94		

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 B-1. (continued) Conventional parameters and individual dioxin/furan congener concentrations for all surface (0-10cm) sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

Congener (pg/g)	TEF	BI-S11	LQ	VQ	BI-S12	LQ	VQ	BI-S13	LQ	VQ	BI-S14	LQ	VQ	BI-S15	LQ	VQ	BI-S16	LQ	VQ	BI-S17	LQ	VQ	BI-S18	LQ	VQ
2,3,7,8-TCDD	1	0.723	J		1.34			0.723	J	J	0.0505	KJ	UJ	0.229			0.42	J		0.399	J		0.609	J	
1,2,3,7,8-PECDD	1	3.63	J		5.96			3.64	J		0.524	J		0.832			2.56	J		2.31	J		3.6	J	
1,2,3,4,7,8-HXCDD	0.1	5.62			7.64			5.81			0.819	J		1.45			4.17	J		3.29	J		6.14		
1,2,3,6,7,8-HXCDD	0.1	48.9		J	47.6		J	34			4.48	J		5.99		J	25.7		J	23.9		J	37.8		J
1,2,3,7,8,9-HXCDD	0.1	20.7		J	23.1		J	17.4			2.35	J		3.52		J	11.5		J	10.2		J	18.5		J
1,2,3,4,6,7,8-HPCDD	0.01	1190		J	940		J	702			87.1			111		J	390		J	379		J	747		J
OCDD	0.0003	10500	D	J	5950			4760			581			788		J	2610		J	2220		J	4820		
2,3,7,8-TCDF	0.1	1.98			4.04			0.0484	K	U	0.344	J		0.64	J		1.52			0.107	K	U	2.43		
1,2,3,7,8-PECDF	0.03	2.71	J		4.77			3.07	J		0.434	J		0.687			1.62	J		1.73	J		3.02	J	
2,3,4,7,8-PECDF	0.3	3.03	J		5.83			3.64	J	J	0.521	J	J	0.892			1.88	J		2	J		3.78	J	
1,2,3,4,7,8-HXCDF	0.1	12.2			17.6			13.4		J	1.7	J	J	2.46			8.68			7.61			15.6		
1,2,3,6,7,8-HXCDF	0.1	5.47		J	8.06		J	6.14			0.788	J		1.09			4.1	J		4.18	J	J	6.58		J
1,2,3,7,8,9-HXCDF	0.1	0.499	J		0.75	J		0.522	J		0.0938	U		0.139			0.407	J		0.403	J		0.651	J	
2,3,4,6,7,8-HXCDF	0.1	5.42			7.27			5.39		J	0.708	J	J	1.03			4.02	J		3.85	J		6.1		
1,2,3,4,6,7,8-HPCDF	0.01	183			234			195			24.3			28.8			147			134			243		
1,2,3,4,7,8,9-HPCDF	0.01	7.94			9			7.44			1.05	J		1.16		J	4.93	J	J	4.53	J		8.6		
OCDF	0.0003	429			344			300			36.8			42.1		J	209		J	185			368		
TEQ 1/2 DL		32.51			34.52			24.38			3.18			4.64			15.87			14.61			26.36		
TEQ 0 DL		32.51			34.52			24.38			3.17			4.64			15.87			14.60			26.36		
Conventionals																									
Total Organic Carbon (% DW)		5.45			3.35			1.81			0.56			0.71			2.9			3.72			3.25		
TVS (%)		14		J	11.7		J	11.8		J	2.5		J	2.58		J	8.69		J	11.4		J	11.3		J
Total Solids (%)		30.3			34.9			33			69.8			66.5			35.2			36.9			31.2		
<u>Grain Size</u>																									
Percent Gravel (>2.0 mm)		0.4			7.89			0			0.03			6.23		J	7.39		J	1.04			0.02		
Percent Sand (<2.0 mm - 0.06 mm)		17.62			15.66			10.66			86.33			81.74			36.58			42.42			18.68		
Percent Silt (0.06 mm - 0.004 mm)		58.5			61.8			69.9			8.49			14.9		J	48.4		J	37.7			56.5		
Percent Fines (<0.06 mm)		82			81			90.8			12.71			18.5			63.6			57.6			81.3		
Percent Clay (<0.004 mm)		23.5			19.2			20.9			4.22			3.6			15.2			19.9			24.8		

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 B-1. (continued) Conventional parameters and individual dioxin/furan congener concentrations for all surface (0-10cm) sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

Congener (pg/g)	TEF	BI-S19	LQ	VQ	BI-S21	LQ	VQ	BI-S23	LQ	VQ	BI-S26	LQ	VQ	BI-S28	LQ	VQ	BI-S29	LQ	VQ	BI-S30	LQ	VQ	BI-S31	LQ	VQ
2,3,7,8-TCDD	1	0.0482	KJ	U	0.547	J		0.372	J		0.552	J		0.0507	KJ	U	0.358	J		0.977	J		0.455	J	
1,2,3,7,8-PECDD	1	0.497	J		2.83	J		2.3	J	J	3.05	J	J	2.43	J		2.03	J		5.06	J		2.71	J	
1,2,3,4,7,8-HXCDD	0.1	0.807	J		4.31	J		3.34	J	J	4.57	J	J	3.87	J		2.85	J		10.4			4.73		
1,2,3,6,7,8-HXCDD	0.1	4.14	J	J	32.2		J	22.7			26.4			17.2		J	13.6		J	77.1		J	27.6		J
1,2,3,7,8,9-HXCDD	0.1	2.25	J	J	13.7		J	11.3			15.7			11.1		J	8.99		J	30.3		J	13.5		J
1,2,3,4,6,7,8-HPCDD	0.01	74.1		J	498		J	411			506			287		J	222		J	2750	D	J	646		J
OCDD	0.0003	557		J	3010		J	2750			3620			2210		J	1690		J	23800	D	J	4470		
2,3,7,8-TCDF	0.1	0.357	J		2.01			4.24			2.53			2.42			2.02			2.19			1.61		
1,2,3,7,8-PECDF	0.03	0.433	J		2.27	J		2.91	J		2.64	J		1.95	J		1.36	J		2.75	J		1.97	J	
2,3,4,7,8-PECDF	0.3	0.567	J		2.49	J		3.36	J		3.37	J		2.53	J		2	J		4.01	J		2.26	J	
1,2,3,4,7,8-HXCDF	0.1	1.6	J		10.4			10.6			14.3			10.1			7.46			20			8.85		
1,2,3,6,7,8-HXCDF	0.1	0.736	J		5.36		J	4.05	J		5.06			3.45	J		2.65	J		7.22			4.18	J	J
1,2,3,7,8,9-HXCDF	0.1	0.093	J		0.659	U		0.377	J		0.471	J		0.285	J		0.24	J		0.613	J		0.366	J	
2,3,4,6,7,8-HXCDF	0.1	0.724	J		5.09			3.87	J	J	4.83		J	3.22	J		2.59	J		6.57			4.06	J	
1,2,3,4,6,7,8-HPCDF	0.01	19			176			157			171			97.7			78.5			228			127		
1,2,3,4,7,8,9-HPCDF	0.01	0.787	J	J	5.96			5.75			8.25			4.86	J	J	3.67	J	J	32.1		J	5.04		
OCDF	0.0003	28.8		J	231			258			456			242		J	198		J	943		J	224		
TEQ 1/2 DL		2.89			19.30			16.45			20.15			13.07			10.68			60.29			19.58		
TEQ 0 DL		2.87			19.27			16.45			20.15			13.04			10.68			60.29			19.58		
Conventionals																									
Total Organic Carbon (% DW)		0.57			4.98			2.39			2.95			2.51			2.17			2.57			2.52		
TVS (%)		2.42		J	14.2		J	9.52		J	11.5		J	8.44		J	6.93		J	6.59		J	8.4		J
Total Solids (%)		67.4			31.8			36.2			27.6			31.7			38.5			53.4			40.5		
<u>Grain Size</u>																									
Percent Gravel (>2.0 mm)		0.46		J	2.07			0.05			0.03			21.2		J	26.4		J	9.94		J	40.7		
Percent Sand (<2.0 mm - 0.06 mm)		88.29			28.43			26.4			13.9			15.59			33.5			52.83			18.79		
Percent Silt (0.06 mm - 0.004 mm)		8.88		J	44.6			51			59.6			49.3		J	32.7		J	35.3		J	34.2		
Percent Fines (<0.06 mm)		13.6			67.8			72.4			88.7			63.9			43.8			40.2			46.7		
Percent Clay (<0.004 mm)		4.72			23.2			21.4			29.1			14.6			11.1			4.9			12.5		

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 B-1. (continued) Conventional parameters and individual dioxin/furan congener concentrations for all surface (0-10cm) sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

Congener (pg/g)	**TEF**	**BI-S32**	**LQ**	**VQ**	**BI-S33**	**LQ**	**VQ**	**BI-S34**	**LQ**	**VQ**	**BI-S35**	**LQ**	**VQ**	**BI-S36**	**LQ**	**VQ**	**BI-S37**	**LQ**	**VQ**	**BI-S38**	**LQ**	**VQ**	**BI-C1**	**LQ**	**VQ**
2,3,7,8-TCDD	1	1.23			0.668	J	J	0.048	KJ	U	0.285	J	J	0.488	J	J	0.424	J	J	0.704	J		0.283	J	J
1,2,3,7,8-PECDD	1	4.9	J		2.86	J		0.791	J	J	1.39	J		2.36	J		2.21	J		3.61	J		1.44	J	
1,2,3,4,7,8-HXCDD	0.1	7.26			4	J		2.09	J	J	2.34	J		3.54	J		3.36	J		6.76			2.44	J	
1,2,3,6,7,8-HXCDD	0.1	43		J	27.9			6.89			16.3			23.9			21.9			36.7		J	14		
1,2,3,7,8,9-HXCDD	0.1	18.2		J	11.1			4.91			7.11			11.8			10.5			18.4		J	7.27		
1,2,3,4,6,7,8-HPCDD	0.01	1100		J	395			171			257			442			413			838		J	265		
OCDD	0.0003	8290	D		2320			1330			1570			3080			2940			8430	D	J	1890		
2,3,7,8-TCDF	0.1	3.01			1.89			0.226	J		0.715	J		1.31			1.4			0.05	K	U	0.631	J	
1,2,3,7,8-PECDF	0.03	3.27	J		2.02	J		0.232	J		1.1	J		1.69	J		1.64	J		2.67	J		1.02	J	
2,3,4,7,8-PECDF	0.3	4.16	J		2.36	J	J	0.291	J		1.17	J	J	2.05	J	J	2	J	J	3.23	J		1.28	J	J
1,2,3,4,7,8-HXCDF	0.1	9.99			7.25		J	1.3	J		4.73	J	J	8.61		J	8.23		J	12.8			4.79		J
1,2,3,6,7,8-HXCDF	0.1	6.25		J	4.6	J		1.02	J		2.69	J		3.82	J		3.82	J		4.8	J		2.42	J	
1,2,3,7,8,9-HXCDF	0.1	0.568	J		0.424	J		0.0893	U		0.222	J		0.35	J		0.373	J		0.482	J		0.0984	KJ	U
2,3,4,6,7,8-HXCDF	0.1	6.83			4.62	J	J	0.859	J	J	2.54	J	J	3.82	J	J	3.38	J	J	4.97	J		2.23	J	J
1,2,3,4,6,7,8-HPCDF	0.01	236			152			37.7			93.5			137			151			200			75.5		
1,2,3,4,7,8,9-HPCDF	0.01	10.5			5.06			2.73	J		3.23	J		5.36			4.98			6.74		J	3.16	J	
OCDF	0.0003	710			181			162			131			222			221			334		J	131		
TEQ 1/2 DL		33.15			16.75			5.21			9.77			16.06			15.22			26.93			9.56		
TEQ 0 DL		33.15			16.75			5.18			9.77			16.06			15.22			26.93			9.56		
Conventionals																									
Total Organic Carbon (% DW)		4.28			4.04			0.57			2.39			3.48			3.62			7.32			3.52		
TVS (%)		12.4		J	12		J	2.69		J	7.82		J	11.9		J	12.3		J	23.2		J	12.6		J
Total Solids (%)		38.5			41.5			85.6			45.3			32.1			29			30.2			33		
<u>Grain Size</u>																									
Percent Gravel (>2.0 mm)		0.21			0.36			50.3			0.78			1.01			0			41.9		J	0		
Percent Sand (<2.0 mm - 0.06 mm)		26.34			34.01			42.44			40.13			11.68			11.38			35.01			19.11		
Percent Silt (0.06 mm - 0.004 mm)		64.6			46.6			2.66			43.1			63.9			69.8			19.3		J	64.1		
Percent Fines (<0.06 mm)		78.5			62.7			4.29			60.1			88.7			89.3			27.29			79.1		
Percent Clay (<0.004 mm)		13.9			16.1			1.63			17			24.8			19.5			7.99			15		

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 B-1. (continued) Conventional parameters and individual dioxin/furan congener concentrations for all surface (0-10cm) sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

Congener (pg/g)	**TEF**	**BI-C2**	**LQ**	**VQ**	**BI-C5**	**LQ**	**VQ**	**BI-C6**	**LQ**	**VQ**	**BI-C7**	**LQ**	**VQ**	**BI-C8**	**LQ**	**VQ**	**BI-C9**	**LQ**	**VQ**	**BI-C10**	**LQ**	**VQ**	**BI-C12**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.78	J	J	0.64	DJ		0.438	J		0.292	J		0.523	J		0.632	J		0.848	J		0.559	J	
1,2,3,7,8-PECDD	1	2.76	J		3.02	DJ		2.19	J	J	1.26	J	J	1.12	J	J	3.66	J	J	4.36	J		3.15	J	J
1,2,3,4,7,8-HXCDD	0.1	4.08	J		5.6	DJ		3.27	J	J	1.88	J	J	1.74	J	J	7.23		J	7.34			5.42	J	J
1,2,3,6,7,8-HXCDD	0.1	21			29.6	D	J	23.1			11.2			6.97		J	35.7		J	40.7		J	25		J
1,2,3,7,8,9-HXCDD	0.1	10.3			15.2	D	J	9.41			5.68			4.29	J	J	19.7		J	21.9		J	15.2		J
1,2,3,4,6,7,8-HPCDD	0.01	320			635	D	J	370			222			118	B		750	B		948		J	442	B	
OCDD	0.0003	2040			4500	D		2260			1430			801			5440			7540	D	J	3210		
2,3,7,8-TCDF	0.1	2.24			2			1.14			0.836	J		1.65			2.53			2.83			2.7		
1,2,3,7,8-PECDF	0.03	1.94	J		2.4	DJ		1.46	J		0.958	J		1.13	J		2.65	J		3.29	J		2.16	J	
2,3,4,7,8-PECDF	0.3	2.55	J	J	2.88	DJ		1.71	J		1.31	J		1.31	J		3.22	J		3.97	J		2.95	J	
1,2,3,4,7,8-HXCDF	0.1	6.58		J	11.2	D		6.48			4.07	J		2.38	J		14			14.5			13.6		
1,2,3,6,7,8-HXCDF	0.1	3.66	J		4.8	DJ	J	3.57	J		1.94	J		1.14	J		5.77			6.77		J	4.73	J	
1,2,3,7,8,9-HXCDF	0.1	0.349	J		0.453	DJ		0.387	J		0.161	J		0.0907	KJ	U	0.496	J		0.575	J		0.427	J	
2,3,4,6,7,8-HXCDF	0.1	3.59	J	J	4.5	DJ		3.55	J	J	1.9	J	J	1.13	J		5.63			6.25			4.63	J	
1,2,3,4,6,7,8-HPCDF	0.01	104			178	D		134			72.7			35.8	B		198	B		206			155	B	
1,2,3,4,7,8,9-HPCDF	0.01	3.77	J		7.63	DJ		4.62	J		2.4	J		0.937	BJ		7.01	B		8.51			6.69	B	
OCDF	0.0003	143			386	D		189			147			0.273	B	U	295	B		400			287	B	
TEQ 1/2 DL		14.48			21.60			14.10			8.18			5.79			25.71			30.59			18.92		
TEQ 0 DL		14.48			21.60			14.10			8.18			5.79			25.71			30.59			18.92		
Conventionals																									
Total Organic Carbon (% DW)		5.62			4.62			2.67			2.45			1.12			3.55			3.53			3.5		
TVS (%)		14.6		J	14.9		J	9.44		J	6.58		J	3.95		J	9.8		J	11.8		J	11.7		J
Total Solids (%)		36.4			23.9			42.9			51.5			63.6			31.4			30			26.2		
<u>Grain Size</u>																									
Percent Gravel (>2.0 mm)		0.19			1.51			2.72			0.76			0.82			56.1			0.25			13.7		J
Percent Sand (<2.0 mm - 0.06 mm)		26.71			16.37			34.73			36.06			79.08			12.66			17.4			14.01		
Percent Silt (0.06 mm - 0.004 mm)		56.8			56			43.3			47.8			20.4			22			59.3			45.3		J
Percent Fines (<0.06 mm)		74.3			81.3			62.6			59.4			24.51			22			84.5			74.4		J
Percent Clay (<0.004 mm)		17.5			25.3			19.3			11.6			4.11			0			25.2			29.1		J

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 B-1. (continued) Conventional parameters and individual dioxin/furan congener concentrations for all surface (0-10cm) sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

Congener (pg/g)	TEF	BI-C13	LQ	VQ	BI-C14	LQ	VQ	BI-C15	LQ	VQ	BI-C16	LQ	VQ	BI-C17	LQ	VQ	BI-C18	LQ	VQ
2,3,7,8-TCDD	1	0.669	J		0.4	J		0.537	J	J	0.449	J	J	0.766	J		0.689	J	
1,2,3,7,8-PECDD	1	3.46	J		1.78	J		2.87	J		2.77	J		4.11	J		2.96	J	
1,2,3,4,7,8-HXCDD	0.1	5.41			2.96	J		4.77			4.32	J		7.28			5.37		
1,2,3,6,7,8-HXCDD	0.1	37.3		J	17.5		J	25.9			27.3			41.5		J	24.4		J
1,2,3,7,8,9-HXCDD	0.1	16.1		J	10.2		J	13.8			13.6			20.2		J	14.6		J
1,2,3,4,6,7,8-HPCDD	0.01	903		J	428		J	538			558			780		J	542		J
OCDD	0.0003	6410			3020		J	4220			4110			5600	D	J	3590		J
2,3,7,8-TCDF	0.1	2.5			0.0656	K	U	1.57			1.62			3.12			1.78		
1,2,3,7,8-PECDF	0.03	3.57	J		1.27	J		1.91	J		2.02	J		3.64	J		2.23	J	
2,3,4,7,8-PECDF	0.3	4.78			1.45	J		2.25	J	J	2.47	J	J	4.15	J		2.93	J	
1,2,3,4,7,8-HXCDF	0.1	12.3			6			9.48		J	10.2		J	21			9.29		
1,2,3,6,7,8-HXCDF	0.1	4.4	J	J	2.83	J	J	4.59	J		4.48	J		7.61			4.56	J	J
1,2,3,7,8,9-HXCDF	0.1	0.459	J		0.234	J		0.423	J		0.387	J		0.631	J		0.566	U	
2,3,4,6,7,8-HXCDF	0.1	4.49	J		2.59	J		4.01	J	J	4.3	J	J	6.89			4.46	J	
1,2,3,4,6,7,8-HPCDF	0.01	114			161			161			160			250			115		
1,2,3,4,7,8,9-HPCDF	0.01	4.71			3.8	J		6.88			6.25			9.09		J	5.88		
OCDF	0.0003	173			245			340			280			485		J	231		
TEQ 1/2 DL		26.16			13.80			19.02			19.20			29.27			18.84		
TEQ 0 DL		26.16			13.79			19.02			19.20			29.27			18.82		
Conventionals																			
Total Organic Carbon (% DW)		1.93			4.59			3.88			3.81			3.47			2.44		
TVS (%)		5.93		J	15.8		J	13.4		J	13.8		J	11		J	7.02		J
Total Solids (%)		59.1			29.6			26.3			28.3			32.4			52.6		
Grain Size																			
Percent Gravel (>2.0 mm)		0.31			17.6			0.08			0.11			24		J	20		
Percent Sand (<2.0 mm - 0.06 mm)		37.99			30.85			13.2			14.26			16.15			34.13		
Percent Silt (0.06 mm - 0.004 mm)		57.6			41.9			72.7			57.8			46.2		J	37.4		
Percent Fines (<0.06 mm)		64.84			58.3			92.3			84.8			65.7		J	46.13		
Percent Clay (<0.004 mm)		7.24			16.4			19.6			27			19.5		J	8.73		

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 B-2. Conventional parameters and individual dioxin/furan congener concentrations for the Capitol Lake surface (0-10cm) sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

Congener (pg/g)	TEF	CL-S2	LQ	VQ	CL-S5	LQ	VQ
2,3,7,8-TCDD	1	0.0555	KJ	U	0.248	J	
1,2,3,7,8-PECDD	1	0.408	J	J	0.727	J	J
1,2,3,4,7,8-HXCDD	0.1	0.674	J	J	1.18	J	J
1,2,3,6,7,8-HXCDD	0.1	2.72	J		4.65	J	
1,2,3,7,8,9-HXCDD	0.1	1.87	J		3.21	J	
1,2,3,4,6,7,8-HPCDD	0.01	49.6			107		
OCDD	0.0003	377			809		
2,3,7,8-TCDF	0.1	0.0555	KJ	U	0.0511	KJ	U
1,2,3,7,8-PECDF	0.03	0.227	J		0.419	J	
2,3,4,7,8-PECDF	0.3	0.32	J		0.583	J	
1,2,3,4,7,8-HXCDF	0.1	0.777	J		1.49	J	
1,2,3,6,7,8-HXCDF	0.1	0.512	J		0.977	J	
1,2,3,7,8,9-HXCDF	0.1	0.103	U		0.143	J	
2,3,4,6,7,8-HXCDF	0.1	0.415	J	J	0.817	J	J
1,2,3,4,6,7,8-HPCDF	0.01	10.3			18.8		
1,2,3,4,7,8,9-HPCDF	0.01	1.06	J		1.22	J	
OCDF	0.0003	26.5			54.9		
TEQ 1/2 DL		1.97			3.94		
TEQ 0 DL		1.94			3.94		
Conventionals							
Total Organic Carbon (% DW)		3.23			3.37		
TVS (%)		11.2			11		
Total Solids (%)		32.1			31.6		
Grain Size							
Percent Gravel (>2.0 mm)		0.74			2.56		
Percent Sand (<2.0 mm - 0.06 mm)		15.95			21.75		
Percent Silt (0.06 mm - 0.004 mm)		74.1			62.7		
Percent Fines (<0.06 mm)		82.9			76		
Percent Clay (<0.004 mm)		8.8			13.3		

B - The analyte was found in the associated method blank

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 B-3. Conventional parameters and individual dioxin/furan congener concentrations for the surface (0-10cm) sediment grabs at the tissue locations. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

Congener (pg/g)	TEF	BI-TISSUE1-SEDIMENT	LQ	VQ	BI-TISSUE1B-SEDIMENT	LQ	VQ	BI-TISSUE2-SEDIMENT	LQ	VQ	BI-TISSUE3-SEDIMENT	LQ	VQ
2,3,7,8-TCDD	1	0.184	J		0.82	J		0.189	J		0.429	J	
1,2,3,7,8-PECDD	1	0.599	J	J	3.67	J	J	0.768	J	J	1.64	J	J
1,2,3,4,7,8-HXCDD	0.1	1	J	J	6.62		J	1.1	J	J	2.25	J	J
1,2,3,6,7,8-HXCDD	0.1	6.21			30			5.77			11.8		
1,2,3,7,8,9-HXCDD	0.1	2.63	J		14.9			3.12	J		6.21		
1,2,3,4,6,7,8-HPCDD	0.01	140			970			107			266		
OCDD	0.0003	1080			7930	D		715			2130		
2,3,7,8-TCDF	0.1	0.0483	KJ	U	1.37			0.667	J		1.28		
1,2,3,7,8-PECDF	0.03	0.388	J		1.3	J		0.648	J		1.36	J	
2,3,4,7,8-PECDF	0.3	0.462	J		1.71	J		0.781	J		2	J	
1,2,3,4,7,8-HXCDF	0.1	1.25	J		4.38	J		1.88	J		4.45	J	
1,2,3,6,7,8-HXCDF	0.1	0.858	J		3.32	J		1.04	J		1.85	J	
1,2,3,7,8,9-HXCDF	0.1	0.0898	U		0.275	J		0.096	J		0.182	J	
2,3,4,6,7,8-HXCDF	0.1	0.991	J	J	3.4	J	J	0.918	J	J	1.82	J	J
1,2,3,4,6,7,8-HPCDF	0.01	30.2			142			23.6			47.2		
1,2,3,4,7,8,9-HPCDF	0.01	1.42	J		5.6			0.958	J		1.73	J	
OCDF	0.0003	63			416			35.8			72.5		
TEQ 1/2 DL		4.29			25.15			4.21			9.50		
TEQ 0 DL		4.29			25.15			4.21			9.50		
Conventionals													
Total Organic Carbon (% DW)		0.77			5.82			0.88			1.48		
TVS (%)		2.84		J	12.4		J	3.77		J	4.33		J
Total Solids (%)		73.7			53			73.5			65.5		
Grain Size													
Percent Gravel (>2.0 mm)		0.46			28.2			18.6			0.17		
Percent Sand (<2.0 mm - 0.06 mm)		89.28			51.39			72.37			61.09		
Percent Silt (0.06 mm - 0.004 mm)		8.1			21.2			12.9			37.7		
Percent Fines (<0.06 mm)		11.81			27.29			16.12			42.97		
Percent Clay (<0.004 mm)		3.71			6.09			3.22			5.27		

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 B-4. Conventional parameters and individual dioxin/furan congener concentrations for all subsurface sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

		BI-C1-			BI-C1-			BI-C1-			BI-C1-			BI-C1-			BI-C2-			BI-C2-		
Congener (pg/g)	**TEF**	**2-3FT**	**LQ**	**VQ**	**3-4FT**	**LQ**	**VQ**	**4-5 FT**	**LQ**	**VQ**	**6-7FT**	**LQ**	**VQ**	**9-10 FT**	**LQ**	**VQ**	**1-2 FT**	**LQ**	**VQ**	**2-3 FT**	**LQ**	**VQ**
2,3,7,8-TCDD	1	1.06			0.845	J		0.824	J		0.775	J		0.314	J		1.48			0.047	U	
1,2,3,7,8-PECDD	1	4.66	J	J	3.35	J	J	2.84	J		1.89	J	J	0.551	J		7.73			0.122	U	
1,2,3,4,7,8-HXCDD	0.1	6.65		J	5.03	J	J	3.37	J		1.42	J	J	0.452	J		12.9			0.179	U	
1,2,3,6,7,8-HXCDD	0.1	50		J	28.1		J	17.7		J	9.16		J	1.03	J	J	63		J	0.179	KJ	U
1,2,3,7,8,9-HXCDD	0.1	20.5		J	13.7		J	9.49		J	3.92	J	J	1.07	J	J	32.3		J	0.327	J	J
1,2,3,4,6,7,8-HPCDD	0.01	892	B		515	B		312		J	108	B		8.6		J	1190		J	6.01		J
OCDD	0.0003	5930	D		3470			1840		J	375			42		J	6740	D		36.8		
2,3,7,8-TCDF	0.1	2.74			0.0488	K	U	2.67			2.51			0.0782	K	U	4.15			0.228	J	
1,2,3,7,8-PECDF	0.03	3.15	J		2.75	J		2.54	J		1.49	J		0.894	J		4.92			0.112	J	
2,3,4,7,8-PECDF	0.3	3.47	J		3.82	J		3.88	J		2.28	J		1.07	J		9			0.0903	KJ	U
1,2,3,4,7,8-HXCDF	0.1	17.4			17.2			11.5			2.38	J		0.677	J		41.7			0.284	J	
1,2,3,6,7,8-HXCDF	0.1	7.91			6.27			5.17		J	2.55	J		0.61	J	J	14.4		J	0.118	J	J
1,2,3,7,8,9-HXCDF	0.1	0.631	J		0.425	J		0.351	J		0.135	J		0.116	U		0.916	J		0.113	U	
2,3,4,6,7,8-HXCDF	0.1	7.02			5.7			4.77			3.08	J		0.53	J		11.6			0.129	J	
1,2,3,4,6,7,8-HPCDF	0.01	252	B		205	B		176			92	B		2.7	J		581			3.99	J	
1,2,3,4,7,8,9-HPCDF	0.01	8.76	B		5.98	B		4	J		1.4	BJ		0.329	J		21.9			0.0931	U	
OCDF	0.0003	314	B		248	B		147			75.4	B		2.64	J		1000			4.18	J	J
TEQ 1/2 DL		31.54			21.44			15.92			8.06			1.79			50.41			0.35		
TEQ 0 DL		31.54			21.44			15.92			8.06			1.78			50.41			0.22		
Conventionals																						
Total Organic Carbon (% DW)		3.1			3.81			3.29			3.18			2.82			9.15			2.7		
TVS (%)		9.36		J	10.8		J	9.5		J	9.37		J	8.36		J	23.5		J	7.56		J
Total Solids (%)		41.4			47.9			52.2			50.9			47.8			40.4			54.5		
Grain Size																						
Percent Gravel (>2.0 mm)		25.3		J	6.87		J	2.92			12.2		J	2.18			15.3			7.3		
Percent Sand (<2.0 mm - 0.06 mm)		20.09			38.13			44.31			39.94			23.9			31.95			59.45		
Percent Silt (0.06 mm - 0.004 mm)		39.2		J	37.1		J	31.5			36.8		J	51.8			30.2			41.3		
Percent Fines (<0.06 mm)		59.7		J	59.6		J	51.5			49.5		J	79.1			56.4			41.31		
Percent Clay (<0.004 mm)		20.5		J	22.5		J	20			12.7		J	27.3			26.2			0.01		

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 B-4. (continued) Conventional parameters and individual dioxin/furan congener concentrations for all subsurface sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

		BI-C3-			BI-C3-			BI-C3-			BI-C3-			BI-C3-			BI-C3-			BI-C4-		
Congener (pg/g)	**TEF**	**0-1 FT**	**LQ**	**VQ**	**1-2 FT**	**LQ**	**VQ**	**2-3 FT**	**LQ**	**VQ**	**3-4FT**	**LQ**	**VQ**	**4-5FT**	**LQ**	**VQ**	**6-7Ft**	**LQ**	**VQ**	**0-1 FT**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.484	J		0.464	J		0.36	J		0.0489	KJ	U	0.0481	KJ	U	0.0469	KJ	U	0.547	DJ	
1,2,3,7,8-PECDD	1	2.38	J	J	1.99	J		1.74	J		0.599	J	J	0.125	U		0.122	U		3.65	DJ	J
1,2,3,4,7,8-HXCDD	0.1	4.16	J	J	3.59	J		2.69	J		1	J	J	0.183	U		0.178	U		7.62	DJ	J
1,2,3,6,7,8-HXCDD	0.1	23.6			22.2		J	19.2		J	6.31		J	0.629	J	J	0.232	J	J	36	D	
1,2,3,7,8,9-HXCDD	0.1	12.1			10.9		J	9.02		J	3.24	J	J	0.423	J	J	0.241	J	J	21.4	D	
1,2,3,4,6,7,8-HPCDD	0.01	535			499		J	385		J	131	B		12.7	B		3.86	BJ		944	D	
OCDD	0.0003	4430			3770			2790			966			92.4			31.3			8360	D	
2,3,7,8-TCDF	0.1	1.23			0.101	K	U	0.0667	K	U	0.429	J		0.0481	KJ	U	0.0469	U		2.41		
1,2,3,7,8-PECDF	0.03	1.7	J		1.58	J		1.37	J		0.481	J		0.0914	U		0.089	U		2.5	DJ	
2,3,4,7,8-PECDF	0.3	1.87	J		1.68	J		1.68	J		0.519	J		0.0924	U		0.09	U		3.08	DJ	
1,2,3,4,7,8-HXCDF	0.1	7.79		J	7.5			6.31			2.73	J		0.266	J		0.0853	U		15.2	D	J
1,2,3,6,7,8-HXCDF	0.1	3.66	J		3.51	J	J	3	J	J	1.13	J		0.117	J		0.112	U		6.05	DJ	
1,2,3,7,8,9-HXCDF	0.1	0.309	J		0.356	J		0.294	J		0.0909	KJ	U	0.0895	U		0.0872	U		0.481	DJ	
2,3,4,6,7,8-HXCDF	0.1	3.27	J	J	3.13	J		2.56	J		1	J		0.115	U		0.112	U		5.4	DJ	J
1,2,3,4,6,7,8-HPCDF	0.01	123			114			88.7			33.6	B		0.0953	BJ	U	0.0928	BJ	U	220	D	
1,2,3,4,7,8,9-HPCDF	0.01	5.02	J		4.49	J		3.29	J		1.39	BJ		0.154	BJ		0.0825	U		9.71	DJ	
OCDF	0.0003	266			166			122			0.274	B	U	0.269	BJ	U	0.262	BJ	U	535	D	
TEQ 1/2 DL		17.13			15.48			12.60			4.33			0.42			0.23			29.06		
TEQ 0 DL		17.13			15.48			12.60			4.30			0.30			0.10			29.06		
Conventionals																						
Total Organic Carbon (% DW)		2.53			2.11			1.47			1.14			1.19			1.25			3.94		
TVS (%)		11.9		J	8.29		J	6.29		J	5.96		J	5.2		J	4.55		J	14		J
Total Solids (%)		33.3			49.2			59			66.2			64.2			65.2			23.9		
Grain Size																						
Percent Gravel (>2.0 mm)		23			29.7			20.7			5.48		J	7.45		J	7.02		J	8.4		
Percent Sand (<2.0 mm - 0.06 mm)		26.22			33.11			41.81			45.9			23.16			15.59			15.54		
Percent Silt (0.06 mm - 0.004 mm)		28.3			21.7			21.3			34.6		J	53.7		J	63.7		J	51.9		
Percent Fines (<0.06 mm)		56.1			41.6			38.4			48.4		J	67.3		J	77.3		J	84.5		
Percent Clay (<0.004 mm)		27.8			19.9			17.1			13.8		J	13.6		J	13.6		J	32.6		

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 B-4. (continued) Conventional parameters and individual dioxin/furan congener concentrations for all subsurface sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

		BI-C4-			BI-C4-			BI-C5-			BI-C5-			BI-C6-			BI-C6-			BI-C7-		
Congener (pg/g)	**TEF**	**3-4 FT**	**LQ**	**VQ**	**6-7 FT**	**LQ**	**VQ**	**3-4 FT**	**LQ**	**VQ**	**6-7 FT**	**LQ**	**VQ**	**1-2 FT**	**LQ**	**VQ**	**2-3 FT**	**LQ**	**VQ**	**1-2 FT**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.917	DJ		1.81	DJ		8.56	DJ		11.6	KDJ	U	0.0475	KJ	U	0.0466	U		0.0474	KJ	U
1,2,3,7,8-PECDD	1	4.59	DJ	J	6.01	DJ	J	31.6	DJ	J	55.5	DJ	J	0.207	J	J	0.121	U	UJ	1	J	J
1,2,3,4,7,8-HXCDD	0.1	7.87	DJ	J	8.6	DJ	J	32.5	DJ	J	89.8	DJ	J	0.216	J	J	0.177	U	UJ	1.16	J	J
1,2,3,6,7,8-HXCDD	0.1	52.1	D		52.9	D		267	D		3130	D		1.6	J		0.168	KJ	U	6.6		
1,2,3,7,8,9-HXCDD	0.1	26.1	D		22	DJ		114	D		413	DJ		0.763	J		0.277	J		3.43	J	
1,2,3,4,6,7,8-HPCDD	0.01	1300	D		1190	D		4800	D		46700	D		25.3			8.42			109		
OCDD	0.0003	10800	D		8720	D		31800	D		402000	D		149			51.6			730		
2,3,7,8-TCDF	0.1	3.44			6.26			15			280			0.0816	U		0.131	U		1.09		
1,2,3,7,8-PECDF	0.03	4.32	DJ		11.1	DJ		60.3	D		925	DJ		0.143	J		0.0886	U		0.855	J	
2,3,4,7,8-PECDF	0.3	5.37	DJ		14.9	DJ		53.6	D		3140	D		0.171	J		0.0896	U		1.15	J	
1,2,3,4,7,8-HXCDF	0.1	31.9	D	J	112	D	J	335	D	J	14900	D	J	0.562	J	J	0.192	J	J	2.35	J	J
1,2,3,6,7,8-HXCDF	0.1	10.9	DJ		28.7	D		87.9	D		2320	D		0.278	J		0.112	U	UJ	1.14	J	
1,2,3,7,8,9-HXCDF	0.1	0.777	DJ		0.899	DJ		19.9	DJ		170	DJ		0.0884	U		0.0868	U		0.099	J	
2,3,4,6,7,8-HXCDF	0.1	7.78	DJ	J	14.4	DJ	J	57.5	D	J	976	D	J	0.27	J	J	0.112	U		1.13	J	J
1,2,3,4,6,7,8-HPCDF	0.01	339	D		1020	D		2020	D		31600	D		9.59			3.23	J		31		
1,2,3,4,7,8,9-HPCDF	0.01	11.9	DJ		23.9	D		128	D		3730	D		0.344	J		0.0821	KJ	U	1.05	J	
OCDF	0.0003	566	D		1250	D		2240	D		42300	D		11			3.73	J		35.1		
TEQ 1/2 DL		41.25			62.53			230.62			4212.52			1.06			0.32			4.73		
TEQ 0 DL		41.25			62.53			230.62			4206.72			1.03			0.18			4.71		
Conventionals																						
Total Organic Carbon (% DW)		4.62			3.71			8.24			7.56			1.52			0.77			1.84		
TVS (%)		14.2		J	10.3		J	13.8		J	15.9			4.7		J	3.69		J	5.76		J
Total Solids (%)		38.4			57.1			40.2			36.8			56.2			59.8			56.6		
Grain Size																						
Percent Gravel (>2.0 mm)		9.75			11.5			23.9			68.9		J	0.34			0.23			2.84		
Percent Sand (<2.0 mm - 0.06 mm)		19.84			35.72			14.58			10.53			40.04			55.35			37.78		
Percent Silt (0.06 mm - 0.004 mm)		35.5			27			30.1			19.4		J	42.3			32.3			44.2		
Percent Fines (<0.06 mm)		72.5			52.5			66.7			35.8			60			46			59.6		
Percent Clay (<0.004 mm)		37			25.5			36.6			16.4			17.7			13.7			15.4		

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 B-4. (continued) Conventional parameters and individual dioxin/furan congener concentrations for all subsurface sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

		BI-C7-			**BI-C10-**			**BI-C10-**			**BI-C12-**			**BI-C12-**			**BI-C13-**			**BI-C13-**		
Congener (pg/g)	**TEF**	**2-3 FT**	**LQ**	**VQ**	**2-3 FT**	**LQ**	**VQ**	**4-5 FT**	**LQ**	**VQ**	**2-3FT**	**LQ**	**VQ**	**4-5FT**	**LQ**	**VQ**	**1-2 FT**	**LQ**	**VQ**	**2-3 FT**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.0463	KJ	U	0.048	KJ	U	0.0367	U		0.0483	KJ	U	0.0486	U		0.55	J		1.14		
1,2,3,7,8-PECDD	1	0.12	KJ	UJ	0.231	J	J	0.0953	U	UJ	0.126	U		0.126	U		1.84	J	J	2.57	J	J
1,2,3,4,7,8-HXCDD	0.1	0.176	U	UJ	0.411	J	J	0.139	U	UJ	0.184	U		0.185	U		2.52	J	J	1.69	J	J
1,2,3,6,7,8-HXCDD	0.1	0.549	J		2.06	J		0.132	U		0.174	KJ	U	0.175	U		16.7			6.38		
1,2,3,7,8,9-HXCDD	0.1	0.527	J		1.18	J		0.125	U		0.329	J	J	0.249	J	J	7.53			4.17	J	
1,2,3,4,6,7,8-HPCDD	0.01	7.7			55.6			1.73	J		4.52	BJ		2.22	BJ		380			58.7		
OCDD	0.0003	60.5			641			15.1		J	35.7			25.8			2830			322		
2,3,7,8-TCDF	0.1	0.141	KJ	U	0.0854	U		0.0367	U		0.0483	KJ	U	0.0486	U		1.6			4.09		
1,2,3,7,8-PECDF	0.03	0.456	J		0.166	J		0.0696	U		0.0918	KJ	U	0.0923	U		2.04	J		3.06	J	
2,3,4,7,8-PECDF	0.3	0.483	J		0.206	J		0.0704	U		0.131	J		0.0933	U		2.83	J		3.42	J	
1,2,3,4,7,8-HXCDF	0.1	0.377	J	J	0.708	J	J	0.0667	U	UJ	0.0879	KJ	U	0.0884	U		7.29		J	4.29	J	J
1,2,3,6,7,8-HXCDF	0.1	0.271	J		0.291	J		0.088	U		0.116	U		0.117	U		3.65	J		3.74	J	
1,2,3,7,8,9-HXCDF	0.1	0.0861	U		0.0893	U		0.0682	U		0.0899	U		0.0904	U		0.284	J		0.214	J	
2,3,4,6,7,8-HXCDF	0.1	0.258	J	J	0.115	KJ	UJ	0.088	U	UJ	0.116	U		0.117	U		3.84	J	J	4.21	J	J
1,2,3,4,6,7,8-HPCDF	0.01	2.16	J		8.26			0.229	J		0.0957	BJ	U	0.0962	BJ	U	245			369		
1,2,3,4,7,8,9-HPCDF	0.01	0.112	J		0.437	J		0.0645	U		0.085	U		0.0855	U		2.43	J		1.47	J	
OCDF	0.0003	2.03	J		14.6			0.348	J		0.271	BJ	U	0.272	BJ	U	133			116		
TEQ 1/2 DL		0.64			1.65			0.14			0.26			0.20			14.80			12.13		
TEQ 0 DL		0.60			1.61			0.02			0.13			0.05			14.80			12.13		
Conventionals																						
Total Organic Carbon (% DW)		1.9			0.74			0.47			2.13			1.76			1.86			1.48		
TVS (%)		7.44		J	2.87		J	2.33		J	6.67		J	5.53		J	6.41		J	6.74		J
Total Solids (%)		50.5			70.1			75			42.9			51.5			56.6			60.6		
Grain Size																						
Percent Gravel (>2.0 mm)		0.63			6.4			4.74			6.04		J	7.09		J	0.58			7.84		
Percent Sand (<2.0 mm - 0.06 mm)		18.3			63.9			83.02			15.16			21.21			31.36			26.81		
Percent Silt (0.06 mm - 0.004 mm)		53.9			21.1			13			41.1		J	44.5		J	43.2			46.8		
Percent Fines (<0.06 mm)		83			30.1			18.43			78.4		J	74.2		J	64			63.1		
Percent Clay (<0.004 mm)		29.1			9			5.43			37.3		J	29.7		J	20.8			16.3		

B - The analyte was found in the associated method blank at a level that is significant relative to the sample result.

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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.

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Table B-4. (continued) Conventional parameters and individual dioxin/furan congener concentrations for all subsurface sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

		BI-C13-			**BI-C13-**			**BI-C14-**			**BI-C14-**			**BI-C14-**			**BI-C15-**			**BI-C15-**		
Congener (pg/g)	**TEF**	**4-5FT**	**LQ**	**VQ**	**6-7FT**	**LQ**	**VQ**	**3-4FT**	**LQ**	**VQ**	**6-7FT**	**LQ**	**VQ**	**9-10FT**	**LQ**	**VQ**	**2-3 FT**	**LQ**	**VQ**	**4-5 FT**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.0488	KJ	U	0.0472	KJ	U	0.0474	KJ	U	0.0455	U		0.0501	KJ	U	0.788	J		0.878	DJ	
1,2,3,7,8-PECDD	1	0.127	KJ	U	0.123	KJ	U	0.951	J	J	0.118	U		0.13	U		4.24	J		4	DJ	J
1,2,3,4,7,8-HXCDD	0.1	0.185	U		0.179	U		1.61	J	J	0.173	U		0.19	U		8.03			6.14	DJ	J
1,2,3,6,7,8-HXCDD	0.1	0.176	KJ	U	0.304	J	J	7.78		J	0.164	U		0.18	U		43.3			45.1	D	
1,2,3,7,8,9-HXCDD	0.1	0.457	J	J	0.401	J	J	4.24	J	J	0.155	U		0.17	U		22.2			18.3	DJ	
1,2,3,4,6,7,8-HPCDD	0.01	4.8	BJ		4.85	B		146	B		0.155	BJ	U	1.02	J	J	954			967	D	
OCDD	0.0003	38.1			42.7			903			11.7			11.2		J	7190	D		7140	D	
2,3,7,8-TCDF	0.1	0.248	J		0.24	J		0.317	J		0.0455	U	UJ	0.0501	U		2.4			2.66		
1,2,3,7,8-PECDF	0.03	0.175	J		0.169	J		0.709	J		0.0864	U		0.0951	U		2.93	J		4.65	DJ	
2,3,4,7,8-PECDF	0.3	0.201	J		0.183	J		1.24	J		0.0874	U		0.0961	U		3.48	J		6.66	DJ	
1,2,3,4,7,8-HXCDF	0.1	0.142	J		0.0858	KJ	U	6.97			0.0828	U		0.0911	U		18.5			37.7	D	J
1,2,3,6,7,8-HXCDF	0.1	0.117	U		0.13	J		2.18	J		0.109	U		0.12	U		7.05			11.3	DJ	
1,2,3,7,8,9-HXCDF	0.1	0.0907	U		0.0877	U		0.126	J		0.0846	U		0.0931	U		0.611	J		1.16	DJ	
2,3,4,6,7,8-HXCDF	0.1	0.117	KJ	U	0.122	J		1.98	J		0.109	U		0.12	U		6.56			7.94	DJ	J
1,2,3,4,6,7,8-HPCDF	0.01	0.0966	BJ	U	0.0934	BJ	U	92.2	B		0.0901	U		0.0991	KJ	U	400			414	D	
1,2,3,4,7,8,9-HPCDF	0.01	0.0859	U		0.083	U		3.03	BJ		0.0801	U		0.0881	U		11.4			18.9	DJ	
OCDF	0.0003	0.273	BJ	U	0.264	BJ	U	159	B		0.255	U		0.28	U		641			771	D	
TEQ 1/2 DL		0.33			0.34			6.62			0.15			0.17			33.03			36.42		
TEQ 0 DL		0.21			0.24			6.60			0.00			0.01			33.03			36.42		
Conventionals																						
Total Organic Carbon (% DW)		2.04			2.22			0.39			0.8			1.05			3.37			2.35		
TVS (%)		9.28		J	9.35		J	2.77		J	4.41		J	4.97		J	10.9		J	5.63		J
Total Solids (%)		52.5			47.9			76.4			68.1			64.6			33.8			61		
Grain Size																						
Percent Gravel (>2.0 mm)		8.02		J	1.66		J	12.2		J	15.1		J	27.3		J	5.71			25.9		
Percent Sand (<2.0 mm - 0.06 mm)		14.07			8.23			75.43			45.26			35.58			18.51			29.55		
Percent Silt (0.06 mm - 0.004 mm)		45.3		J	46.5		J	10.5		J	23.5		J	23		J	41.6			23.9		
Percent Fines (<0.06 mm)		74.6		J	76.6		J	14.24		J	39.3		J	40.5		J	82.2			44.8		
Percent Clay (<0.004 mm)		29.3		J	30.1		J	3.74		J	15.8		J	17.5		J	40.6			20.9		

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 B-4. (continued) Conventional parameters and individual dioxin/furan congener concentrations for all subsurface sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

Congener (pg/g)	TEF	BI-C15- 6-7FT	LQ	VQ	BI-C15- 9-10FT	LQ	VQ	BI-C16- 1-2 FT	LQ	VQ	BI-C16- 2-3 FT	LQ	VQ	BI-C17- 1-2FT	LQ	VQ	BI-C17- 3-4FT	LQ	VQ	BI-C18- 1-2- FT	LQ	VQ
2,3,7,8-TCDD	1	0.046	KJ	U	0.0478	U		0.174	J		0.0484	U		0.0576	U		0.0497	U		0.0474	KJ	U
1,2,3,7,8-PECDD	1	0.12	U		0.124	U		0.541	J	J	0.126	U	UJ	0.139	J		0.129	U		0.212	J	J
1,2,3,4,7,8-HXCDD	0.1	0.319	J		0.182	U		0.727	J	J	0.184	U	UJ	0.203	J		0.189	U		0.363	J	J
1,2,3,6,7,8-HXCDD	0.1	1.14	J	J	0.172	U		4.66	J		0.174	U		1.02	J	J	0.179	U		1.46	J	
1,2,3,7,8,9-HXCDD	0.1	0.613	J	J	0.163	KJ	U	1.95	J		0.164	U		0.484	J	J	0.169	KJ	U	0.892	J	
1,2,3,4,6,7,8-HPCDD	0.01	51		J	2.92	J	J	93.9			1.41	J		16.5		J	1.57	J	J	32.4		
OCDD	0.0003	490		J	219		J	627			9.6	J		120		J	15.8		J	210		
2,3,7,8-TCDF	0.1	0.046	U		0.0478	U		0.101	KJ	U	0.0484	U		0.0505	KJ	U	0.0497	U		0.0751	KJ	U
1,2,3,7,8-PECDF	0.03	0.0874	U		0.0908	U		0.517	J		0.0919	U		0.096	U		0.0943	U		0.157	J	
2,3,4,7,8-PECDF	0.3	0.0883	U		0.0918	U		1.01	J		0.0928	U		0.175	J		0.0953	U		0.201	J	
1,2,3,4,7,8-HXCDF	0.1	0.361	J		0.087	U		4.67	J	J	0.088	U	UJ	0.462	J		0.0904	U		0.637	J	J
1,2,3,6,7,8-HXCDF	0.1	0.13	J		0.115	U		1.42	J		0.116	U		0.209	J		0.119	U		0.338	J	
1,2,3,7,8,9-HXCDF	0.1	0.0856	U		0.0889	U		0.107	U		0.0899	U		0.0939	U		0.0924	U		0.0882	U	
2,3,4,6,7,8-HXCDF	0.1	0.132	J		0.115	U		1.12	J	J	0.116	U	UJ	0.254	J		0.119	U		0.308	J	J
1,2,3,4,6,7,8-HPCDF	0.01	7.23			0.0946	U		89.8			0.677	J		6.24			0.0983	KJ	U	25.9		
1,2,3,4,7,8,9-HPCDF	0.01	0.923	J	J	0.0841	U		2.43	J		0.0851	U		0.269	J	J	0.0874	U		0.361	J	
OCDF	0.0003	44.2		J	0.268	U		146			0.912	J		9.19	J	J	0.297	J	J	18.1		
TEQ 1/2 DL		1.13			0.25			4.59			0.18			0.76			0.18			1.36		
TEQ 0 DL		1.02			0.09			4.58			0.02			0.72			0.02			1.33		
Conventionals																						
Total Organic Carbon (% DW)		0.1			1.14			0.87			0.08			2.02			1.53			0.86		
TVS (%)		1.25		J	3.1		J	2.55		J	1.04		J	5.76		J	6.2		J	5.33		J
Total Solids (%)		87.3			74.9			75.5			88.6			45.2			54.2			53.5		
Grain Size																						
Percent Gravel (>2.0 mm)		61.6		J	11.9		J	63			48.1			17.9		J	16.1		J	5.34		
Percent Sand (<2.0 mm - 0.06 mm)		42.19			58.18			25.16			50.67			28.7			29.62			56.79		
Percent Silt (0.06 mm - 0.004 mm)		0.76		J	24.6		J	10.5			1.14			41.2		J	43.4		J	48.8		
Percent Fines (<0.06 mm)		1.38		J	29.84		J	16.48			1.63			55.6		J	56.2		J	48.81		
Percent Clay (<0.004 mm)		0.62		J	5.24		J	5.98			0.49			14.4		J	12.8		J	0.01		

B - The analyte was found in the associated method blank at a level that is significant relative to the sample result.

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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 B-4. (continued) Conventional parameters and individual dioxin/furan congener concentrations for all subsurface sediment grabs. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).

Congener (pg/g)	TEF	BI-C18-2-3 FT	LQ	VQ
2,3,7,8-TCDD	1	0.0497	U	
1,2,3,7,8-PECDD	1	0.129	U	UJ
1,2,3,4,7,8-HXCDD	0.1	0.189	U	UJ
1,2,3,6,7,8-HXCDD	0.1	0.179	U	
1,2,3,7,8,9-HXCDD	0.1	0.169	U	
1,2,3,4,6,7,8-HPCDD	0.01	2.03	J	
OCDD	0.0003	15		
2,3,7,8-TCDF	0.1	0.0497	U	
1,2,3,7,8-PECDF	0.03	0.0943	U	
2,3,4,7,8-PECDF	0.3	0.0953	U	
1,2,3,4,7,8-HXCDF	0.1	0.0904	U	UJ
1,2,3,6,7,8-HXCDF	0.1	0.119	U	
1,2,3,7,8,9-HXCDF	0.1	0.0924	U	
2,3,4,6,7,8-HXCDF	0.1	0.119	U	UJ
1,2,3,4,6,7,8-HPCDF	0.01	0.346	J	
1,2,3,4,7,8,9-HPCDF	0.01	0.0874	U	
OCDF	0.0003	0.516	J	
TEQ 1/2 DL		0.18		
TEQ 0 DL		0.03		
Conventionals				
Total Organic Carbon (% DW)		0.78		
TVS (%)		2.9		J
Total Solids (%)		70.5		
Grain Size				
Percent Gravel (>2.0 mm)		5.75		
Percent Sand (<2.0 mm - 0.06 mm)		65.96		
Percent Silt (0.06 mm - 0.004 mm)		24.7		
Percent Fines (<0.06 mm)		31.54		
Percent Clay (<0.004 mm)		6.84		

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.

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Table B-5. Individual dioxin/furan congener concentrations for benthic invertebrates. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006). L = littleneck clam, G = ghost shrimp, MAC = bent nose clam

Congener (pg/g)	TEF	BI-S30- MAC 1	LQ	VQ	BI-S30- MAC 2	LQ	VQ	BI-S30- MAC 3	LQ	VQ	BI-TISSUE1- G1	LQ	VQ	BI-TISSUE1- G2	LQ	VQ	BI-TISSUE1- G3	LQ	VQ
2,3,7,8-TCDD	1	0.113			0.106	J		0.14			0.244			0.175			0.201		
1,2,3,7,8-PECDD	1	0.493	J		0.48	J		0.505	J		1.47			1.03			1.14	G	J
1,2,3,4,7,8-HXCDD	0.1	0.874			0.726			0.838			1.17			0.837			0.861		
1,2,3,6,7,8-HXCDD	0.1	3.34			3.13			3.2			8.32			5.45			5.87		
1,2,3,7,8,9-HXCDD	0.1	1.87			1.83			2.06			1.91			1.31			1.38		
1,2,3,4,6,7,8-HPCDD	0.01	55.9			53.7			66.1			19.4			12.8			15.4		
OCDD	0.0003	350			349			437			62			52.9			65.4		
2,3,7,8-TCDF	0.1	0.257			0.222			0.276			0.692			0.54			0.546		
1,2,3,7,8-PECDF	0.03	0.256	J		0.222	J		0.252	J		0.686			0.431	J		0.46	J	
2,3,4,7,8-PECDF	0.3	0.316	J		0.326	J		0.326	J		0.943			0.596			0.657		
1,2,3,4,7,8-HXCDF	0.1	1.15			1.09			1.18			1.5			1.06			1.15		
1,2,3,6,7,8-HXCDF	0.1	0.536			0.506			0.537			0.896			0.523			0.601		
1,2,3,7,8,9-HXCDF	0.1	0.0371	KJ	U	0.0371	KJ	U	0.061	J		0.067	J		0.047	J		0.049	J	
2,3,4,6,7,8-HXCDF	0.1	0.525	J		0.45	J		0.497	J		0.459	J		0.331	J		0.391	J	
1,2,3,4,6,7,8-HPCDF	0.01	12.5			11.4			12.6			6.92			4.24			5.11		
1,2,3,4,7,8,9-HPCDF	0.01	0.723			0.733			0.918			0.205	J		0.0512	KJ	U	0.179	J	
OCDF	0.0003	24.9			25.2			28.7			4.34	B		2.93			4.03		
TEQ 1/2 DL		2.37			2.26			2.55			3.80			2.59			2.86		
TEQ 0 DL		2.37			2.26			2.55			3.80			2.59			2.86		
Lipid %		0.77			0.68			0.71			2.28			0.86			0.98		

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 B-5. (continued) Individual dioxin/furan congener concentrations for benthic invertebrates. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006). L = littleneck clam, G = ghost shrimp, MAC = bent nose clam

		BI-TISSUE1B-			BI-TISSUE1B-			BI-TISSUE1B-			BI-TISSUE1-			BI-TISSUE1-			BI-TISSUE1-		
Congener (pg/g)	**TEF**	**L1**	**LQ**	**VQ**	**L2**	**LQ**	**VQ**	**L3**	**LQ**	**VQ**	**MAC1**	**LQ**	**VQ**	**MAC 2**	**LQ**	**VQ**	**MAC 3**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.0198	KJ	U	0.0199	KJ	U	0.0199	KJ	U	0.036	J		0.0199	KJ	U	0.058	J	
1,2,3,7,8-PECDD	1	0.078	J		0.083	J		0.085	J		0.151	J		0.206	J		0.175	J	
1,2,3,4,7,8-HXCDD	0.1	0.095	J		0.0798	U		0.092	J		0.241	J		0.331	J		0.293	J	
1,2,3,6,7,8-HXCDD	0.1	0.566			0.476	J		0.519	J		1.47			1.62			1.64		
1,2,3,7,8,9-HXCDD	0.1	0.215	J		0.205	J		0.224	J		0.585			0.792			0.714		
1,2,3,4,6,7,8-HPCDD	0.01	5.22			4.12			5.65			21.1			24.8			22.4		
OCDD	0.0003	22.3			20			30.8			112			157			137		
2,3,7,8-TCDF	0.1	0.0198	KJ	U	0.0199	KJ	U	0.087	J		0.114			0.0199	KJ	U	0.02	KJ	U
1,2,3,7,8-PECDF	0.03	0.038	KJ	U	0.0407	U		0.0407	U		0.112	J		0.105	J		0.113	J	
2,3,4,7,8-PECDF	0.3	0.066	J		0.071	J		0.0407	KJ	U	0.116	J		0.134	J		0.113	J	
1,2,3,4,7,8-HXCDF	0.1	0.125	J		0.107	J		0.155	J		0.346	J		0.448	J		0.394	J	
1,2,3,6,7,8-HXCDF	0.1	0.083	J		0.0371	KJ	U	0.078	J		0.211	J		0.245	J		0.237	J	
1,2,3,7,8,9-HXCDF	0.1	0.0368	U		0.0371	U		0.0371	U		0.037	J		0.0371	U		0.0371	U	
2,3,4,6,7,8-HXCDF	0.1	0.089	J		0.087	J		0.109	J		0.239	J		0.0371	KJ	U	0.252	J	
1,2,3,4,6,7,8-HPCDF	0.01	1.75			1.3			1.69			6.94			7.61			7.08		
1,2,3,4,7,8,9-HPCDF	0.01	0.067	J		0.0511	U		0.051	U		0.241	J		0.282	J		0.268	J	
OCDF	0.0003	1.73	B		1.38			2.46			9.34	B		10.9			9.39		
TEQ 1/2 DL		0.31			0.27			0.31			0.87			0.98			0.97		
TEQ 0 DL		0.29			0.25			0.29			0.87			0.97			0.96		
Lipid %		0.97			0.89			0.73			0.63			0.51			0.48		

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.

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Table B-5. (continued) Individual dioxin/furan congener concentrations for benthic invertebrates.
Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).
L = littleneck clam, G = ghost shrimp, MAC = bent nose clam

		BI-TISSUE2-			BI-TISSUE2-			BI-TISSUE2-			BI-TISSUE2-			BI-TISSUE2-			BI-TISSUE2-		
Congener (pg/g)	**TEF**	**G1**	**LQ**	**VQ**	**G2**	**LQ**	**VQ**	**G3**	**LQ**	**VQ**	**L1**	**LQ**	**VQ**	**L2**	**LQ**	**VQ**	**L3**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.174			0.265			0.186			0.0197	KJ	U	0.0198	KJ	U	0.0195	U	
1,2,3,7,8-PECDD	1	1.27			1.97			1.68			0.0512	KJ	U	0.248	J		0.065	J	
1,2,3,4,7,8-HXCDD	0.1	1.21			2.28			1.95			0.0788	U		0.487	J		0.086	J	
1,2,3,6,7,8-HXCDD	0.1	8.45			12.3			11.3			0.412	J		2.36			0.446	J	
1,2,3,7,8,9-HXCDD	0.1	2.16			3.73			3.21			0.164	J		1.49			0.219	J	
1,2,3,4,6,7,8-HPCDD	0.01	21.7			33.3			30.7			4.06			45.7			4.19		
OCDD	0.0003	51.9			84			75.1			17.1			313			18.4		
2,3,7,8-TCDF	0.1	0.599			1.08			0.816			0.0197	KJ	U	0.0764	KJ	U	0.0643	KJ	U
1,2,3,7,8-PECDF	0.03	0.807			1.09			0.886			0.0378	KJ	U	0.176	J		0.043	J	
2,3,4,7,8-PECDF	0.3	1.15			1.58			1.37			0.056	J		0.211	J		0.074	J	
1,2,3,4,7,8-HXCDF	0.1	1.99			3.17			2.61			0.11	J		0.826			0.137	J	
1,2,3,6,7,8-HXCDF	0.1	0.852			1.32			1.12			0.063	J		0.395	J		0.073	J	
1,2,3,7,8,9-HXCDF	0.1	0.061	J		0.0371	KJ	U	0.056	J		0.0366	U		0.0369	U		0.0363	U	
2,3,4,6,7,8-HXCDF	0.1	0.454	J		0.707			0.541			0.06	J		0.357	J		0.061	J	
1,2,3,4,6,7,8-HPCDF	0.01	5.16			7.6			6.55			0.939			9.96			0.988		
1,2,3,4,7,8,9-HPCDF	0.01	0.143	J		0.207	J		0.181	J		0.056	J		0.423	J		0.0417	U	
OCDF	0.0003	2.5	B		3.46			5.12			0.966	BJ		14	B		1.04	BJ	
TEQ 1/2 DL		3.68			5.64			4.86			0.20			1.58			0.26		
TEQ 0 DL		3.68			5.64			4.86			0.15			1.57			0.25		
Lipid %		1.75			1.72			1.47			0.89			0.66			0.64		

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 B-5. (continued) Individual dioxin/furan congener concentrations for benthic invertebrates. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006). L = littleneck clam, G = ghost shrimp, MAC = bent nose clam

		BI-TISSUE2-			BI-TISSUE2-			BI-TISSUE2-			BI-TISSUE-			BI-TISSUE-			BI-TISSUE-		
Congener (pg/g)	**TEF**	**MAC1**	**LQ**	**VQ**	**MAC 2**	**LQ**	**VQ**	**MAC 3**	**LQ**	**VQ**	**G1**	**LQ**	**VQ**	**G2**	**LQ**	**VQ**	**G3**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.0383	KJ	U	0.0276	KJ	U	0.0211	KJ	U	0.236			0.209			0.221		
1,2,3,7,8-PECDD	1	0.164	J		0.135	J		0.17	J		1.8			1.52			1.68		
1,2,3,4,7,8-HXCDD	0.1	0.251	J		0.244	J		0.271	J		1.85			1.5			1.66		
1,2,3,6,7,8-HXCDD	0.1	1.16			1.19			1.22			12.5			8.97			10.3		
1,2,3,7,8,9-HXCDD	0.1	0.573	J		0.658	J		0.669			3.35			2.66			2.99		
1,2,3,4,6,7,8-HPCDD	0.01	18.7			18			18.2			42.1			31.5			35.8		
OCDD	0.0003	104			108			110			72.8			82			94.4		
2,3,7,8-TCDF	0.1	0.0383	KJ	U	0.081	KJ	U	0.0839	KJ	U	0.731			0.71			0.828		
1,2,3,7,8-PECDF	0.03	0.098	J		0.053	KJ	U	0.108	J		1.11			0.923			0.908		
2,3,4,7,8-PECDF	0.3	0.152	J		0.152	J		0.125	J		1.75			1.36			1.45		
1,2,3,4,7,8-HXCDF	0.1	0.374	J		0.365	J		0.407	J		3.18			2.66			2.86		
1,2,3,6,7,8-HXCDF	0.1	0.193	J		0.166	J		0.173	J		1.19			0.937			1.03		
1,2,3,7,8,9-HXCDF	0.1	0.0712	U		0.0513	U		0.0393	U		0.0371	KJ	U	0.053	J		0.0372	KJ	U
2,3,4,6,7,8-HXCDF	0.1	0.178	J		0.191	J		0.174	J		0.714			0.556			0.601		
1,2,3,4,6,7,8-HPCDF	0.01	4.29			4.15			4.16			7.56			5.79			6.58		
1,2,3,4,7,8,9-HPCDF	0.01	0.0819	KJ	U	0.165	J		0.183	J		0.131	J		0.115	J		0.153	J	
OCDF	0.0003	5.82	B		5.43	B		5.09	B		1.99	B		2.31			3.12		
TEQ 1/2 DL		0.77			0.74			0.78			5.47			4.37			4.85		
TEQ 0 DL		0.75			0.72			0.76			5.47			4.37			4.84		
Lipid %		0.8			0.39			0.35			2.19			1.85			1.89		

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 B-5. (continued) Individual dioxin/furan congener concentrations for benthic invertebrates. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006). L = littleneck clam, G = ghost shrimp, MAC = bent nose clam

Congener (pg/g)	TEF	BI-TISSUE3- MAC1	LQ	VQ	BI-TISSUE3- MAC 2	LQ	VQ	BI-TISSUE3- MAC 3	LQ	VQ
2,3,7,8-TCDD	1	0.02	KJ	U	0.0199	KJ	U	0.077	J	
1,2,3,7,8-PECDD	1	0.183	J		0.393	J		0.296	J	
1,2,3,4,7,8-HXCDD	0.1	0.291	J		0.66			0.496	J	
1,2,3,6,7,8-HXCDD	0.1	1.63			3.23			2.54		
1,2,3,7,8,9-HXCDD	0.1	0.772			1.79			1.34		
1,2,3,4,6,7,8-HPCDD	0.01	31.4			67.9			50.2		
OCDD	0.0003	190			483			341		
2,3,7,8-TCDF	0.1	0.11			0.175			0.135		
1,2,3,7,8-PECDF	0.03	0.139	J		0.266	J		0.203	J	
2,3,4,7,8-PECDF	0.3	0.201	J		0.341	J		0.275	J	
1,2,3,4,7,8-HXCDF	0.1	0.593			1.3			0.97		
1,2,3,6,7,8-HXCDF	0.1	0.243	J		0.0342	U		0.367	J	
1,2,3,7,8,9-HXCDF	0.1	0.0372	U		0.043	J		0.0368	U	
2,3,4,6,7,8-HXCDF	0.1	0.215	J		0.442	J		0.335	J	
1,2,3,4,6,7,8-HPCDF	0.01	6.33			13.8			9.6		
1,2,3,4,7,8,9-HPCDF	0.01	0.229	J		0.484	J		0.337	J	
OCDF	0.0003	8.83	B		19.4	B		13.1	B	
TEQ 1/2 DL		1.08			2.25			1.79		
TEQ 0 DL		1.07			2.24			1.79		
Lipid %		0.79			0.36			0.59		

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 B-6. Individual dioxin/furan congener concentrations for trawl samples.
Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).
SF = starry flounder, E = English sole

		BI-TRAWL1-			BI-TRAWL1-			BI-TRAWL1-			BI-TRAWL2-			BI-TRAWL2-			BI-TRAWL2-			BI-TRAWL2-		
Congener (pg/g)	**TEF**	**SF1**	**LQ**	**VQ**	**SF2**	**LQ**	**VQ**	**SF3**	**LQ**	**VQ**	**SF1**	**LQ**	**VQ**	**SF2**	**LQ**	**VQ**	**SF3**	**LQ**	**VQ**	**SF4**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.087	J		0.0196	KJ	U	0.02	KJ	U	0.0198	K	U	0.02	K	U	0.151			0.02	KJ	U
1,2,3,7,8-PECDD	1	0.209	J		0.153	J		0.178	J		0.325	J		0.0519	KJ	U	0.267	J		0.207	J	
1,2,3,4,7,8-HXCDD	0.1	0.0794	U		0.0785	U		0.0799	U		0.0792	U		0.0799	U		0.0776	U		0.0799	U	
1,2,3,6,7,8-HXCDD	0.1	0.594			0.0487	KJ	U	0.36	J		1.04			0.699			0.951			0.701		
1,2,3,7,8,9-HXCDD	0.1	0.087	J		0.062	J		0.066	J		0.117	J		0.0356	KJ	U	0.03345	KJ	U	0.127	J	
1,2,3,4,6,7,8-HPCDD	0.01	1.04			0.887			0.902			1.38			1.01			1.01			0.674		
OCDD	0.0003	2.53			2.37			2.8			2.32			1.72			2.54			0.978	J	
2,3,7,8-TCDF	0.1	0.284			0.213			0.056	K	U	0.424			0.452			0.553			0.56		
1,2,3,7,8-PECDF	0.03	0.073	J		0.049	J		0.065	J		0.038	KJ	U	0.075	J		0.0373	KJ	U	0.082	J	
2,3,4,7,8-PECDF	0.3	0.221	J		0.161	J		0.162	J		0.366	J		0.239	J		0.322	J		0.238	J	
1,2,3,4,7,8-HXCDF	0.1	0.163	J		0.097	J		0.112	J		0.314	J		0.165	J		0.156	J		0.196	J	
1,2,3,6,7,8-HXCDF	0.1	0.086	J		0.045	J		0.041	J		0.14	J		0.072	J		0.069	J		0.087	J	
1,2,3,7,8,9-HXCDF	0.1	0.0369	U		0.0365	U		0.0371	U		0.0368	U		0.0372	U		0.0361	U		0.0372	U	
2,3,4,6,7,8-HXCDF	0.1	0.0306	KJ	U	0.037	J		0.046	J		0.111	J		0.059	J		0.073	J		0.061	J	
1,2,3,4,6,7,8-HPCDF	0.01	0.304	J		0.235	J		0.255	J		0.361	J		0.296	J		0.314	J		0.226	J	
1,2,3,4,7,8,9-HPCDF	0.01	0.0425	U		0.042	U		0.0427	U		0.0424	U		0.0427	U		0.0415	U		0.0428	U	
OCDF	0.0003	0.242	BJ		0.0389	BJ	U	0.301	BJ		0.0392	KBJ	U	0.0396	KBJ	U	0.0384	BJ	U	0.106	BJ	U
TEQ 1/2 DL		0.51			0.28			0.32			0.68			0.28			0.72			0.48		
TEQ 0 DL		0.50			0.26			0.30			0.67			0.23			0.71			0.46		
LIPID		1.04			1.19			1.37			1.19			1.14			1.36			0.75		

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 B-6. (continued) Individual dioxin/furan congener concentrations for trawl samples.
Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006).
SF = starry flounder, E = English sole

		BI-TRAWL2-			BI-TRAWL3-			BI-TRAWL3-			BI-TRAWL3-			BI-TRAWL3-			BI-TRAWL3-		
Congener (pg/g)	**TEF**	**SF5**	**LQ**	**VQ**	**SF1**	**LQ**	**VQ**	**SF2**	**LQ**	**VQ**	**SF3**	**LQ**	**VQ**	**SF4**	**LQ**	**VQ**	**SF5**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.0197	KJ	U	0.0197	KJ	U	0.0199	K	U	0.12			0.107	J		0.069	J	
1,2,3,7,8-PECDD	1	0.062	J		0.257	J		0.571			0.453	J		0.349	J		0.219	J	
1,2,3,4,7,8-HXCDD	0.1	0.0786	U		0.079	U		0.147	J		0.079	U		0.0788	U		0.0781	U	
1,2,3,6,7,8-HXCDD	0.1	0.17	J		0.759			1.88			1.27			0.878			0.59		
1,2,3,7,8,9-HXCDD	0.1	0.048	J		0.0351	KJ	U	0.242	J		0.172	J		0.118	J		0.0348	KJ	U
1,2,3,4,6,7,8-HPCDD	0.01	0.293	J		0.937			0.868			1.77			1.13			0.815		
OCDD	0.0003	0.697	J		1.16			1.19			3.71			3.93			1.41		
2,3,7,8-TCDF	0.1	0.227			1.03			0.738			0.441			0.561			0.31		
1,2,3,7,8-PECDF	0.03	0.0378	U		0.105	J		0.263	J		0.139	J		0.099	J		0.065	J	
2,3,4,7,8-PECDF	0.3	0.072	J		0.329	J		0.626			0.396	J		0.415	J		0.23	J	
1,2,3,4,7,8-HXCDF	0.1	0.056	J		0.153	J		0.566			0.316	J		0.301	J		0.232	J	
1,2,3,6,7,8-HXCDF	0.1	0.0338	U		0.07	J		0.197	J		0.17	J		0.093	J		0.08	J	
1,2,3,7,8,9-HXCDF	0.1	0.0366	U		0.0367	U		0.0369	U		0.0367	U		0.0367	U		0.0363	U	
2,3,4,6,7,8-HXCDF	0.1	0.0303	U		0.083	J		0.119	J		0.0304	KJ	U	0.078	J		0.0301	KJ	U
1,2,3,4,6,7,8-HPCDF	0.01	0.098	J		0.222	J		0.286	J		0.49	J		0.0505	KJ	U	0.182	J	
1,2,3,4,7,8,9-HPCDF	0.01	0.0421	U		0.0422	U		0.0425	U		0.0423	U		0.0422	U		0.0418	U	
OCDF	0.0003	0.0389	BJ	U	0.0391	KBJ	U	0.0393	BJ	U	0.312	BJ		0.039	KBJ	U	0.0387	KBJ	U
TEQ 1/2 DL		0.16			0.60			1.18			0.96			0.81			0.50		
TEQ 0 DL		0.14			0.58			1.17			0.96			0.80			0.49		
LIPID		2.13			1.22			1.01			0.76			0.75			0.71		

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 B-6. (continued) Individual dioxin/furan congener concentrations for trawl samples. Total TEQ are calculated using WHO 2005 TEF (Van den Berg et al. 2006). SF = starry flounder, E = English sole

		BI-TRAWL3-			BI-TRAWL3-			BI-TRAWL3-		
Congener (pg/g)	**TEF**	**E1**	**LQ**	**VQ**	**E2**	**LQ**	**VQ**	**E3**	**LQ**	**VQ**
2,3,7,8-TCDD	1	0.0197	KJ	U	0.0199	KJ	U	0.088	J	
1,2,3,7,8-PECDD	1	0.441	J		0.395	J		0.418	J	
1,2,3,4,7,8-HXCDD	0.1	0.154	J		0.151	J		0.135	J	
1,2,3,6,7,8-HXCDD	0.1	0.969			0.761			0.783		
1,2,3,7,8,9-HXCDD	0.1	0.131	J		0.0353	KJ	U	0.114	J	
1,2,3,4,6,7,8-HPCDD	0.01	1.09			0.909			0.881		
OCDD	0.0003	3.92			3.01			3.28		
2,3,7,8-TCDF	0.1	0.798			0.902			0.703		
1,2,3,7,8-PECDF	0.03	0.148	J		0.128	J		0.124	J	
2,3,4,7,8-PECDF	0.3	0.663			0.524			0.525		
1,2,3,4,7,8-HXCDF	0.1	0.261	J		0.24	J		0.209	J	
1,2,3,6,7,8-HXCDF	0.1	0.104	J		0.075	J		0.076	J	
1,2,3,7,8,9-HXCDF	0.1	0.0366	U		0.0369	U		0.0365	U	
2,3,4,6,7,8-HXCDF	0.1	0.102	J		0.083	J		0.09	J	
1,2,3,4,6,7,8-HPCDF	0.01	0.328	J		0.248	J		0.266	J	
1,2,3,4,7,8,9-HPCDF	0.01	0.0421	KJ	U	0.0425	U		0.042	U	
OCDF	0.0003	0.8	BJ		0.33	BJ		0.365	BJ	
TEQ 1/2 DL		0.92			0.80			0.89		
TEQ 0 DL		0.91			0.79			0.89		
LIPID		0.79			1.09			0.74		

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 B-7. SMS chemistry data for surface and subsurface sediment samples from Budd Inlet and Capitol Lake.

	WA SMS	WA SMS																		
Station Number	**Chem**	**Max Chm**	**BI-S1**			**BI-S4**			**BI-S5**			**BI-S7**			**BI-S9**			**BI-S11**		
Collection Date	**Criteria**	**Criteria**	**4/11/2007**	**LQ**	**VQ**	**4/13/2007**	**LQ**	**VQ**	**4/12/2007**	**LQ**	**VQ**	**4/12/2007**	**LQ**	**VQ**	**4/13/2007**	**LQ**	**VQ**	**4/13/2007**	**LQ**	**VQ**
Metals in mg/kg DW																				
Antimony	—	—	0.12		J	0.16		J	0.19		J	0.97		J	0.07		UJ	0.15		J
Arsenic	57	93	5.65		J	7.28		J	7.8			10.1			3.82		J	7.02		J
Cadmium	5.1	6.7	1.9			2.18			1.31			1.66			0.723			2.48		
Chromium	—	—	32.2		J	33.9		J	22.5			28.2			23		J	33.8		J
Copper	390	390	64.2		J	77.5		J	38.1		J	58.2		J	27.7		J	70.4		J
Lead	450	530	18.3			35.7			22.3			70.3			17.4			20.6		
Mercury	0.41	0.59	0.1			0.395			0.163			0.186			0.088			0.163		
Nickel	—	—	27.8		J	27.8		J	18.2			21.5			18.1		J	27.4		J
Silver	6.1	6.1	0.46			1.43			0.415			0.496			0.3			0.6		
Zinc	410	960	84		J	115		J	71.5		J	95.1		J	52.1		J	113		J
Butyltins (Porewater) ug/L																				
Tetra-n-butyltin	—	—				0.022	U											0.022	U	
Tri-n-butyltin	—	—				0.041	U											0.041	U	
Di-n-butyltin	—	—				0.0081	U											0.11		
n-Butyltin	—	—				0.011	U											0.11		
LPAH in mg/kg TOC																				
Naphthalene	99	170	0.17	J		0.23	J		0.91			0.25			0.99			0.09	J	
Acenaphthylene	66	66	0.30	J		0.43			0.28	J		0.13	J		0.34	J		0.16	J	
Acenaphthene	16	57	0.11	J		0.22	J		0.26	J		0.09	J		0.19	J		0.06	U	
Fluorene	23	79	0.18	J		0.31	J		0.34	J		0.12	J		0.24	J		0.10	U	
Phenanthrene	100	480	0.91			2.07			2.49			1.51			1.93			0.55		
Anthracene	220	1200	0.69			1.18			0.67			0.22			0.57	J		0.31		
2-Methylnaphthalene	38	64	0.12	J		0.15	J		0.22	J		0.08	J		0.19	J		0.07	U	
Total LPAH*	370	780	2.48	J		4.60	J		4.95	J		2.31	J		4.45	J		1.11	J	
HPAH in mg/kg TOC																				
Fluoranthene	160	1200	3.69			7.21			4.66			2.16			3.60			2.02		
Pyrene	1000	1400	3.94			7.45			4.15			1.94			3.42			2.02		
Benzo(a)anthracene	110	270	1.40			3.61			1.66			0.64			1.18			0.66		
Chrysene	110	460	2.46			6.25			2.46			1.19			1.61			1.67		
Benzofluoranthenes*	230	450	3.67		J	7.81		J	3.94			1.52			2.73		J	1.96		J
Benzo(a)pyrene	99	210	1.26			3.37			1.84			0.84			1.43			0.70		
Indeno(1,2,3-cd)pyrene	34	88	1.01			2.09			1.30			0.68			1.18			0.51		
Dibenz(a,h)anthracene	12	33	0.19	J		0.46			0.28	J		0.23			0.25	U		0.13	U	
Benzo(g,h,i)perylene	31	78	0.86			1.75			1.22			0.64			1.18			0.48		
Total HPAH*	960	5300	18.49	J		40.00			21.50	J		9.84			16.34			10.02		

Benzofluoranthenes = Sum of benzo(b)fluoranthene and benzo(k)fluoranthene   Total PCBs = Sum of all Aroclors   Gray shading denotes SMS exceedance

LPAH = Sum of all LPAH except 2-methylnaphthalene.   HPAH = Sum of all HPAH

Station Number	WA SMS Chem Criteria	WA SMS Max Chm Criteria	BI-S1			BI-S4			BI-S5			BI-S7			BI-S9			BI-S11		
Collection Date			4/11/2007	LQ	VQ	4/13/2007	LQ	VQ	4/12/2007	LQ	VQ	4/12/2007	LQ	VQ	4/13/2007	LQ	VQ	4/13/2007	LQ	VQ
Chlorinated Aromatics in mg/kg TOC																				
1,3-Dichlorobenzene	–	–	0.12	U		0.16	J		0.34	U		0.15	U		0.19	U		0.10	U	
1,4-Dichlorobenzene	3.1	9	0.14	U		0.53			0.34	U		0.15	U		0.22	U		0.12	U	
1,2-Dichlorobenzene	2.3	2.3	0.10	U		0.22	J		0.34	U		0.15	U		0.15	U		0.08	U	
1,2,4-Trichlorobenzene	0.81	1.8	0.11	U		0.15	J		0.34	U		0.15	U		0.17	U		0.09	U	
Hexachlorobenzene	0.38	2.3	0.16	U		0.16	U		0.34	U		0.15	U		0.24	U		0.13	U	
Phthalate Esters in mg/kg TOC																				
Dimethylphthalate	53	53	0.14	U		0.14	U		0.34	U		0.15	U		0.21	U		0.11	U	
Diethylphthalate	61	110	0.27	U		0.29	U		0.78			0.06	J		0.40	U		0.22	U	
Di-n-Butylphthalate	220	1700	0.24	J		0.21	J		2.56			0.98			0.30	U		0.20	J	
Butylbenzylphthalate	4.9	64	0.11	U		0.34	J		0.34	U		0.15	U		0.25	J		0.09	U	
bis(2-Ethylhexyl)phthalate	47	78	1.97	J		12.50			1.48	J		1.30	J		2.36	J		1.05	J	
Di-n-Octylphthalate	58	4500	0.09	U		0.09	U		0.34	U		0.15	U		0.14	U		0.07	U	
Phenols in ug/kg DW																				
Phenol	420	1200	38	J		13	J	U	32	J	U	59		U	7.4	J	U	11	J	U
2-Methylphenol	63	63	11	U		11	U		13	U		14	U		6.3	U		12	U	
4-Methylphenol	670	670	8.8	U		62			11	J		56			7.6	J		9.6	U	
2,4-Dimethylphenol	29	29	17	U		18	U		62	U		69	U		11	U		19	U	
Pentachlorophenol	360	690	26	U		27	U		130	U		140	U		16	U		29	U	
Miscellaneous Extractables in mg/kg TOC																				
Benzyl Alcohol (ug/kg DW)	57	73	12.0	U		12.0	U		5.6	J		7.4	J		6.8	U		13.0	U	
Benzoic Acid (ug/kg DW)	650	650	290.0	U		310.0	U		250.0	U	R	280.0	U	R	180.0	U		320.0	U	
Dibenzofuran	15	58	0.13	J		0.18	J		0.19	J		0.09	J		0.19	J		0.08	U	
Hexachloroethane	–	–	0.17	U		0.17	U		0.34	U		0.15	U		0.25	U		0.13	U	
Hexachlorobutadiene	3.9	6.2	0.11	U		0.11	U		0.34	U		0.15	U		0.16	U		0.09	U	
N-Nitrosodiphenylamine	28	130	0.17	U		0.17	U		0.34	U		0.07	J		0.25	U		0.13	U	
Pesticides and PCBs in mg/kg TOC																				
Aroclor-1016	–	–	0.13	U		0.13	U		0.26	U		0.11	U		0.20	U		0.10	U	
Aroclor-1242	–	–	0.13	U		0.13	Ui		0.52	U		0.22	U		0.20	U		0.10	U	
Aroclor-1248	–	–	0.13	U		0.13	U		0.26	U		0.11	U		0.20	U		0.10	U	
Aroclor-1254	–	–	0.27	J		1.11			0.26	U		0.11	U		0.81			0.24	J	
Aroclor-1260	–	–	0.13	U		0.13	U		0.26	U		0.11	U		0.20	U		0.10	U	
Aroclor-1221	–	–	0.13	U		0.13	U		0.73			0.25			0.20	U		0.10	U	
Aroclor-1232	–	–	0.13	U		0.13	U		0.26	U		0.11	U		0.20	U		0.10	U	
Total PCBs*	12	65	0.27	J		1.11			0.73			0.25			0.81			0.24	J	

B - The analyte was found in the associated method blank at a level that is significant relative to the sample result.

Gray shading denotes SMS exceedance

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 B-7. (continued) SMS chemistry data for surface (0-10 cm) sediment grabs from Budd Inlet and Capitol Lake.

Station Number Collection Date	WA SMS Chem Criteria	WA SMS Max Chm Criteria	BI-S12 4/13/2007	LQ	VQ	BI-S15 4/14/2007	LQ	VQ	BI-S17 4/13/2007	LQ	VQ	BI-S18 4/14/2007	LQ	VQ	BI-S21 4/13/2007	LQ	VQ	BI-S30 6/15/2007	LQ	VQ
Metals in mg/kg DW																				
Antimony	—	—	0.08		UJ	0.05		J	0.13		J							0.17		J
Arsenic	57	93	6.2		J	3.6			7.16		J							5		
Cadmium	5.1	6.7	1.97			0.707			1.87									0.642		
Chromium	—	—	35		J	13			26.2		J							25.7		
Copper	390	390	67.4		J	12.4		J	36.1		J							34.3		J
Lead	450	530	24.4			5.47			13.7									39.9		
Mercury	0.41	0.59	0.172			0.06			0.119									0.108		
Nickel	—	—	26.1		J	13.1			20.9		J							23.8		
Silver	6.1	6.1	0.63			0.124			0.41									0.299		
Zinc	410	960	79.7		J	34		J	59.3		J							101		J
Butyltins (Porewater) ug/L																				
Tetra-n-butyltin	—	—																		
Tri-n-butyltin	—	—																		
Di-n-butyltin	—	—																		
n-Butyltin	—	—																		
LPAH in mg/kg TOC																				
Naphthalene	99	170	2.93			1.69			0.38	J		0.43	J		0.19	J		1.95	U	
Acenaphthylene	66	66	0.60			0.34	J		0.15	J		0.16	J		0.17	J		0.66	JD	
Acenaphthene	16	57	0.27	J		1.41	U		0.08	U		0.10	U		0.06	U		0.62	JD	
Fluorene	23	79	0.42	J		1.41	U		0.13	U		0.17	U		0.11	U		0.74	JD	
Phenanthrene	100	480	2.54			1.08	J		0.43			0.49	J		0.52			11.67	D	
Anthracene	220	1200	1.49			0.49	J		0.23	J		0.25	J		0.30	J		2.22	D	
2-Methylnaphthalene	38	64	0.36	J		1.41	U		0.09	U		0.13	J		0.09	J		1.95	U	
Total LPAH*	370	780	8.60	J		3.61	J		1.19			1.47			1.27			15.91	JD	
HPAH in mg/kg TOC																				
Fluoranthene	160	1200	3.58			1.97			1.21			1.05			1.53			27.24	D	
Pyrene	1000	1400	5.37			2.39			1.29			1.26			1.81			23.35	D	
Benzo(a)anthracene	110	270	8.06			0.55	J		0.48			0.43	J		0.70			11.67	D	
Chrysene	110	460	6.87			0.77	J		0.86			0.58			1.71			16.34	D	
Benzofluoranthenes*	230	450	18.51		J	1.66	J		1.21	J	J	1.17	J	J	2.07		J	34.63	D	
Benzo(a)pyrene	99	210	10.15			0.73	J		0.48			0.55			0.76			15.56	D	
Indeno(1,2,3-cd)pyrene	34	88	4.48			0.63	J		0.32	J		0.40	J		0.54			14.40	D	
Dibenz(a,h)anthracene	12	33	1.07			1.41	U		0.16	U		0.22	U		0.14	U		5.06	D	
Benzo(g,h,i)perylene	31	78	3.58			0.69	J		0.30	J		0.49	J		0.48			13.62	D	
Total HPAH*	960	5300	61.67			9.41	J		6.16			5.94			9.60			161.87	D	

Benzofluoranthenes = Sum of benzo(b)fluoranthene and benzo(k)fluoranthene Total PCBs = Sum of all Aroclors Gray shading denotes SMS exceedance

LPAH = Sum of all LPAH except 2-methylnaphthalene. HPAH = Sum of all HPAH

Station Number	WA SMS Chem Criteria	WA SMS Max Chm Criteria	BI-S12			BI-S15			BI-S17			BI-S18			BI-S21			BI-S30		
Collection Date			4/13/2007	LQ	VQ	4/14/2007	LQ	VQ	4/13/2007	LQ	VQ	4/14/2007	LQ	VQ	4/13/2007	LQ	VQ	6/15/2007	LQ	VQ
Chlorinated Aromatics in mg/kg TOC																				
1,3-Dichlorobenzene	—	—	0.14	U		1.41	U		0.12	U		0.16	U		0.10	U		1.95	U	
1,4-Dichlorobenzene	3.1	9	0.16	U		1.41	U		0.14	U		0.19	U		0.12	U		1.95	U	
1,2-Dichlorobenzene	2.3	2.3	0.11	U		1.41	U		0.10	U		0.13	U		0.08	U		1.95	U	
1,2,4-Trichlorobenzene	0.81	1.8	0.13	U		1.41	U		0.11	U		0.15	U		0.10	U		1.95	U	
Hexachlorobenzene	0.38	2.3	0.18	U		1.41	U		0.15	U		0.21	U		0.13	U		1.95	U	
Phthalate Esters in mg/kg TOC																				
Dimethylphthalate	53	53	0.16	U		1.41	U		0.13	U		0.18	U		0.11	U		1.95	U	
Diethylphthalate	61	110	0.33	U		1.41	U		0.26	U		0.37	U		0.24	U		1.95	U	
Di-n-Butylphthalate	220	1700	0.25	J		2.96			0.32	J		0.26	U		0.22	J		3.89	U	
Butylbenzylphthalate	4.9	64	0.13	U		1.41	U		0.11	U		0.15	U		0.10	U		1.95	U	
bis(2-Ethylhexyl)phthalate	47	78	1.13	J		2.25	J		0.43	J	U	0.55	J		0.44	J	U	24.12	D	
Di-n-Octylphthalate	58	4500	0.10	U		1.41	U		0.09	U		0.12	U		0.08	U		1.95	U	
Phenols in ug/kg DW																				
Phenol	420	1200	210			16	J	U	12	J	U	6.1	U		13	J	U	150	U	
2-Methylphenol	63	63	9.8	U		10	U		9.3	U		11	U		11	U		50	U	
4-Methylphenol	670	670	59			14			21			9.3	U		36			17	JD	
2,4-Dimethylphenol	29	29	16	U		50	U		15	U		18	U		18	U		250	U	
Pentachlorophenol	360	690	25	U		100	U		24	U		28	U		27	U		500	U	
Miscellaneous Extractables in mg/kg TOC																				
Benzyl Alcohol (ug/kg DW)	57	73	11.0	U		10.0	U		11.0	U		12.0	U		12.0	U		50.0	U	
Benzoic Acid (ug/kg DW)	650	650	280.0	U		200.0	U	R	270.0	U		310.0	U		310.0	U		1000.0	U	R
Dibenzofuran	15	58	0.30	J		1.41	U		0.10	U		0.13	U		0.08	U		1.95	U	
Hexachloroethane	—	—	0.19	U		1.41	U		0.16	U		0.22	U		0.14	U		1.95	U	
Hexachlorobutadiene	3.9	6.2	0.12	U		1.41	U		0.10	U		0.14	U		0.09	U		1.95	U	
N-Nitrosodiphenylamine	28	130	0.19	U		1.41	U		0.16	U		0.22	U		0.14	U		1.95	U	
Pesticides and PCBs in mg/kg TOC																				
Aroclor-1016	—	—	0.15	U		1.41	U		0.13	U		0.17	U		0.11	U		0.39	U	
Aroclor-1242	—	—	0.15	U		2.82	U		0.13	U		0.17	U		0.11	U		0.78	U	
Aroclor-1248	—	—	0.15	U		1.41	U		0.13	U		0.17	U		0.11	U		0.39	U	
Aroclor-1254	—	—	0.54			1.41	U		0.30	J		0.37	J		0.20	J		0.39	U	
Aroclor-1260	—	—	0.15	U		1.41	U		0.13	U		0.17	U		0.11	U		0.39	U	
Aroclor-1221	—	—	0.15	U		1.41	U		0.13	U		0.17	U		0.11	U		1.48		
Aroclor-1232	—	—	0.15	U		1.41	U		0.13	U		0.17	U		0.11	U		0.39	U	
Total PCBs*	12	65	0.54			2.82	U		0.30	J		0.37	J		0.20	J		1.48		

B - The analyte was found in the associated method blank at a level that is significant relative to the sample result. Gray shading denotes SMS exceedance

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 B-7. (continued) SMS chemistry data for surface and subsurface sediment samples from Budd Inlet and Capitol Lake.

Station Number Collection Date	WA SMS Chem Criteria	WA SMS Max Chm Criteria	BI-S31 4/14/2007	LQ	VQ	BI-S32 4/14/2007	LQ	VQ	BI-S34 4/6/2007	LQ	VQ	BI-C2 4/12/2007	LQ	VQ	BI-C5 4/14/2007	LQ	VQ	BI-C10 4/13/2007	LQ	VQ
Metals in mg/kg DW																				
Antimony	–	–				0.13		J	0.06		UJ	0.13		J	0.13		UJ	0.13		J
Arsenic	57	93				6.74		J	1.34		J	6.23			6.59		J	6.22		J
Cadmium	5.1	6.7				2.32			0.07			1.54			2.45			2.11		
Chromium	–	–				36.3		J	11.6		J	25.3			34.8		J	35.7		J
Copper	390	390				51.1		J	10.2		J	41.3			60.3		J	65.2		J
Lead	450	530				52.8			5.38			16.3			21.2			26		
Mercury	0.41	0.59				0.187			0.014	B		0.159			0.101			0.154		
Nickel	–	–				24.6		J	16.5		J	20			28.2		J	26.4		J
Silver	6.1	6.1				0.52			0.03			0.51			0.59			0.61		
Zinc	410	960				133		J	116		J	63			101		J	88.7		J
Butyltins (Porewater) ug/L																				
Tetra-n-butyltin	–	–				0.022	U								0.022	U		0.022	U	
Tri-n-butyltin	–	–				0.041	U								0.041	U		0.041	U	
Di-n-butyltin	–	–				0.0081	U								0.026	JP	U	0.012	J	U
n-Butyltin	–	–				0.011	U								0.018	J		0.011	U	
LPAH in mg/kg TOC																				
Naphthalene	99	170	0.56			1.52	D		0.28	U		0.44			0.32	J		0.62	U	
Acenaphthylene	66	66	0.87			0.75	D		0.35	J		0.18	J		0.30	J		0.68	U	
Acenaphthene	16	57	0.56			1.82	D		0.21	U		0.08	J		0.43	J		0.48	U	
Fluorene	23	79	0.60			1.45	D		0.35	U		0.13	J		0.80			0.82	U	
Phenanthrene	100	480	9.13			16.12	D		1.93			0.69			1.99			1.05	JD	
Anthracene	220	1200	1.87			3.50	D		0.65	J		0.30			1.13			0.68	U	
2-Methylnaphthalene	38	64	0.40	J		0.42	JD		0.26	U		0.11	J		0.30	J		0.57	U	
Total LPAH*	370	780	13.97	J		25.58	JD		2.93	J		1.94	J		5.28	J		1.05	JD	
HPAH in mg/kg TOC																				
Fluoranthene	160	1200	16.67			32.71	D		5.61			1.35			6.71			4.53	D	
Pyrene	1000	1400	12.70			28.04	D		4.74			1.62			6.28			4.53	D	
Benzo(a)anthracene	110	270	3.49			11.45	D		1.93			0.59			2.38			1.30	JD	
Chrysene	110	460	7.54			15.19	D		3.33			0.98			4.55			2.66	D	
Benzofluoranthenes*	230	450	8.06		J	22.90	D	J	5.25		J	1.30		J	4.05		J	2.66	D	UJ
Benzo(a)pyrene	99	210	2.66			11.92	D		2.28			0.60			1.67			1.33	JD	
Indeno(1,2,3-cd)pyrene	34	88	1.59			7.94	D		1.93			0.46			1.04			0.96	JD	
Dibenz(a,h)anthracene	12	33	0.36	J		1.80	D		0.46	U		0.11	U		0.21	J		1.05	U	
Benzo(g,h,i)perylene	31	78	1.55			7.24	D		1.93			0.44			0.95			1.10	U	
Total HPAH*	960	5300	54.61	J		139.18	D		27.00			7.35			27.83	J		17.99	JD	

Benzofluoranthenes = Sum of benzo(b)fluoranthene and benzo(k)fluoranthene Total PCBs = Sum of all Aroclors Gray shading denotes SMS exceedance

LPAH = Sum of all LPAH except 2-methylnaphthalene. HPAH = Sum of all HPAH

Station Number	WA SMS Chem Criteria	WA SMS Max Chm Criteria	BI-S31			BI-S32			BI-S34			BI-C2			BI-C5			BI-C10		
Collection Date			4/14/2007	LQ	VQ	4/14/2007	LQ	VQ	4/6/2007	LQ	VQ	4/12/2007	LQ	VQ	4/14/2007	LQ	VQ	4/13/2007	LQ	VQ
Chlorinated Aromatics in mg/kg TOC																				
1,3-Dichlorobenzene	—	—	0.16	U		0.20	U		0.33	U		0.08	U		0.15	U		0.76	U	
1,4-Dichlorobenzene	3.1	9	0.19	U		0.23	U		0.40	U		0.09	U		0.17	U		0.91	U	
1,2-Dichlorobenzene	2.3	2.3	0.13	U		0.16	U		0.28	U		0.06	U		0.12	U		0.62	U	
1,2,4-Trichlorobenzene	0.81	1.8	0.15	U		0.18	U		0.32	U		0.07	U		0.14	U		0.71	U	
Hexachlorobenzene	0.38	2.3	0.21	U		0.26	U		0.44	U		0.10	U		0.19	U		0.99	U	
Phthalate Esters in mg/kg TOC																				
Dimethylphthalate	53	53	1.23			0.22	U		0.39	U		0.09	U		0.16	U		0.85	U	
Diethylphthalate	61	110	0.35	U		0.44	U		0.72	U		0.17	U		0.32	U		1.67	U	
Di-n-Butylphthalate	220	1700	0.35	J		0.77	D		0.54	U		0.15	J		0.32	J		1.25	U	
Butylbenzylphthalate	4.9	64	1.23			0.79	D		0.32	U		0.07	U		0.14	U		0.71	U	
bis(2-Ethylhexyl)phthalate	47	78	2.70	J		32.71	D		16.32			0.96	J		1.93	J		2.83	U	
Di-n-Octylphthalate	58	4500	0.12	U		0.15	U		0.26	U		0.06	U		0.11	U		0.57	U	
Phenols in ug/kg DW																				
Phenol	420	1200	4.7	U		17	JD	U	2.3	U		47			13	J	U	32	U	
2-Methylphenol	63	63	8.4	U		18	U		4	U		9.4	U		15	U		57	U	
4-Methylphenol	670	670	11	J		40	D		3.4	U		32			34			49	U	
2,4-Dimethylphenol	29	29	14	U		29	U		6.5	U		16	U		24	U		92	U	
Pentachlorophenol	360	690	21	U		45	U		10	U		24	U		36	U		150	U	
Miscellaneous Extractables in mg/kg TOC																				
Benzyl Alcohol (ug/kg DW)	57	73	9.2	U		20.0	U		4.4	U		11.0	U		16.0	U		62.0	U	
Benzoic Acid (ug/kg DW)	650	650	240.0	U		500.0	U		120.0	U		270.0	U		410.0	U		1600.0	U	
Dibenzofuran	15	58	0.52			0.70	D		0.28	U		0.09	J		0.43	J		0.62	U	
Hexachloroethane	—	—	0.22	U		0.28	U		0.46	U		0.11	U		0.20	U		1.05	U	
Hexachlorobutadiene	3.9	6.2	0.14	U		0.17	U		0.30	U		0.07	U		0.13	U		0.68	U	
N-Nitrosodiphenylamine	28	130	0.22	U		0.28	U		0.46	U		0.11	U		0.20	U		1.05	U	
Pesticides and PCBs in mg/kg TOC																				
Aroclor-1016	—	—	0.17	U		0.11	U		0.35	U		0.08	U		0.16	U		0.16	U	
Aroclor-1242	—	—	0.17	U		0.11	U		0.35	U		0.08	U		0.16	U		0.16	U	
Aroclor-1248	—	—	0.17	U		0.11	U		0.35	U		0.08	U		0.16	U		0.16	U	
Aroclor-1254	—	—	0.23	J		6.31			0.35	U		0.25	J		0.16	U		0.42	J	
Aroclor-1260	—	—	0.17	U		0.11	U		0.35	U		0.08	U		0.16	U		0.16	U	
Aroclor-1221	—	—	0.17	U		0.11	U		0.35	U		0.08	U		0.16	U		0.16	U	
Aroclor-1232	—	—	0.17	U		0.11	U		0.35	U		0.08	U		0.16	U		0.16	U	
Total PCBs*	12	65	0.23	J		6.31			0.35	U		0.25	J		0.16	U		0.42	J	

B - The analyte was found in the associated method blank at a level that is significant relative to the sample result.

Gray shading denotes SMS exceedance

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 B-7. (continued) SMS chemistry data for surface and subsurface sediment samples from Budd Inlet and Capitol Lake.

Station Number	WA SMS Chem Criteria	WA SMS Max Chm Criteria	BI-C13			BI-C14			BI-C18			CL-S5			BI-TISSUE1-SEDIMENT			BI-TISSUE1B-SEDIMENT		
Collection Date			4/13/2007	LQ	VQ	4/13/2007	LQ	VQ	4/12/2007	LQ	VQ	4/13/2007	LQ	VQ	4/6/2007	LQ	VQ	4/6/2007	LQ	VQ
Metals in mg/kg DW																				
Antimony	—	—				0.1		UJ	0.08		UJ	0.13		J	0.08		UJ	0.21		J
Arsenic	57	93				4.97		J	4.42		J	2.76		J	2.59		J	4.44		J
Cadmium	5.1	6.7				1.71		J	0.729			0.194			0.72			1.16		
Chromium	—	—				26.9			21.1		J	27.7		J	20.4		J	24.2		J
Copper	390	390				45.9		J	27.2		J	44.5		J	16.8		J	41.4		J
Lead	450	530				13.4			17.5			10			34.6			52.7		
Mercury	0.41	0.59				0.087			0.071			0.064		J	0.092			0.314		
Nickel	—	—				22.8		J	17.8		J	24.6		J	16.4		J	19		J
Silver	6.1	6.1				0.45			0.29			0.11			0.11			0.21		
Zinc	410	960				72.8		J	48.9		J	58.9		J	260		J	182		J
Butyltins (Porewater) ug/L																				
Tetra-n-butyltin	—	—																		
Tri-n-butyltin	—	—																		
Di-n-butyltin	—	—																		
n-Butyltin	—	—																		
LPAH in mg/kg TOC																				
Naphthalene	99	170	12.44	D		0.48	U		0.57	JD		0.62	U		2.60			1.00	D	
Acenaphthylene	66	66	0.62	JD		0.52	U		0.57	U		0.68	U		1.10			0.64	JD	
Acenaphthene	16	57	2.59	D		1.74	JD		0.39	U		0.47	U		8.44			3.61	D	
Fluorene	23	79	2.07	D		0.76	JD		0.70	U		0.80	U		7.14			2.41	D	
Phenanthrene	100	480	6.22	D		13.29	D		1.60	JD		0.62	U		70.13			24.05	D	
Anthracene	220	1200	3.99	D		1.57	JD		0.57	U		0.68	U		18.18			6.70	D	
2-Methylnaphthalene	38	64	1.50	D		0.46	U		0.49	U		0.56	U		1.04			0.48	JD	
Total LPAH*	370	780	29.43	JD		17.36	JD		2.17	JD		0.80	U		108.64			38.88	JD	
HPAH in mg/kg TOC																				
Fluoranthene	160	1200	11.92	D		15.69	D		3.85	D		1.04	JD		119.48	D		37.80	D	
Pyrene	1000	1400	14.51	D		14.38	D		3.44	D		1.01	JD		107.79	D		36.08	D	
Benzo(a)anthracene	110	270	3.73	D		4.36	D		1.35	JD		0.68	U		63.64			18.90	D	
Chrysene	110	460	7.25	D		5.23	D		1.52	JD		0.77	JD		71.43			20.62	D	
Benzofluoranthenes*	230	450	6.79	D	J	5.49	JD	J	3.81	JD	J	1.19	U	UJ	105.19		J	30.76	D	J
Benzo(a)pyrene	99	210	3.01	D		1.94	D		1.68	JD		0.77	U		62.34			18.90	D	
Indeno(1,2,3-cd)pyrene	34	88	1.87	D		1.07	JD		1.60	JD		0.92	U		40.26			12.37	D	
Dibenz(a,h)anthracene	12	33	0.48	JD		0.83	U		0.86	U		1.04	U		9.48			2.75	D	
Benzo(g,h,i)perylene	31	78	1.76	D		1.07	JD		1.64	JD		1.10	U		37.66			11.68	D	
Total HPAH*	960	5300	51.31	JD		49.22	JD		18.89	JD		2.82	JD		617.27	D		189.86	D	

Benzofluoranthenes = Sum of benzo(b)fluoranthene and benzo(k)fluoranthene   Total PCBs = Sum of all Aroclors   Gray shading denotes SMS exceedance

LPAH = Sum of all LPAH except 2-methylnaphthalene.   HPAH = Sum of all HPAH

Station Number	WA SMS Chem Criteria	WA SMS Max Chm Criteria	BI-C13			BI-C14			BI-C18			CL-S5			BI-TISSUE1-SEDIMENT			BI-TISSUE1B-SEDIMENT		
Collection Date			4/13/2007	LQ	VQ	4/13/2007	LQ	VQ	4/12/2007	LQ	VQ	4/13/2007	LQ	VQ	4/6/2007	LQ	VQ	4/6/2007	LQ	VQ
Chlorinated Aromatics in mg/kg TOC																				
1,3-Dichlorobenzene	—	—	0.28	U		0.61	U		0.66	U		0.77	U		0.29	U		0.27	U	
1,4-Dichlorobenzene	3.1	9	0.34	U		0.72	U		0.78	U		0.92	U		0.34	U		0.31	U	
1,2-Dichlorobenzene	2.3	2.3	0.23	U		0.48	U		0.53	U		0.62	U		0.23	U		0.22	U	
1,2,4-Trichlorobenzene	0.81	1.8	0.26	U		0.57	U		0.61	U		0.71	U		0.27	U		0.26	U	
Hexachlorobenzene	0.38	2.3	0.37	U		0.78	U		0.82	U		1.01	U		0.38	U		0.34	U	
Phthalate Esters in mg/kg TOC																				
Dimethylphthalate	53	53	0.32	U		0.68	U		0.74	U		0.86	U		0.32	U		0.29	U	
Diethylphthalate	61	110	0.62	U		1.31	U		1.39	U		1.66	U		0.62	U		0.58	U	
Di-n-Butylphthalate	220	1700	0.46	U		0.96	U		1.02	U		1.25	U		2.08			1.62	D	
Butylbenzylphthalate	4.9	64	0.26	U		0.57	U		0.61	U		0.71	U		5.45			0.98	D	
bis(2-Ethylhexyl)phthalate	47	78	0.83	JD		2.00	JD		3.65	JD		1.45	JD		181.82	D		56.70	D	
Di-n-Octylphthalate	58	4500	0.21	U		0.46	U		0.49	U		0.56	U		0.22	U		0.21	U	
Phenols in ug/kg DW																				
Phenol	420	1200	6.5	U		44	JD	U	140	JD		31	U		11	J	U	39	JD	U
2-Methylphenol	63	63	12	U		58	U		33	U		54	U		4.7	U		33	U	
4-Methylphenol	670	670	40	D		49	U		28	U		46	U		7.1			73	D	
2,4-Dimethylphenol	29	29	19	U		93	U		53	U		88	U		7.5	U		52	U	
Pentachlorophenol	360	690	29	U		150	U		81	U		140	U		12	U		81	U	
Miscellaneous Extractables in mg/kg TOC																				
Benzyl Alcohol (ug/kg DW)	57	73	13.0	U		63.0	U		36.0	U		1.75	U		0.66	U		0.60	U	
Benzoic Acid (ug/kg DW)	650	650	330.0	U		1700.0	U		920.0	U		47.48	U		18.18	U		15.64	U	
Dibenzofuran	15	58	1.61	D		0.48	U		0.53	U		0.62	U		3.12			1.07	D	
Hexachloroethane	—	—	0.39	U		0.83	U		0.86	U		1.04	U		0.39	U		0.36	U	
Hexachlorobutadiene	3.9	6.2	0.25	U		0.52	U		0.57	U		0.68	U		0.25	U		0.24	U	
N-Nitrosodiphenylamine	28	130	0.39	U		0.83	U		0.86	U		1.04	U		0.39	U		0.36	U	
Pesticides and PCBs in mg/kg TOC																				
Aroclor-1016	—	—	0.15	U		0.13	U		0.14	U		0.16	U		0.31	U		0.06	U	
Aroclor-1242	—	—	0.15	U		0.13	U		0.14	U		0.16	U		0.31	U		0.06	U	
Aroclor-1248	—	—	0.15	U		0.13	U		0.14	U		0.16	U		0.31	U		0.06	U	
Aroclor-1254	—	—	0.49			0.19	J		0.49			0.25	J		1.95			2.06		
Aroclor-1260	—	—	0.15	U		0.13	U		0.14	U		0.16	U		0.31	U		0.06	U	
Aroclor-1221	—	—	0.15	U		0.13	U		0.14	U		0.16	U		0.31	U		0.06	U	
Aroclor-1232	—	—	0.15	U		0.13	U		0.14	U		0.16	U		0.31	U		0.06	U	
Total PCBs*	12	65	0.49			0.19	J		0.49			0.25	J		1.95			2.06		

B - The analyte was found in the associated method blank at a level that is significant relative to the sample result.

Gray shading denotes SMS exceedance

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 B-7. (continued) SMS chemistry data for surface and subsurface sediment samples from Budd Inlet and Capitol Lake.

Station Number	WA SMS Chem Criteria	WA SMS Max Chm Criteria	BI-TISSUE2-SEDIMENT			BI-TISSUE3-SEDIMENT			BI-C4-0-1FT			BI-C4-6-7 FT			BI-C5-3-4 FT			BI-C5-6-7FT		
Collection Date			4/6/2007	LQ	VQ	4/6/2007	LQ	VQ	4/2/2007	LQ	VQ	4/4/2007	LQ	VQ	4/3/2007	LQ	VQ	4/3/2007	LQ	VQ
Metals in mg/kg DW																				
Antimony	–	–	0.09		UJ	0.06		UJ	0.14		UJ	0.27		J	0.33		J	0.24		J
Arsenic	57	93	4.05		J	3.26		J	5.56		J	10.5		J	6.09		J	7.9		
Cadmium	5.1	6.7	0.482			0.762			2.06			2.12			2.22			2.58		
Chromium	–	–	29.1		J	19.6		J	31.8		J	24.8			31.6			36.8		
Copper	390	390	17.1		J	15.1		J	61.7		J	63.1		J	72.1		J	74.2		J
Lead	450	530	7.83			5.04			21.6			57.2			63.5			59.3		
Mercury	0.41	0.59	0.037			0.057			0.109			0.39			0.322			0.91		
Nickel	–	–	23.3		J	15.5		J	26.7		J	23.2			26.9			29.2		
Silver	6.1	6.1	0.1			0.18			0.65			0.78			1.47			1.52		
Zinc	410	960	39.5		J	37.2		J	89.4		J	128		J	169		J	131		J
Butyltins (Porewater) ug/L																				
Tetra-n-butyltin	–	–																		
Tri-n-butyltin	–	–																		
Di-n-butyltin	–	–																		
n-Butyltin	–	–																		
LPAH in mg/kg TOC																				
Naphthalene	99	170	1.25			6.76			0.71	U		19.14	D		1.70	D		5.69	D	
Acenaphthylene	66	66	1.82			0.54			0.76	U		3.23	D		1.70	D		2.38	D	
Acenaphthene	16	57	0.43	J		1.55			0.53	U		15.90	D	J	7.52	D	J	26.46	D	
Fluorene	23	79	2.16			1.08			0.91	U		16.71	D		2.67	D		22.49	D	
Phenanthrene	100	480	20.45			3.85			2.54	JD		78.17	D		7.65	D		82.01	D	
Anthracene	220	1200	12.50			1.76			1.70	JD		29.65	D		9.95	D		39.68	D	
2-Methylnaphthalene	38	64	0.20	J		0.95			0.66	U		4.85	D		1.58	U		3.97	D	
Total LPAH*	370	780	38.82	J		16.49			4.24	JD		162.80	D		31.19	D		178.70	D	
HPAH in mg/kg TOC																				
Fluoranthene	160	1200	30.68			5.81			1.19	D		88.95	D		69.17	D		108.47	D	
Pyrene	1000	1400	29.55			8.11			0.71	D		80.86	D		48.54	D		85.98	D	
Benzo(a)anthracene	110	270	14.77			1.49			2.79	D		32.35	D		21.84	D		39.68	D	
Chrysene	110	460	15.91			2.23			4.31	D		40.43	D		29.13	D		43.65	D	
Benzofluoranthenes*	230	450	17.73		J	2.91		J	3.81	D	UJ	48.25	D		31.92	D		46.30	D	
Benzo(a)pyrene	99	210	13.64			1.35			2.46	JD		32.35	D		16.99	D		34.39	D	
Indeno(1,2,3-cd)pyrene	34	88	7.39			1.01			1.52	JD		19.14	D		7.65	D		18.52	D	
Dibenz(a,h)anthracene	12	33	1.70			0.23	U		1.19	U		7.28	D	J	2.79	D	J	8.07	D	
Benzo(g,h,i)perylene	31	78	6.02			1.08			1.47	JD		16.44	D		6.07	D		15.87	D	
Total HPAH*	960	5300	137.39			23.99			18.27	JD		366.04	D		234.10	D		400.93	D	

Benzofluoranthenes = Sum of benzo(b)fluoranthene and benzo(k)fluoranthene Total PCBs = Sum of all Aroclors Gray shading denotes SMS exceedance

LPAH = Sum of all LPAH except 2-methylnaphthalene. HPAH = Sum of all HPAH

Station Number	WA SMS Chem Criteria	WA SMS Max Chm Criteria	BI-TISSUE2-SEDIMENT			BI-TISSUE3-SEDIMENT			BI-C4-0-1FT			BI-C4-6-7 FT			BI-C5-3-4 FT			BI-C5-6-7FT		
Collection Date			4/6/2007	LQ	VQ	4/6/2007	LQ	VQ	4/2/2007	LQ	VQ	4/4/2007	LQ	VQ	4/3/2007	LQ	VQ	4/3/2007	LQ	VQ
Chlorinated Aromatics in mg/kg TOC																				
1,3-Dichlorobenzene	–	–	0.25	U		0.17	U		0.86	U		1.35	U	UJ	1.58	U	UJ	1.85	U	
1,4-Dichlorobenzene	3.1	9	0.30	U		0.20	U		1.02	U		1.35	U	UJ	1.58	U	UJ	1.85	U	
1,2-Dichlorobenzene	2.3	2.3	0.20	U		0.14	U		0.71	U		1.35	U	UJ	1.58	U	UJ	1.85	U	
1,2,4-Trichlorobenzene	0.81	1.8	0.24	U		0.16	U		0.81	U		1.35	U		1.58	U		1.85	U	
Hexachlorobenzene	0.38	2.3	0.33	U		0.22	U		1.12	U		1.35	U		1.58	U		1.85	U	
Phthalate Esters in mg/kg TOC																				
Dimethylphthalate	53	53	0.28	U		0.19	U		0.96	U		1.35	U		1.58	U		1.85	U	
Diethylphthalate	61	110	0.55	U		0.36	U		1.88	U		1.35	U		1.58	U		1.85	U	
Di-n-Butylphthalate	220	1700	0.41	U		0.27	U		1.40	U		2.70	U		3.03	U		3.70	U	
Butylbenzylphthalate	4.9	64	0.24	U		0.16	U		0.81	U		1.35	U		1.58	U		1.85	U	
bis(2-Ethylhexyl)phthalate	47	78	0.74	J	U	0.88	J	U	1.62	JD		13.48	U		15.78	U		18.52	U	
Di-n-Octylphthalate	58	4500	0.19	U		0.13	U		0.66	U		1.35	U		1.58	U		1.85	U	
Phenols in ug/kg DW																				
Phenol	420	1200	9.8	J	U	11	J	U	40	U		150	U		380	U		410	U	
2-Methylphenol	63	63	4.7	U		5.2	U		72	U		50	U		130	U		140	U	
4-Methylphenol	670	670	5	J		28			79	JD		120	D		87	JD		340	D	
2,4-Dimethylphenol	29	29	7.5	U		8.4	U		120	U		250	U	R	630	U	R	680	U	
Pentachlorophenol	360	690	12	U		13	U		180	U		500	U		1300	U		1400	U	
Miscellaneous Extractables in mg/kg TOC																				
Benzyl Alcohol (ug/kg DW)	57	73	0.58	U		0.39	U		1.98	U		1.35	U		1.58	U		1.85	U	
Benzoic Acid (ug/kg DW)	650	650	15.91	U		10.14	U		53.30	U		26.95	U		30.34	U		37.04	U	R
Dibenzofuran	15	58	0.41	J		0.68			0.71	U		7.01	D		0.95	JD		6.88	D	
Hexachloroethane	–	–	0.34	U		0.23	U		1.19	U		1.35	U	R	1.58	U	R	1.85	U	
Hexachlorobutadiene	3.9	6.2	0.23	U		0.15	U		0.76	U		1.35	U		1.58	U		1.85	U	
N-Nitrosodiphenylamine	28	130	0.34	U		0.23	U		1.19	U		1.35	U		1.58	U		1.85	U	
Pesticides and PCBs in mg/kg TOC																				
Aroclor-1016	–	–	0.27	U		0.18	U		0.18	U		0.27	U		0.12	U		0.13	U	
Aroclor-1242	–	–	0.27	U		0.18	U		0.18	U		0.27	U		0.12	U		0.26	U	
Aroclor-1248	–	–	0.27	U		0.18	U		0.18	U		0.27	U		4.25			0.13	U	
Aroclor-1254	–	–	0.27	U		0.38	J		0.33	J		1.64			2.91			0.13	U	
Aroclor-1260	–	–	0.27	U		0.18	U		0.18	U		1.21			0.12	U		0.13	U	
Aroclor-1221	–	–	0.27	U		0.18	U		0.18	U		0.54	U		0.24	U		1.30	Ui	
Aroclor-1232	–	–	0.27	U		0.18	U		0.18	U		0.27	U		0.12	U		0.13	U	
Total PCBs*	12	65	0.27	U		0.38	J		0.33	J		2.86			7.16			1.30	Ui	

B - The analyte was found in the associated method blank at a level that is significant relative to the sample result. Gray shading denotes SMS exceedance

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.

APPENDIX F

Radioisotrope Analysis Report

The radioisotope results in Appendix F are a combination of the hard copy data report that was prepared on 8/14/2007, and updated results for cores D1 and D3 that were sent electronically on 8/16/2007.

Budd Inlet Age-Dating on Sediment Cores

^{7}Be, ^{210}Pb, ^{137}Cs Analysis in Sediments

Contract: 53261

Data Report Prepared
14 August 2007

Release date:
14 August 2007

Submitted by Linda S. Bingler
Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, Washington 98382

Budd Inlet Age-Dating on Sediment Cores

^{7}Be, ^{210}Pb, ^{137}Cs Analysis in Sediments

Contract: 53261

Data Report sent to
John Nakayama, SAIC, Inc.

14 August 2007

Submitted by: Linda S. Bingler
Battelle
Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, Washington 98382

LOG-IN CHECKLIST

Reference SOP# MSL-A-001

Central File #: 2702 Sample No(s): 1-180 Project Manager: Bingler

TO BE COMPLETED BY PROJECT MANAGER (prior to arrival when possible)

Matrix: Sediment WP# W80660

Yes	No	
☐	☒	Navy-type Project (requires high-level sample tracking procedures)
☐	☒	Filter Samples: *Amount:* Entire sample Half of sample
☒	☐	Freeze dry sample(s) - samples will be weighed and placed in ultralow temp freezer (Lab# 130)
☐	☒	Special instructions:

Sample Preservation Instructions:

Date To Archive: Date To Dispose: Sue Sims

TO BE COMPLETED UPON SAMPLE ARRIVAL/LOG-IN

Yes	No	N/A	Indicate in Appropriate Box
☒	☐	☐	Was a custody seal present?
☒	☐	☐	Was the custody seal intact?
☒	☐	☐	Was cooler(s) temperature(s) within acceptable range of 4±2°C or frozen? (if multiple coolers, note temp. of each) #1 -2.4 #3 -5°C #2 -2.4 °C
☐	☐	☒	Was Project Manager notified of any custody/login discrepancies (cooler temp, sponsor codes, etc)? Comment/Remedy:
☒	☐	☐	Were all chain of custody forms signed and dated?
☐	☒	☐	Were samples filtered at MSL?

Sample condition(s): [✓ Acceptable] Other (explain):

Container type: Teflon Poly Glass [✓ Spex] Other:

Notes:

Completed By: **Date/Time:** 04/10/09 1300

SAMPLE PRESERVATION

☐ Sample(s) were preserved at MSL

☐ Sample(s) were preserved prior to arrival at MSL (noted on CoC / Sample / per PM Instruction)

☐ Random pH checked for ~10% of samples (use dip paper) Sample IDs:

☐ Complete pH check required for project (use pH meter and record on pH Record form)

If preservation necessary, record Acid Lot#

Type: ☐ 0.2% HNO3 Notes: N/A BB 5/4/07

☐ 0.5% HCl (Hg samples) Notes:

☐ Refrigerate/Freeze Notes:

☐ Other Notes:

Completed By: **Date/Time:**

Revsed 033006

SAIC

18912
~~18706~~ North Creek Parkway, Suite ~~110~~ 101
Bothell, Washington 98011
425/485-5800 • FAX: ~~485-5566~~ 425-487-1491

MASTER SAMPLE LOG AND CHAIN OF CUSTODY RECORD

Project No.: 01-0236-00-9900 Project Mgr.: John Nakayama
Project Name: Budd Inlet Sediment Investigation
Project Location: Olympia, WA
Client Name: Ecology

Shipment No.:
Shipping Container No.:
Custody Seal No.:
Date Shipped: 4/9/07
Carrier: FedEx
Shipper:
Shipper Bill No.:

Sampling Location	Sample Number	Sample Depth	Sample Matrix	Sampling Date	Sampling Time	Sample Collector(s)	Analyses: Sedimentation Rate : Mix Layer Analysis (Pb 210 Cs 137)	Sample Containers/ Preservatives: 225 ml plastic	Comments
BI-D1		0-360cm	Sediment	4/3/07	0850	JW, BJ, DD	X	63	Attn: Linda Bingler
BI-D2		0-338cm		4/2/07	1632	↓	X	61	
BI-D3		0-360cm		4/3/07	1047	↓	X	63	

RELINQUISHED BY:
Signature:
Date/Time: 4/9/07 1130
Affiliation: SAIC

RECEIVED BY:
Signature:
Date/Time: 04/10/07
Affiliation: MSL

RELINQUISHED BY:
Signature:
Date/Time:
Affiliation:

RECEIVED BY:
Signature:
Date/Time:
Affiliation:

• White: Lab Returns to Originator Upon Receipt of Samples; • Canary: Lab Retains; • Pink: Lab Returns to Project Manager with Final Report; • Goldenrod: Retained by Sampler

cc: Project Manager/Central File
Login File 2702

SAMPLE LOGIN

(SOP# MSL-A-001)

PROJECT: SAIC

Project Manager: Bingler
Date Received: 04/10/07
Batch: 1

SPONSOR CODE	Depth	To be analyzed	BATTELLE CODE	MATRIX	STORAGE LOCATION	PARAMETERS REQUESTED	COLLECTION DATE	INITIALS
BI-D1	0	x	2702-1	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	2		2702-2	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	4		2702-3	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	6	x	2702-4	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	8		2702-5	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	10		2702-6	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	12	x	2702-7	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	14		2702-8	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	16		2702-9	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	18	x	2702-10	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	20		2702-11	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	22		2702-12	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	24	x	2702-13	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	26		2702-14	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	28		2702-15	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	30	x	2702-16	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	32		2702-17	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	34		2702-18	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	36	x	2702-19	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	38		2702-20	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	40		2702-21	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	42	x	2702-22	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	44		2702-23	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	46		2702-24	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM

cc: Project Manager/Central File
Login File 2702

SAMPLE LOGIN

(SOP# MSL-A-001)

Project Manager: Bingler
Date Received: 04/10/07
Batch: 1

PROJECT: SAIC

SPONSOR CODE	Depth	To be analyzed	BATTELLE CODE	MATRIX	STORAGE LOCATION	PARAMETERS REQUESTED	COLLECTION DATE	INITIALS
BI-D1	48	x	2702-25	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	50		2702-26	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	55	x	2702-27	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	60		2702-28	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	65	x	2702-29	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	70		2702-30	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	75	x	2702-31	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	80		2702-32	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	85	x	2702-33	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	90		2702-34	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	95	x	2702-35	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	100		2702-36	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	105	x	2702-37	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	110		2702-38	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	115	x	2702-39	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D1	120		2702-40	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	130		2702-41	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	140		2702-42	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	150		2702-43	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	160		2702-44	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	170		2702-45	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	180		2702-46	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	190		2702-47	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	200		2702-48	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM

cc: Project Manager/Central File
Login File 2702

SAMPLE LOGIN

(SOP# MSL-A-001)

Project Manager: Bingler
Date Received: 04/10/07
Batch: 1

PROJECT: SAIC

SPONSOR CODE	Depth	To be analyzed	BATTELLE CODE	MATRIX	STORAGE LOCATION	PARAMETERS REQUESTED	COLLECTION DATE	INITIALS
BI-D1	210		2702-49	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	220		2702-50	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	230		2702-51	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	240		2702-52	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	250		2702-53	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	260		2702-54	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	270		2702-55	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	280		2702-56	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	290		2702-57	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	300		2702-58	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	310		2702-59	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D1	320		2702-60	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D2	0	x	2702-61	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	2		2702-62	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	4		2702-63	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	6	x	2702-64	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	8		2702-65	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	10		2702-66	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	12	x	2702-67	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	14		2702-68	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	16		2702-69	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	18	x	2702-70	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	20		2702-71	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	22		2702-72	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM

cc: Project Manager/Central File
Login File 2702

SAMPLE LOGIN

(SOP# MSL-A-001)

Project Manager: Bingler
Date Received: 04/10/07
Batch: 1

PROJECT: SAIC

SPONSOR CODE	Depth	To be analyzed	BATTELLE CODE	MATRIX	STORAGE LOCATION	PARAMETERS REQUESTED	COLLECTION DATE	INITIALS
BI-D2	24	x	2702-73	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	26		2702-74	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	28		2702-75	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	30	x	2702-76	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	32		2702-77	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	34		2702-78	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	36	x	2702-79	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	38		2702-80	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	40		2702-81	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	42	x	2702-82	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	44		2702-83	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	46		2702-84	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	48	x	2702-85	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	50		2702-86	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	55	x	2702-87	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	60		2702-88	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	65	x	2702-89	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	70		2702-90	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	75	x	2702-91	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	80		2702-92	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	85	x	2702-93	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	90		2702-94	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	95	x	2702-95	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	100		2702-96	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM

cc: Project Manager/Central File
Login File 2702

SAMPLE LOGIN

(SOP# MSL-A-001)

Project Manager: Bingler
Date Received: 04/10/07
Batch: 1

PROJECT: SAIC

SPONSOR CODE	Depth	To be analyzed	BATTELLE CODE	MATRIX	STORAGE LOCATION	PARAMETERS REQUESTED	COLLECTION DATE	INITIALS
BI-D2	105	x	2702-97	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	110		2702-98	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	115	x	2702-99	sed core	Deep Freezer	Pb 210, Cs 137	04/02/07	MLFM
BI-D2	120		2702-100	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	130		2702-101	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	140		2702-102	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	150		2702-103	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	160		2702-104	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	170		2702-105	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	180		2702-106	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	190		2702-107	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	200		2702-108	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	210		2702-109	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	220		2702-110	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	230		2702-111	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	240		2702-112	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	250		2702-113	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	260		2702-114	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	270		2702-115	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	280		2702-116	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	290		2702-117	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	300		2702-118	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	310		2702-119	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM
BI-D2	320		2702-120	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/02/07	MLFM

cc: Project Manager/Central File
Login File 2702

SAMPLE LOGIN

(SOP# MSL-A-001)

Project Manager: Bingler
Date Received: 04/10/07
Batch: 1

PROJECT: SAIC

SPONSOR CODE	Depth	To be analyzed	BATTELLE CODE	MATRIX	STORAGE LOCATION	PARAMETERS REQUESTED	COLLECTION DATE	INITIALS
BI-D3	0	x	2702-121	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	2		2702-122	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	4		2702-123	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	6	x	2702-124	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	8		2702-125	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	10		2702-126	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	12	x	2702-127	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	14		2702-128	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	16		2702-129	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	18	x	2702-130	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	20		2702-131	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	22		2702-132	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	24	x	2702-133	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	26		2702-134	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	28		2702-135	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	30	x	2702-136	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	32		2702-137	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	34		2702-138	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	36	x	2702-139	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	38		2702-140	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	40		2702-141	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	42	x	2702-142	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	44		2702-143	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	46		2702-144	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM

cc: Project Manager/Central File
Login File 2702

SAMPLE LOGIN

(SOP# MSL-A-001)

Project Manager: Bingler
Date Received: 04/10/07
Batch: 1

PROJECT: SAIC

SPONSOR CODE	Depth	To be analyzed	BATTELLE CODE	MATRIX	STORAGE LOCATION	PARAMETERS REQUESTED	COLLECTION DATE	INITIALS
BI-D3	48	x	2702-145	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	50		2702-146	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	55	x	2702-147	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	60		2702-148	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	65	x	2702-149	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	70		2702-150	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	75	x	2702-151	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	80		2702-152	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	85	x	2702-153	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	90		2702-154	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	95	x	2702-155	sed core	Deep Freezer	Pb 210, Cs 137	04/03/07	MLFM
BI-D3	100		2702-156	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	105		2702-157	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	110		2702-158	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	115		2702-159	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	120		2702-160	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	130		2702-161	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	140		2702-162	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	150		2702-163	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	160		2702-164	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	170		2702-165	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	180		2702-166	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	190		2702-167	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	200		2702-168	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM

cc: Project Manager/Central File
Login File 2702

SAMPLE LOGIN

(SOP# MSL-A-001)

Project Manager: Bingler
Date Received: 04/10/07
Batch: 1

PROJECT: SAIC

SPONSOR CODE	Depth	To be analyzed	BATTELLE CODE	MATRIX	STORAGE LOCATION	PARAMETERS REQUESTED	COLLECTION DATE	INITIALS
BI-D3	210		2702-169	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	220		2702-170	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	230		2702-171	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	240		2702-172	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	250		2702-173	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	260		2702-174	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	270		2702-175	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	280		2702-176	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	290		2702-177	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	300		2702-178	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	310		2702-179	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM
BI-D3	320		2702-180	sed core	Outside Freezer	Archive,Pb 210, Cs 137	04/03/07	MLFM

QA/QC NARRATIVE

PROJECT: BUDD INLET
PARAMETER: Radionuclide Analysis: ^{7}Be
LABORATORY: Battelle Marine Sciences Laboratory, Sequim, Washington
MATRIX: Sediment
Includes samples 2702*1-5, 61-65, 121-125

SAMPLE CUSTODY AND PROCESSING: Fifteen samples were freeze-dried and counted by gamma spectroscopy for ^{7}Be.

DATA QUALITY OBJECTIVES: Replicate Precision (Duplicate): ≤ 30% RPD

METHOD: Analysis of sediment samples for gamma-emitting isotopes such as ^{7}Be was conducted according to Battelle SOP MSL-C-013, *Analyses of ^{137}Cs and other Gamma Emitting Isotopes by Gamma Counting*. Samples were counted using a Canberra Series 40 MCA gamma counter for approximately 24 hours each. After counting and calculations, sample results are reported as ^{7}Be activity in units of counts per minute per gram.

DETECTION LIMIT: The detection limit is defined as three times the square root of the background counts and is calculated for each sample within the spreadsheet.

STANDARD DISK COUNTS: A ^{7}Be standard was collected prior to sample analysis from recently deposited soil in a clean spex jar and counted to set the instrument channels for the region of interest around the ^{7}Be peak. A second ^{7}Be standard was collected after all sample analyses were complete and analyzed to verity instrumental drift did not occur. A certified standard is not readily available due to the short half-life of ^{7}Be.

CHECK STANDARD ACCURACY: The ^{7}Be standard was analyzed prior to and after the samples. Results are not calculated because the activity of the standard is not certified.

REPLICATE PRECISION: One replicate sample was counted with this batch of samples just after the decay time of 53 days (see Note below). Results were not calculated as replicate pair results were below the detection limit.

NOTE: Samples were collected on April 10, 2007, but contract finalization was not completed until May 11, 2007. Samples were immediately processed and analyzed, however the short half-life of ^{7}Be in combination with planned travel and laboratory renovations precluded analysis completion within the time frame needed (i.e. within 53 days of sample collection: June 2, 2007). The sample replicate and the second ^{7}Be standard were the only samples analyzed after the half-life deadline. All of the results were undetected values and the regions of interest did not change during the analysis, therefore, it is unlikely that exceedance of the half-life had a negative impact on data quality. The half-life indicates that ½ of the isotope activity decays to other isotopes within that time. After 53 days, half of the ^{7}Be activity is still detected as ^{7}Be.

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6/22/2007

Budd Inlet

^{7}Be in Sediment Samples

Samples received 4/10/07, contract finalized 5/11/07

Results expressed in counts/min/g (cmg)

Project 2702

BATTELLE CODE	**Core ID**	**SPONSOR CODE**	**Depth (cm)**	**Detection limit (cmg)**	**Dry Wt (g)**	**Percent Dry Wt. (g)**	***Be 7* (cmg)**	
Be std	NA	NA	NA	0.00049	195	98.0	0.00843	
2702-1	BI-D1	BI-D1-0-2	0-2	0.00159	59.7	38.2	-0.00139	U
2702-2	BI-D1	BI-D1-2-4	2-4	0.00139	70.2	40.4	-0.00075	U
2702-3	BI-D1	BI-D1-4-6	4-6	0.00125	79.4	41.3	-0.00240	U
2702-4	BI-D1	BI-D1-6-8	6-8	0.00150	65.0	42.5	-0.00157	U
2702-5	BI-D1	BI-D1-8-10	8-10	0.00107	88.1	44.4	-0.000473	U
2702-61	BI-D2	BI-D2-0-2	0-2	0.00122	78.7	47.7	-0.000791	U
2702-62	BI-D2	BI-D2-2-4	2-4	0.00106	92.0	50.6	-0.000276	U
2702-63 R1	BI-D2	BI-D2-4-6	4-6	0.00098	98.3	50.5	-0.000057	U
2702-63 R2	BI-D2	BI-D2-4-6	4-6	0.00098	98.3	50.5	0.000015	U
2702-64	BI-D2	BI-D2-6-8	6-8	0.00086	112	52.1	-0.00123	U
2702-65	BI-D2	BI-D2-8-10	8-10	0.00089	108	54.0	-0.000792	U
2702-121	BI-D3	BI-D3-0-2	0-2	0.00181	54.2	34.3	-0.00218	U
2702-122	BI-D3	BI-D3-2-4	2-4	0.00167	55.9	34.1	-0.00148	U
2702-123	BI-D3	BI-D3-4-6	4-6	0.00179	53.4	34.2	-0.000754	U
2702-124	BI-D3	BI-D3-6-8	6-8	0.00239	40.3	35.3	-0.00245	U
2702-125	BI-D3	BI-D3-8-10	8-10	0.00186	52.5	35.2	-0.00180	U
Be std	NA	NA	NA	0.00048	195	75.0	0.00285	

U = result detected at or below the detection limit.

Budd Inlet Sedimentation Rate Narrative
Completed by Linda Bingler 8/13/07

Each of the three cores analyzed for Pb-210 and Cs-137 had reasonably consistent percent dry weight with depth, meeting one of the primary assumptions for sedimentation rate calculations. A slight gradual increase in percent dry weight is normal and is associated with core compaction. Core D2 had relatively high percent dry weight for the core overall, indicating the sediment was sandy.

Sedimentation rates and associated section ages were calculated for each core. Noting that some sections were excluded from analysis by client request, the sedimentation rate was calculated using only measured Pb-210 results and that rate was then applied to the missing sections through extrapolation. Data for Pb-210 were averaged for each missing section from the section activity directly above and directly below the missed section. Dry weight values were measured for each section and were used to calculate sedimentation rate. Using this methodology provided reasonable ages for each section with depth. Although Pb-210 activity was fairly low for each of these cores, enough detail was available because of the section intervals chosen that reliable sedimentation rates could be calculated. Results for Cs-137 were used to verify the dates obtained from the sedimentation rate determined from Pb-210.

The radioisotope, Cs-137, was produced from fission during nuclear testing between the years 1957-1965 with peak activity found in sediments dated to 1963, in most systems. It was deposited on the earth's surface from fall-out. In marine systems, the Cs-137 is associated with organic particles in the water column. The particles, carrying the Cs-137 with them, settle very slowly into the sediments. Rather than looking for a peak of activity in marine sediments, as we would in freshwater systems, we look for the point (horizon) at which Cs-137 activity decreases to a non-significant number. In some profiles, mixing due to bioturbation or other disruptions allows for some activity to be detected at very low levels deeper than the horizon. Our experience has shown that the shallowest depth of the undetected value is in most instances, the horizon. Grain size does have an impact on the level of activity detected. Therefore, it must be considered when determining the activity horizon.

Core D1
Percent dry weight varied from 38.2 to 64.0% with reasonably consistent values with depth to 120 cm. The supported (or background level) Pb-210 was assumed to be 0.30 disintegrations per minute per gram (dpm/g) based on the bottom section activities of the Pb-210 profile. Overall the Pb-210 activity in this core was consistent with marine sediments. The sedimentation rate was quite low at 0.53 g/cm2/year. From the calculated sedimentation rates, the year of deposition for 1963 occurs at 36-38 cm depth and correlates well with the Cs-137 data obtained for this core where a decline in Cs-137 activity occurs below 42 cm.

Core D2

Percent dry weight varied from 47.7 to 75.7%. Percent dry weight results greater than 50% are assumed to be fairly sandy. Since radioactive particles are usually found in greater concentrations associated with organic particles, sandy sediments typically have little activity. However, the Pb-210 profile for this core showed a nice decreasing trend and the sedimentation rate was calculable. The supported Pb-210 was assumed to be 0.17 dpm/g based on the Pb-210 profile. The sedimentation rate was 0.60 g/cm2/year providing sediment ages that agreed well with Cs-137. Sediment dated to 1963 was found below a depth of 32 cm and the Cs-137 horizon was found at 34-36 cm depth.

Core D3

Percent dry weight varied from 34.3 to 61.7%. The Pb-210 profile for this core showed a nice decreasing trend similar to Core D1. The supported Pb-210 was assumed to be 0.28 dpm/g based on the Pb-210 profile. The sedimentation rate was 0.42 g/cm2/year providing sediment ages that agreed well with Cs-137. Sediment dated to 1963 was found between a depth of 36 and 42 cm the Cs-137 horizon was found at 36-38 cm depth.

QA/QC NARRATIVE

PROJECT: BUDD INLET – Core D1
PARAMETER: Radionuclide Analysis: ^{210}Pb
LABORATORY: Battelle Marine Sciences Laboratory, Sequim, Washington
MATRIX: Sediment
Includes samples 2702*1, 4, 7, 10, 13, 16, 19, 22, 25, 27, 29, 31, 33, 35, 37, 39

SAMPLE CUSTODY AND PROCESSING: Sixteen samples were received in good condition, weighed, frozen and freeze-dried. An aliquot of dried sample was digested and counted by alpha spectroscopy for ^{210}Pb.

DATA QUALITY OBJECTIVES:
^{210}Pb Check Standard Accuracy: ≤ 30% PD
Replicate Precision (Duplicate): ≤ 30% RPD

METHOD: Analysis of sediment samples for ^{210}Pb was conducted according to Battelle SOP MSL-C-012, *^{210}Pb Dating Digestion and Analysis*. An approximate 3-g aliquot of each dry sediment sample was removed for acid digestion and plated onto a small metal disk. Polonium-208 is added to each sample during processing as an internal standard. The disks are counted individually using a Tennelec TC 256 Si (Li) alpha particle spectrometer, Model 7401. Samples were counted for approximately 24 hours each. After counting and calculations, sample results are reported as ^{210}Pb activity in units of disintegrations per minute per gram.

CHECK STANDARD ACCURACY: A ^{210}Pb check standard was analyzed once with this core. The batch size was 16 samples. The results of the check standard analysis was 7 percent difference (PD) and was within the QC acceptance criteria of 30% PD.

REPLICATE PRECISION: One sample was analyzed in duplicate with this batch of samples. Precision of duplicate analysis, expressed as the relative percent difference (RPD) of replicate results was 7% and was within the QC acceptance criteria of 30% RPD.

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8/16/2007

Budd Inlet - Core 1

Pb-210 RESULTS IN SEDIMENT

Samples received 4/10/07, contract finalized 5/11/07

Results expressed in disintegrations/minute/gram (dpm/g)

Project 2702

BATTELLE CODE	**SPONSOR ID**	**Depth (cm)**	**Sample Wt. (g dry wt.)**	**Percent Dry Weight (g)**	***ACTIVITY Pb210 dpm/g***	**RPD (%)**	
BLANK	N/A	N/A	3.000	N/A	0.000		
BLANK SPIKE	N/A	N/A	3.000	N/A	0.000		
CHECK STD	N/A	N/A	3.002	N/A	7.17	7%	*
2702-1	BI-D1-0-2	0-2	2.465	38.2	1.34		
2702-4 R1	BI-D1-6-8	6-8	2.564	42.5	1.36		
2702-4 R2	BI-D1-6-8	6-8	2.595	42.5	1.27	7%	@
2702-7	BI-D1-12-14	12-14	2.492	43.9	1.21		
2702-10	BI-D1-18-16	18-20	2.785	44.2	1.12		
2702-13	BI-D1-24-26	24-26	3.093	49.4	0.764		
2702-16	BI-D1-30-32	30-32	2.436	51.3	0.624		
2702-19	BI-D1-36-38	36-38	3.330	55.3	0.362		
2702-22	BI-D1-42-44	42-44	2.957	49.9	0.352		
2702-25	BI-D1-48-50	48-50	3.052	55.9	0.299		
2702-27	BI-D1-55-60	55-60	2.783	54.4	0.419		
2702-29	BI-D1-65-70	65-70	2.975	54.7	0.343		
2702-31	BI-D1-75-80	75-80	3.277	58.0	0.344		
2702-33	BI-D1-85-90	85-90	2.761	61.0	0.380		
2702-35	BI-D1-95-100	95-100	3.043	60.9	0.338		
2702-37	BI-D1-105-110	105-110	2.981	64.0	0.294		
2702-39	BI-D1-115-120	115-120	2.744	60.4	0.334		

@ = RPD
* = % difference
Check Standard known value = 6.71 dpm/g

QA/QC NARRATIVE

PROJECT: BUDD INLET – Core D1
PARAMETER: Radionuclide Analysis: ^{137}Cs
LABORATORY: Battelle Marine Sciences Laboratory, Sequim, Washington
MATRIX: Sediment
Includes samples 2702*10, 13, 16, 18-26

SAMPLE CUSTODY AND PROCESSING: Twelve samples were received, dried and counted by gamma spectroscopy for ^{137}Cs.

DATA QUALITY OBJECTIVES:

^{137}Cs Check Standard Accuracy:	≤ 30% PD
Replicate Precision (Duplicate):	≤ 30% RPD

METHOD: Analysis of sediment samples for gamma-emitting isotopes such as ^{137}Cs was conducted according to Battelle SOP MSL-C-013, *Analyses of ^{137}Cs and other Gamma Emitting Isotopes by Gamma Counting*. Samples were counted using a Canberra Series 40 MCA gamma counter for approximately 24 hours each. After counting and calculations, sample results are reported as ^{137}Cs activity in units of disintegrations per minute per gram.

DETECTION LIMIT: The detection limit is defined as three times the square root of the background counts and is calculated for each sample.

STANDARD DISK COUNTS: A ^{137}Cs standard disk was counted to set the instrument channels for the region of interest around the ^{137}Cs peak. Counts from the ^{137}Cs standard disk were also used in the calculation of the ^{137}Cs decay rate.

CHECK STANDARD ACCURACY: Check standard IAEA 135 was analyzed twice with this batch of samples. Results of check standard analyses were 11 and 22 percent difference (PD) and were within the QC acceptance criteria of 30% PD.

REPLICATE PRECISION: A replicate sample was not analyzed with this batch of samples as replicates are required as one per batch of 20 samples. Since only 12 samples were analyzed for Core D1, the replicate required was analyzed with Core D2.

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8/16/2007

Cs-137 Results in Sediments
BUDD INLET
Samples received 4/10/07, contract finalized 5/11/07
Results in disintegrations per minute per gram (Dpm/g)

PROJECT: 2702

BATTELLE CODE	Core ID	SPONSOR CODE	Depth (cm)	Dry Wt. (g)	Dry Wt. (%)	Detection Limit (dpm/g)	Cs 137 dpm/g (dry wt.)		SRM CERTIFIED VALUE (dpm/g)	%RPD	
IAEA-135	NA	IAEA 135	NA	11.0	NA	0.514	41.8		46.8	11%	*
2702*10	D1	BI-D1-18-20	18-20	75.9	44.2	0.0739	0.245				
2702*13	D1	BI-D1-24-26	24-26	81.0	49.4	0.0738	0.164				
2702*16	D1	BI-D1-30-32	30-32	98.9	51.3	0.0567	0.133				
2702*18	D1	BI-D1-34-36	34-36	125	58.6	0.0451	0.137				
2702*19	D1	BI-D1-36-38	36-38	96.8	55.3	0.0589	0.0967				
2702*20	D1	BI-D1-38-40	38-40	107	52.3	0.0539	0.107				
2702*21	D1	BI-D1-40-42	40-42	107	48.6	0.0538	0.0857				
2702*22	D1	BI-D1-42-44	42-44	99.7	49.9	0.0576	0.0576	U			
2702*23	D1	BI-D1-44-46	44-46	102	53.8	0.0550	0.109				
2702*24	D1	BI-D1-46-48	46-48	111	54.6	0.0536	0.0765				
2702*25	D1	BI-D1-48-50	48-50	120	56.0	0.0475	0.0527				
2702*26	D1	BI-D1-50-55	50-55	110	59.1	0.0700	0.0700	U			
IAEA-135	NA	IAEA 135	NA	11.0	NA	0.512	36.7		46.8	22%	*

U = less than or equal to calculated detection limit.
* = % difference.
@ = RPD.

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8/16/2007

SEDIMENTATION RATES
FOR
Budd Inlet Core #1

Core D1

Sedimentation Rate (S) for depths 0-55= 0.45

Sedimentation Rate (S) for depths 55-120= 0.68

upported Pb210 (dpm/g)= 0.3

Sample #	Sponsor code	Segment Depth (cm)	Mean Depth (cm)	Pb 210 (dpm/g)		Dry Weight (%)	Dry wt. Density (g/cm3)	Sediment Age (years)	Deposition Year	Sediment Accumulation Rate (cm/yr)
2702-1	BI-D1-0-2	0-2	1	1.34		38.2	0.478	1	2006	0.935
		2-6	4	1.33		40.9	0.526	4	2003	0.890
2702-4	BI-D1-6-8	6-8	7	1.32		42.5	0.558	8	1999	0.865
		8-12	10	1.27		43.2	0.571	12	1995	0.841
2702-7	BI-D1-12-14	12-14	13	1.21		43.9	0.584	16	1991	0.825
		14-18	16	1.16		44.0	0.587	20	1987	0.813
2702-10	BI-D1-18-20	18-20	19	1.12		44.2	0.590	24	1983	0.804
		20-24	22	0.941		46.8	0.643	28	1979	0.790
2702-13	BI-D1-24-26	24-26	25	0.764		49.4	0.699	32	1975	0.775
		26-30	28	0.694		50.4	0.720	37	1970	0.756
2702-16	BI-D1-30-32	30-32	31	0.624		51.3	0.740	42	1965	0.739
		32-36	34	0.493		53.3	0.785	47	1960	0.722
2702-19	BI-D1-36-38	36-38	37	0.362	x	55.3	0.832	52	1955	0.705
		38-42	40	0.357	x	52.6	0.769	58	1949	0.692
2702-22	BI-D1-42-44	42-44	43	0.352	x	49.9	0.709	63	1944	0.685
		44-48	46	0.325	x	52.9	0.777	68	1939	0.678
2702-25	BI-D1-48-50	48-50	49	0.299		55.9	0.848	73	1934	0.669
		50-55	52.5	0.359		55.2	0.830	80	1927	0.658
2702-27	BI-D1-55-60	55-60	57.5	0.419		54.4	0.812	58	1949	0.986
		60-65	62.5	0.381		54.6	0.815	64	1943	0.973
2702-29	BI-D1-65-70	65-70	67.5	0.343		54.7	0.819	70	1937	0.961
		70-75	72.5	0.344		56.3	0.858	76	1931	0.949
2702-31	BI-D1-75-80	75-80	77.5	0.344		58.0	0.898	83	1924	0.936
		80-85	82.5	0.362		59.5	0.935	90	1917	0.921
2702-33	BI-D1-85-90	85-90	87.5	0.380		61.0	0.974	97	1910	0.906
		90-95	92.5	0.359		60.9	0.974	104	1903	0.892
2702-35	BI-D1-95-100	95-100	97.5	0.338		60.9	0.974	111	1896	0.880
		100-105	102.5	0.316		62.5	1.015	118	1889	0.868
2702-37	BI-D1-105-110	105-110	107.5	0.294		64.0	1.06	126	1881	0.855
		110-115	112.5	0.314		62.2	1.01	133	1874	0.844
2702-39	BI-D1-115-120	115-120	117.5	0.334	x	60.4	0.961	140	1867	0.837

x = not used in calculations; ages should be considered estimates.

Percent Dry Weight

8/10/07

Project: Budd Inlet
Analyst L. Bingler

Matrix: Sediments
CF#: 2702
Balance #: 11

(weights reported to two decimal places, percents reported to three significant figures)

Sample Number	Tare Weight (g)	Tare + Wet Weight (g)	Tare + Dry Weight (g)	Wet Weight (g)	Dry Weight (g)	% Dry Weight	% Wet Weight	Cs Dry Weight
2702-1	18.06	174.37	77.80	156.31	59.74	38.22	61.8	NA
2702-2	17.87	191.84	88.11	173.97	70.24	40.37	59.6	NA
2702-3	18.02	210.27	97.46	192.25	79.44	41.32	58.7	NA
2702-4	18.12	171.03	83.14	152.91	65.02	42.52	57.5	NA
2702-5	17.94	216.13	106.00	198.19	88.06	44.43	55.6	NA
2702-7	18.01	186.29	91.84	168.28	73.83	43.87	56.1	NA
2702-10	18.19	196.26	96.84	178.07	78.65	44.17	55.8	75.9
2702-13	18.24	188.27	102.30	170.03	84.06	49.44	50.6	81.0
2702-16	18.25	215.70	119.56	197.46	101.31	51.31	48.7	98.9
2702-18	1.29	9.10	5.86	7.81	4.58	58.63	41.4	125
2702-19	18.06	199.15	118.16	181.08	100.10	55.28	44.7	96.8
2702-20	1.58	10.95	6.48	9.37	4.90	52.33	47.7	107
2702-21	1.57	15.16	8.18	13.60	6.61	48.61	51.4	107
2702-22	18.03	223.70	120.64	205.67	102.60	49.89	50.1	99.6
2702-23	1.57	19.86	11.41	18.29	9.84	53.80	46.2	102
2702-24	1.58	14.57	8.67	12.99	7.09	54.58	45.4	111
2702-25	18.35	237.97	141.22	219.61	122.86	55.95	44.1	120
2702-26	1.58	9.60	6.32	8.02	4.74	59.05	40.9	110
2702-27	18.08	230.10	133.51	212.02	115.42	54.44	45.6	NA
2702-29	18.32	230.97	134.69	212.65	116.37	54.72	45.3	NA
2702-31	18.16	202.91	125.24	184.75	107.08	57.96	42.0	NA
2702-33	18.13	231.67	148.29	213.55	130.16	60.95	39.0	NA
2702-35	18.31	207.74	133.76	189.44	115.46	60.95	39.1	NA
2702-37	18.04	247.37	164.79	229.33	146.75	63.99	36.0	NA
2702-39	18.21	235.07	149.25	216.86	131.04	60.43	39.6	NA

QA/QC NARRATIVE

PROJECT: BUDD INLET – Core D2

PARAMETER: Radionuclide Analysis: ^{210}Pb

LABORATORY: Battelle Marine Sciences Laboratory, Sequim, Washington

MATRIX: Sediment
Includes samples 2702*61, 64, 67, 70, 73, 76, 79, 82, 85, 87, 89, 91, 93, 95, 97, 99

SAMPLE CUSTODY AND PROCESSING: Sixteen samples were received in good condition, weighed, frozen and freeze-dried. An aliquot of dried sample was digested and counted by alpha spectroscopy for ^{210}Pb.

DATA QUALITY OBJECTIVES:

^{210}Pb Check Standard Accuracy:	≤ 30% PD
Replicate Precision (Duplicate):	≤ 30% RPD

METHOD: Analysis of sediment samples for ^{210}Pb was conducted according to Battelle SOP MSL-C-012, *^{210}Pb Dating Digestion and Analysis*. An approximate 3-g aliquot of each dry sediment sample was removed for acid digestion and plated onto a small metal disk. Polonium-208 is added to each sample during processing as an internal standard. The disks are counted individually using a Tennelec TC 256 Si (Li) alpha particle spectrometer, Model 7401. Samples were counted for approximately 24 hours each. After counting and calculations, sample results are reported as ^{210}Pb activity in units of disintegrations per minute per gram.

CHECK STANDARD ACCURACY: A ^{210}Pb check standard was analyzed twice with this core. The batch size was 16 samples. The results of the check standard analyses were 13 and 8 percent difference (PD) and were within the QC acceptance criteria of 30% PD.

REPLICATE PRECISION: One sample was analyzed in duplicate with this batch of samples. Precision of duplicate analysis, expressed as the relative percent difference (RPD) of replicate results was 13% and was within the QC acceptance criteria of 30% RPD.

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8/16/2007

Budd Inlet - Core 2
Pb-210 RESULTS IN SEDIMENT
Samples received 4/10/07, contract finalized 5/11/07
Results expressed in disintegrations/minute/gram (dpm/g)

Project 2702

BATTELLE CODE	**SPONSOR ID**	**Depth (cm)**	**Sample Wt. (g dry wt.)**	**Percent Dry Weight (g)**	***ACTIVITY Pb210 dpm/g***	**RPD (%)**	
BLANK	N/A	N/A	3.000	N/A	0.000		
BLANK SPIKE	N/A	N/A	3.000	N/A	0.000		
CHECK STD	N/A	N/A	3.014	N/A	7.01	4%	*
2702-61 R1	BI-D2-0-2	0-2	2.578	47.7	1.33		
2702-61 R2	BI-D2-6-8	6-8	2.478	47.7	1.17	13%	@
2702-64	BI-D2-6-8	6-8	2.847	52.1	1.12		
2702-67	BI-D2-12-14	12-14	3.223	58.7	0.811		
2702-70	BI-D2-18-16	18-16	2.742	55.0	1.10		
2702-73	BI-D2-24-26	24-26	3.305	57.3	0.497		
2702-76	BI-D2-30-32	30-32	3.082	57.4	0.349		
2702-79	BI-D2-36-38	36-38	3.207	60.9	0.279		
2702-82	BI-D2-42-44	42-44	3.803	63.0	0.289		
2702-85	BI-D2-48-50	48-50	3.321	63.4	0.281		
2702-87	BI-D2-55-60	55-60	3.378	67.5	0.309		
BLANK	N/A	N/A	3.000	N/A	0.000		
BLANK SPIKE	N/A	N/A	3.000	N/A	0.000		
CHECK STD	N/A	N/A	3.024	N/A	6.19	8%	*
2702-89	BI-D2-65-70	65-70	3.000	68.6	0.172		
2702-91	BI-D2-75-80	75-80	2.997	68.4	0.212		
2702-93	BI-D2-85-90	85-90	2.999	69.0	0.181		
2702-95	BI-D2-95-100	95-100	3.010	71.4	0.188		
2702-97	BI-D2-105-110	105-110	3.009	75.7	0.169		
2702-99	BI-D2-115-120	115-120	3.030	73.2	0.191		

@ = RPD
* = % difference
Check Standard known value = 6.71 dpm/g

QA/QC NARRATIVE

PROJECT:	BUDD INLET – Core D2
PARAMETER:	Radionuclide Analysis: ^{137}Cs
LABORATORY:	Battelle Marine Sciences Laboratory, Sequim, Washington
MATRIX:	Sediment Includes samples 2702*70, 73, 76-82

SAMPLE CUSTODY AND PROCESSING: Nine samples were received, dried and counted by gamma spectroscopy for ^{137}Cs.

DATA QUALITY OBJECTIVES:

^{137}Cs Check Standard Accuracy:	≤ 30% PD
Replicate Precision (Duplicate):	≤ 30% RPD

METHOD: Analysis of sediment samples for gamma-emitting isotopes such as ^{137}Cs was conducted according to Battelle SOP MSL-C-013, *Analyses of ^{137}Cs and other Gamma Emitting Isotopes by Gamma Counting*. Samples were counted using a Canberra Series 40 MCA gamma counter for approximately 24 hours each. After counting and calculations, sample results are reported as ^{137}Cs activity in units of disintegrations per minute per gram.

DETECTION LIMIT: The detection limit is defined as three times the square root of the background counts and is calculated for each sample.

STANDARD DISK COUNTS: A ^{137}Cs standard disk was counted to set the instrument channels for the region of interest around the ^{137}Cs peak. Counts from the ^{137}Cs standard disk were also used in the calculation of the ^{137}Cs decay rate.

CHECK STANDARD ACCURACY: Check standard IAEA 135 was analyzed three times with this batch of samples because during the analysis of sections for Core D2, the laboratory experienced intermittent electrical power and the instrument had to be turned off to avoid damage to the electrical components. Results of check standard analyses were 11, 22, and 10 percent difference (PD) and were within the QC acceptance criteria of 30% PD.

REPLICATE PRECISION: A replicate sample was analyzed with this batch of samples. The result was 13 relative percent difference (RPD). The precision was within the criteria of 30% RPD.

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8/16/2007

Cs-137 Results in Sediments
BUDD INLET
Samples received 4/10/07, contract finalized 5/11/07
Results in disintegrations per minute per gram (Dpm/g)

PROJECT: 2702

BATTELLE CODE	Core ID	SPONSOR CODE	Depth (cm)	Dry Wt. (g)	Dry Wt. (%)	Detection Limit (dpm/g)	Cs 137 dpm/g (dry wt.)	SRM CERTIFIED VALUE (dpm/g)	%RPD
IAEA-135	NA	IAEA 135	NA	11.0	NA	0.514	41.8	46.8	11% *
2702*70 R1	D2	BI-D2-18-20	18-20	111	55.0	0.0510	0.133		
2702*70 R2	D2	BI-D2-18-20	18-20	111	55.0	0.0519	0.117		13% @
2702-73	D2	BI-D2-24-26	24-26	112	57.3	0.0515	0.0892		
2702-76	D2	BI-D2-30-32	30-32	103	57.4	0.0589	0.0808		
2702-77	D2	BI-D2-32-34	32-34	112	62.7	0.0414	0.0486		
2702-78	D2	BI-D2-34-36	34-36	139	64.2	0.0528	0.0528 U		
2702-79	D2	BI-D2-36-38	36-38	108	60.9	0.0530	0.0981		
2702-80	D2	BI-D2-38-40	38-40	149	65.7	0.0402	0.0513		
IAEA-135	NA	IAEA 135	NA	11.0	NA	0.512	36.7	46.8	22% *
2702-81	D2	BI-D2-40-42	40-42	162	67.8	0.0363	0.0637		
2702-82	D2	BI-D2-42-44	42-44	121	63.0	0.0499	0.0499 U		
IAEA-135	NA	IAEA 135	NA	11.0	NA	0.522	41.9	46.8	10% *

U = less than or equal to calculated detection limit.
* = % difference.
@ = RPD.

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8/16/2007

SEDIMENTATION RATES
FOR
Budd Inlet Core #2

Core D2

Sedimentation Rate (S): 0.60
upported Pb210 (dpm/g)= 0.17

Sample #	**Sponsor code**	**Segment Depth (cm)**	**Mean Depth (cm)**	**Pb 210 (dpm/g)**		**Dry Weight (%)**	**Dry wt. Density (g/cm3)**	**Sediment Age (years)**	**Deposition Year**	**Sediment Accumulation Rate (cm/yr)**
2702-61	BI-D2-0-2	0-2	1	1.25		47.7	0.662	1	2006	0.902
		2-6	4	1.19		49.9	0.709	5	2002	0.871
2702-64	BI-D2-6-8	6-8	7	1.12		52.1	0.759	8	1999	0.850
		8-12	10	0.966		55.4	0.835	12	1995	0.813
2702-67	BI-D2-12-14	12-14	13	0.811		58.7	0.915	17	1990	0.781
		14-18	16	0.956		56.8	0.869	21	1986	0.759
2702-70	BI-D2-18-20	18-20	19	1.10		55.0	0.825	25	1982	0.749
		20-24	22	0.799		56.2	0.853	30	1977	0.743
2702-73	BI-D2-24-26	24-26	25	0.497		57.3	0.882	34	1973	0.736
		26-30	28	0.423		57.4	0.883	38	1969	0.729
2702-76	BI-D2-30-32	30-32	31	0.349		57.4	0.884	43	1964	0.724
		32-36	34	0.314		59.2	0.928	47	1960	0.717
2702-79	BI-D2-36-38	36-38	37	0.279		60.9	0.973	52	1955	0.709
		38-42	40	0.284		61.9	1.00	57	1950	0.700
2702-82	BI-D2-42-44	42-44	43	0.289		63.0	1.03	62	1945	0.691
		44-48	46	0.285		63.2	1.03	67	1940	0.682
2702-85	BI-D2-48-50	48-50	49	0.281		63.4	1.04	73	1934	0.675
		50-55	52.5	0.295		65.4	1.10	79	1928	0.665
2702-87	BI-D2-55-60	55-60	57.5	0.309		67.5	1.15	88	1919	0.651
		60-65	62.5	0.241		68.0	1.17	98	1909	0.637
2702-89	BI-D2-65-70	65-70	67.5	0.172		68.6	1.19	108	1899	0.625
		70-75	72.5	0.192	x	68.5	1.19	118	1889	0.615
2702-91	BI-D2-75-80	75-80	77.5	0.212	x	68.4	1.18	128	1879	0.606
		80-85	82.5	0.196	x	68.7	1.19	138	1869	0.599
2702-93	BI-D2-85-90	85-90	87.5	0.181	x	69.0	1.20	148	1859	0.592
		90-95	92.5	0.184	x	70.2	1.24	158	1849	0.585
2702-95	BI-D2-95-100	95-100	97.5	0.188	x	71.4	1.27	169	1838	0.578
		100-105	102.5	0.179	x	73.5	1.34	180	1827	0.571
2702-97	BI-D2-105-110	105-110	107.5	0.169	x	75.7	1.41	191	1816	0.563
		110-115	112.5	0.180	x	74.4	1.37	203	1804	0.555
2702-99	BI-D2-115-120	115-120	117.5	0.191	x	73.2	1.33	214	1793	0.549

x = not used in calculations; ages should be considered estimates.

Percent Dry Weight

8/10/07

Project: Budd Inlet
Analyst L. Bingler

Matrix: Sediments
CF#: 2702
Balance #: 11

(weights reported to two decimal places, percents reported to three significant figures)

Sample Number	Tare Weight (g)	Tare + Wet Weight (g)	Tare + Dry Weight (g)	Wet Weight (g)	Dry Weight (g)	% Dry Weight	% Wet Weight	Cs Dry Weight
2702-61	18.24	183.35	96.97	165.11	78.73	47.68	52.3	NA
2702-62	18.04	199.83	110.01	181.79	91.97	50.59	49.4	NA
2702-63	18.04	212.48	116.32	194.44	98.27	50.54	49.5	NA
2702-64	18.02	233.26	130.20	215.24	112.18	52.12	47.9	NA
2702-65	18.25	217.94	126.07	199.69	107.82	53.99	46.0	NA
2702-67	18.24	199.71	124.69	181.47	106.45	58.66	41.3	NA
2702-70	17.88	225.14	131.80	207.25	113.92	54.97	45.0	111
2702-73	18.48	219.01	133.46	200.53	114.98	57.34	42.7	112
2702-76	18.10	202.68	124.11	184.58	106.01	57.43	42.6	103
2702-77	1.58	11.69	7.92	10.11	6.34	62.67	37.3	112
2702-78	1.57	9.52	6.68	7.96	5.11	64.23	35.8	139
2702-79	18.25	201.59	129.92	183.34	111.67	60.91	39.1	108
2702-80	1.58	9.13	6.53	7.55	4.96	65.65	34.3	149
2702-81	1.28	11.85	8.45	10.58	7.17	67.79	32.2	162
2702-82	18.05	215.48	142.38	197.43	124.34	62.98	37.0	121
2702-85	18.24	237.29	157.05	219.06	138.81	63.37	36.6	NA
2702-87	18.27	200.78	141.36	182.51	123.10	67.45	32.6	NA
2702-89	18.04	269.86	190.70	251.82	172.66	68.56	31.4	NA
2702-91	18.16	231.76	164.36	213.60	146.20	68.44	31.6	NA
2702-93	18.27	278.04	197.51	259.78	179.24	69.00	31.0	NA
2702-95	18.04	257.50	189.02	239.47	170.99	71.40	28.6	NA
2702-97	17.88	285.77	220.60	267.89	202.72	75.67	24.3	NA
2702-99	18.49	202.15	152.88	183.66	134.39	73.17	26.8	NA

QA/QC NARRATIVE

PROJECT:	BUDD INLET – Core D3
PARAMETER:	Radionuclide Analysis: ^{210}Pb
LABORATORY:	Battelle Marine Sciences Laboratory, Sequim, Washington
MATRIX:	Sediment Includes samples 2702*121, 124, 127, 130, 133, 136, 139, 142, 145, 147, 149, 151, 153, 155, 157, 159
SAMPLE CUSTODY AND PROCESSING:	Sixteen samples were received in good condition, weighed, frozen and freeze-dried. An aliquot of dried sample was digested and counted by alpha spectroscopy for ^{210}Pb.
DATA QUALITY OBJECTIVES:	^{210}Pb Check Standard Accuracy: ≤ 30% PD Replicate Precision (Duplicate): ≤ 30% RPD
METHOD:	Analysis of sediment samples for ^{210}Pb was conducted according to Battelle SOP MSL-C-012, *^{210}Pb Dating Digestion and Analysis*. An approximate 3-g aliquot of each dry sediment sample was removed for acid digestion and plated onto a small metal disk. Polonium-208 is added to each sample during processing as an internal standard. The disks are counted individually using a Tennelec TC 256 Si (Li) alpha particle spectrometer, Model 7401. Samples were counted for approximately 24 hours each. After counting and calculations, sample results are reported as ^{210}Pb activity in units of disintegrations per minute per gram.
CHECK STANDARD ACCURACY:	A ^{210}Pb check standard was analyzed once with this core. The batch size was 16 samples. The results of the check standard analysis was 8 percent difference (PD) and was within the QC acceptance criteria of 30% PD.
REPLICATE PRECISION:	One sample was analyzed in duplicate with this batch of samples. Precision of duplicate analysis, expressed as the relative percent difference (RPD) of replicate results was 3% and was within the QC acceptance criteria of 30% RPD.

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8/16/2007

Budd Inlet - Core 3

Pb-210 RESULTS IN SEDIMENT

Samples received 4/10/07, contract finalized 5/11/07

Results expressed in disintegrations/minute/gram (dpm/g)

Project 2702

BATTELLE CODE	**SPONSOR ID**	**Depth (cm)**	**Sample Wt. (g dry wt.)**	**Percent Dry Weight (g)**	***ACTIVITY Pb210 dpm/g***	**RPD (%)**	
BLANK	N/A	N/A	3.000	N/A	0.000		
BLANK SPIKE	N/A	N/A	3.000	N/A	0.000		
CHECK STD	N/A	N/A	3.024	N/A	6.19	8%	*
2702*121 R1	BI-D3-0-2	0-2	2.994	34.3	1.33		
2702*121 R2	BI-D3-0-2	0-2	3.013	34.3	1.37	3%	@
2702*124	BI-D3-6-8	6-8	2.995	35.3	1.09		
2702*127	BI-D3-12-14	12-14	3.005	38.2	0.962		
2702*130	BI-D3-18-16	18-16	2.993	38.2	0.619		
2702*133	BI-D3-24-26	24-26	3.028	38.5	0.493		
2702*136	BI-D3-30-32	30-32	3.005	41.5	0.475		
2702*139	BI-D3-36-38	36-38	3.677	40.4	0.300		
2702*142	BI-D3-42-44	42-44	3.017	43.1	0.335		
2702*145	BI-D3-48-50	48-50	3.001	45.5	0.384		
2702*147	BI-D3-55-60	55-60	3.013	47.5	0.437		
2702*149	BI-D3-65-70	65-70	3.001	53.9	0.372		
2702*151	BI-D3-75-80	75-80	3.010	57.9	0.313		
2702*153	BI-D3-85-90	85-90	3.010	56.4	0.276		
2702*155	BI-D3-95-100	95-100	2.996	58.8	0.285		
2702*157	BI-D3-105-110	105-110	3.015	56.7	0.272		
2702*159	BI-D3-115-120	115-120	3.001	61.7	0.276		

@ = RPD

* = % difference

Check Standard known value = 6.71 dpm/g

QA/QC NARRATIVE

PROJECT: BUDD INLET – Core D3
PARAMETER: Radionuclide Analysis: ^{137}Cs
LABORATORY: Battelle Marine Sciences Laboratory, Sequim, Washington
MATRIX: Sediment
Includes samples 2702*133, 136, 138, 139, 142, 144-147

SAMPLE CUSTODY AND PROCESSING: Nine samples were received, dried and counted by gamma spectroscopy for ^{137}Cs.

DATA QUALITY OBJECTIVES:
^{137}Cs Check Standard Accuracy: ≤ 30% PD
Replicate Precision (Duplicate): ≤ 30% RPD

METHOD: Analysis of sediment samples for gamma-emitting isotopes such as ^{137}Cs was conducted according to Battelle SOP MSL-C-013, *Analyses of ^{137}Cs and other Gamma Emitting Isotopes by Gamma Counting*. Samples were counted using a Canberra Series 40 MCA gamma counter for approximately 24 hours each. After counting and calculations, sample results are reported as ^{137}Cs activity in units of disintegrations per minute per gram.

DETECTION LIMIT: The detection limit is defined as three times the square root of the background counts and is calculated for each sample.

STANDARD DISK COUNTS: A ^{137}Cs standard disk was counted to set the instrument channels for the region of interest around the ^{137}Cs peak. Counts from the ^{137}Cs standard disk were also used in the calculation of the ^{137}Cs decay rate.

CHECK STANDARD ACCURACY: Check standard IAEA 135 was analyzed twice with this batch of samples. Results of check standard analyses were 10 and 13 percent difference (PD) and were within the QC acceptance criteria of 30% PD.

REPLICATE PRECISION: A replicate sample was analyzed with this batch of samples. The result was 11 relative percent difference (RPD). The precision was within the criteria of 30% RPD.

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8/16/2007

Cs-137 Results in Sediments
BUDD INLET
Samples received 4/10/07, contract finalized 5/11/07
Results in disintegrations per minute per gram (Dpm/g)

PROJECT: 2702

BATTELLE CODE	Core ID	SPONSOR CODE	Depth (cm)	Dry Wt. (g)	Dry Wt. (%)	Detection Limit (dpm/g)	Cs 137 dpm/g (dry wt.)	SRM CERTIFIED VALUE (dpm/g)	%RPD
IAEA-135	NA	IAEA 135	NA	11.0	NA	0.522	41.9	46.8	10% *
2702-133 R1	D3	BI-D3-24-26	24-26	64.4	38.5	0.0866	0.168		
2702-133 R2	D3	BI-D3-24-26	24-26	64.4	38.5	0.119	0.188		11% @
2702-136	D3	BI-D3-30-32	30-32	71.2	41.5	0.107	0.116		
2702-138	D3	BI-D3-34-36	34-36	94.1	46.2	0.0796	0.125		
2702-139	D3	BI-D3-36-38	36-38	70.0	40.4	0.0836	0.0836 U		
2702-142	D3	BI-D3-42-44	42-44	53.9	43.1	0.105	0.105 U		
2702-144	D3	BI-D3-46-48	46-48	94.8	47.5	0.0598	0.0853		
2702-145	D3	BI-D3-48-50	48-50	66.1	45.2	0.0863	0.0863 U		
2702-146	D3	BI-D3-50-55	50-55	92.3	52.9	0.0621	0.0787		
2702-147	D3	BI-D3-55-60	55-60	90.1	47.5	0.0681	0.0681 U		
IAEA-135	NA	IAEA 135	NA	11.0	NA	1.21	40.5	46.8	13% *

U = less than or equal to calculated detection limit.
* = % difference.
@ = RPD.

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SEDIMENTATION RATES
FOR
Budd Inlet Core #3

Core D3

Sedimentation Rate (S) for depths 0-32= 0.24

Sedimentation Rate (S) for depths 32-120: 0.29

Supported Pb210 (dpm/g)= 0.3

Sample #	**Sponsor code**	**Segment Depth (cm)**	**Mean Depth (cm)**	**Pb 210 (dpm/g)**		**Dry Weight (%)**	**Dry wt. Density (g/cm3)**	**Sediment Age (years)**	**Deposition Year**	**Sediment Accumulation Rate (cm/yr)**
2702-121	BI-D3-0-2	0-2	1	1.35		34.3	0.409	2	2005	0.584
		2-6	4	1.22		34.8	0.418	7	2000	0.578
2702*124	BI-D3-6-8	6-8	7	1.09		35.3	0.426	12	1995	0.574
		8-12	10	1.02		36.7	0.452	18	1989	0.563
2702*127	BI-D3-12-14	12-14	13	0.962		38.2	0.477	24	1983	0.553
		14-18	16	0.791		38.2	0.477	30	1977	0.542
2702*130	BI-D3-18-16	18-16	19	0.619		38.2	0.477	35	1972	0.535
		20-24	22	0.556		38.3	0.480	41	1966	0.530
2702*133	BI-D3-24-26	24-26	25	0.493		38.5	0.483	48	1959	0.526
		26-30	28	0.484		40.0	0.511	54	1953	0.520
2702*136	BI-D3-30-32	30-32	31	0.475		41.5	0.539	60	1947	0.514
		32-36	34	0.388	x	40.9	0.528	55	1952	0.622
2702*139	BI-D3-36-38	36-38	37	0.300	x	40.4	0.517	60	1947	0.617
		38-42	40	0.317	x	41.7	0.543	65	1942	0.611
2702*142	BI-D3-42-44	42-44	43	0.335	x	43.1	0.569	71	1936	0.605
		44-48	46	0.359	x	44.3	0.592	77	1930	0.597
2702*145	BI-D3-48-50	48-50	49	0.384		45.5	0.617	83	1924	0.589
		50-55	52.5	0.410		46.5	0.637	91	1916	0.579
2702*147	BI-D3-55-60	55-60	57.5	0.437		47.5	0.657	102	1905	0.565
		60-65	62.5	0.404		50.7	0.727	114	1893	0.550
2702*149	BI-D3-65-70	65-70	67.5	0.372		53.9	0.800	127	1880	0.533
		70-75	72.5	0.343		55.9	0.847	141	1866	0.516
2702*151	BI-D3-75-80	75-80	77.5	0.313		57.9	0.896	155	1852	0.499
		80-85	82.5	0.295	x	57.2	0.877	171	1836	0.484
2702*153	BI-D3-85-90	85-90	87.5	0.276	x	56.4	0.859	185	1822	0.472
		90-95	92.5	0.280	x	57.6	0.888	200	1807	0.462
2702*155	BI-D3-95-100	95-100	97.5	0.285	x	58.8	0.918	216	1791	0.452
		100-105	102.5	0.278	x	57.8	0.892	231	1776	0.444
2702*157	BI-D3-105-110	105-110	107.5	0.272	x	56.7	0.867	246	1761	0.437
		110-115	112.5	0.274	x	59.2	0.929	261	1746	0.430
2702*159	BI-D3-115-120	115-120	117.5	0.276	x	61.7	0.994	278	1729	0.423

x = not used in calculations; ages should be considered estimates.

Percent Dry Weight

8/10/07

Project: Budd Inlet
Analyst L. Bingler

Matrix: Sediments
CF#: 2702
Balance #: 11

(weights reported to two decimal places, percents reported to three significant figures)

Sample Number	Tare Weight (g)	Tare + Wet Weight (g)	Tare + Dry Weight (g)	Wet Weight (g)	Dry Weight (g)	% Dry Weight	% Wet Weight	Cs Dry Weight
2702-121	18.19	176.39	72.39	158.20	54.21	34.26	65.7	NA
2702-122	18.15	182.16	74.07	164.01	55.92	34.09	65.9	NA
2702-123	18.16	174.16	71.56	156.00	53.40	34.23	65.8	NA
2702-124	17.96	132.21	58.24	114.25	40.28	35.26	64.7	NA
2702-125	18.32	167.39	70.82	149.07	52.51	35.22	64.8	NA
2702-127	18.23	184.27	81.65	166.04	63.42	38.19	61.8	NA
2702-130	18.15	169.46	75.88	151.31	57.73	38.15	61.8	NA
2702-133	18.24	193.38	85.65	175.14	67.40	38.49	61.5	64.4
2702-136	17.98	196.61	92.16	178.64	74.18	41.53	58.5	71.2
2702-138	1.30	8.58	4.66	7.28	3.36	46.19	53.8	94.1
2702-139	18.04	200.69	91.76	182.65	73.72	40.36	59.6	70.0
2702-142	17.85	150.10	74.80	132.26	56.96	43.07	56.9	53.9
2702-144	1.39	11.89	6.38	10.50	4.99	47.54	52.5	94.8
2702-145	18.10	170.03	87.21	151.93	69.12	45.49	54.5	66.1
2702-146	1.57	11.25	6.69	9.68	5.12	52.89	47.1	92.3
2702-147	17.94	214.14	111.08	196.20	93.14	47.47	52.5	90.1
2702-149	17.95	233.72	134.28	215.77	116.33	53.92	46.1	NA
2702-151	18.03	223.67	137.10	205.64	119.07	57.90	42.1	NA
2702-153	18.15	223.54	134.00	205.38	115.84	56.40	43.6	NA
2702-155	18.06	217.99	135.57	199.94	117.51	58.77	41.2	NA
2702-157	17.97	226.66	136.39	208.69	118.41	56.74	43.3	NA
2702-159	18.22	194.65	127.05	176.43	108.83	61.69	38.3	NA

STATEMENT OF WORK
WDOE Age-Dating
Battelle Project No. 53261
Revised 3/19/07

Battelle, Pacific Northwest Laboratories, Marine Sciences Laboratory (MSL) proposes to provide containers and analyze sediment samples for Be-7, Pb-210 and Cs-137. Sediment samples for radioisotopes will be digested and analyzed for Pb-210 following MSL SOP MSL-C-012 using alpha spectroscopy and Be-7 and Cs-137 following MSL-C-013 using gamma spectroscopy.

Sediment samples will be freeze-dried to determine percent dry weight following SOP MSL-C-003, then digested for Pb-210 following the protocol described in SOP MSL-C-012. Samples will be acid-digested, filtered and the filtrate evaporated to remove any remaining nitric acid. A metal disk is suspended in the evaporated filtrate and the radioisotopes of interest are spontaneously plated onto the disks that are then counted using a silica lithium alpha particle spectrometer. The technique selected is based on past experience with Pb-210 analyses and was designed to minimize interference. Be-7 and Cs-137 samples are counted directly using a germanium-lithium (GeLi) gamma detector, without a digestion step.

Minimum quality control/quality assurance (QA/QC) requirements, as standard procedure at Battelle's Marine Sciences Laboratory (MSL), include a procedural blank, blank spike, check standard and duplicate per batch of Pb-210 samples and a check standard and duplicate per batch of samples for Be-7 and Cs-137. QC samples are billable.

Protocol for sample shipment is as follows: the samples will be transported in coolers maintained at 4 ± 2°C to the MSL. Samples will be logged into the MSL tracking system and given MSL identification codes, freeze-dried and analyzed.

Data analysis includes percent dry weight and Pb-210 in disintegrations per minute per gram (dpm/g), Be-7 in cpm/g and Cs-137 in dpm/g. Sedimentation rate information includes sediment age in years, year of deposition, sediment accumulation rate (cm/yr) and sedimentation rate in g/cm2/yr and is included in the price with Pb-210 analysis. The sedimentation rate data is normally derived from Pb-210 results, however, in some cases the Cs-137 data is used to determine the sedimentation rate and sediment ages. Cs-137 results are normally used to verify dates determined with sedimentation rates. Be-7 results are used to estimate the mixed depth. Raw data are provided for an additional 15% of the project cost.

For the radioisotope samples, the estimated project turn-around time is 4 weeks from receipt of samples or contract finalization. If preliminary results are needed prior to this time, they will be provided by core. Written results will be provided within this turn-around. Data summaries will be sent in hard copy and electronic formats. The data will include a cover letter, a data summary, and a narrative explaining analytical problems (if any) or failure(s) to meet quality control limits.

COSTING

Pb-210 Samples (includes sedimentation rates)	$225/sample
Cs-137 Samples	$110/sample
Be-7 Samples	$80/sample

*Costs are based on analysis of 48 field samples for P-210, 30 field samples for Cs-137, and 15 field samples for Be-7. QC samples are billable. If fewer samples are received for analysis, these prices will be reviewed, adjusted as appropriate and submitted to the client for approval.