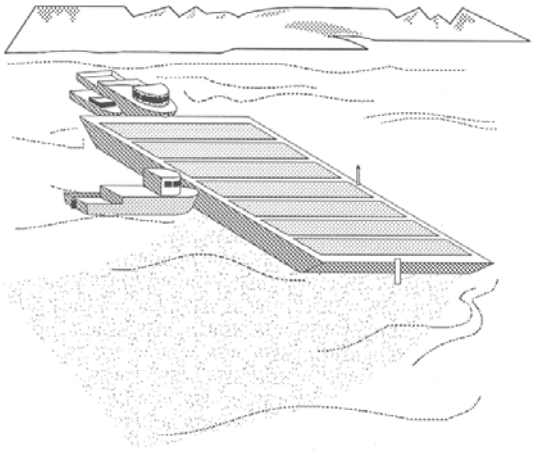


Pier 53-55 Sediment Cap and Enhanced Natural Recovery Area Remediation Project 2002 Data and Final Report

June 2010

King County

Department of
Natural Resources and Parks
Water and Land Resources Division

This page left intentionally blank.

Pier 53-55 Sediment Cap and Enhanced Natural Recovery Area Remediation Project 2002 Data and Final Report

Elliott Bay/Duwamish Restoration Program Panel

Prepared for:
King County Department of Natural Resources and Parks
Elliott Bay/Duwamish Restoration Program

Prepared by:
Jenée Colton
King County Department of Natural Resources and Parks

Panel Publication 43

June 2010

Elliott Bay/Duwamish Restoration Program
c/o Restoration Center/NW
National Marine Fisheries Service – NOAA
7600 Sand Point Way NE
Seattle Washington 98115-0070

206-526-4338
(FAX) 206-526-6665

This page left intentionally blank.

TABLE OF CONTENTS

Executive Summary xi

SECTION 1: INTRODUCTION 1

Project Site 1

Project Background 1

Monitoring Program 3

Monitoring Plan 3

Status Report on the Monitoring Program 4

Modifications to the Monitoring Plan 5

SECTION 2: CAP THICKNESS AND SETTLEMENT 8

Methods 8

Results and Discussion 10

Cap Thickness 10

Seafloor Settlement 14

SECTION 3: CORE CHEMISTRY 18

Methods 18

Sediment Sub-Sample Collection and Analysis 19

Results and Discussion 20

SECTION 4: SURFACE SEDIMENT CHEMISTRY 25

Methods 25

Sample Collection 25

Sample Analysis 26

Results and Discussion 27

Dry Weight Values for Detected SMS Chemicals 27

Comparison to SMS Values - 2002 31

Chemical Change Over the Monitoring Period 36

TOC and Fines Changes Over Monitoring Period 44

SECTION 5: BENTHIC RECOLONIZATION 47

Methods 47

Results and Discussion 49

2002 Taxonomic Results 49

2002 Indices 52

Biomass – 2002 and Overview 52

Video Survey Results 2002 54

Recolonization Over the Monitoring Period 55

Benthic Community Recolonization Summary 63

SECTION 6: CONCLUSIONS 65

Cap Thickness and Settlement 65

Sediment cores and chemical isolations 65

Surface sediment chemical changes 65

Benthic community recolonization 66

SECTION 7: RETROSPECTIVE ON MONITORING DESIGN 67

REFERENCES 70

Appendix A 73

Monitoring Plan for Pier 53 Sediment Cap 73

Appendix B 74

2002 QA Chemistry Report 74

Appendix C 75

Chemistry Data 75

Appendix D 76

Benthic Community Data 76

TABLES

Table 1-1. Pier 53-55 sediment cap long-term monitoring activities 5

Table 2-1 Changes in cap thickness (Units are cm).....11

Table 2-2. Seafloor settlement (Units are cm) 15

Figure 2-5. Initial Seafloor Settlement in 1992 and 1993.....16

Table 2-3. Total consolidation of cap and seafloor.....16

Table 3-1. Core stations: Detected chemicals in first 6-inch sediment interval above cap interface (Dry Weight).....21

Table 4-1. 2002 Surface sediment stations: Detected SMS chemicals (Dry Weight) 29

Table 4-2. 2002 surface sediment stations – SMS comparison 0-10 cm 32

Table 4-3. 2002 surface sediment stations – SMS comparison 0-2 cm 34

Table 4-4. Post-cap surface (0-2 cm) sediment contaminant concentrations 38

Table 4-5. Pre-cap surface (0-2 cm) sediment contaminant concentrations.....38

Table 5-1. Abundance per replicate in 2002. 50

Table 5-2 Species abundance per replicate in 2002.....51

Table 5-3. 2002 Mean benthic indices compared to Ecology Reference Value Ranges 52

Table 5-4. 2002 Average wet weight benthic invertebrate biomass (g/0.1 m^2) per station 53

Table 5-5. Major taxa mean biomass (g/0.1 m^2 ww) changes with time.....54

Table 5-6. Mean abundance (per 0.1 m^2) of benthic invertebrates over monitoring period compared to RVR. 57

Table 5-7. Mean abundance (species per 0.1 m^2) of benthic invertebrates over monitoring period compared to RVR. 58

Table 5-8. Results of two-sample t-tests comparing abundance at cap and ENR stations, pre-cap and 2002.....59

Table 5-9. Mann-Whitney U test results Comparing Cap and ENR stations By Year 62

Table 5-10. Cumulative Top 5 most abundant taxa across all samples, pre-cap and 2002. 63

FIGURES

Figure 1-1. Location of the Pier 53 Remediation Area.....2

Figure 1-2. Sampling Stations.....4

Figure 2-1. Barge Tracks and Measuring Stake Locations with 2002 Thickness Measurements. 9

Figure 2-2. Measuring Stake Assembly.....10

Figure 2-3. WDFW Trawl Paths Near the Pier 53 Site.....12

Figure 2-4. Changes in Cap/Layer Thickness Over Time 13

Figure 2-6. Net consolidation between monitoring periods.....17

Figure 3-1. Core Sampling Stations.....19

Figure 4-1. Surface Sampling Stations 26

Figure 4-2. Total LPAH Concentrations in Surface Sediment Samples Over Time 37

Figure 4-3. Total HPAH Concentrations in Surface Sediment Samples over Time.....37

Figure 4-4. Copper Concentrations in Surface Sediment Samples over Time 40

Figure 4-5. Lead Concentrations in Surface Sediment Samples over Time 41

Figure 4-6. Total PCB Concentrations in Surface Sediment Samples over Time 41

Figure 4-7. Bis(2-Ethylhexyl) Phthalate Concentrations in Surface Sediment Samples over Time 42

Figure 4-8. 2002 Mean Organics Concentrations in Cap and ENR Surface Sediment Samples Compared to Pre-cap 43

Figure 4-9. 2002 Mean Copper and Lead Concentrations in Cap and ENR Surface Sediment Samples Compared to Pre-cap 44

Figure 4-10. Mean Percent Fines in Relation to Mean Percent TOC in Surface Sedimente Samples Using Data from Table 4-5.....45

Figure 4-11. Fines and TOC in 0-2 cm Compared to 0-10 cm 2002 Grabs 46

Figure 5-1. Benthic Taxonomy Stations 48

Figure 5-2. 2002 Average Counts of Major Taxa in Cap and ENR Samples 50

Figure 5-3. 2002 Total Species of Major Taxa Identified in Cap and ENR Samples.....52

Figure 5-4. Mean Biomass of Major Taxa at Cap Compared to ENR Stations Across Monitoring Events 54

Figure 5-5. Mean Abundance (per 0.1 m^2) of Major Taxa Across All Stations Over Monitoring Period. 56

Figure 5-6. Total Species (per 0.1 m^2) Across All Stations Over Monitoring Period. 58

Figure 5-7. Mean Swartz's Dominance Index (SDI) Over Time.....60

Figure 5-8. Mean Shannon Diversity Index (H) Over Time.....60

Figure 5-9. Mean Pielou's Evenness Index Over Time. 61

APPENDICES

Appendix A. Monitoring Plan for Pier 53 Sediment Cap

Appendix B. 2002 Chemistry QA Report

Appendix C. 2002 Chemistry Data

Appendix D. 2002 Benthic Invertebrate Data

This page left intentionally blank.

EXECUTIVE SUMMARY

In March 1992, contractors for the U.S. Army Corps of Engineers (the Corps) placed 22,000 cubic yards of clean sand offshore of Piers 53, 54, and 55 in Elliott Bay on Seattle's downtown waterfront, capping 4.5 acres of chemically contaminated bottom sediments. This action, known as the Pier 53 project, was the culmination of over four years of study and planning by many agencies, including the City of Seattle Department of Engineering, the King County Department of Natural Resources and Parks (KCDNRP) (formerly the Municipality of Metropolitan Seattle, or Metro), the Corps, the Washington State Department of Ecology (Ecology), the Washington State Department of Natural Resources (DNR), the Washington State Department of Fisheries, and the U.S. Environmental Protection Agency (EPA).

The purpose of this report is to document the methods, results, and conclusions of monitoring conducted on the Pier 53 project site in 2002 as part of the monitoring program established for the project. In addition, this report presents a comparison of all the monitoring data collected in 1992, 1993, 1996, and 2002 and discusses the monitoring results within the context of the program objectives. It was determined that environmental monitoring for the Pier 53 project should consist of both short-term activities needed to place the cap and long-term activities needed to document the effectiveness of the cap. The monitoring plan included seven objectives:

- Provide pre-cap benthic invertebrate taxonomic data.
- Guide and document the cap placement, thickness, and long-term stability.
- Document how well the 91-cm (3-foot) cap functions to isolate contaminated sediments and prevent migration upward into the cap.
- Determine whether offsite chemicals migrate and accumulate on the surface of the cap and enhanced natural remediation (ENR) area.
- Determine the amount and type of benthic recolonization that occurs in the remediation area and whether benthic recolonization differs between the cap and ENR area.
- Review and evaluate the monitoring data to determine whether the cap is functioning as expected and whether further actions are warranted in the capped area.
- Provide data that may inform and assist the Panel and other agency teams in developing future cleanup plans for Elliott Bay.

A 3-foot sediment cap and 1-foot ENR area were completed in 1992 at Pier 53-55. Following, were monitoring activities that occurred over ten years, ending in 2002. Four monitoring events occurred one in each of the years 1992, 1992, 1996, and 2002. This report discusses the methods and presents the results of the 2002 monitoring work. In addition, a discussion comparing 2002

results to previously collected monitoring data is included and conclusions of the monitoring efforts are summarized.

The 2002 monitoring activities included cap thickness and settlement measurements, core sediment chemistry, surface sediment chemistry, and benthic community analysis. Cap thickness and settlement were measured using stakes and clamps attached to settlement plate assemblies placed during cap creation. Some stakes and clamps disappeared over the course of 10 years and some stakes were damaged. Core samples were taken in 2002 at all 5 stations using a new sampler called a Mud Mole which uses an air-driven piston hammer to drive the core tube into the bottom. Some difficulties were encountered during sampling that required modifications to obtain acceptable subsamples. Some of these modifications could feasibly have resulted in sample contamination. Subsamples of the cores were taken as in previous years. All but the first 6 inches above the cap/below cap interface were archived. At each station, a 0-2 cm and 0-10 cm surface sample were collected.

Monitoring indicated that small changes in cap thickness occurred over the 10 years monitoring period and seafloor settlement was not substantial. Differences in seafloor settlement were not detected between the cap and ENR area. Neither were changes in cap thickness detected associated with one area versus another. Overall, the cap appears stable and experiences small surficial changes in erosion and accumulation at a very local level, likely due to human activities.

PCBs were detected in 2002 core samples for the first time. Detections are believed to be due to MDL improvements for 2002 Aroclor analyses and not from chemical migration across the cap interface. PAH compounds were also detected in cores at the same levels as previous years. There is substantial spatial variability in PAHs as demonstrated by replicate samples. One potential identified PAH source is Duwamish River mud mixed with the capping sand from the turning basin. This was documented as a PAH source at the Denny Way cap. Alternatively, the natural heterogeneity of contamination at the site, as demonstrated by the replicate sample at C4, may explain the change observed between monitoring events.

In 2002, there were more chemicals detected in surface sediment samples than previous years. However, a reduction in analytical MDLs is partially responsible for this increase. PCBs were detected on the cap for the first time in the 1996 samples and several stations had increased values in 2002. Increased PCB concentrations probably originated from resuspension of contaminated sediments, potentially those located under piers where high PCB concentrations are documented. The monitoring data over 10 years show an increase in PAH and metals concentrations in 1992 due to recontamination from pilings removal at the ferry dock and subsequent “recovery” to near original concentrations before recontamination. Mean concentrations of the major site contaminants (PCBs, PAHs, BEHP, copper and lead) measured in 2002 were similar between the cap and ENR area stations and all 2002 concentrations were significantly lower than pre-cap concentrations.

The official comparison of 10-cm samples to SMS shows that only BEHP at VG4 exceeded the SMS in 2002. All BEHP values were qualified with B for blank contamination but concentrations at two stations are high enough to indicate that BEHP may be recontaminating the

site. Deposition of resuspended sediment may be contributing to any actual increases in concentrations.

The site appears to have been recolonized from offsite infaunal invasion and recruitment and native infauna appear to have been buried by cap sediment. Benthic invertebrate succession on the site appears to have occurred as expected. Abundances of major taxa changed markedly initially but returned to more balanced proportions by 1996. Species abundance of major taxa was similar to pre-cap by 1993. The comparison of three indices showed that SDI, diversity and evenness remained lower than mean pre-cap values in 1996 and didn't exceed this threshold until sometime between 1996 and 2002. Based on comparison to Ecology Reference Value Ranges (RVR), the 2002 community is within the typical ranges in Puget Sound for individual and species abundance and the SDI, H, and Pielou's Evenness indices. Thus, no benthic community impacts are indicated. The total biomass of benthic invertebrates was low in 2002 compared to before cap placement. However, it is in agreement with that measured at the Denny Way cap after 10 years. There was similar abundance and higher diversity measured at the Pier 53 site in 2002 compared to those measured at Denny Way cap after 10 years. Overall, the various lines of evidence indicate that the 2002 benthic community at Pier 53 is healthier and more species rich than that present before cap placement. The community may still be changing with time as more sediment fines are deposited. However, the project goal appears to have been met.

The final section discusses the success of the program in meeting its goals and what improvements could be made in future capping projects. In summary, most of the project goals were met. A high damage rate of settling plate assemblies was a weakness for final settlement data interpretation although the cap appears to be functioning as intended and settlement has not been problematic. Monitoring data for the experimental ENR area neither demonstrate that benthic recolonization occurred from native infauna nor that chemical concentrations in surface sediment are different from those in the cap. A thinner sediment layer is recommended in future natural remediation projects than that used in the ENR. The largest issue that the monitoring program illuminated is the ongoing recontamination of the site from identified and unidentified sources offsite. Sediment redistribution appears to be occurring, although sediment contaminants were below SMS in 2002 with one exception at one station, and may warrant future sampling to look for continued increases in PCBs.

This page left intentionally blank.

SECTION 1: INTRODUCTION

In March 1992, contractors for the U.S. Army Corps of Engineers (the Corps) placed 22,000 cubic yards of clean sand offshore of Piers 53, 54, and 55 in Elliott Bay on Seattle's downtown waterfront, capping 4.5 acres of chemically contaminated bottom sediments. This action, known as the Pier 53 project, was the culmination of over four years of study and planning by many agencies, including the City of Seattle Department of Engineering, the King County Department of Natural Resources and Parks (KCDNRP) (formerly the Municipality of Metropolitan Seattle, or Metro), the Corps, the Washington State Department of Ecology (Ecology), the Washington State Department of Natural Resources (DNR), the Washington State Department of Fisheries, and the U.S. Environmental Protection Agency (EPA).

The purpose of this report is to document the methods, results, and conclusions of monitoring conducted on the Pier 53 project site in 2002 as part of the monitoring program established for the project. In addition, this report presents a comparison of all the monitoring data collected in 1992, 1993, 1996, and 2002 and discusses the monitoring results within the context of the program objectives. For further background information, see *Pier 53–55 Sediment Cap and Enhanced Natural Recovery Area Remediation Project* (EB/DRP, 1993), *Pier 53–55 Sediment Cap and Enhanced Natural Recovery Area Remediation Project 1993 data* (EB/DRP 1995a) and *Pier 53–55 Sediment Cap and Enhanced Natural Recovery Area Remediation Project 1996 data* (EB/DRP 1997).

Project Site

The project site is an east-west-trending, roughly triangular area located offshore of Piers 53, 54, and 55 (Figure 1–1). The site is west and slightly north of the intersection of Madison Street and Alaskan Way in downtown Seattle. The project consists of a 3-foot-thick sediment cap covering the 2.9 acres farthest offshore and to the south and an experimental 1-foot-thick enhanced natural recovery area (ENR) covering the 1.6 acres nearshore and to the north.

Project Background

Planning for a remediation project along the Seattle waterfront began as part of Metro's Toxic Sediment Remediation Program, which was formed to coordinate and plan multi-agency efforts to clean up contaminated sediment in Elliott Bay and the lower Duwamish Estuary. An interagency committee was formed to provide guidance for this program. The Denny Way sediment cap—located north of Seattle's downtown waterfront—sponsored by Metro, and constructed in 1990, was the first project completed under the Toxic Sediment Remediation Program.

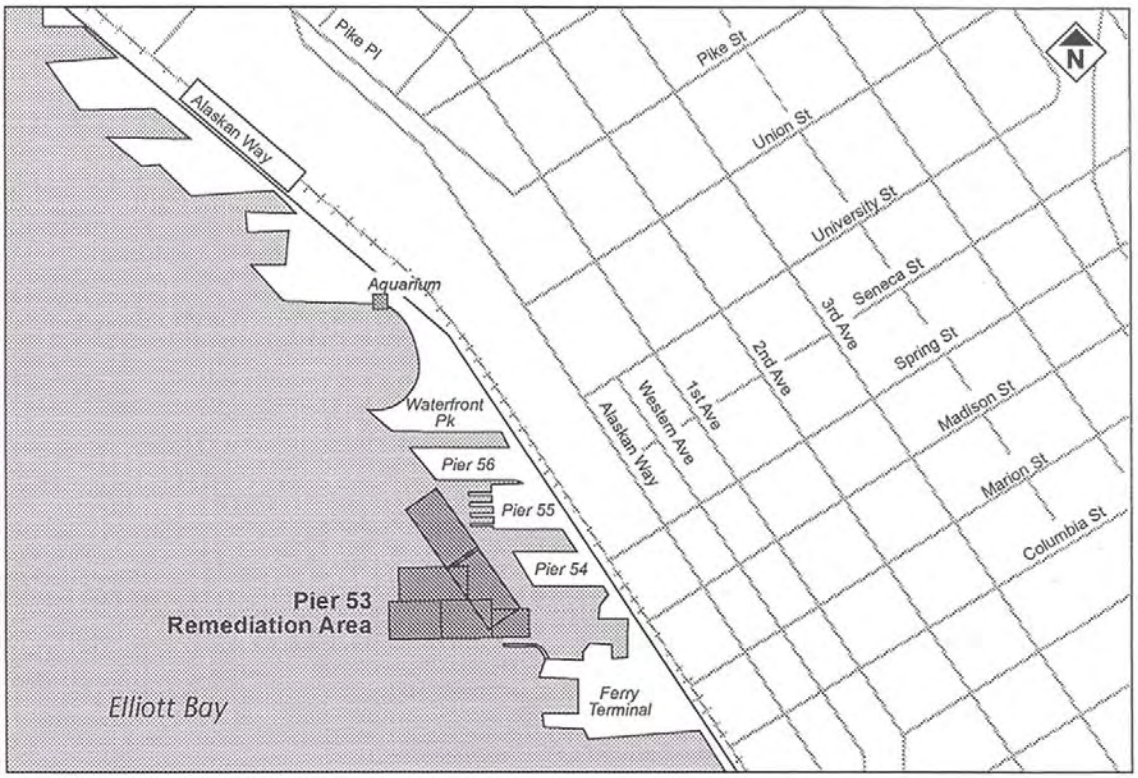


Figure 1-1. Location of the Pier 53 Remediation Area

The first major step in planning a new sediment remediation project along the Seattle waterfront was to contract Parametrix, Inc. to conduct a risk assessment and prioritize a list of 49 potential sites. The list was later expanded to include sites in the Duwamish River for a total of 68 sites. The sites were ranked on the basis of the number and types of chemicals present and the maximum concentration of these chemicals. Of the initial 49 sites, the two highest ranked sites were Seacrest Park, located south of the Seacrest Marina on the West Seattle side of Elliott Bay, and the Pier 53 site. A preliminary remediation plan was developed for these two sites as part of the Parametrix report (Parametrix, 1992).

The City of Seattle and Metro decided to develop the cleanup plans and coordinate with regulatory agencies during the permit process. The Corps was committed to complete dredging in the Duwamish River by the end of March 1992 and would dispose of the sand at the open water disposal site in Elliott Bay if no beneficial capping project was possible. Because of this dredging schedule, the time frame for acquiring the necessary permits for capping and the review period for the permitting agencies were very short. All permitting agencies were cooperative, and all permits for capping were obtained.

After Pier 53 capping was complete and the Elliott Bay/Duwamish Restoration Panel was formed (the Panel), the project was presented to the Panel. The Panel reviewed the project and, after deciding it met certain criteria, declared that the project was eligible for credit towards the 12 million dollars allocated to sediment remediation projects as required under the consent decree. The management of the Pier 53 project then proceeded under the direction of the Panel

with the City of Seattle as project sponsor. Metro, and now King County DNRP, agreed to conduct the monitoring program, which was established during the permitting process.

Monitoring Program

Environmental monitoring for the Pier 53 project consisted of both short-term activities needed to place the cap and long-term activities needed to document the effectiveness of the cap. The long-term activities included intensive sampling and observation during the first year after capping, followed by a less frequent schedule of monitoring at 4-years and 10-years. The 10-year monitoring plan was adopted and is contained in Appendix A. The first monitoring event of the approved plan was four months after cap placement. Additional monitoring events occurred after one-year (1993), four years (1996), and ten years (2002).

Monitoring Plan

The monitoring plan (Appendix A) lists seven objectives and provides an outline for the periodic monitoring report. The objectives are as follows:

- Provide pre-cap benthic invertebrate taxonomic data.
- Guide and document the cap placement, thickness, and long-term stability.
- Document how well the 3-foot cap functions to isolate contaminated sediments and prevent migration upward into the cap.
- Determine whether offsite chemicals migrate and accumulate on the surface of the 3-foot cap and ENR.
- Determine the amount and type of benthic recolonization that occurs in the remediation area and whether benthic recolonization differs between the 3-foot cap and ENR.
- Review and evaluate the monitoring data to determine whether the cap is functioning as expected and whether further actions are warranted in the capped area.
- Provide data that may inform and assist the Panel and other agency teams in developing future cleanup plans for Elliott Bay.

To meet these objectives, the monitoring plan required the establishment of bottom stakes for measuring cap thickness, surface sediment stations for chemical and taxonomical analysis, and core sediment stations for chemical analysis (Figure 1-2). Sediment chemistry data collected during monitoring are to be normalized for total organic carbon (TOC) as needed and compared to the state Sediment Management Standards (SMS) (Ecology, 1991) to determine whether the site continues to meet the state cleanup criteria. The SMS include the Cleanup Screening Levels (CSL) and the more protective Sediment Quality Standards (SQS).

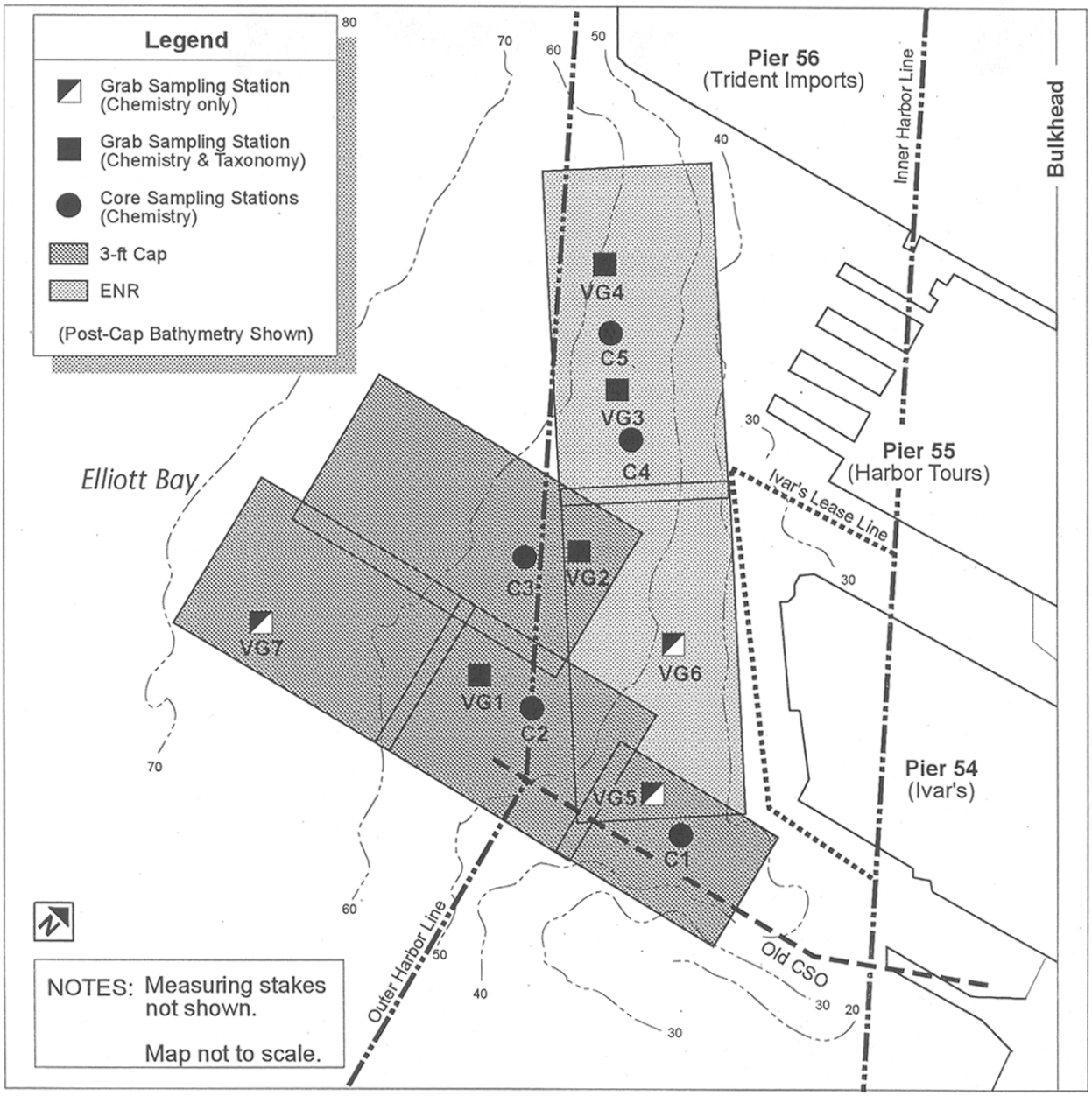


Figure 1-2. Sampling Stations

Status Report on the Monitoring Program

Table 1-1 shows the monitoring activities that have been conducted in 1992, 1993, 1996, and 2002 at the Pier 53 site and includes pre-cap information. The first monitoring activities took place in 1992 with the collection of pre-cap benthic taxonomy and sediment chemistry samples. Monitoring was conducted again in 1992 about four months after capping to establish early recolonization conditions, and also in 1993, 1996 and 2002. Monitoring data included cap placement, thickness, and settlement; benthic taxonomy; surface sediment chemistry; and core

chemistry. A video camera survey of the cap was conducted in 1992, 1993 and 2002 and a sediment-profile camera survey was conducted in 1992. Three reports have been finalized previously summarizing monitoring events (EB/DRP 1993, 1995a, 1997). This report includes a summary of the last monitoring year, 2002, monitoring results, comparison to previous monitoring data, and a review of the performance of the 10 year monitoring program in the context of the program objectives.

Table 1-1. Pier 53-55 sediment cap long-term monitoring activities

YEAR Elapsed Time	1992 Pre-cap	1992 4-month	1993 1 year	1996 4 years	2002 10 years
Stake for cap thickness	0	13	12	10	10
Coring stations	0	5	5	3	5
Surface Chemistry Stations 0-2 cm	6	7	7	7	7
Surface Chemistry Stations 0-10 cm	0	0	0	3	7
Benthic Community Stations	2	4	4	4	4
REMOTS Camera Survey	0	grid	0	0	0
Video Survey Transects	0	3	3	0	3
Bioassay Stations	2	0	0	0	0

Modifications to the Monitoring Plan

Experience gained from monitoring at the Pier 53 project and at the Denny Way sediment cap has shown that not all of the scheduled activities listed in the monitoring plan for the Pier 53 project (Appendix A) were necessary to meet the objectives outlined in the plan. Difficulties with certain sampling methods and the usefulness of the collected data made it necessary to continually re-evaluate the effectiveness and costs of the original monitoring plan. The following is a discussion of modifications to the plan.

It should be noted here that soon after the cap placement occurred, a wing wall at the ferry terminal, just south of the Pier 53 cap, was removed which resulted in resuspension and redistribution of contaminated sediments in the area. The impacts of this event are discussed within this document.

Core samples

Chemical results from the under-cap samples in past years at Pier 53 (1992 and 1993) and at the Denny Way cap (1990, 1991, and 1992) have been widely variable. Coring through the cap sand and into the underlying mud has apparently resulted in inconsistent sample capture. Because of this, the 2002 under-cap samples have been archived. No purpose was identified for these samples and they were never analyzed.

During the 1992 baseline monitoring and one year monitoring in 1993, all core sections were analyzed and showed very low or undetected results for all chemicals. Based on this, only the first 6-inch sections above the cap/under-cap interface in each core sample were analyzed in subsequent monitoring years for organics, metals, and conventional parameters. The second 6-inch section taken from the ENR and the second, third, and fourth 6-inch sections taken from the cap were archived. Archived samples could be analyzed in the future if it proved helpful to answer questions regarding isolation efficacy. However, this was never necessary and these samples were never analyzed. Also, during the Year 4 sampling event in 1996, the number of coring stations was reduced to three instead of five because of previous consistently low detection rates. C1 was chosen for sampling because it was located in the area of greatest pre-cap contamination. C4 and C5 were sampled because they were located in the thinner ENR (EB/DRP 1997). The number of stations was returned to the original five in 2002.

Surface samples

The 0- to 2-cm samples were taken every sampling event to characterize the most recent changes in contamination on the surface of the cap and ENR. In 1996, additional 2- to 10-cm-deep samples were also collected at stations VG3, VG4, and VG5 because the standard sampling depth for comparisons with the SMS is 10 cm. During data interpretation, the results of these samples were proportionally combined with the results from the top 2 cm at these stations to reflect the overall chemical concentrations in the top 10-cm biologically active zone. To avoid the need for sample reconstruction, in 2002, 0–10 cm samples were added to the 0–2 cm samples in the original monitoring plan. Results from these separate 0-10 cm samples were compared to the SMS.

Benthic taxonomy

The benthic taxonomy samples collected after only one year showed that recolonization occurred rapidly on the cap and ENR. For the four-year sampling event in 1996, the decision was made to collect a benthic taxonomy reference sample to enable comparisons of the cap to a reference community that represents normal and stable conditions. The selected reference station, located off Richmond Beach, had the same sandy bottom conditions as the cap material. However, this reference station was in a high energy environment that prevented fine grain sediments from accumulating. This was different than the low energy environment at the Pier 53–55 cap. Energy and potentially other characteristics resulted in different benthic community structure. No reference station was sampled in 2002 because an appropriate site with similar conditions to the Pier 53–55 site could not be located.

REMOTS sediment-profile survey

After capping, the REMOTS sediment-profile survey was used to determine how far capping sand drifted offsite during construction. The REMOTS study was also used for an initial assessment of the benthic community during the first stages of recolonization. Two notable observations particularly relevant to this report are: that scans of the 3-foot cap and 1-foot ENR layer in 1992 showed that materials were often poorly sorted; and scans immediately offshore of Harbor Tours cruise vessel moorage area (Pier 54) demonstrated thin top layers of well sorted

material (SAIC 1992). These scans indicate the original state of the capping material after placement was heterogeneous in grain size. Also, they suggest that disturbances along the waterfront may be causing sediment redistribution. No further REMOTS surveys was conducted during this monitoring program because no additional information was needed on capping sand location and benthic recolonization was subsequently evaluated using benthic taxonomy studies and sometimes video survey.

Video camera survey

Video camera surveys were not required by the monitoring plan but were determined to provide useful information about the cap. Two years of video camera surveys have been conducted on the cap. The video surveys were able to show the actual surface of the cap and spatial pattern of initial recolonization.

Video surveys have also shown a surface organic layer that increased since capping, marine plants and organisms, and a buildup of litter and other debris. The video survey information is not easily quantifiable and other methods were available for determining organic content of sediments and evaluating the benthic community. Thus, the video survey was not conducted after 1993.

SECTION 2: CAP THICKNESS AND SETTLEMENT

Once the Pier 53 cap was installed, the monitoring plan required periodic measurement of cap thickness and seafloor settlement. These measurements document changes that could compromise the integrity of the cap and its ability to isolate contaminated sediments. In addition, these measurements assist in characterizing the dynamics of cap placement. This section describes the cap-measuring stakes and settling plate assemblies, documents cap thickness and settlement, and compares these measurements to the previous monitoring results.

Methods

Before the cap was placed in 1992, Metro directed contract divers to install 13 bottom stakes and settling plate assemblies in the capping target area (Figure 2-1). The stakes and assemblies measure cap thickness and seafloor settlement after cap placement. The stakes were 3.9 to 5.4 m long (13 to 18 feet), 2.5 cm diameter (1-inch) steel pipes, pounded 2.4 to 3.9 m (8 to 13 feet) into the bottom, with 1.46 to 1.48 m (4.8 to 4.9 feet) left exposed. Settling plate assemblies were then fitted over each steel stake.

Settling plate assemblies were made of a 40 cm -diameter (16-inch) plate sitting horizontally on the pre-cap seafloor, attached to a vertical 10 cm diameter (4-inch) PVC cylinder long enough to remain exposed after the cap was placed (Figure 2-2). The settling plate assembly was designed to slide down the stake as the contaminated sediments were compressed under the weight of the overlying cap. A metal clamp fastened to the steel stake marked the position of the PVC cylinder before capping. The distance between the bottom edge of the metal clamp and the top of the PVC cylinder was a direct measurement of seafloor settlement after capping. Cap thickness was determined by measuring the length of PVC cylinder exposed above the cap surface, and subtracting that length from the total length of the cylinder measured before capping.

Using a surveyor's rod, divers measured stake height upon cap placement on 3/18/92. In addition, both cap thickness and seafloor settlement, together called consolidation, were measured at each of the 13 stakes one week after capping on 3/24/92, then one year later in 1993, and again in 1996, and 2002.

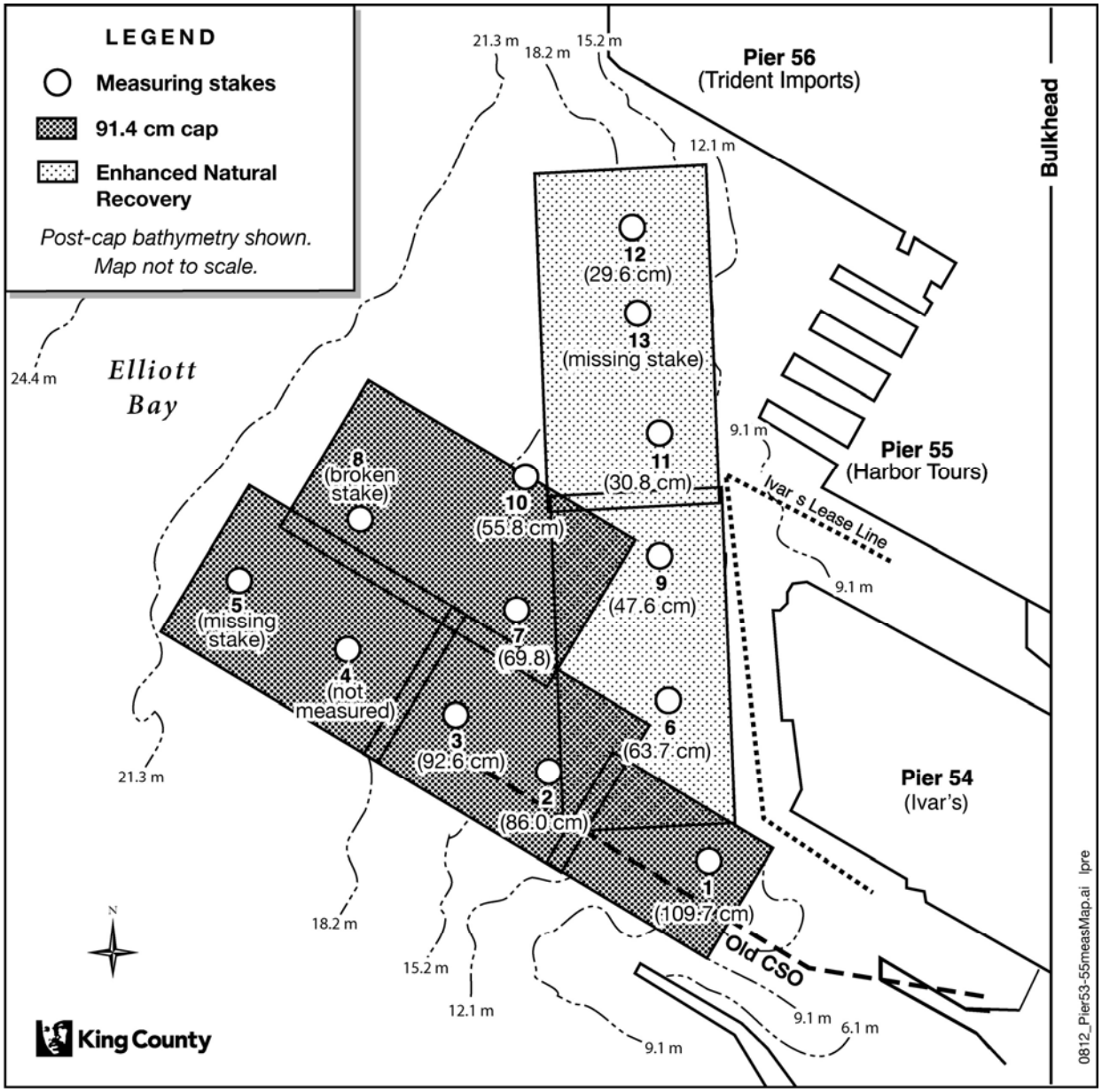


Figure 2-1. Barge Tracks and Measuring Stake Locations with 2002 Thickness Measurements.

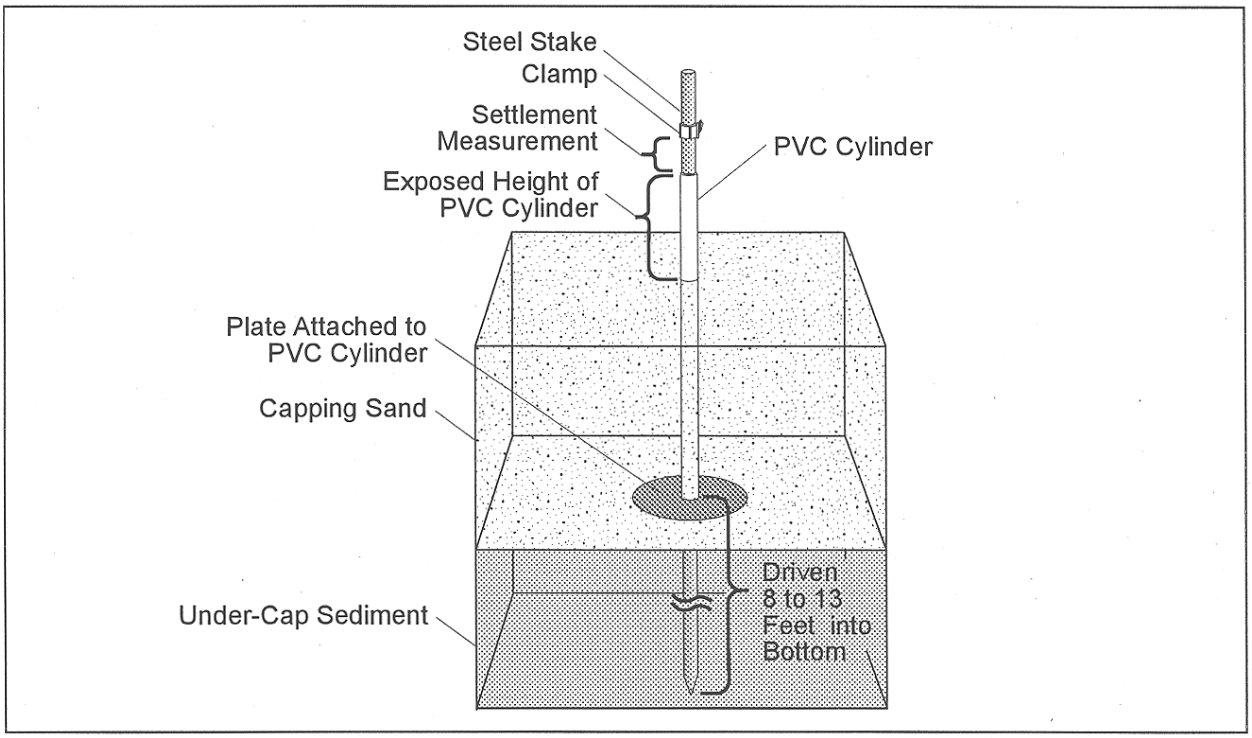


Figure 2-2. Measuring Stake Assembly

Results and Discussion

Cap thickness and settlement measurements taken on the cap and ENR in 2002 showed that all but one stake (#11) had been damaged or was missing; however, there was enough information to get thickness measurements from the stakes that were not missing (9) and settlement measurements where clamps were still present (7).

Cap Thickness

Cap thickness measurements (in cm) for 2002 are shown in Figure 2-1 next to the stake number. Three of the 13 stakes were missing or damaged within the first 4 years (stake #5 one year; stakes #8 and #13 four years). During the last 6-year period (1996 to 2002) additional damage (i.e., bending) occurred at all but one of the remaining 10 stakes. Also, steel clamps for measuring settlement were missing at stakes #2 and #3 (entire steel pipe gone at stake #2). In these cases, the calculated cap thickness measurements for 2002 shown in Figure 2-1 and Table 2-1 and 2-2 were based on the total exposed stake length. Method error and the uncertainty associated with measurements collected from bent stakes are both potential sources of variability in the settlement estimates. It is possible that these stakes were bent from large anchor cables used to moor construction barges for projects occurring adjacent to the Pier 53 site. Washington Department of Fish and Wildlife (WDFW) has also confirmed that a regular trawling site exists

in the offshore area near the cap (personal communication with O'Neil and West 4/12/07). This site was sampled annually 1989-2001 and typically targets 300 meter depths or greater.

Table 2-1. Changes in cap thickness (Units are cm)

Stake #	0 - Year Cap Depth	Change 0 - 1 YR	1 - Year Cap Depth	Change 1 - 4 YR	4 - Year Cap Depth	Change 4 - 10 YR	10 - Year Cap Depth	Change 0 - 10 YR
Cap	**1992**		**1993**		**1996**		**2002**	
1	88.4	16.5	105	4.9	110	0.0	110	21.6
2	79.3	3.7	83.0	(0.6)	82.3	3.7	86.0	6.7
3	85.4	0.6	86.0	3.0	89.1	3.7	92.7	7.3
4	107	1.8	109	0.6	109		**	
5	91.5		*		*		*	
7	76.2	0.0	76.2	(1.8)	74.4	(4.6)	69.8	(6.4)
8	76.2	1.2	77.5		*		*	
10	57.9	(1.2)	56.7	(1.8)	54.9	0.9	55.8	(2.1)
ENR								
6	64.0	3.0	67.1	(0.6)	66.5	(2.7)	63.7	(0.3)
9	45.7	0.6	46.4	1.8	48.2	(0.6)	47.5	1.8
11	27.4	(3.7)	23.8	5.2	29.0	1.8	30.8	3.4
12	30.5	(3.7)	26.8	3.7	30.5	(0.9)	29.6	(0.9)
13	24.4	0.9	25.3		*		*	

* Missing or broken stake and assembly
** Severely bent stake - no measurement taken
(Change) = Decrease

However, trawling path coordinates received from WDFW and mapped by King County show that three trawls passed over the cap (around 60 feet depth) between 1996 and 1998 and earlier trawls were also located in the project area (Figure 2-3). GPS coordinates were not consistently collected for trawls before 1997[1]. The two trawl dates with reliable coordinates that map on the cap occurred after Year 4, possibly accounting for a number of damaged stakes. For example, stake #4 was severely bent sometime between 1996 and 2002. A number of trawls occurred in the vicinity of the cap before 1997, when trawl coordinates were not reliably measured, and may have also damaged stakes. It is also possible that other unknown and unexpected factors may have contributed to stake damage.

[1] According to WDFW (West, 2007), the coordinates for trawls completed before 1997 have a high degree of error associated with them due to inconsistent GPS use; thus, their exact locations are uncertain.

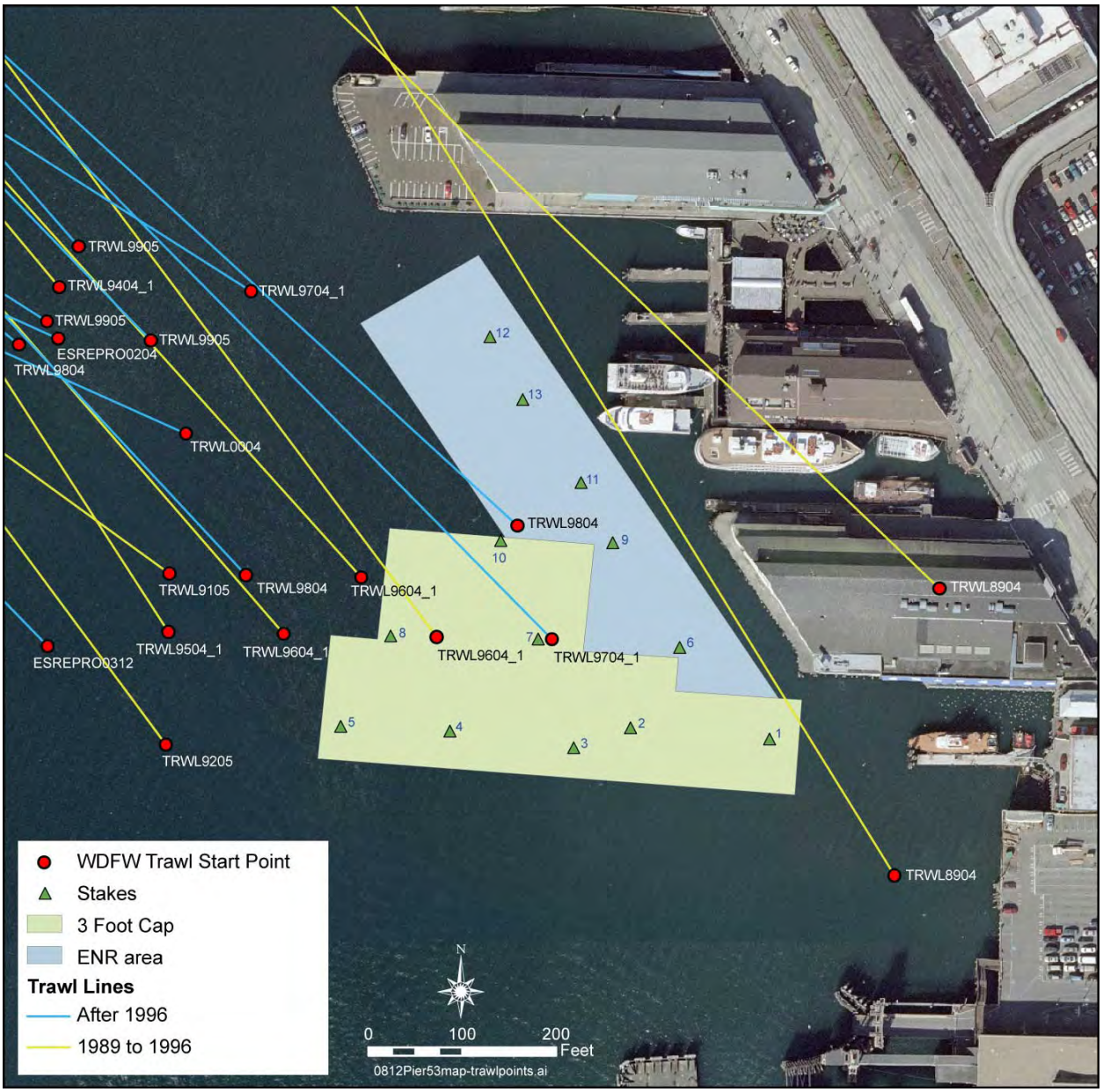


Figure 2-3. WDFW Trawl Paths Near the Pier 53 Site

Actual cap thickness after placement ranged from 58 to 107 cm (1.9 – 3.5 feet) (Table 2-1). Over the monitoring period, there were small increases and decreases at each stake with the net changes being positive or negative across the cap (Figure 2-3). Stakes #1-3 (#4 stake bent in 2002) show a net increase over 10 years ranging from 6.7 to 21 cm (0.22 to 0.7 feet). Thickness measurements were obtained at only two stations on the offshore side of the cap: 91 cm (3.0 feet) at stake #5 in 1992 and 76 cm (2.5 feet) at stake #8 in 1992 and 1993. Toward the center of the cap, thickness at stake #7 decreased by 4.6 cm (0.15 feet) over the last 6 years and thickness at #10 increased by a nominal amount (Figure 2-4). There has been a net decrease at both these stakes although the loss at #10 is minor (< 3 cm).

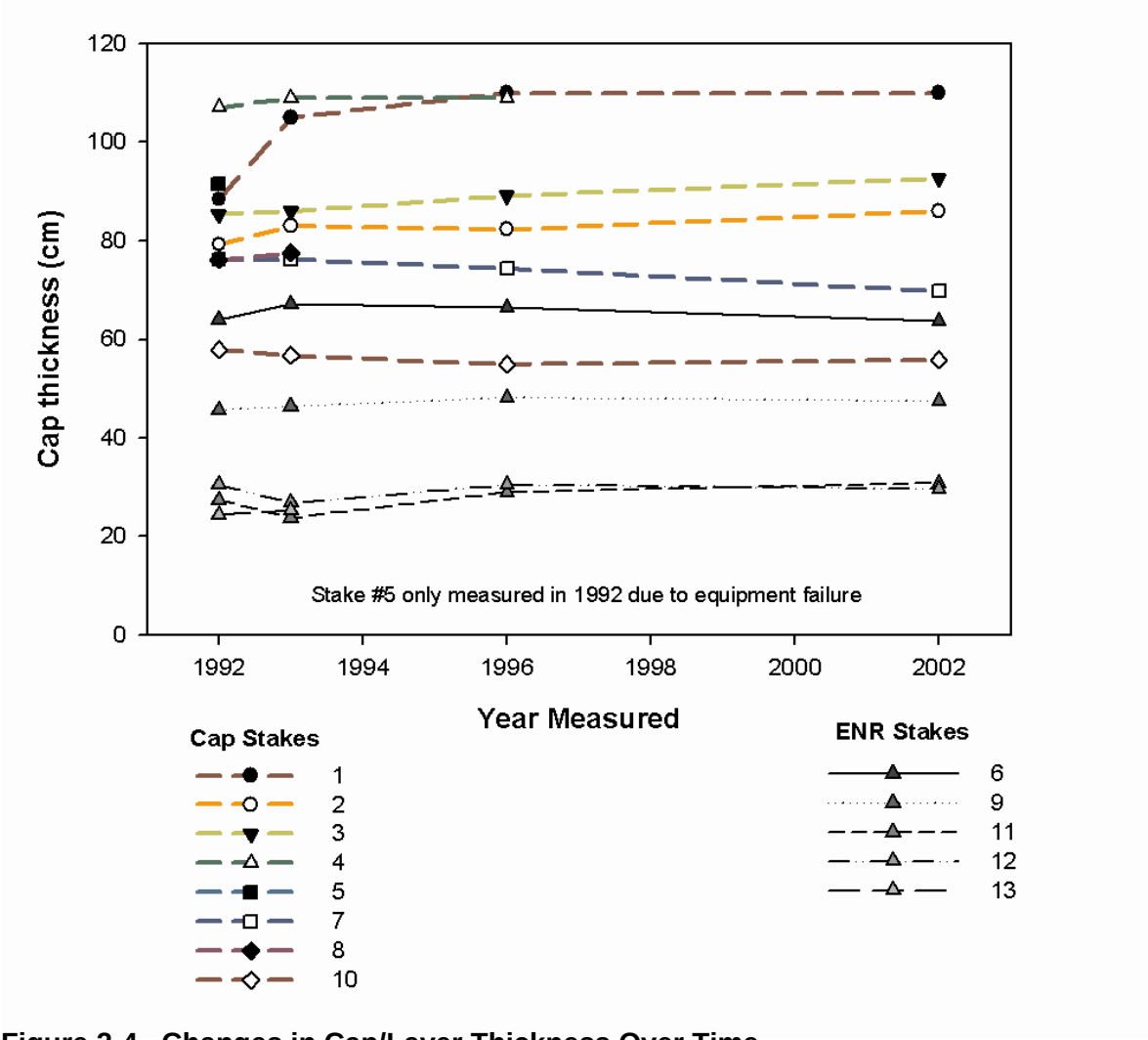


Figure 2-4. Changes in Cap/Layer Thickness Over Time

Compared to the 0-year cap measurements, cap thickness has increased over the southern end of the cap (stakes #1-3) and decreased on the northern end (stakes #7 and #10). Net increases at all cap stations ranged from 6.7 to 21 cm (0.22 to 0.7 feet). Net decreases were smaller and ranged from 2.1 to 6.4 cm (0.07 to 0.21 feet) indicating redistribution of sediment caused a net accumulation on the cap. More sediment seems to have accumulated at stake #1, however, most of this occurred in the first 2 years and no change has been observed between 1996 and 2002. This increase was likely caused by sediment resuspension due to removal of the nearby wing-wall in 1992.

The only area of the cap to show greater than 3 cm (0.1 feet) net reduction in cap thickness across the 10 year monitoring period is at stake # 7. This stake is located near the center of the cap in relatively deep water (about 55 feet). The nearest stakes to the south (#2 and #3) showed a net increase. The closest stake to the north is #10 is where very minor (<3 cm or 0.1 feet) changes were observed cumulatively and between each monitoring period. Thus, changes at stake #7 do not appear similar to surrounding stakes to the north and south. Considering the dominant current at the site is longshore (north/south), the thickness data on the cap does not suggest influence from the current causing sediment movement. Also, there is no clear pattern

suggesting that the stakes closest to the Washington State Ferry Terminal are impacted by large boat activity.

The ENR sand thickness at stakes #6 and 9, adjacent to the cap, is closer to 0.64 m (2.0 feet) rather than the design thickness of 0.3 m (1.0 foot). This is because some of the sand from the cap area drifted onto the ENR layer. During the past six years there was little change at stake #9, but stake #6 showed a small reduction in cap thickness. During the past three sampling events sediment thickness at stake #6 (ENR) decreased slowly (Table 2-1). The northern ENR area is close to the design thickness. There was little change during the past six years at stakes #11 and #12; both stations showed a small net increase. These stakes are located in front of Argosy Harbor Cruises, an area of high boat activity, which could explain small changes in sediment thickness. All of the stake measurements in the ENR area indicate increased cap thickness (0.3 to 28 cm) over the last 10 years of monitoring with the exception of the southernmost stake #6 which decreased slightly by 0.3 cm (0.01 feet) (Figure 2-4). All of these changes are considered minor and could be explained by settlement of existing cap sediments and/or regular sediment redistribution (i.e., scour, resuspension, and redeposition) from waterfront activities or storm events.

Settlement of a cap can occur after placement when sediment particles consolidate, making the cap more dense and thus, less thick. This could have contributed reduction over the 10 year monitoring period, partially countering any accumulation processes. Sedimentation can contribute to sediment accumulation. The sedimentation rate for the Seattle waterfront has been estimated at 0.19 to 0.7 cm/yr (EB/DRP 1995b). That equals a rate of 19 to 70 cm over 10 years which covers the range of site cap thickness increase observed at any station. The highest sedimentation rate observed on the cap or ENR layer based on the last 6 year monitoring interval is 0.6 cm (0.02 feet) /year, not accounting for settlement. This is within the annual estimated sedimentation rate range for the waterfront. Other factors that could contribute to sediment redistribution on the Seattle waterfront are wave energy and vessel activity. Previous study of the waterfront (EB/DRP 1995b, EB/DRP 1995c) has concluded that waves cause insignificant resuspension outside of a tight band along the shoreline, but that vessel movements play an important role in sediment resuspension along the central waterfront, especially in summer and early fall months. The observed cap and ENR thickness changes indicate overall, small positive and negative shifts that are likely explained by sediment redistribution and compaction of the cap sediments. Overall, the cap and ENR area appear to be stable and meeting the original objectives with no signs of substantial erosion or downslope movement.

Seafloor Settlement

Seafloor settlement occurs as a result of the overlying weight of the cap sand and is greatest when capping silty seafloors (Palermo et al. 1998). Typically, the greatest seafloor settlement occurs immediately after a cap is laid down. The total area of 16,700 cubic meters (22,000 cubic yards) of sand caused seafloor settlement according to some stake measurements, as anticipated. Table 2-2 provides settlement measurements for all four sampling events. The 2002 settlement measurements are limited to seven of the 13 original stakes because four stakes were severely damaged, missing or missing clamps in 1993 (#2, #3, #5, and #8), one more in 1996 (#13) and another in 2002 (#12). Four of the seven settlement measurements in 2002 were in the cap and

ranged from 1.8 cm (0.06 feet) to 12.3 cm (0.41 feet). Three of the seven settlement measurements in 2002 were on the ENR (stakes #6, #9, and #11) (Figure 2-5). These values ranged from 2.7 cm (0.09 feet) to 8.1 cm (0.27 feet).

Seafloor or under-cap settlement was anticipated to be greatest immediately post-cap placement and greater in the cap area than in the ENR area, where the surface sand layer is thinner. However, this is not the pattern that was observed. One week post-cap, no settlement was observed at most of the cap stakes (#1-5, #7) and some settlement was observed at most ENR stakes (#6, #11-13) and the two northernmost cap stakes (#8 and #10) (Figure 2-5). One year later, settlement at additional cap stakes occurred (#1, #4, #7). ENR stakes showed small changes +/- < 6 cm (0.2 feet). The measurements in 1996 and 2002 demonstrated similar gains or losses with no apparent causes for the changes. By 2002, 6 of the 13 stake assemblies were missing or broken such that settlement measurements could not be taken, perhaps indicating the need for improvements to methods for settlement monitoring. Overall, assuming the method applied was reasonably accurate when measurements could be taken, seafloor consolidation data did not follow the expected results in that settlement under the thicker cap occurred later than beneath the thinner ENR sand. However, measured changes in seafloor settlement were collectively no larger than 9.1 cm (0.3 feet) and appeared to fluctuate with time, resulting in net changes of 12 cm (0.41 feet) or less. By 2002, seafloor settlement at ENR stakes was similar to or less than that at cap stakes.

Table 2-2. Seafloor settlement (Units are cm)

Stake	1992[1] Settlement	1992/1993 Change	1993[1] Settlement	1993/1996 Change	1996[1] Settlement	1996/2002 Change	2002[1] Settlement
Cap							
1	No settlement	9.15	9.15	1.55	10.7	(2.77)	7.93
2	No settlement	N/A	Missing steel pipe	N/A	Missing steel pipe	N/A	Missing steel pipe
3	No settlement	N/A	Missing clamp	N/A	Missing clamp	N/A	Missing clamp
4	No settlement	9.15	9.15	(0.61)	8.54	3.96	12.5
5	No settlement	N/A	Missing stake and assembly	N/A	Missing stake and assembly	N/A	Missing stake and assembly
7	No settlement	4.88	4.88	0.30	5.18	1.53	6.71
8	3.66	N/A	Broken stake and assembly	N/A	Broken stake and assembly	N/A	Broken stake and assembly
10	5.49	(4.27)	1.22	6.40	7.62	(5.79)	1.83
ENR							
6	3.66	2.44	6.10	0.91	7.01	0.30	7.31
9	No settlement	6.10	6.10	1.82	7.93	0.30	8.23
11	6.10	(4.88)	1.22	0.30	1.52	1.22	2.74
12	4.57	(3.35)	1.22	(0.31)	0.91	N/A	Missing clamp
13	3.05	(2.44)	0.61	N/A	Missing stake and assembly	N/A	Missing stake and assembly

[1] Settlement measurements are cumulative. 1992 settlement is difference after one week.
N/A = measurement could not be taken
(Change) = decrease

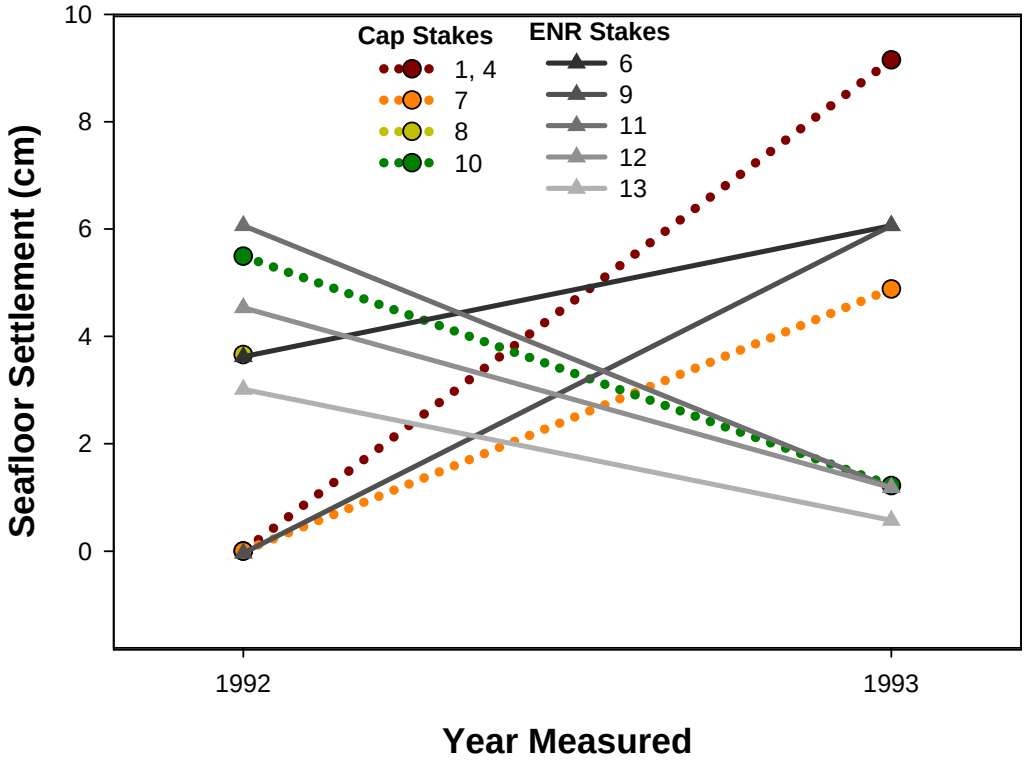


Figure 2-5. Initial Seafloor Settlement in 1992 and 1993

Accounting for accumulation, erosion of the deposited material, and consolidation in the cap and seafloor, the net consolidation was calculated and showed variable changes between stations over time (Table 2-3, Figure 2-6). Net consolidation values in the cap compared to ENR area are similarly absent of pattern. However, the four stakes (#6, 7, 9, and 10) where net compaction/settlement (up to 13 cm) occurred are all located near the center of the entire cap/ENR area (Figure 2-1). Remaining stakes #1 and #11, which border this net loss center to the north and south, were measured to have net accumulation? Net consolidation could not be calculated at half of the 12 stakes due some type of assembly damage preventing optimal characterization of the site.

Table 2-3. Total consolidation of cap and seafloor

	Total Change (cm)			
Stake	1992/1993	1993/1996	1996/2002	1992/2002
Cap				
1	7.35	3.35	2.79	13.7
4	(7.35)	1.21	NA	NA
7	(4.88)	(2.10)	(6.13)	(13.1)
10	3.07	(8.2)	6.69	(3.93)
ENR				
6	0.56	(1.51)	(3.0)	(7.61)
9	(5.5)	(0.02)	(0.91)	(6.43)
11	1.18	4.9	0.58	0.66
12	(0.35)	4.01	NA	NA

Only stakes where measurements could be taken most years are included
NA = A measurement was not available to do the calculation
Consolidation = Accumulation
(Consolidation) = Compaction/settlement

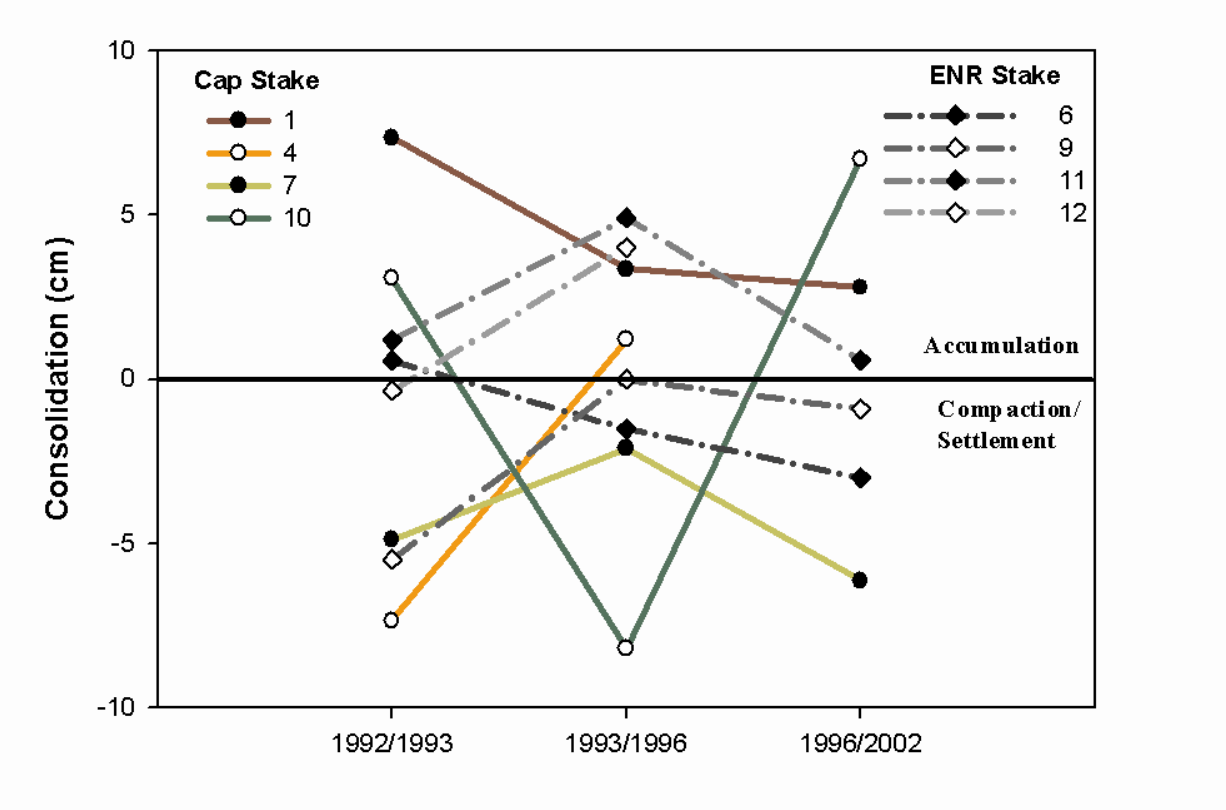


Figure 2-6. Net consolidation between monitoring periods

In conclusion, monitoring indicated that small changes in cap thickness occurred over the 10 years monitoring period and seafloor settlement was not substantial. Differences in seafloor settlement were not detected in the cap compared to the ENR area. Neither were changes in cap thickness associated with one area versus another. Overall, the cap appears stable and experiences small surficial changes in erosion and accumulation at a very local level, likely due to human activities.

SECTION 3: CORE CHEMISTRY

The monitoring team collected core samples from the 3-foot cap and ENR area in September 2002. The samples were collected and analyzed to determine whether contaminants are migrating upward from under-cap sediments into the cap. Core samples were analyzed for trace metal, organic, and conventional parameters. This section describes the core sampling methods and compares the results of the chemical analysis to the SMS and to the 1992, 1993, and 1996 results.

Methods

The monitoring plan defined five core sampling stations (C1 through C5), as shown in Figure 3 1. Two stations are in the ENR area (C4 and C5), and three stations are in the 3-foot cap (C1, C2, and C3) to allow comparisons between the two areas. The stations are located in water depths of 16.6 to 18 m (55 to 60 feet). C1 is located in the southeast corner of the site where some of the highest chemical levels were previously observed and where sampling is more likely to detect the possible upward migration of contaminants into the cap. All five stations are situated at least 9 m (30 feet) away from the surface sampling stations so that any potential release of contaminated sediment from core sampling activities would not affect surface samples.

All five core stations were sampled in 2002. Two cores were collected at each station and a replicate core was collected at one station (C4). One of the cores was analyzed first, while the second served as backup in case of a problem with the first. In 2002, the sampling equipment used to collect the cores was different than in the three previous sampling events. Previously, a diver used an underwater jackhammer to drive a 4-inch aluminum diameter core tube into the cap and ENR to a depth of about 152 cm (5 feet). In 1992 and 1993, all five core stations were sampled, and in 1996 this was reduced to three core stations (C1, C4, and C5 per an approved revised sampling plan). Core sampling equipment was changed in 2002 to allow the collection of sediment from the core tube on board the vessel instead of the laboratory. The first time the County used this type of coring equipment was two years earlier when the ten-year sediment cores were collected from the Denny Way cap in 2000.

Conversion to a new coring method was based on an evaluation of different coring methods available. The goal was to provide the most similar data while simplifying the core-cutting process required for sub-sampling. After reviewing various coring methods, King County selected the MudMole coring device. The MudMole uses an air-driven piston hammer to drive a square core tube into the bottom, which causes minimum disturbance of the cap/contaminated sediment interface. Also, the MudMole allows sub-sample collection without needing to cut the core tube, minimizing potential for sample contamination.

Some difficulties were encountered finding the cap/contaminated sediment interface at some stations using the MudMole. At the three cap stations, a longer core tube was used than specified in the SAP (10-foot long instead of 7 feet) to obtain acceptable samples. The longer core tube allowed deeper penetration and successful identification of the interface.

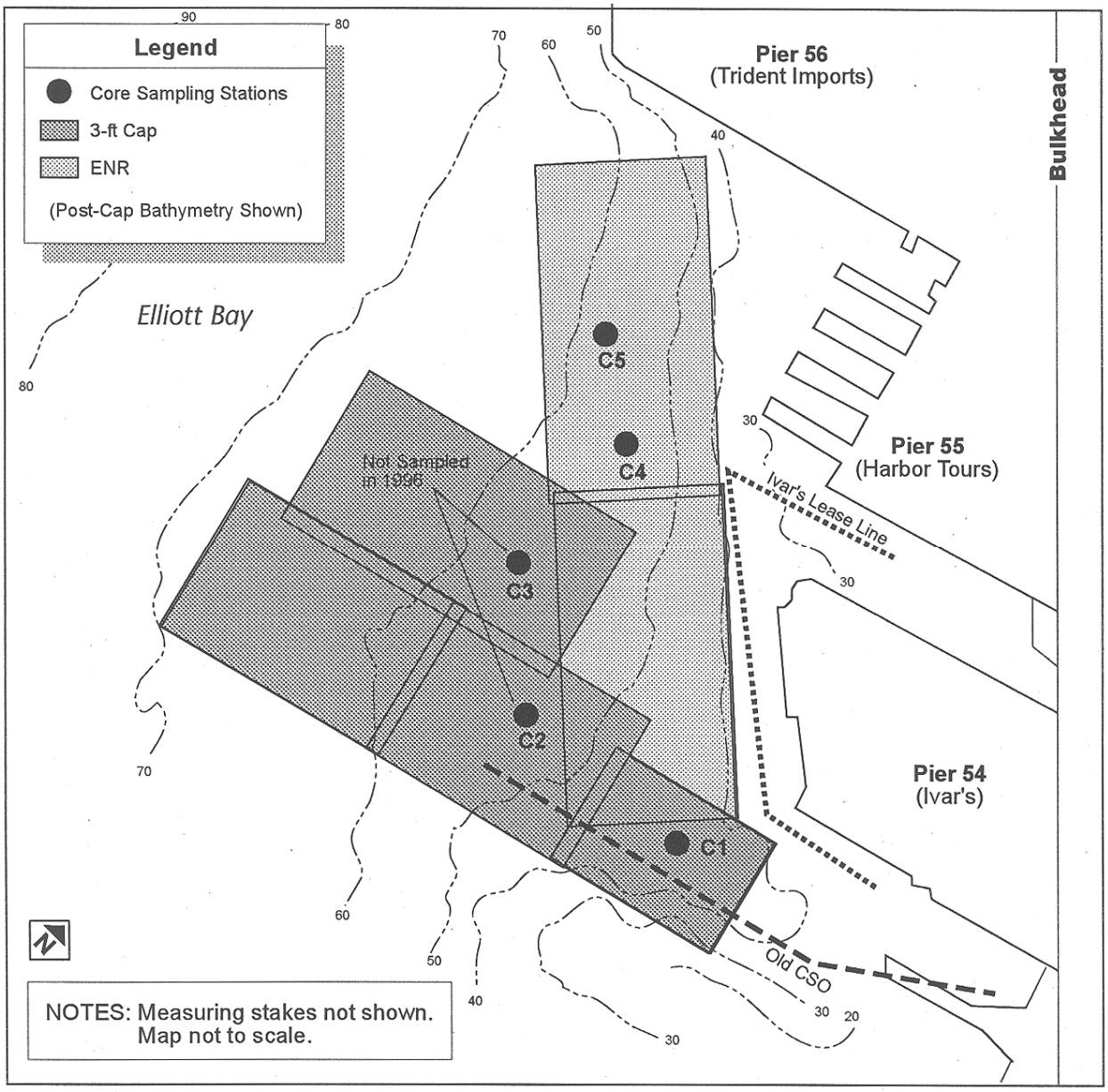


Figure 3-1. Core Sampling Stations

Sediment Sub-Sample Collection and Analysis

When sub-samples were collected from the core, care was taken to obtain a clean sample without any contamination from the core tube or contaminated sediments below the interface. To minimize the chance of accidentally including material from below the interface, the first 6-inch sample was taken one inch above the interface. When smeared mud was observed on the sand cap material in the core, it was scraped off before sampling. At the two ENR stations (C4 and C5), the interface couldn't be definitely located and there is the possibility that contaminated sediment was included in these samples. Other sample collection methods were conducted according to the SAP. The King County Environmental Laboratory (KCEL) analyzed the

samples for trace metals, BNA compounds, chlorinated pesticides, PCBs, percent solids, and TOC. AmTest, Inc. analyzed the samples for particle size distribution. All analyses were performed following guidance recommended in the Puget Sound Protocols (PSEP 1986, 1997a and 1997b) including associated QA/QC practices. Analytical methods and QA procedures are included in Appendix B under the applicable analytical section of the quality assurance review.

Results and Discussion

All of the 2002 core chemistry data are provided in Appendix C. Table 3-1 provides a summary of the 2002 dry weight values for SMS chemicals measured in the first 6-inch core section. A summary of all results for the first 6-inch core section are presented in Table 3-2. All chemistry data underwent a QA review at the King County Environmental Laboratory. A QA1 review package can be found in Appendix B. Eighty-five chemicals were detected in core samples and 27 of these were SMS chemicals. More chemicals were detected in 2002 than any of the three previous events. However, this is at least in part due to the decrease in analytical method detection limits (MDLs) which enabled detections of chemicals such as multiple PAHs and PCBs at lower concentrations than in 1996 or earlier.

The MDLs for 1996 PAH analyses ranged from 12 to 55 µg/kg dry weight (dw). Individual PAHs were detected at core stations in 2002 at concentrations 5.9 to 57 µg/kg dw with one exception: the pyrene concentration measured in the C4 replicate was 82 µg/kg dw. Thus, although more PAHs were detected in 2002, PAHs were likely also present in 1996 but at concentrations too low to be detected. In 2002, LPAHs were elevated at C2, as high as 166 µg/kg for phenanthrene, and HPAHs were the highest of all stations at both C2 and C3. PAH compounds have been found in previous core samples and could also be the result of PAHs present in the original sand dredged from the turning basin. Composite core data from 1991 sample collection in the turning basin indicates that HPAHs ranged from 44 to 749 µg/kg dw, averaging 397 µg/kg dw in the 0-4 foot intervals (USACE 2007). This average is comparable to the total HPAH concentrations at C2 and C3 in 2002 of 260 and 312 µg/kg dw, respectively. However, total LPAH concentrations measured in turning basin core samples were 26-95 µg/kg dw, lower than the 389 µg/kg dw observed at C2 in 2002. Thus, cross-contamination of PAHs from the capping material is not fully supported by available information. Alternatively, the natural heterogeneity of contamination at the site, as demonstrated by the replicate sample at C4, may explain the change observed between monitoring events. Realistically, some combination of these factors is most likely responsible.

All five core stations were sampled in 2002 compared to three in 1996 (C1, C4 and C5). BEHP was detected at the highest concentrations in 2002, particularly high at C5 (365 µg/kg dw). Other than C5, BEHP at other stations was the same magnitude as previous years. It is suspected the unusually high BEHP concentration at C5 is caused by high spatial variability in the capping material.

The replicate sample collected at C4 in 2002 demonstrates the variability in cores at the same station. Comparison to the replicate sample shows that total mercury was 0.396 compared to the

Table 3-1. Core stations: Detected chemicals in first 6-inch sediment interval above cap interface (Dry Weight)

Station Locator	P53C1			P53C2			P53C3			P53C4			P53C4 (rep)			P53C5		
Date Sampled	24-Sep-02			24-Sep-02			24-Sep-02			24-Sep-02			24-Sep-02			24-Sep-02		
Sample Number	L25512-1			L25512-2			L25512-3			L25512-4			L25512-6			L25512-5		
% Solids	75.1			80.8			74.1			78.5			74.7			76.9		
% TOC	0.696			0.36			0.556			0.699			0.651			0.381		
Metals (mg/kg dry weight)	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL
Arsenic, Total, ICP	5.2	<RDL	16	5.2	<RDL	16	5.5	<RDL	17	3.4	<RDL	16	3.5	<RDL	16	5.6	<RDL	16
Cadmium, Total, ICP	ND	<MDL	0.19	ND	<MDL	0.19	ND	<MDL	0.2	ND	<MDL	0.19	ND	<MDL	0.19	ND	<MDL	0.2
Chromium, Total, ICP	12.7			13			12.6			11.5			12.5			16.1		
Copper, Total, ICP	13.7			12.6			14			11.2			15			13.9		
Lead, Total, ICP	6.9	<RDL	9.6	6.2	<RDL	9.5	6.1	<RDL	10	5.4	<RDL	9.7	8.8	<RDL	9.6	5.3	<RDL	9.6
Mercury, Total, CVAA	ND	<MDL	0.02	0.038	<RDL	0.23	0.038	<RDL	0.27	ND	<MDL	0.024	0.396			0.026	<RDL	0.24
Silver, Total, ICP	ND	<MDL	0.19	ND	<MDL	0.26	ND	<MDL	0.27	ND	<MDL	0.25	ND	<MDL	0.25	ND	<MDL	0.26
Zinc, Total, ICP	50.3			45.2			49.4			47			50.2			45.9		
BNA Organics (µg/kg dry weight)																		
1,2-Dichlorobenzene	ND	<MDL,G	0.35	ND	<MDL,G	0.32	ND	<MDL,G	0.35	0.883	G		ND	<MDL,G	0.35	ND	<MDL,G	0.34
1,4-Dichlorobenzene	0.782	G		ND	<MDL,G	0.16	ND	<MDL,G	0.18	1.43	G		1.32	G		ND	<MDL,G	0.17
1,2,4-Trichlorobenzene	ND	<MDL,G	0.35	ND	<MDL,G	0.32	ND	<MDL,G	0.35	ND	<MDL,G	0.33	ND	<MDL,G	0.35	ND	<MDL,G	0.34
Hexachlorobenzene	ND	<MDL	0.88	ND	<MDL	0.82	ND	<MDL	0.89	ND	<MDL	0.84	ND	<MDL	0.88	ND	<MDL	0.86
Dimethyl Phthalate	ND	<MDL	15	ND	<MDL	14	ND	<MDL	15	ND	<MDL	14	ND	<MDL	15	ND	<MDL	14
Diethyl Phthalate	ND	<MDL	8	ND	<MDL	7.4	ND	<MDL	8.1	ND	<MDL	7.6	ND	<MDL	8	ND	<MDL	7.8
Di-N-Butyl Phthalate	15	<RDL,B	18	16.8	B		13	<RDL,B	18	13	<RDL,B	17	16	<RDL,B	18	16	<RDL,B	17
Benzyl Butyl Phthalate	ND	<MDL	17	ND	<MDL	16	19	<RDL	36	ND	<MDL	17	21	<RDL	36	18	<RDL	35
Bis(2-Ethylhexyl)Phthalate	37.7	B		28	<RDL,B	33	49.5	B		25	<RDL,B	34	51.4	B		365	B	
Di-N-Octyl Phthalate	ND	<MDL	36	ND	<MDL	33	ND	<MDL	36	ND	<MDL	34	ND	<MDL	36	ND	<MDL	35
Dibenzofuran	ND	<MDL	19	57.8			ND	<MDL	19	ND	<MDL	18	ND	<MDL	19	ND	<MDL	18
Hexachlorobutadiene	ND	<MDL,G	1	ND	<MDL,G	0.93	ND	<MDL,G	1	ND	<MDL,G	0.96	ND	<MDL,G	1	ND	<MDL,G	0.98
N-Nitrosodiphenylamine	ND	<MDL	27	ND	<MDL	25	ND	<MDL	27	ND	<MDL	25	ND	<MDL	27	ND	<MDL	26
Phenol	ND	<MDL	12	ND	<MDL	11	ND	<MDL	12	ND	<MDL	11	ND	<MDL	12	ND	<MDL	12
2-Methylphenol	ND	<MDL	25	ND	<MDL	24	ND	<MDL	26	ND	<MDL	24	ND	<MDL	25	ND	<MDL	25
4-Methylphenol	ND	<MDL	21	ND	<MDL	20	ND	<MDL	22	ND	<MDL	20	ND	<MDL	21	ND	<MDL	21
2,4-Dimethylphenol	ND	<MDL	9.3	ND	<MDL	8.7	ND	<MDL	9.4	ND	<MDL	8.9	ND	<MDL	9.4	ND	<MDL	9.1
Pentachlorophenol	ND	<MDL	17	ND	<MDL	16	ND	<MDL	18	ND	<MDL	17	ND	<MDL	17	ND	<MDL	17
Benzyl Alcohol	ND	<MDL,X	8	ND	<MDL,X	7.4	ND	<MDL,X	8.1	ND	<MDL,X	7.6	ND	<MDL,X	8	ND	<MDL,X	7.8
Benzoic Acid	81	G		69.6	G		85.7	G		90.1	G		88.5	G		79.1	G	
Total PCBs	24.9			14.2			37.9			38.7			38.6			31.9		

ND = not detected
MDL = method detection limit
RDL = reporting detection limit
Qual = Qualifier
Summing rules: PAHs and PCBs were sums of detected components only and the maximum MDL was selected when there were no detections.

Table 3-1 (continued)

Station Locator	P53C1			P53C2			P53C3			P53C4			P53C4 (rep)			P53C5		
Date Sampled	24-Sep-02			24-Sep-02			24-Sep-02			24-Sep-02			24-Sep-02			24-Sep-02		
Sample Number	L25512-1			L25512-2			L25512-3			L25512-4			L25512-6			L25512-5		
% Solids	75.1			80.8			74.1			78.5			74.7			76.9		
% TOC	0.696			0.36			0.556			0.699			0.651			0.381		
BNA Organics (µg/kg dry weight)	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL
LPAHs																		
Napthalene	ND	<MDL,G	19	58.3	G		ND	<MDL,G	19	ND	<MDL,G	18	ND	<MDL,G	19	ND	<MDL,G	18
Acenaphthylene	ND	<MDL	20	ND	<MDL	19	ND	<MDL	20	ND	<MDL	19	ND	<MDL	20	ND	<MDL	20
Acenaphthene	ND	<MDL	9.3	46.9			ND	<MDL	9.4	ND	<MDL	8.9	ND	<MDL	9.4	ND	<MDL	9.1
Fluorene	ND	<MDL	17	93.6			ND	<MDL	18	ND	<MDL	17	ND	<MDL	17	ND	<MDL	17
Phenanthrene	12.7			166			50.6			5.9			25.7			13.4		
Anthracene	ND	<MDL,G	5.3	24.4	G		10.7	<RDL,G	10.8	ND	<MDL,G	5.1	13.7	G		8.1	<RDL,G	10
Total LPAH	12.7			389			61.3			5.9			39.3			21.5		
HPAHs																		
Fluoranthene	21.7			131			72.2			14			56.1			26.8		
Pyrene	9.7	<RDL	10.6	26			57.6			17.7			82.1			34.2		
Benzo(a)anthracene	9.5			37.5			32.8			5.1	<RDL		30.7			18.9		
Chrysene	8.8	<RDL	10.6	18.8			34.3			6.1			45.4			30.7		
Benzo(b)fluoranthene	10.2			23.6			39.1			7.4			50.9			29.8		
Benzo(k)fluoranthene	8.4			16.2			30.9			7.3			34.7			19.4		
Total Benzofluoranthenes	18.6			39.8			70			14.7			85.6			49.2		
Benzo(a)pyrene	8.0			6.6			29.1			6.5			48.9			29.6		
Indeno(1,2,3-Cd)Pyrene	ND	<MDL	12	ND	<MDL	11	16	<RDL	24	ND	<MDL	11	26			16	<RDL	23
Dibenzo(a,h)anthracene	ND	<MDL	9.3	ND	<MDL	8.7	ND	<MDL	9.4	ND	<MDL	8.9	10	<RDL	19	ND	<MDL	9.1
Benzo(g,h,i)perylene	ND	<MDL	11	ND	<MDL	9.9	ND	<MDL	11	ND	<MDL	10	27			14	<RDL	21
Total HPAH	76.3			260			312			64.1			411			219		

ND = not detected
MDL = method detection limit, reported for <MDL qualifiers
RDL = reporting detection limit, reported for <RDL qualifiers
Qual = Qualifier

undetected result which was below the MDL of 0.024 mg/kg dw. Similarly, individual PAH concentrations were up to 8 times higher in one sample than another. Differences this large were not seen for other detected contaminants. This suggests that mercury and perhaps other contaminants in the cap are heterogeneous.

Table 3-2. Post-cap core sediment concentrations (dry weight) for the first six inch interval above the interface

	Cap			ENR	
Chemical	**C1**	**C2**	**C3**	**C4**	**C5**
Copper (mg/kg)					
1992 1	2	9.7	12	65	9.4
1993 1	8	16 16		15 17	
1996 1	1	NS	NS	11	11
2002 1	4	13	14	13 14	
Lead (mg/kg)					
1992 5	.3	3.8	3.9	100	3.7
1993 <5	.1	<4.9 <3.8		<3.8 <5.1	
1996 <4	.6	NS	NS	<4.4	<4.4
2002 <9	.2	<6.2	<6.1	<7.1 <5.3	
BEHP (µg/kg)					
1992 7	1	<21	47	<33	<27
1993 [a] <13		<12 <13		<13 <13	
1996 3	5	NS	NS	<17	<20
2002 [a] 38		<28	50	17 36	5
HPAH (µg/kg)					
1992 3	62	<63	236	1090	<82
1993 8	8	18 2	19	132	85
1996 5	3	NS	NS	<46	<53
2002 7	6	260	312	238 2	19
LPAH (µg/kg)					
1992 4	2	<63	41	280	<82
1993 <3	8	<37 39		26	13
1996 <5	5	NS	NS	<46	<53
2002 1	3	389	61	23 21	
PCBs (µg/kg)					
1992	<44	<42 <4	4	<65 <5	5
1993 <1	0	<10 <10		<10 <10	
1996 <1	7	NS	NS	<14	<16
2002 2	5	14	38	39 32	

Shaded values are an average with one field duplicate
[a] All results for this year were qualified for blank contamination (B)
NS Not sampled

In 2002, PCBs were detected for the first time in the first 6-inch interval core samples. Total PCB values this year ranged from 14 to 39 µg/kg dw (Table 3-2). There are several possible explanations of why PCBs were detected in these samples in 2002 and not previous years. One explanation is that PCBs were present in 1996 or earlier, but could not be detected due to

detection limit restrictions. MDLs for individual Aroclors were lower in 2002 than previous years: 1.6-3.4 µg/kg dw compared to 13.9 or 16.7 µg/kg dw in 1996. Detected individual Aroclor results in 2002 ranged from 5.1 to 17.0 µg/kg dw, falling below and just above the 1996 detection limits. Also, these 2002 concentrations are within the range of total PCBs measured in turning basin cores (0-4 feet interval) in 1991 which were nondetect at MDLs of 32 to 47 µg/kg dw (US ACOE 2007). Other factors contribute variability to analytical results including, but not limited to, the imprecise science of Aroclor peak quantification, instrument error, extraction splits for other parameters and spatial heterogeneity between samples. The combination of lowered detection limits and these other typical sources of variability may account for the appearance of detections in 2002 samples.

The processes of advection and diffusion through the cap from underlying sediment are other possible explanations for the appearance of detected PCBs. PCBs were never detected in the first 6-inch core interval since the cap was placed. There were only two years where the second 6-inch core interval above the interface was analyzed – 1992 and 1993. No Aroclors were detected in these samples either year. Thus, there is no evidence prior to 2002 that advection or diffusion was bringing PCBs up through the cap. However, it is feasible that advection or diffusion was beginning to bring measurable quantities of PCBs into the first 6 inches of the cap, perhaps even earlier, in 1996. If the second 6-inch intervals had been brought out of archive and analyzed, more information demonstrating whether this process was occurring in Year 10, might have been available. Unfortunately, delays in project work resulted in data analysis occurring after the holding time for PCB analysis in sediment was exceeded.

One other factor that must be considered is the possibility of extrinsic disturbance. At an active waterfront such as this site, large boat propellers, anchors, barge lines, and trawlers are potentially significant physical disruptions to a cap. The most probable of these disturbances is large boat propellers and the WDFW trawler, none of which could feasibly reach depths of two to three feet into the cap within water 40 to 60 feet deep. Thus, extrinsic disturbances would not logically explain the Aroclor detections observed in 2002 core samples.

During cap placement, mixing at the cap/sediment interface occurs, at least within the first couple centimeters (Reible et al. 2006). The interface is not an impermeable boundary. Thus, there may have been slightly higher PCB concentrations just above the interface at cap placement and thereafter. In addition, over time some diffusion of pore water and/or advection of particles may have occurred moving PCBs from the contaminated sediment slowly through the cap. These processes combined with the decrease in analytical detection limits are likely and plausible explanations for the observed results in the first 6-inch core interval above the interface. The mixing of sediments across the cap/sediment interface is a process that could have impacted the measured concentrations of many other chemicals as well.

SECTION 4: SURFACE SEDIMENT CHEMISTRY

In September 2002, the monitoring team collected surface sediment samples from the 3-foot cap and the ENR area. The samples were analyzed for trace metal, organic, and conventional parameters. This section describes the surface sampling methods, reports the results of the surface sample analysis, and compares the results to the Washington State sediment management standards (SMS) (Ecology 1991). Lastly, changes in chemical values in surface sediment over the ten years of monitoring are discussed.

Methods

Within the remediation area, the monitoring plan defines seven surface sampling stations (VG1 through VG7). These stations provide spatial coverage across the cap and ENR (Figure 4-1). VG3, VG4, and VG6 were placed along the centerline of the long axis of the rectangular-shaped ENR. VG5 was placed in the southeast corner of the remediation area on the shallower inshore end of the 3-foot cap. VG1, VG2, and VG7 provide sampling coverage of the 3-foot cap in deeper water.

During the ten year monitoring program, surface sediment chemistry samples were collected a total of five times from the seven stations in the remediation area. Samples were collected in 1992, pre and post cap placement, in 1993, 1996 and 2002.

Sample Collection

In 2002, samples from the 0 to 2 cm depth (2-cm) were collected at all seven surface stations on the cap and ENR as in previous years of the study to look for the most recent changes in surface conditions. Also, for the first time, 0 to 10 cm depth samples (10-cm) were collected at all seven stations to provide the official 10-cm depth for comparison to Washington State SMS, specifically the sediment quality standard (SQS) and the cleanup screening level (CSL). A replicate 10-cm deep sample was taken at VG7. In 1996, 0-2 and 2-10 cm samples were collected and a proportional average was calculated to represent the 0-10 cm sample. In 1992 and 1993, only 0-2 cm samples were collected and compared to SMS.

The surface sediment samples for chemistry analysis were collected with a 0.1-m^2 double Van Veen grab sampler operated from King County's research vessel RV Liberty. Station position was determined with a differential global positioning system (DGPS). Three individual grab samples were taken at each station. From one grab sampler, 2-cm deep subsamples were removed using a stainless steel “cookie cutter” sampler and stainless steel spatula. Ten-centimeter subsamples were removed from the second grab sampler. Three subsamples were composited for each depth in a stainless steel bowl and subsequently homogenized before filling clean sample containers provided by the lab.

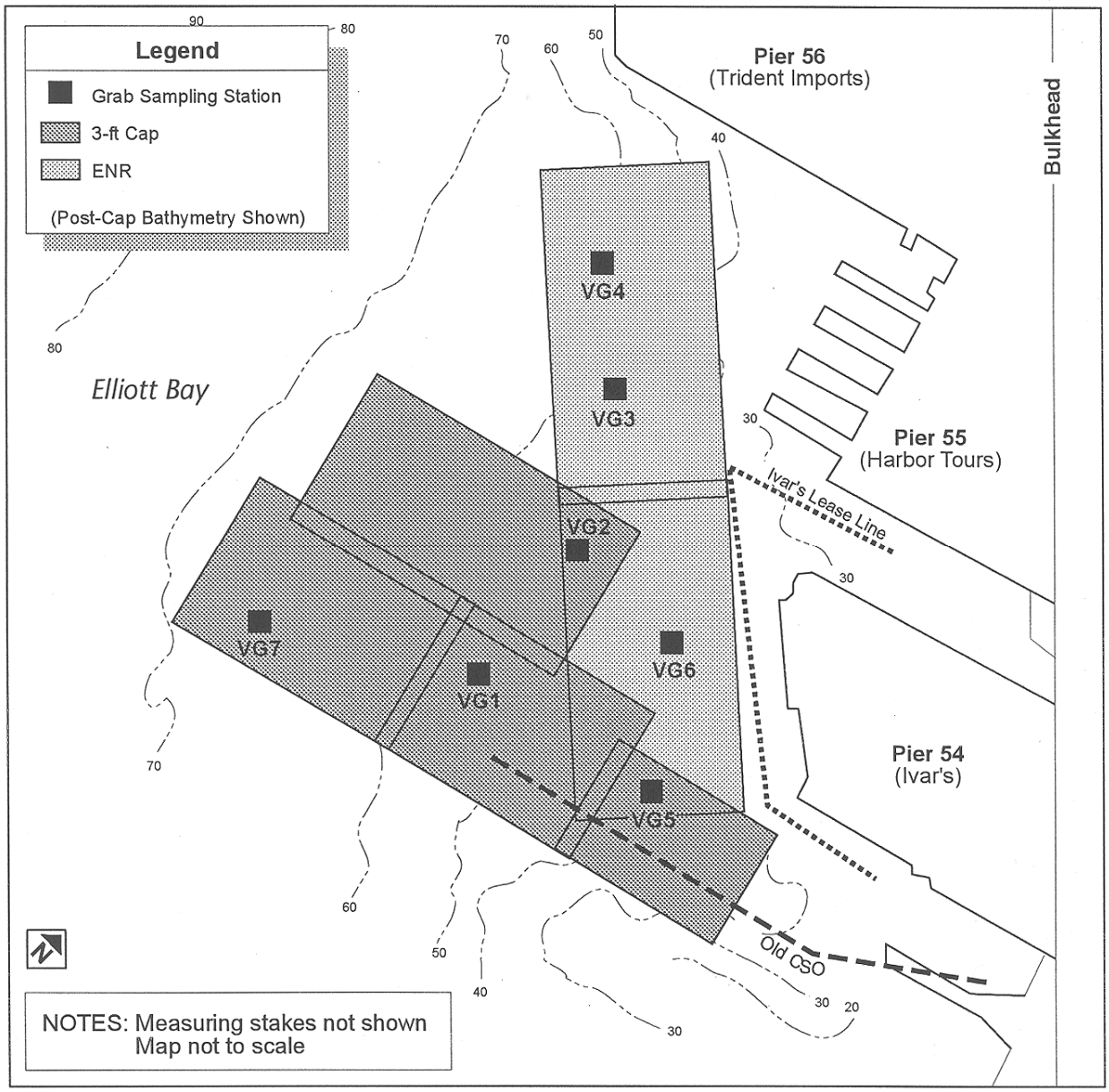


Figure 4-1. Surface Sampling Stations

Sample Analysis

The King County Environmental Laboratory analyzed the samples for trace metals, BNA compounds, chlorinated pesticides, PCBs, volatile organic compounds, percent solids, and TOC. AmTest, Inc. analyzed the samples for particle size distribution. All analyses were performed following guidance recommended in the Puget Sound Protocols (PSEP 1986, 1997a and 1997b) including associated QA/QC practices. All QA procedures are provided in Appendix B.

Results and Discussion

A summary of the dry weight values for detected SMS chemicals are listed in Table 4-1 for both 2-cm and 10-cm deep samples. Tables 4-2 and 4-3 provide the values for 10-cm and 2-cm deep samples respectively, and compares these values to SMS. Figures 4-2 to 4-8 show the changes in chemical values observed for LPAH, HPAH, copper, lead, BEHP, and PCB at each station during the four sampling events over the 10-year time period. All total compounds were calculated by summing across detected constituents only, using the MDL value for nondetects.

A complete listing of all 2002 surface sediment dry weight chemistry data are contained in Appendix C. All chemistry data underwent a QA review at the King County Environmental Laboratory. A QA1 review package can be found in Appendix B.

Dry Weight Values for Detected SMS Chemicals

The dry weight values in Table 4-1 show that PAH detections in 2002 were frequent at all seven stations. The highest concentrations continue to be at VG5 where the greatest recontamination by piling removal was first measured in 1993. In 2002, all six LPAH compounds on the SMS list were detected and nine of the ten HPAH compounds were detected (not benzo[g,h,i]perylene) at VG5. The least number of detected PAHs and lowest concentrations continued to be at VG7, which is the farthest offshore station and showed the least amount of impact when recontamination was first measured in 1993.

In 2002, six of 14 other BNA compounds were detected and included 1, 4-dichlorobenzene, dibenzofuran, PCBs and the three phthalate compounds: di-n-butyl phthalate (DNBP), bis(2-ethylhexyl)phthalate (BEHP) and benzyl butyl phthalate (BBP). All DNBP and BEHP values were qualified with B for blank contamination making their concentrations potentially overestimated. Both VG4 and VG5 stations had notably higher BEHP values than other stations and are located on opposite ends of the cap and ENR. The BBP values reported for all seven stations were qualified as below the reporting detection limit (<RDL), as were most of the DNBP values except at VG4, VG5, and VG6. PCBs were detected at all seven stations as was benzoic acid. None of the phenol compounds detected in 1996 were detected in 2002.

The apparent increases in PCBs and BEHP in 1996 and 2002 may signal recontamination from sources off the cap. There are data showing that off-cap sediments have relatively high concentrations of PCBs. In 1992, two stations south of the cap (VG8 and VG9) and four stations under Piers 54-56, east of the cap, were composite-sampled for sediment chemistry (EB/DRP 1993). The 0-2 cm layer was sampled at all stations and the 0-10 cm layer was also sampled at two under-pier stations and one station south of the cap. Aroclor 1260 was detected at one station (VG8) south of the cap at 270 µg/kg dw in 0-10 cm, and the other results in this area were nondetect. Under the piers, total PCB concentrations ranged from 280 to 3,850 µg/kg dw in 0-2 cm samples and 660 to 1,530 µg/kg dw in 0-10 cm samples. The highest total PCB concentrations at both depth intervals were under Pier 54 at UP-2. These sediments may be resuspended periodically from a variety of physical forces and redeposited over the cap. BEHP results were all B-qualified and MDLs were 90-200 µg/kg dw, not as high as concentrations found in 2002 cap station samples (350-600 µg/kg dw). BEHP is a more modern contaminant than PCBs, which were phased out of production starting in 1977. Given the local presence of

PCBs in the area at the time of capping, it seems likely that sediment resuspension and drift onto the cap could recontaminate cap sediments. Over the 10 year monitoring period, BEHP was widely used in PVC and other plastic products (Ecology 2008). At the same time, hazards of phthalate exposure were being discovered and detection limits were being refined. These facts point to BEHP recontamination of the cap from active external sources (e.g., wastewater, stormwater, atmospheric deposition, etc.).

Chromium, copper, lead, and zinc were detected at all stations at low, but unqualified values. The remaining four detected metals, arsenic, cadmium, mercury and silver, have very low values qualified as <MDL or <RDL. VG2 and VG5 were the only stations where cadmium was detected, but all values were qualified with <RDL. Silver was detected at <RDL at VG5 (2-cm and 10-cm) and VG6 and VG7 (2-cm). Both arsenic and mercury were <RDL at all stations (2-cm and 10-cm) except at VG3 where arsenic was <MDL in the 10-cm sample.

Table 4-1. 2002 Surface sediment stations: Detected SMS chemicals (Dry Weight)

Station Locator	P53VG1			P53VG1			P53VG2			P53VG2			P53VG3			P53VG3			P53VG4			P53VG4		
Date Sampled	Sep 09, 2002			Sep 09, 2002			Sep 09, 2002			Sep 09, 2002			Sep 09, 2002			Sep 09, 2002			Sep 09, 2002			Sep 09, 2002		
Range - cm	2			10			2			10			2			10			2			10		
Sample Number	L25702-1			L25702-2			L25702-3			L25702-4			L25702-5			L25702-6			L25702-7			L25702-8		
% Solids:	68.4			70.7			62.8			68.9			71.4			73.1			69.5			70		
% TOC dry	0.728			0.702			2.5			2.05			1.04			0.859			1.03			0.89		
Metals (mg/kg dry weight)	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL
Arsenic, Total, ICP	4.7	<RDL	17	5	<RDL	18	6.7	<RDL	19	7.1	<RDL	18	4.9	<RDL	17		<MDL	3.3	8.3	<RDL	17	5.9	<RDL	19
Cadmium, Total, ICP		<MDL	0.2		<MDL	0.21		<MDL	0.22	0.26	<RDL	1.1		<MDL	0.21		<MDL	0.21		<MDL	0.2		<MDL	0.23
Chromium, Total, ICP	15.2		0.35	13.4		0.37	18.3		0.38	16.8		0.36	15.5		0.34	14.1		0.33	16.1		0.35	18.9		0.37
Copper, Total, ICP	21.8		0.28	20.4		0.29	33.1		0.30	25.7		0.29	24.2		0.28	23.8		0.26	30.8		0.27	27.3		0.3
Lead, Total, ICP	15.8		2.0	12.5		2.1	24.4		2.2	16.7		2.2	18.2		2.1	15.5		2.0	21.2		2.0	19.9		2.3
Mercury, Total, CVAA	0.089	<RDL	0.29	0.086	<RDL	0.28	0.25	<RDL	0.31	0.11	<RDL	0.28	0.15	<RDL	0.28	0.093	<RDL	0.27	0.13	<RDL	0.28	0.14	<RDL	0.28
Silver, Total, ICP		<MDL	0.28		<MDL	0.3		<MDL	0.29		<MDL	0.28		<MDL	0.28		<MDL	0.26		<MDL	0.27		<MDL	0.3
Zinc, Total, ICP	58.3		0.35	54			70.2		0.38	58.9		0.36	59.2		0.34	56.2		0.33	67.6		0.34	65.3		0.37
BNA Organics (µg/kg dry weight)																								
LPAHs																								
Naphthalene		<MDL,G	20		<MDL,G	20		<MDL,G	22		<MDL,G	20		<MDL,G	20		<MDL,G	19		<MDL,G	20		<MDL,G	20
Acenaphthylene		<MDL	22		<MDL	21		<MDL	22		<MDL	22		<MDL	21		<MDL	21	33	<RDL	43	31	<RDL	43
Acenaphthene	16	<RDL	20		<MDL	9.9	23.9		24	17	<RDL	10	21.6		9.8	11	<RDL	19	46.2		10	27.3		10
Fluorene	25	<RDL	38		<MDL	18	50.6		6.4	29	<RDL	19	59		18	48.8		18	69.9		19	45.6		19
Phenanthrene	140		5.8	89.5		5.7	264		6.4	165		5.8	266		5.6	181		5.5	412		5.8	436		5.7
Anthracene	93.9	G	5.8	107	G	5.7	234	G	6.4	113	G	5.8	276	G	5.6	356	G	5.5	311	G	5.8	229	G	5.7
2-Methylnaphthalene		<MDL	20		<MDL	20		<MDL	22		<MDL	20		<MDL	20		<MDL	19		<MDL	20		<MDL	20
Total LPAH	275			196			572.9			325.4			622.5			596.3			871.5			768.6		
HPAHs																								
Fluoranthene	365		11.7	199		11.3	591		13	415		12	529		11	356		11	862		11	740		11
Pyrene	338		5.8	214		5.7	578		6.4	392		5.8	450		5.6	213		5.5	337		5.8	231		5.7
Benzo(a)anthracene	234		2.9	134		2.8	468		3.2	274		2.9	317		2.8	233		2.7	471		2.9	337		2.9
Chrysene	379		5.8	228		5.7	779		6.4	480		5.8	590		5.6	439		5.5	751		5.8	601		5.7
Benzo(b)fluoranthene	287		4.4	202		4.2	572		4.8	382		4.3	401		4.2	249		4.1	435		4.3	333		4.3
Benzo(k)fluoranthene	266		4.4	173		4.2	583		4.8	395		4.3	394		4.2	309		4.1	499		4.3	391		4.3
Benzo(a)pyrene	288		4.4	208		4.2	608		4.8	422		4.3	324		4.2	112		4.1	129		4.3	90		4.3
Indeno(1,2,3-Cd)Pyrene	136		13.2	97.3		12.7	295		14	184		13	183		13	76.9		12	87.3		13	65.1		13
Dibenzo(a,h)anthracene	53.8		10.2	40.5		9.9	107		11	74.3		10	76.1		9.8	60.3		9.6	105.0		10	85.1		10
Benzo(g,h,i)perylene	132		11.7	91.7		11.3	285		13	181		12	26.3		11		<MDL	11		<MDL	12		<MDL	11.0
Total HPAH	2479			1586			4865			3201			3289			2048			3676			2874		
Other BNA																								
1,2-Dichlorobenzene		<MDL,G	0.38		<MDL,G	0.37		<MDL,G	0.41		<MDL,G	0.38		<MDL,G	0.36		<MDL,G	0.36		<MDL,G	0.37		<MDL,G	0.37
1,4-Dichlorobenzene	1.29	G	0.19	0.641	G	0.18	2.21	G	0.21	1.51	G	0.19	1.23	G	0.18	1.31	G	0.18	1.77	G	0.19	1.67	G	0.19
1,2,4-Trichlorobenzene		<MDL,G	0.38		<MDL,G	0.37		<MDL,G	0.41		<MDL,G	0.38		<MDL,G	0.36		<MDL,G	0.36		<MDL,G	0.37		<MDL,G	0.37
Hexachlorobenzene		<MDL	0.96		<MDL	0.93		<MDL	1.1		<MDL	0.96		<MDL	0.92		<MDL	0.9		<MDL	0.95		<MDL	0.94
Dimethyl Phthalate		<MDL	16		<MDL	16		<MDL	18		<MDL	16		<MDL	15		<MDL	15		<MDL	16		<MDL	16
Diethyl Phthalate		<MDL	8.8		<MDL	8.5		<MDL	9.6		<MDL	8.7		<MDL	8.4		<MDL	8.2		<MDL	8.6		<MDL	8.6
Di-N-Butyl Phthalate	18	<RDL,B	19	16	<RDL,B	19	19	<RDL,B	21	17	<RDL,B	9.7	20.4	B	9.4	16	<RDL,B	18	21.9	B	9.6	20.1	B	9.6
Benzyl Butyl Phthalate	25	<RDL	39	23	<RDL	38	29	<RDL	43	26	<RDL	19	24	<RDL	37	22	<RDL	37	27	<RDL	38	27	<RDL	38
Bis(2-Ethylhexyl)Phthalate	121	B	19	187	B	18.4	229	B	21	179	B	19	211	B	18	208	B	18	420	B	19	469	B	19
Di-N-Octyl Phthalate		<MDL	39		<MDL	38		<MDL	43		<MDL	39		<MDL	38		<MDL	37		<MDL	39		<MDL	39
Dibenzofuran		<MDL	20		<MDL	20		<MDL	22		<MDL	20	28	<RDL	39		<MDL	19	37	<RDL	40	31	<RDL	40
Hexachlorobutadiene		<MDL,G	1.1		<MDL,G	1.1		<MDL,G	1.2		<MDL,G	1.1		<MDL,G	1.1		<MDL,G	1		<MDL,G	1.1		<MDL,G	1.1
N-Nitrosodiphenylamine		<MDL	29		<MDL	28		<MDL	32		<MDL	29		<MDL	28		<MDL	27		<MDL	29		<MDL	29
Phenol		<MDL	13		<MDL	13		<MDL	14		<MDL	13		<MDL,G	13		<MDL,G	12		<MDL	13		<MDL,G	13
2-Methylphenol		<MDL	28		<MDL	27		<MDL	30		<MDL	28		<MDL,G	27		<MDL,G	26		<MDL	27		<MDL,G	27
4-Methylphenol		<MDL	23		<MDL	23		<MDL	25		<MDL	23		<MDL,G	22		<MDL,G	22		<MDL	23		<MDL,G	23
2,4-Dimethylphenol		<MDL	10		<MDL	9.9		<MDL	11		<MDL	10		<MDL,G	9.8		<MDL,G	9.6		<MDL	10		<MDL,G	10
Pentachlorophenol		<MDL	19		<MDL	18		<MDL	21		<MDL	19		<MDL,G	18		<MDL,G	18		<MDL	19		<MDL,G	19
Benzyl Alcohol		<MDL,X	8.8		<MDL,X	8.5		<MDL,X	9.6		<MDL,X	8.7		<MDL,X	8.4		<MDL,X	8.2		<MDL,X	8.6		<MDL,X	8.6
Benzoic Acid	123	G	39.5	109	G	38.2	128	G	43	104	G	39	225	G	38	126	G	37	153	G	39	119	G	39
Total PCBs	51.5			47.3			92.0			99.3			65.5			43.2			27.1			11.4		

<MDL - Undetected at the method detection limit
<RDL - Detected below reporting detection limits
E- estimate
G - Low standard reference material recovery
B - Blank contamination
X - Matrix spike or surrogate recovery < 10%

Table 4-1. (Continued)

Station Locator	P53VG5			P53VG5			P53VG6			P53VG6			P53VG7			P53VG7			P53VG7		
Date Sampled	Sep 09, 2002			Sep 09, 2002			Sep 09, 2002			Sep 09, 2002			Sep 09, 2002			Sep 09, 2002			Sep 09, 2002		
Range - cm	2			10			2			10			2			10			10		
Sample Number	L25702-9			L25702-10			L25702-11			L25702-12			L25702-13			L25702-14			L25702-15		
% Solids:	54.6			57.4			68.2			62.7			75			74.3			73.1		
% TOC dry	2.18			1.81			1.05			1.75			0.4			0.306			0.286		
Metals (mg/kg dry weight)	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL	Value	Qual	MDL/RDL
Arsenic, Total, ICP	10	<RDL	23	7.7	<RDL	22	7.3	<RDL	18	6.7	<RDL	19	8.3	<RDL	17	7.1	<RDL	17	5.9	<RDL	17
Cadmium, Total, ICP	0.31	<RDL	1.4	0.42	<RDL	1.3		<MDL	0.22		<MDL	0.24		<MDL	0.2		<MDL	0.2		<MDL	0.21
Chromium, Total, ICP	23.4		0.46	30.1		0.44	18.6		0.37	18.8		0.38	12.4		0.33	14.3		0.34	12		0.34
Copper, Total, ICP	48.4		0.37	52.1		0.35	31.8		0.29	34.1		0.30	14.3		0.27	15.7		0.27	16.3		0.27
Lead, Total, ICP	46.2		2.7	74.4		2.6	23.9		2.2	24.2		2.4	10.8		2	9.4	<RDL	10	8.3	<RDL	10
Mercury, Total, CVAA	0.31	<RDL	0.36	0.33	<RDL	0.35	0.14	<RDL	0.29	0.15	<RDL	0.32	0.04	<RDL	0.26	0.05	<RDL	0.26	0.033	<RDL	0.26
Silver, Total, ICP	0.57	<RDL	1.8	0.82	<RDL	1.7	0.34	<RDL	1.5		<MDL	0.3		<MDL	0.27		<MDL	0.27		<MDL	0.27
Zinc, Total, ICP	85.9		0.46	110		0.44	66.9		0.37	69.2		0.38	45.7		0.33	49.5		0.34	48.7		0.34
BNA Organics (µg/kg dry weight)																					
LPAHs																					
Naphthalene	64.7	G	26	69.2	G	24		<MDL,G	21		<MDL,G	22		<MDL,G	19		<MDL,G	19		<MDL,G	19
Acenaphthylene	121		27	127		26	40	<RDL	44	70.7		24		<MDL	20		<MDL	20		<MDL	21
Acenaphthene	72.2		13	85.5		24	22.4		10	29.2		11		<MDL	9.3		<MDL	9.4		<MDL	9.6
Fluorene	167		24	132		23	41.6		19	62.2		21		<MDL	17		<MDL	17		<MDL	18
Phenanthrene	632		7.3	441		7.0	204		5.9	274		6.4	55.7		5.3	30.4		5.4	36.8		5.5
Anthracene	632	G	7.3	545	G	7.0	217	G	5.9	344	G	6.4	85.3	G	5.3	36.1	G	5.4	41.7	G	5.5
2-Methylnaphthalene		<MDL	26		<MDL	24		<MDL	21		<MDL	22		<MDL	19		<MDL	19		<MDL	19
Total LPAH	168.9			1400			524.5			780.9			141.1			66.5			78.5		
HPAHs																					
Fluoranthene	1180		15	990		14	446		12	620.0		13	95.2		11	89.4		11	120.0		11
Pyrene	436		7.3	551		7.0	204		5.9	219.0		6.4	50.1		5.3	53.4		5.9	150.0		5.5
Benzo(a)anthracene	973		3.7	763		3.5	333		2.9	510.0		3.2	201.0		2.7	42.4		2.7	75.4		2.7
Chrysene	1320		7.3	1070		7.0	545		5.9	721.0		6.4	187.0		5.3	80.3		5.4	119.0		5.5
Benzo(b)fluoranthene	762		5.5	786		5.2	343		4.4	475.0		4.8	203.0		4.0	72.8		4.0	97.7		4.1
Benzo(k)fluoranthene	817		5.5	916		5.2	371		4.4	512.0		4.8	187.0		4.0	97.2		4.0	120.0		4.1
Benzo(a)pyrene	182		5.5	185		5.2	94.7		4.4	123.0		4.8	41.2		4.0	21.7		4.0	45.1		4.1
Indeno(1,2,3-Cd)Pyrene	126		16	112		16	64.7		13	71.8		14		<MDL	12.0	15.0	<RDL	24.0	36.9		12
Dibenzo(a,h)anthracene	183		13	174		12	87.4		10	114.0		11		<MDL	9.3	19.4		9.4	43.5		9.6
Benzo(g,h,i)perylene		<MDL	15		<MDL	14		<MDL	12		<MDL	13		<MDL	11		<MDL	11		<MDL	11
Total HPAH	5985			5543			2489			3366			964			491.6			807.9		
Other BNA																					
1,2-Dichlorobenzene		<MDL,G	0.48		<MDL,G	0.45		<MDL,G	0.38		<MDL,G	0.41		<MDL,G	0.35		<MDL,G	0.35		<MDL,G	0.36
1,4-Dichlorobenzene	2.05	G	0.24	2.18	G	0.23	1.29	G	0.19	1.61	G	0.21		<MDL,G	0.17		<MDL,G	0.17	0.657	G	0.18
1,2,4-Trichlorobenzene		<MDL,G	0.48		<MDL,G	0.45		<MDL,G	0.38		<MDL,G	0.41		<MDL,G	0.35		<MDL,G	0.35		<MDL,G	0.36
Hexachlorobenzene		<MDL	1.2		<MDL	1.1		<MDL	0.97		<MDL	1.1		<MDL	0.88		<MDL	0.89		<MDL	0.9
Dimethyl Phthalate		<MDL	20		<MDL	19		<MDL	16		<MDL	18		<MDL	15		<MDL	15		<MDL	15
Diethyl Phthalate		<MDL	11		<MDL	10		<MDL	8.8		<MDL	9.6		<MDL	8		<MDL	8.1		<MDL	8.2
Di-N-Butyl Phthalate	28	B	12	32.2	B	12	21.3	B	9.8	23.8	B	11	15	<RDL,B	18	15	<RDL,B	18	15	<RDL,B	18
Benzyl Butyl Phthalate	40	<RDL	49	37	<RDL	46	31	<RDL	39	37	<RDL	43	20	<RDL	36		<MDL	17	19	<RDL	37
Bis(2-Ethylhexyl)Phthalate	348	B	24	427	B	23	183	B	19	169	B	21	36.5	B	17	44.1	B	17	85.5	B	18
Di-N-Octyl Phthalate		<MDL	49		<MDL	47		<MDL	40		<MDL	43		<MDL	36		<MDL	36		<MDL	37
Dibenzofuran	80.6		26	78.2		24		<MDL	21	24	<RDL	45		<MDL	19		<MDL	19		<MDL	19
Hexachlorobutadiene		<MDL,G	1.4		<MDL,G	1.3		<MDL,G	1.1		<MDL,G	1.2		<MDL,G	1		<MDL,G	1		<MDL,G	1
N-Nitrosodiphenylamine		<MDL	37		<MDL	35		<MDL	29		<MDL	32		<MDL	27		<MDL	27		<MDL	27
Phenol		<MDL,G	16		<MDL	16		<MDL,G	29		<MDL,G	14		<MDL	12		<MDL,G	12		<MDL,G	12
2-Methylphenol		<MDL,G	35		<MDL	33		<MDL,G	28		<MDL,G	30		<MDL	25		<MDL,G	26		<MDL,G	26
4-Methylphenol		<MDL,G	29		<MDL	28		<MDL,G	23		<MDL,G	26		<MDL	21		<MDL,G	22		<MDL,G	22
2,4-Dimethylphenol		<MDL,G	13		<MDL	12		<MDL,G	10		<MDL,G	11		<MDL	9.3		<MDL,G	9.4		<MDL,G	9.6
Pentachlorophenol		<MDL,G	24		<MDL	23		<MDL,G	19		<MDL,G	21		<MDL	17		<MDL,G	17		<MDL,G	18
Benzyl Alcohol		<MDL,X	11		<MDL,X	10		<MDL,X	8.8		<MDL,X	9.6		<MDL,X	8		<MDL,X	8.1		<MDL,X	8.2
Benzoic Acid	175	G	49	140	G	47	116	G	40	159	G	43	191	G	36	111	G	36	150	G	37
Total PCBs	25.5				<MDL	4.35	19.67			5.58			5.01				<MDL	3.4	25.6		

<MDL - Undetected at the method detection limit
<RDL - Detected below reporting detection limits
B - Blank contamination
G - Low standard reference material recovery
E- estimate
X - Matrix spike or surrogate recovery < 10%

Comparison to SMS Values - 2002

The official comparison of 10-cm samples to SMS is provided in Table 4-2. A comparison of 2-cm samples to SMS is also provided in Table 4-3. Values were compared to SQS and CSL when TOC was greater than 0.5% or less than 3.0%. When TOC was outside this range, all results were compared to apparent effect threshold (AET) values in dry weight (Ecology 1996). Michelson (1992) recommends comparison to dry-weight normalized AET values when TOC is outside the range of 0.5 – 3.0%. The only exceedance of SMS is for BEHP at VG4 in the 0-10 cm sample.

BEHP just exceeded the SQS (47 mg/kg OC) at VG4 with a value of 53 mg/kg OC. The 2002 2-cm BEHP concentration was lower at 41 mg/kg OC (Table 4-3). A portion of the detected concentrations is due to sample contamination as indicated by the "B" qualifiers. However, BEHP detections in 10-cm and 2-cm samples at VG4 in 1996 were 36 mg/kg OC and 48 mg/kg OC, respectively and were not B-qualified. Considering the 2002 concentrations are inflated by at least a small level of lab/field contamination, BEHP concentrations appear to be nearly the same as in 1996 when they were first detected. BEHP is a ubiquitous contaminant derived from plasticizers, with multiple sources. Sediment resuspension likely occurs with many waterfront activities near the cap and the deposition of resuspended sediment may account for the BEHP detections.

During the previous two sampling events in 1993 and 1996, the 2-cm samples were compared to SMS, although not required, and numerous chemicals exceeded the SMS. In 2002, these same chemicals were absent or reduced in the 0-2 cm samples and none exceeded the SMS. The 1993 sampling event occurred immediately after the cap area was recontaminated by piling removal and showed that two of the seven stations exceeded the SMS for multiple chemicals (VG5 and VG1). The highest values were at VG5, which exceeded the CSL for total LPAH and several individual LPAHs, total HPAH and several individual HPAHs, and mercury. Also, several individual LPAH and HPAH compounds exceeded SQS. The 1996 samples from VG5 showed that after three years, all PAH concentrations declined and only one PAH (chrysene) and mercury exceeded the SQS. The 2002 samples show that after another six years both the chrysene and mercury concentrations had decreased greatly and neither exceeded the SMS.

Table 4-2. 2002 surface sediment stations – SMS comparison 0-10 cm

Station Locator	Sediment		P53VG1				P53VG2				P53VG3				P53VG4		
Date Sampled	Management		Sep 09, 2002				Sep 09, 2002				Sep 09, 2002				Sep 09, 2002		
Range	Standards		0-10 cm				0-10 cm				0-10 cm				0-10 cm		
Sample Number			L25702-2				L25702-4				L25702-6				L25702-8		
% Solids			70.7				68.9				73.1				70		
% Total Organic Carbon			0.702				2.05				0.859				0.89		
BNA Organics (mg/kg OC)	SQS	CSL		Value	Qual	MDL/ RDL		Value	Qual	MDL/ RDL		Value	Qual	MDL/ RDL		Value	Qual	MDL/ RDL
Naphthalene	99	170			<MDL,G	2.85			<MDL,G	0.98			<MDL,G	2.21			<MDL,G	2.25
Acenaphthylene	66	66			<MDL	2.99			<MDL	1.07			<MDL	2.45		3.48	<RDL	4.8
Acenaphthene	16	57			<MDL	1.41		0.829	<RDL	0.99		1.28	<RDL	1.12		3.07		1.12
Fluorene	23	79			<MDL	2.56		1.41	<RDL	1.8		5.68		2.10		5.12		2.13
Phenanthrene	100	480		12.7		0.81		8.05		0.28		21.1		0.64		49.0		0.64
Anthracene	220	1200		15.2	G	0.81		5.51	G	0.28		41.4	G	0.64		25.7	G	0.64
Total LPAH	370	780		27.9				15.9				69.4				86.4		
HPAHs (mg/kg TOC)																		
Fluoranthene	160	1200		28.3		1.57		20.2		0.59		41.4		1.281		83.1		1.24
Pyrene	1000	1400		30.5		0.81		19.1		0.28		24.8		0.64		26.0		0.64
Benzo(a)anthracene	110	270		19.1		0.4		13.4		0.14		27.1		0.314		37.9		0.33
Chrysene	110	460		32.5		0.81		23.4		0.28		51.1		0.64		67.5		0.64
Total Benzoflouranthenes	230	450		53.4				37.9		0.2		65.0				81.4		
Benzo(a)pyrene	99	210		29.6		0.6		20.6		0.21		13.0		0.477		10.1		0.48
Indeno(1,2,3-Cd)Pyrene	34	88		13.9		1.85		8.98		0.63		8.95		1.397		7.31		1.46
Dibenzo(a,h)anthracene	12	33		5.77		1.41		3.62		0.49		7.02		1.118		9.56		1.12
Benzo(g,h,i)perylene	31	78		13.1		1.57		8.83		0.59			<MDL	1.281			<MDL	1.24
Total HPAH	960	5300		226				156				238				323		
Other (mg/kg TOC)																		
1,2-Dichlorobenzene	2.3	2.3			<MDL,G	0.05			<MDL,G	0.02			<MDL,G	0.042			<MDL,G	0.04
1,4-Dichlorobenzene	3.1	9		0.091	G	0.03		0.074	G	0.01		0.153	G	0.021		0.188	G	0.02
1,2,4-Trichlorobenzene	0.81	1.8			<MDL,G	0.05			<MDL,G	0.02			<MDL,G	0.042			<MDL,G	0.04
Hexachlorobenzene	0.38	2.3			<MDL	0.13			<MDL	0.05			<MDL	0.105			<MDL	0.11
Dimethyl Phthalate	53	53			<MDL	2.28			<MDL	0.78			<MDL	1.746			<MDL	1.8
Diethyl Phthalate	61	110			<MDL	1.21			<MDL	0.42			<MDL	0.955			<MDL	0.97
Di-N-Butyl Phthalate	220	1700		2.279	<RDL,B	4.4		0.829	<RDL,B	0.94		1.863	<RDL,B	2.1		2.258	B	1.08
Benzyl Butyl Phthalate	4.9	64		3.276	<RDL	5.4		1.27	<RDL	1.9		2.561	<RDL	4.3		3.034	<RDL	4.3
Bis(2-Ethylhexyl)Phthalate	47	78		26.64	B	2.56		8.73	B	0.93		24.21	B	2.095	*	52.7	B	2.13
Di-N-Octyl Phthalate	58	4500			<MDL	5.41			<MDL	1.9			<MDL	4.307			<MDL	4.38
Dibenzofuran	15	58			<MDL	2.85			<MDL	0.98			<MDL	2.212		3.483	<RDL	4.5
Hexachlorobutadiene	3.9	6.2			<MDL,G	0.16			<MDL,G	0.05			<MDL,G	0.116			<MDL,G	0.12
N-Nitrosodiphenylamine	11	11			<MDL,G	3.99			<MDL,G	1.41			<MDL,G	3.143			<MDL,G	3.26
Total PCB	12	65		6.74				4.85				5.02				1.28		
Other (µg/kg dry weight)																		
Phenol	420	1200			<MDL	13			<MDL	13			<MDL,G	12			<MDL,G	13
2-Methylphenol	63	63			<MDL	27			<MDL	28			<MDL,G	26			<MDL,G	27
4-Methylphenol	670	670			<MDL	23			<MDL	23			<MDL,G	22			<MDL,G	23
2,4-Dimethylphenol	29	29			<MDL	9.9			<MDL	10			<MDL,G	9.6			<MDL,G	10
Pentachlorophenol	360	690			<MDL	18			<MDL	19			<MDL,G	18			<MDL,G	19
Benzyl Alcohol	57	73			<MDL,X	8.5			<MDL,X	8.7			<MDL,X	8.2			<MDL,X	8.6
Benzoic Acid	650	650		109	G	38		104	G	39		126	G	37		119	G	39
Metals (mg/kg dry weight)																		
Arsenic, Total, ICP	57	93		5	<RDL	18		7.1	<RDL	18			<MDL	3.3		5.9	<RDL	19
Cadmium, Total, ICP	5.1	6.7			<MDL	0.21			<MDL				<MDL	0.21			<MDL	0.23
Chromium, Total, ICP	260	270		13.4		0.37		16.8		0.36		14.1		0.33		18.9		0.37
Copper, Total, ICP	390	390		20.4		0.3		25.7		0.29		23.8		0.26		27.3		0.3
Lead, Total, ICP	450	530		12.5		2.1		16.7		2.2		15.5		2.1		19.9		2.3
Mercury, Total, CVAA	0.41	0.59		0.086	<RDL	0.28		0.11	<RDL	0.28		0.093	<RDL	0.27		0.14	<RDL	0.28
Silver, Total, ICP	6.1	6.1			<MDL	0.3			<MDL	0.29			<MDL	0.026			<MDL	0.3
Zinc, Total, ICP	410	960		54		0.37		58.9		0.36		56.2		0.33		65.3		0.37

* exceeds SQS
** exceeds CSL
Qual - Qualifier
<MDL - Undetected at the method detection limit; B - Blank contamination; E- estimate
<RDL - Detected below reporting detection limits; G - Low standard reference material recovery; X - Matrix spike or surrogate recovery < 10%
LPAHs: Low Molecular Weight Polynuclear Aromatic Hydrocarbons
HPAHs: High Molecular Weight Polynuclear Aromatic Hydrocarbons
PCBs: Polychlorinated Biphenyls

Table 4-2. (Continued)

Station Locator	Sediment		P53VG5			P53VG6			P53VG7			P53VG7		
Date Sampled	Management		Sep 09, 2002			Sep 09, 2002			Sep 09, 2002			Sep 09, 2002		
Range	Standards		0-10			0-10			0-10			0-10		
Sample Number			L25702-10			L25702-12			L25702-14			L25702-15 (field rep)		
% Solids			57.4			62.7			74.3			73.1		
% Total Organic Carbon			1.81			1.75			0.306			0.286		
LPAHs (mg/kg TOC)	**SQS**	**CSL**	**Value**	**Qual**	MDL/ RDL	**Value**	**Qual**	MDL/ RDL	**Value**	**Qual**	MDL/ RDL	**Value**	**Qual**	MDL/ RDL
Naphthalene	99	170	3.82	G	1.33		<MDL,G	1.26		<MDL,G	6.21		<MDL,G	6.64
Acenaphthylene	66	66	7.02		1.44	4.04		1.37		<MDL	6.54		<MDL	7.34
Acenaphthene	16	57	4.72		0.663	1.67		0.629		<MDL	3.07		<MDL	3.36
Fluorene	23	79	7.29		1.27	3.55		1.2		<MDL	5.56		<MDL	6.29
Phenanthrene	100	480	24.4		0.387	15.7		0.366	9.93		1.77	12.9		1.92
Anthracene	220	1200	30.1	G	0.387	19.7	G	0.366	11.8	G	1.77	14.6	G	1.92
Total LPAH	370	780	77.3			44.5			21.7			27.5		
HPAHs (mg/kg TOC)														
Fluoranthene	160	1200	54.7		0.773	35.4		0.743	29.2		3.59	42.0		3.85
Pyrene	1000	1400	30.4		0.387	12.5		0.366	17.5		1.77	52.4		1.92
Benzo(a)anthracene	110	270	42.1		0.193	29.1		0.183	13.9		0.882	26.4		0.944
Chrysene	110	460	59.1		0.387	41.2		0.366	26.2		1.76	41.6		1.92
Total Benzofluoranthenes	230	450	94.0			56.4			55.6			76.1		
Benzo(a)pyrene	99	210	10.2		0.287	7.03		0.274	7.09		1.31	15.8		1.43
Indeno(1,2,3-Cd)Pyrene	34	88	6.19		0.884	4.10		0.8	4.902	<RDL	3.92	12.9		4.20
Dibenzo(a,h)anthracene	12	33	9.61		0.663	6.51		0.629	6.34		3.07	15.2		3.36
Benzo(g,h,i)perylene	31	78		<MDL	0.773		<MDL	0.743		<MDL	3.59		<MDL	3.85
Total HPAH	960	5300	306			192			161			283		
Other (mg/kg TOC)														
1,2-Dichlorobenzene	2.3	2.3		<MDL,G	0.025		<MDL,G	0.023		<MDL,G	0.114		<MDL,G	0.126
1,4-Dichlorobenzene	3.1	9	0.12	G	0.013	0.092	G	0.012		<MDL,G	0.056	0.23	G	0.063
1,2,4-Trichlorobenzene	0.81	1.8		<MDL,G	0.025		<MDL,G	0.023		<MDL,G	0.114		<MDL,G	0.126
Hexachlorobenzene	0.38	2.3		<MDL	0.061		<MDL	0.063		<MDL	0.291		<MDL	0.311
Dimethyl Phthalate	53	53		<MDL	1.05		<MDL	1.029		<MDL	4.90		<MDL	5.24
Diethyl Phthalate	61	110		<MDL	0.552		<MDL	0.549		<MDL	2.65		<MDL	2.87
Di-N-Butyl Phthalate	220	1700	1.78	B	0.663	1.36	B	0.629	4.902	<RDL,B	2.91	5.24	<RDL,B	3.22
Benzyl Butyl Phthalate	4.9	64	2.04	<RDL	1.27	2.11	<RDL	1.2		<MDL	5.56	6.64	<RDL	6.29
Bis(2-Ethylhexyl)Phthalate	47	78	23.6	B	1.27	9.66	B	1.2	14.41	B	5.56	29.9	B	6.29
Di-N-Octyl Phthalate	58	4500		<MDL	2.60		<MDL	2.46		<MDL	11.8		<MDL	12.9
Dibenzofuran	15	58	4.32		1.32	1.37	<RDL	1.26		<MDL	6.21		<MDL	6.64
Hexachlorobutadiene	3.9	6.2		<MDL,G	0.072		<MDL,G	0.069		<MDL,G	0.33		<MDL,G	0.35
N-Nitrosodiphenylamine	11	11		<MDL,G	1.93		<MDL,G	1.83		<MDL,G	8.82		<MDL	9.44
Total PCB	12	65		<MDL	0.24	0.318				<MDL	1.10	8.95		
Other (µg/kg dry weight)														
Phenol	420	1200		<MDL	16		<MDL,G	14		<MDL,G	12		<MDL,G	12
2-Methylphenol	63	63		<MDL	33		<MDL,G	30		<MDL,G	26		<MDL,G	26
4-Methylphenol	670	670		<MDL	28		<MDL,G	26		<MDL,G	22		<MDL,G	22
2,4-Dimethylphenol	29	29		<MDL	12		<MDL,G	11		<MDL,G	9.4		<MDL,G	9.4
Pentachlorophenol	360	690		<MDL	23		<MDL,G	21		<MDL,G	17		<MDL,G	17
Benzyl Alcohol	57	73		<MDL,X	10		<MDL,X	9.6		<MDL,X	8.1		<MDL,X	8.1
Benzoic Acid	650	650	140	G	47	159	G	43	111	G	36	111	G	36
Metals (mg/kg dry weight)														
Arsenic, Total, ICP	57	93	7.7	<RDL	4.4	6.7	<RDL	3.8	7.1	<RDL	3.4	5.9	<RDL	3.4
Cadmium, Total, ICP	5.1	6.7	0.42	<RDL	0.26		<MDL	0.24		<MDL	0.2		<MDL	0.21
Chromium, Total, ICP	260	270	30.1		0.44	18.8		0.38	14.3		0.34	12		0.34
Copper, Total, ICP	390	390	52.1		0.35	34.1		0.3	15.7		0.27	16.3		0.27
Lead, Total, ICP	450	530	74.4		2.6	24.2		2.4	9.4	<RDL	2	8.3	<RDL	2.1
Mercury, Total, CVAA	0.41	0.59	0.33	<RDL	0.035	0.15	<RDL	0.032	0.05	<RDL	0.026	0.033	<RDL	0.026
Silver, Total, ICP	6.1	6.1	0.82	<RDL	0.35		<MDL	0.3		<MDL	0.027		<MDL	0.27
Zinc, Total, ICP	410	960	110		0.44	69.2		0.38	49.5		0.34	48.7		0.34

* exceeds SQS
** exceeds CSL
Qual – Qualifier
Shaded – TOC >0.5% or < 3.0%; thus, dry-weight -normalized values compared to AETs.
<MDL - Undetected at the method detection limit; B - Blank contamination; E- estimate
<RDL - Detected below reporting detection limits; G - Low standard reference material recovery; X - Matrix spike or surrogate recovery < 10%
LPAHs: Low Molecular Weight Polynuclear Aromatic Hydrocarbons
HPAHs: High Molecular Weight Polynuclear Aromatic Hydrocarbons
PCBs: Polychlorinated Biphenyls

Table 4-3. 2002 surface sediment stations – SMS comparison 0-2 cm

Station Locator	Sediment		P53VG1			P53VG2			P53VG3			P53VG4		
Date Sampled	Management		Sep 09, 2002			Sep 09, 2002			Sep 09, 2002			Sep 09, 2002		
Range	Standards		0-2 cm			0-2 cm			0-2 cm			0-2 cm		
Sample Number			L25702-1			L25702-3			L25702-5			L25702-7		
% Solids			68.4			62.8			71.4			69.5		
% Total Organic Carbon			0.728			2.5			1.04			1.03		
LPAHs (mg/kg TOC)	SQS	CSL	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL	Value	Qual	MDL/ RDL
Naphthalene	99	170		<MDL,G	2.74		<MDL,G	0.88		<MDL,G	1.92		<MDL,G	1.94
Acenaphthylene	66	66		<MDL	3.02		<MDL	0.96		<MDL	2.02	3.2	<RDL	4.19
Acenaphthene	16	57	2.12	<RDL	2.8	0.956		0.44	2.077		0.94	4.48		0.97
Fluorene	23	79	3.43	<RDL	5.2	2.02		0.84	5.673		1.73	6.79		1.85
Phenanthrene	100	480	19.2		0.797	10.6		0.256	25.58		0.54	40		0.56
Anthracene	220	1200	12.9	G	0.797	9.36	G	0.256	26.54	G	0.54	30.2	G	0.56
Total LPAH	370	780	37.7			22.9			59.9			84.9		
HPAHs (mg/kg TOC)														
Fluoranthene	160	1200	50.137		1.65	23.64		0.52	50.9		1.06	83.7		1.17
Pyrene	1000	1400	46.42		0.797	23.12		0.256	43.3		0.54	32.7		0.56
Benzo(a)anthracene	110	270	32.14		0.398	18.72		0.128	30.5		0.27	45.7		0.28
Chrysene	110	460	52.06		0.797	31.16		0.256	56.7		0.54	72.9		0.56
Total Benzofluoranthenes	230	450	75.96			46.2			76.4			90.7		
Benzo(a)pyrene	99	210	39.56		0.604	24.3		0.192	31.1		0.4	12.5		0.42
Indeno(1,2,3-Cd)Pyrene	34	88	18.68		1.79	11.8		0.56	17.6		1.25	8.48		1.26
Dibenzo(a,h)anthracene	12	33	7.39		1.37	4.28		0.44	7.32		0.94	10.2		0.97
Benzo(g,h,i)perylene	31	78	18.13		1.65	11.4		0.52	2.528		1.06		<MDL	1.17
Total HPAH	960	5300	340			195			316			357		
Other (mg/kg TOC)														
1,2-Dichlorobenzene	2.3	2.3		<MDL,G	0.05		<MDL,G	0.016		<MDL,G	0.03		<MDL,G	0.04
1,4-Dichlorobenzene	3.1	9	0.177	G	0.026	0.884	G	0.088	0.118	G	0.02	0.172	G	0.02
1,2,4-Trichlorobenzene	0.81	1.8		<MDL,G	0.05		<MDL,G	0.016		<MDL,G	0.03		<MDL,G	0.04
Hexachlorobenzene	0.38	2.3		<MDL	0.132		<MDL	0.044		<MDL	0.09		<MDL	0.09
Dimethyl Phthalate	53	53		<MDL	2.197		<MDL	0.72		<MDL	1.44		<MDL	1.55
Diethyl Phthalate	61	110		<MDL	1.21		<MDL	0.384		<MDL	0.81		<MDL	0.83
Di-N-Butyl Phthalate	220	1700	2.47	<RDL,B	2.7	0.76	<RDL,B	0.85	1.96	B	0.9	2.13	B	0.93
Benzyl Butyl Phthalate	4.9	64	3.43	<RDL	5.4	1.16	<RDL	1.7	2.31	<RDL	3.6	2.62	<RDL	3.7
Bis(2-Ethylhexyl)Phthalate	47	78	16.6	B	2.61	9.16	B	0.84	20.3	B	1.73	40.8	B	1.85
Di-N-Octyl Phthalate	58	4500		<MDL	5.36		<MDL	1.72		<MDL	3.65		<MDL	3.79
Dibenzofuran	15	58		<MDL	2.75		<MDL	0.88	2.69	<RDL	1.92	3.59	<RDL	1.94
Hexachlorobutadiene	3.9	6.2		<MDL,G	0.15		<MDL,G	0.048		<MDL,G	0.11		<MDL,G	0.11
N-Nitrosodiphenylamine	11	11		<MDL	3.98		<MDL	1.28		<MDL	2.69		<MDL	2.82
Total PCB	12	65	7.07			3.68			6.30			2.64		
Other (µg/kg dry weight)														
Phenol	420	1200		<MDL	13		<MDL	13		<MDL,G	13		<MDL	13
2-Methylphenol	63	63		<MDL	28		<MDL	27		<MDL,G	27		<MDL	27
4-Methylphenol	670	670		<MDL	23		<MDL	25		<MDL,G	22		<MDL	23
2,4-Dimethylphenol	29	29		<MDL	10		<MDL	11		<MDL,G	9.8		<MDL	10
Pentachlorophenol	360	690		<MDL	19		<MDL	21		<MDL,G	18		<MDL	19
Benzyl Alcohol	57	73		<MDL,X	8.8		<MDL,X	9.6		<MDL,X	8.4		<MDL,X	8.6
Benzoic Acid	650	650	123	G	39	128	G	43	225	G	38	153	G	39
Metals (mg/kg dry weight)														
Arsenic, Total, ICP	57	93	4.7	<RDL	18	6.7	<RDL	19.3	4.9	<RDL	17	8.3	<RDL	17
Cadmium, Total, ICP	5.1	6.7		<MDL	0.2		<MDL	0.22		<MDL	0.21		<MDL	0.2
Chromium, Total, ICP	260	270	15.2		0.35	18.3		0.38	15.5		0.34	16.1		0.35
Copper, Total, ICP	390	390	21.8		0.28	33.1		0.3	24.2		0.28	30.8		0.27
Lead, Total, ICP	450	530	15.8		2	24.2		2.2	18.2		2.1	21.2		2
Mercury, Total, CVAA	0.41	0.59	0.089	<RDL	0.28	0.25	<RDL	0.31	0.15	<RDL	0.28	0.13	<RDL	0.28
Silver, Total, ICP	6.1	6.1		<MDL	0.28		<MDL	0.3		<MDL	0.28		<MDL	0.27
Zinc, Total, ICP	410	960	58.3		0.35	70.2		0.38	59.2		0.34	67.6		0.35

* exceeds SQS
** exceeds CSL
Qual – Qualifier
<MDL - Undetected at the method detection limit; B - Blank contamination; E- estimate
<RDL - Detected below reporting detection limits; G - Low standard reference material recovery; X - Matrix spike or surrogate recovery < 10%
LPAHs: Low Molecular Weight Polynuclear Aromatic Hydrocarbons
HPAHs: High Molecular Weight Polynuclear Aromatic Hydrocarbons
PCBs: Polychlorinated Biphenyls

Table 4-3. (continued)

Station Locator	Sediment		P53VG5				P53VG6				P53VG7		
Date Sampled	Management		Sep 09, 2002				Sep 09, 2002				Sep 09, 2002		
Range	Standards		0-2 cm				0-2 cm				0-2 cm		
Sample Number			L25702-9				L25702-11				L25702-13		
% Solids			54.6				68.2				75		
% Total Organic Carbon			2.18				1.05				0.4		
LPAHs (mg/kg TOC)	SQS	CSL		Value	Qual	MDL/RDL		Value	Qual	MDL/RDL		Value	Qual	MDL/RDL
Naphthalene	99	170		2.97	G	1.19			<MDL,G	2			<MDL,G	4.75
Acenaphthylene	66	66		5.55		1.24		3.81	<RDL	4.2			<MDL	5
Acenaphthene	16	57		3.31		0.6		2.13		0.95			<MDL	2.33
Fluorene	23	79		7.66		1.1		3.96		1.81			<MDL	4.25
Phenanthrene	100	480		29.0		0.34		19.4		0.56		13.9		1.33
Anthracene	220	1200		29.0	G	0.34		20.7	G	0.56		21.3	G	1.33
Total LPAH	370	780		77.5				49.9				35.3		
HPAHs (mg/kg TOC)														
Fluoranthene	160	1200		58.1		0.69		46.9		1.14		32.6		2.75
Pyrene	1000	1400		20		0.34		19.4		0.56		12.5		1.33
Benzo(a)anthracene	110	270		44.6		0.17		31.7		0.28		50.2		0.68
Chrysene	110	460		60.6		0.33		51.9		0.56		46.8		1.33
Total Benzofluoranthenes	230	450		72.4				68				97.5		
Benzo(a)pyrene	99	210		8.35		0.25		9.02		0.42		10.3		1
Indeno(1,2,3-Cd)Pyrene	34	88		5.78		0.73		6.16		1.24			<MDL	3
Dibenzo(a,h)anthracene	12	33		8.39		0.6		8.32		0.95			<MDL	2.33
Benzo(g,h,i)perylene	31	78			<MDL	0.69			<MDL	1.14			<MDL	2.71
Total HPAH	960	5300		275				237				241		
Other (mg/kg TOC)														
1,2-Dichlorobenzene	2.3	2.3			<MDL,G	0.02			<MDL,G	0.04			<MDL,G	0.09
1,4-Dichlorobenzene	3.1	9		0.094	G	0.01		0.123	G	0.02			<MDL,G	0.04
1,2,4-Trichlorobenzene	0.81	1.8			<MDL,G	0.02			<MDL,G	0.04			<MDL,G	0.09
Hexachlorobenzene	0.38	2.3			<MDL	0.06			<MDL	0.09			<MDL	0.22
Dimethyl Phthalate	53	53			<MDL	0.92			<MDL	1.52			<MDL	3.75
Diethyl Phthalate	61	110			<MDL	0.5			<MDL	0.84			<MDL	2
Di-N-Butyl Phthalate	220	1700			B	1.29			B	2.03		3.75	<RDL,B	4.4
Benzyl Butyl Phthalate	4.9	64		1.83	<RDL	2.2		2.95	<RDL	3.7		5	<RDL	8.9
Bis(2-Ethylhexyl)Phthalate	47	78		16.0	B	1.1		17.4	B	1.81		9.13	B	4.25
Di-N-Octyl Phthalate	58	4500			<MDL	2.25			<MDL	3.81			<MDL	9
Dibenzofuran	15	58		3.70		1.19			<MDL	2			<MDL	4.75
Hexachlorobutadiene	3.9	6.2			<MDL,G	0.06			<MDL,G	0.1			<MDL,G	0.25
N-Nitrosodiphenylamine	11	11			<MDL	1.7			<MDL	2.67			<MDL,G	6.75
Total PCB	12	65		1.17				1.86				1.25		
Other (µg/kg dry weight)														
Phenol	420	1200			<MDL,G	16			<MDL,G	13			<MDL	12
2-Methylphenol	63	63			<MDL,G	35			<MDL,G	28			<MDL	25
4-Methylphenol	670	670			<MDL,G	29			<MDL,G	23			<MDL	21
2,4-Dimethylphenol	29	29			<MDL,G	13			<MDL,G	10			<MDL	9.3
Pentachlorophenol	360	690			<MDL,G	24			<MDL,G	19			<MDL	17
Benzyl Alcohol	57	73			<MDL,X	11			<MDL,X	8.8			<MDL,X	8
Benzoic Acid	650	650		175	G	49		116	G	40			G	191
Metals (mg/kg dry weight)														
Arsenic, Total, ICP	57	93		10	<RDL	23		7.3	<RDL	18		8.3	<RDL	17
Cadmium, Total, ICP	5.1	6.7		0.31	<RDL	1.4			<MDL	0.22			<MDL	0.2
Chromium, Total, ICP	260	270		23.4		0.46		18.6		0.37		12.4		0.33
Copper, Total, ICP	390	390		48.4		0.37		31.8		0.29		14.3		0.27
Lead, Total, ICP	450	530		46.2		2.7		23.9		2.2		10.8		2
Mercury, Total, CVAA	0.41	0.59		0.31	<RDL	0.36		0.14	<RDL	0.29		0.04	<RDL	0.26
Silver, Total, ICP	6.1	6.1		0.57	<RDL	1.8		0.34	<RDL	1.5			<MDL	0.27
Zinc, Total, ICP	410	960		85.9		0.46		66.9		0.37		45.7		0.33

* exceeds SQS
** exceeds CSL
Qual – Qualifier
<MDL - Undetected at the method detection limit; B - Blank contamination; E- estimate
<RDL - Detected below reporting detection limits; G - Low standard reference material recovery; X - Matrix spike or surrogate recovery < 10%
LPAHs: Low Molecular Weight Polynuclear Aromatic Hydrocarbons
HPAHs: High Molecular Weight Polynuclear Aromatic Hydrocarbons
PCBs: Polychlorinated Biphenyls

Neither phenol nor 4-methylphenol were detected in 2002 even though these chemicals exceeded SMS in 1996. Phenol and 4-methylphenol were only detected in the 1996 sampling event where three stations exceeded SMS. Station VG5 exceeded the CSL for both phenol (2-cm) and 4-methylphenol (2-cm and 10-cm). Also, the phenol SQS value was exceeded at VG3 (2-cm) and VG6 (2-cm). The possible source of these phenol chemicals was investigated for the 1996 report, but no definitive answer was found. Phenol degrades rapidly in the environment which likely explains the lack of detections in 2002.

Chemical Change Over the Monitoring Period

This section discusses changes in sediment chemistry over the 10 year monitoring period.

Change over all stations

Plots of chemical change over time are shown in Figures 4-2 to 4-7. Only chemicals that showed substantial changes are featured: total LPAHs, total HPAHs, copper, lead, total PCBs and BEHP. These figures are based on dry weight values for 2-cm deep samples (Table 4-4) because these samples can be more indicative of recent change than 10-cm samples which can represent input over a much longer period. For discussion purposes, Table 4-5 presents 2-cm concentrations from pre-cap sampling which was conducted at different station locations (see EB/DRP 1993). During each sampling event, the 2-cm samples were collected at all seven stations, unlike the 10-cm samples. In 1992, before the cap was placed, surface sediment samples were collected at six stations across the site (EB/DRP 1993). Results for the comparable chemicals are summarized in Table 4-5 and the site averages are included in Figures 4-2 to 4-7 for comparison purposes.

The changes in LPAH values over time are shown in Figure 4-2 in dry weight concentrations. Total LPAH concentrations peaked in 1993 with the highest concentrations at VG5 and the lowest at VG7. LPAH concentrations at all stations have since declined over time with significant drops observed in 1996. Sampling in 2002 showed that concentrations have continued to drop and at some stations, leveling out near pre-cap concentrations.

The total LPAH concentration at VG5 in 2002 (1689 µg/kg dw) was double that at VG4 (871 µg/kg dw), the station with the next highest concentration. Stations VG1 through VG4 and VG6 demonstrated lower concentrations of total LPAH (275 – 871 µg/kg dw) compared to VG5, in agreement with their farther distance from the PAH recontamination source. VG6, located near VG5, was measured to have much lower LPAH concentrations than VG5. Total HPAH concentrations follow the same pattern (Figure 4-3). This spatial pattern is consistent with the proximity of the stations to the area where creosote pilings were removed. PAH concentrations in surface sediment samples have largely declined since 1993. The 2002 measurements indicate that the highest LPAH and HPAH concentrations are a small fraction (<34%) of the lowest SMS values.

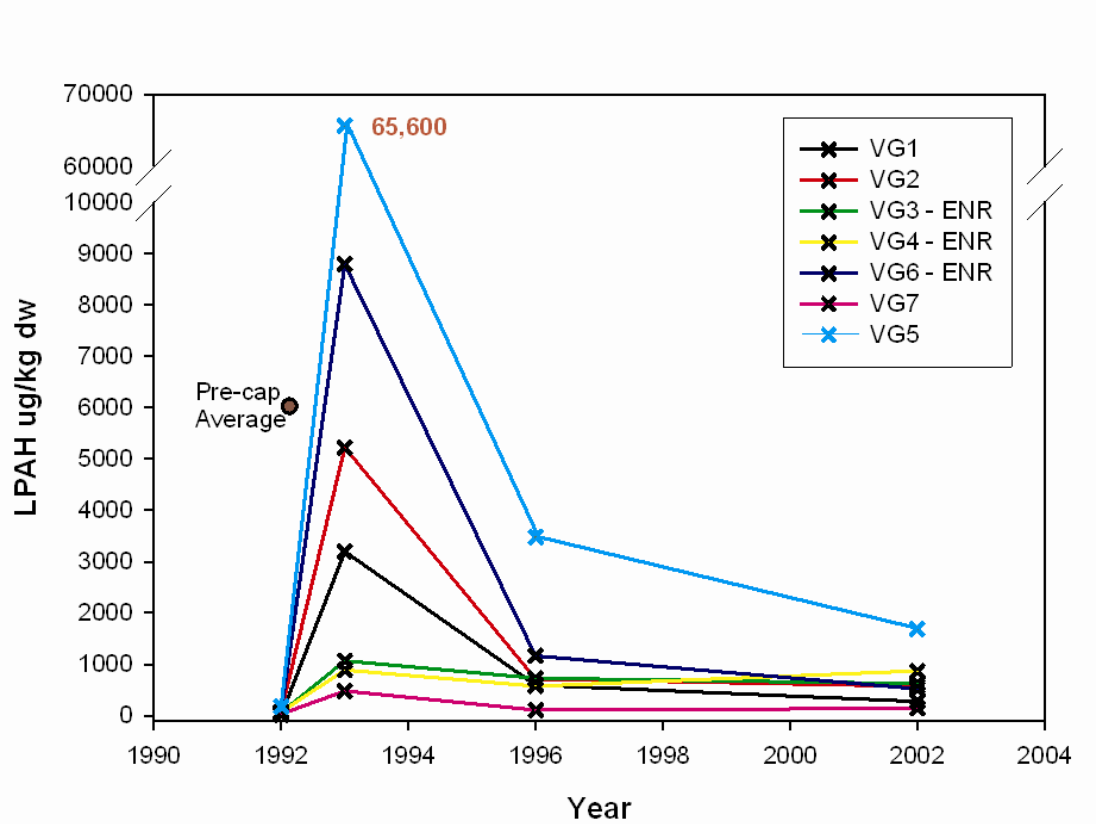


Figure 4-2. Total LPAH Concentrations in Surface Sediment Samples Over Time

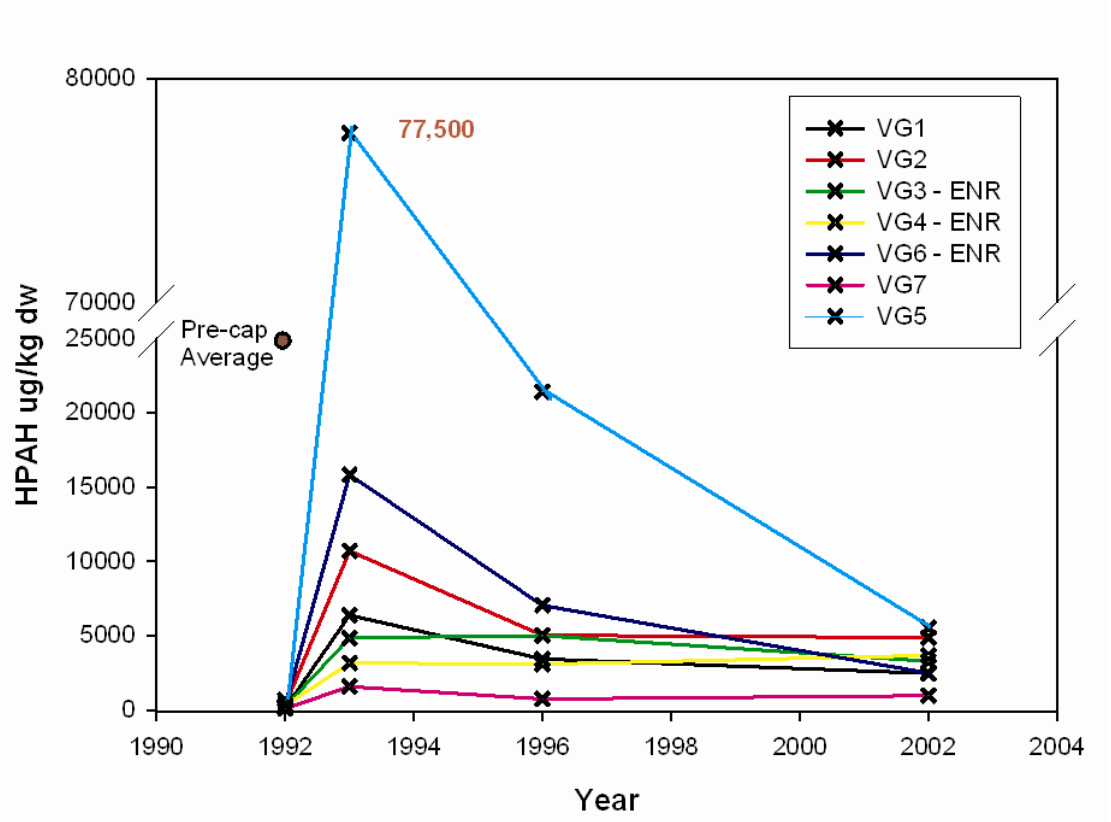


Figure 4-3. Total HPAH Concentrations in Surface Sediment Samples over Time

Table 4-4. Post-cap surface (0-2 cm) sediment contaminant concentrations

	Cap				ENR		
Chemical	VG1	VG2	VG5	VG7	VG 3	VG 4	VG6
LPAH (µg/kg dw)							
1992	10	80	176 3	1 6	1 7	1	76
1993	3,196	5,223	65,614 4	82	1,065 8	87	8,791
1996 5	96	716	3,477	108 7	30 5	76	1,164
2002 2	75	573	1,689	141 6	23 8	71	524
HPAH (µg/kg dw)							
1992	136	349 6	72 9	9	240	293	337
1993	6,382 1	0,696 7	7,544 1	,567 4	,852 3	,161 1	5,825
1996 3	,438	5,028	21,398 7	46	5,003	3,080	7,031
2002 2	,479	4,865	5,544	964 3	,289	3,676	2,489
Copper (mg/kg dw)							
1992	<16	<18	<12	<12 <1	3 <1	3	<13
1993	35	35	89	21 35	32		58
1996 2	5	25	45	16 36	25		31
2002 2	0	22	48	14 24	31		24
Lead (mg/kg dw)							
1992	5.4	6.4	5.7	5.1 5	.8 5	.4	6.1
1993	16 49		167	9.7	15	20 58	
1996 1	7	26	99 8.	9	26	16	31
2002 1	6	18	46	11 18	21		24
Total PCBs (µg/kg dw)							
1992	<20	<30	<20	<20 <2	0 <2	0	<30
1993	<13 <14		<14	<11 <1	2 <1	2	<14
1996 <2	0	36	151 <1	7 2	6 <1	8	35
2002 5	1	92	25	5.0 65		27	20
BEHP (µg/kg dw)							
1992	<10	<10	<10	<10 <1	0 <1	0	<10
1993	<16	<17	<175 <1	4 <1	5 <1	4	<18
1996 1	43	263	288 5	7	289	371	281
2002 1	21	229	348	36 2	11	420	183

dw = dry weight
Shaded values are an average of two field replicates

Table 4-5. Pre-cap surface (0-2 cm) sediment contaminant concentrations

Station	**T2**	**S11**	**ST1**	**S9**	**S1**	**S2**
Chemical						
LPAH (µg/kg dw)	3700 2	450 4	100 3	800 6	020 4	300
HPAH (µg/kg dw)	18400 1	8880 2	3200 2	6740 3	7600 2	8200
Copper (mg/kg dw)	128	90	218 1	70 1	50 1	50
Lead (mg/kg dw)	233 1	35 2	95 3	18 2	80 2	20
Total PCBs (µg/kg dw)	660 5	20 5	20 4	70	1080	1690
BEHP (µg/kg dw)	540 7	50 5	70 7	00	1200	1100

dw = dry weight
Data from EB/DRP 1993

The changes in copper and lead values over time are shown in Figures 4-4 and 4-5, respectively. In 1993, similar to the LPAH and HPAH concentrations, those for copper and lead spiked due to the recontamination from piling removal and decreased with distance from the recontamination source. Copper and lead concentrations at VG5 (48 mg copper/kg dw; 46 mg lead/kg dw) were 1.5 and 1.9 times higher than at VG6 (32 mg copper/kg dw; 24 mg lead/kg dw), the next most contaminated station. VG7 was the least contaminated with copper and lead, and overall, changes in lead at this station were barely perceptible. Copper and lead concentrations at all stations were much lower in 1996 and continued to decrease since then, according to 2002 measurements. The last measurements indicate that lead and copper concentrations are a small fraction (<15%) of the SQS values.

Changes in surface sediment PCB concentrations over time are presented in Figure 4-6. No PCBs were detected during either the baseline in 1992 (MDL of <20 µg/kg dw) or the 1-year sampling event in 1993 (MDL of <10 µg/kg dw). PCBs were detected for the first time in 1996 at four stations: VG2, VG3, VG5 and VG6. Detected concentrations of individual Aroclors at these stations, except at VG5, were close to detection limits. The PCB concentration at VG5 (151 µg/kg dw) was at least four times higher than any other station. In 2002, PCBs were detected at every station. PCB concentrations at VG5 had decreased substantially to 25 µg/kg dw. At stations VG1, VG2 and VG3, PCB concentrations were above 30 µg/kg dw with the highest concentration of 92 µg/kg dw at VG2. The decrease in Aroclor MDLs between 1996 and 2002, previously discussed in Section 3, may explain the later detection of low Aroclor concentrations at VG4, VG5, VG6 and VG7.

Increases in PCB concentrations were seen in 2002 at stations VG1-VG4. PCBs at VG2 were the highest among stations sampled in 2002 (92 µg/kg dw). The cause of this increase is unknown but this may be a sign of surface resuspension of waterfront sediments from outside the cap and ENR area settling on the project site. Surface sediment samples (0-2 cm) collected beneath Piers 54 and 55 in 1993 were at least seven times higher in Aroclors (e.g., 350 to 2,500 Aroclor 1254 µg/kg dw) than in the most current cap samples. The EB/DRP (1995b and c) waterfront study determined that vessel activity is an important driving force of sediment redistribution on the Seattle waterfront. Thus, it seems highly likely that prop wash from vessels active near the piers have contributed to redistributing sediments from under the piers or other PCB-contaminated areas onto the cap and ENR. Other, more minor forces may include storm wave energy and longshore currents. The EB/DRP study results suggest that net transport along the Seattle waterfront is southward, which could explain why samples from the most nearshore and southern station, VG5, had the highest concentrations of copper, lead, total LPAHs, HPAHs and PCBs since the wingwall removal in 1992. Although PCB concentrations are increasing, they remain below the SQS at VG5 (<58% of SQS). PCB analysis in samples from the remaining three stations (VG5, VG6 and VG7) indicates that PCB concentrations in 2002 were similar to 1992 measurements. However, given the large differential between PCB surface concentrations at the site compared to those measured under the piers, resuspension could further increase PCB concentrations in surface sediments on the cap and ENR layer over time.

Figure 4-7 shows BEHP concentrations over the 10—year monitoring period. BEHP was not detected during either the baseline event in 1992 (MDL of <10 µg/kg) or the one-year sampling event in 1993 (MDL of <10 µg/kg to <200 µg/kg). BEHP was detected for the first time in

1996, when all seven stations had measurable values ranging from 57 µg/kg at VG7 up to 370 µg/kg at VG4. The 2002 data showed that after another six years BEHP concentrations declined or stayed about the same, and only those at VG4 and VG5 increased from 370 µg/kg dw to 420 µg/kg dw and from 288 µg/kg dw to 348 µg/kg dw, respectively. All the BEHP values measured in 2002 were B-qualified indicating that reported concentrations may be biased high by lab contamination. Comparison of 2002 2-cm and 10-cm BEHP concentrations (Table 4-2 and 4-3) shows that there is little difference between depths. BEHP is a ubiquitous contaminant derived from a wide range of sources that contain plasticizers. There may be BEHP present in surrounding sediments that are being slowly redistributed. The highest BEHP value in 2002 was at VG4. This represents an increase from previous years but still remains below the SMS (87% of SQS).

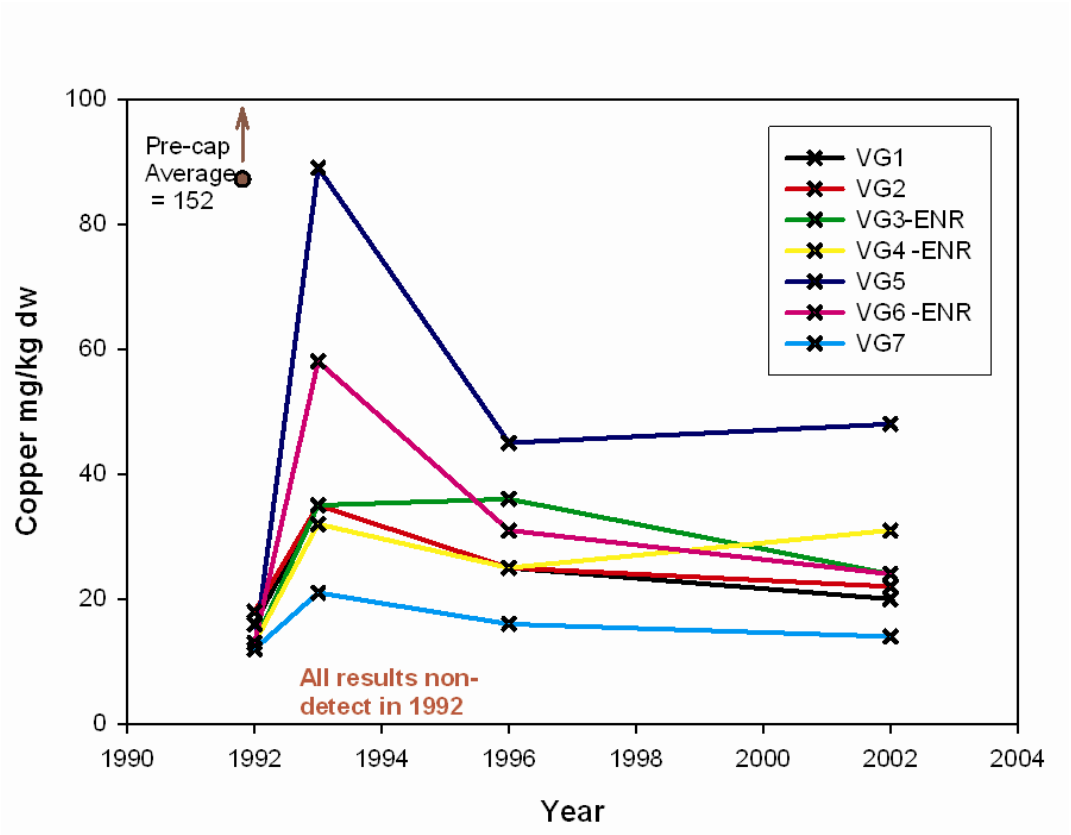


Figure 4-4. Copper Concentrations in Surface Sediment Samples over Time

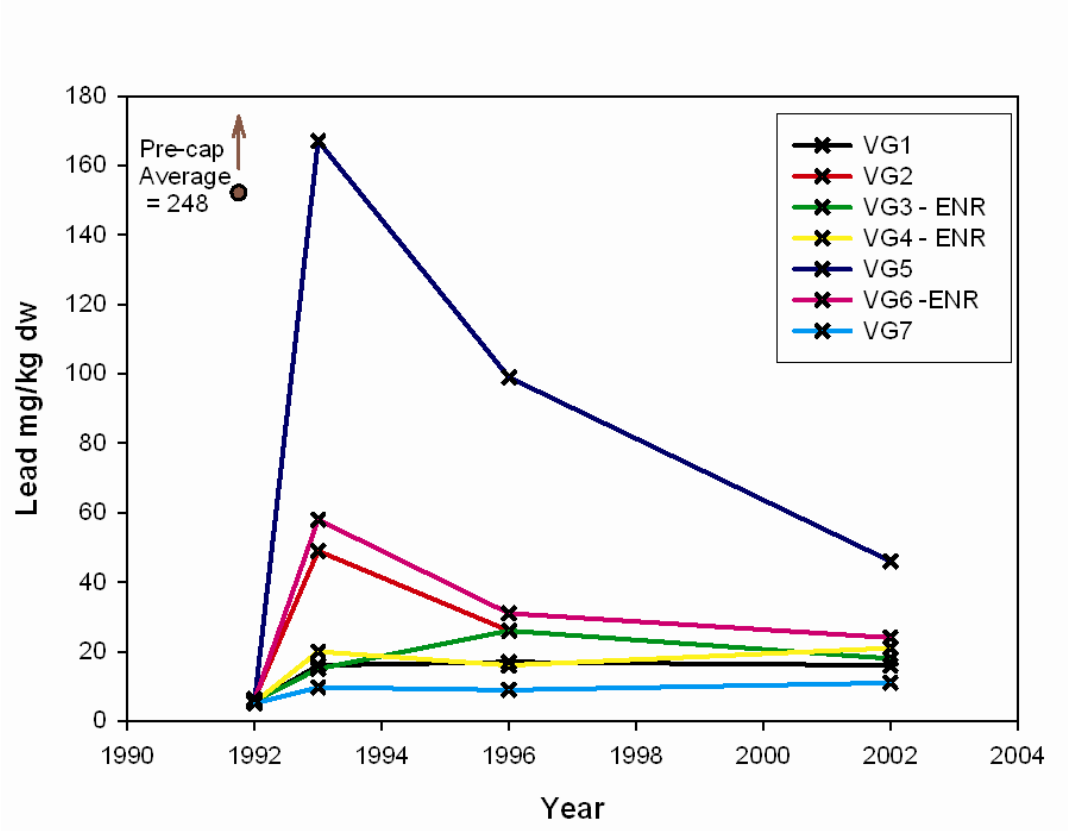


Figure 4-5. Lead Concentrations in Surface Sediment Samples over Time

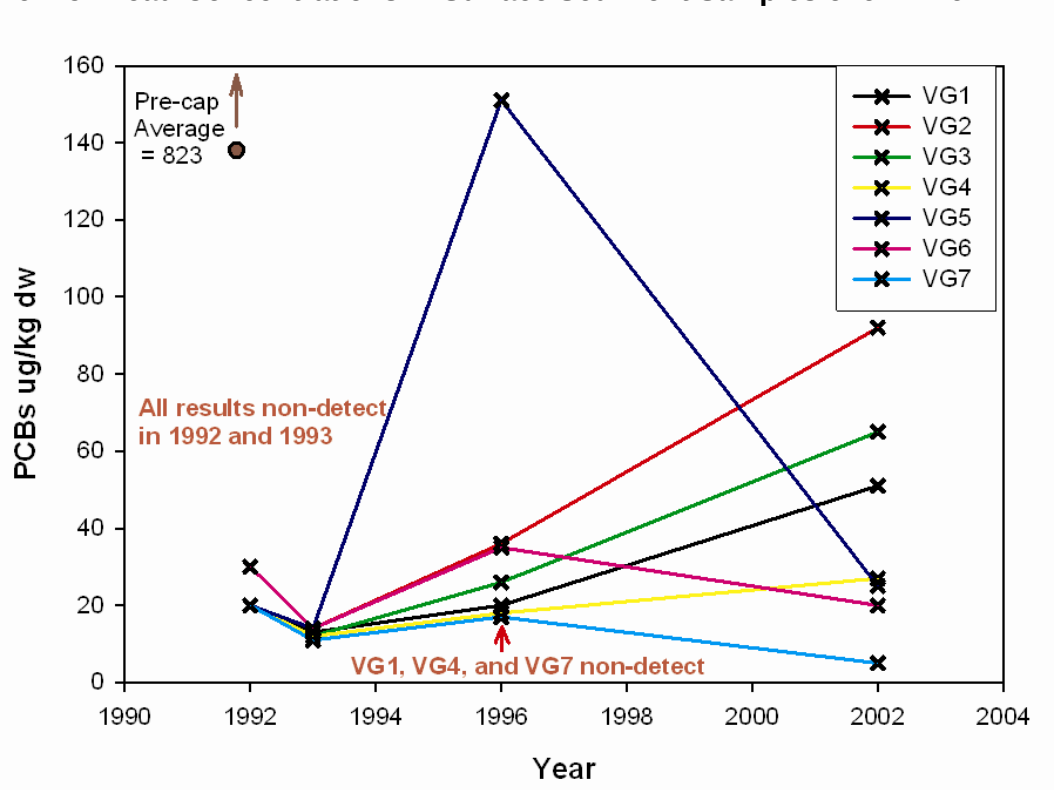


Figure 4-6. Total PCB Concentrations in Surface Sediment Samples over Time

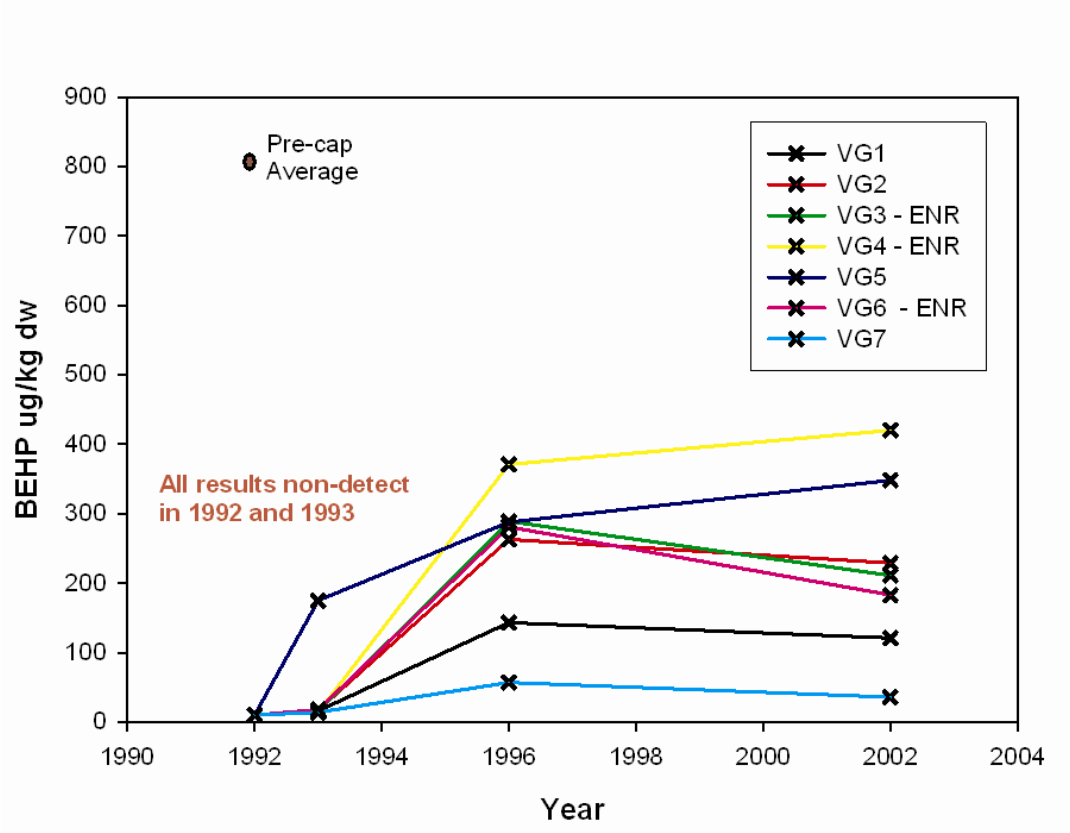


Figure 4-7. Bis(2-Ethylhexyl) Phthalate Concentrations in Surface Sediment Samples over Time

Chemical change at cap compared to ENR stations

To determine if any differences exist between the chemical concentrations on the cap compared to ENR, the mean concentrations for major detected chemicals in 2002 were plotted based on 0-2 cm results at cap stations and ENR stations. For perspective, the mean concentrations of the six[2] pre-cap surface sediment samples collected in 1992 (EB/DRP 1993) are also shown. These data are presented for organic and metal compounds in Figures 4-8 and 4-9.

[2] Stations located on the area where the cap and ENR were placed were named S1, S2, T1, T2, S9 and S11 in 1992. These do not correspond to the surface sediment monitoring stations but cover the same general area.

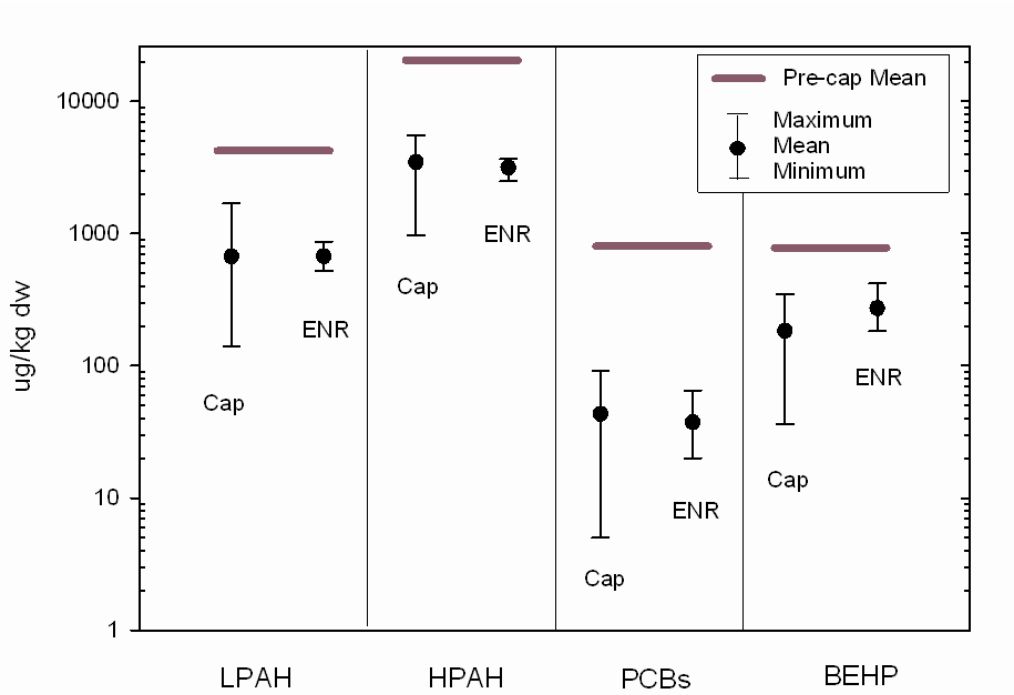


Figure 4-8. 2002 Mean Organics Concentrations in Cap and ENR Surface Sediment Samples Compared to Pre-cap

Although the range of values for cap stations is sometimes larger for cap than ENR stations, mean values are very similar between cap and ENR for both organics and metals. Bioturbation in the ENR could theoretically have increased sediment concentrations by mixing sediments of higher concentrations from below; however, no indications of this type of mixing were observed. Alternatively and more likely, diffusion and advection through the thinner sand layer could have also caused increases in the ENR compared to the cap. However, aside from the higher variability in the cap stations, the surface chemistry data do not show notable differences between the two areas.

Comparison of cap and ENR mean concentrations to those of pre-cap stations indicate that concentrations of the main contaminants (i.e. those plotted) in 2002 are well below the area pre-cap mean concentration from 1992. The difference between the concentrations in the cap or ENR and the pre-cap data are statistically significant (t-test, $p<0.05$).

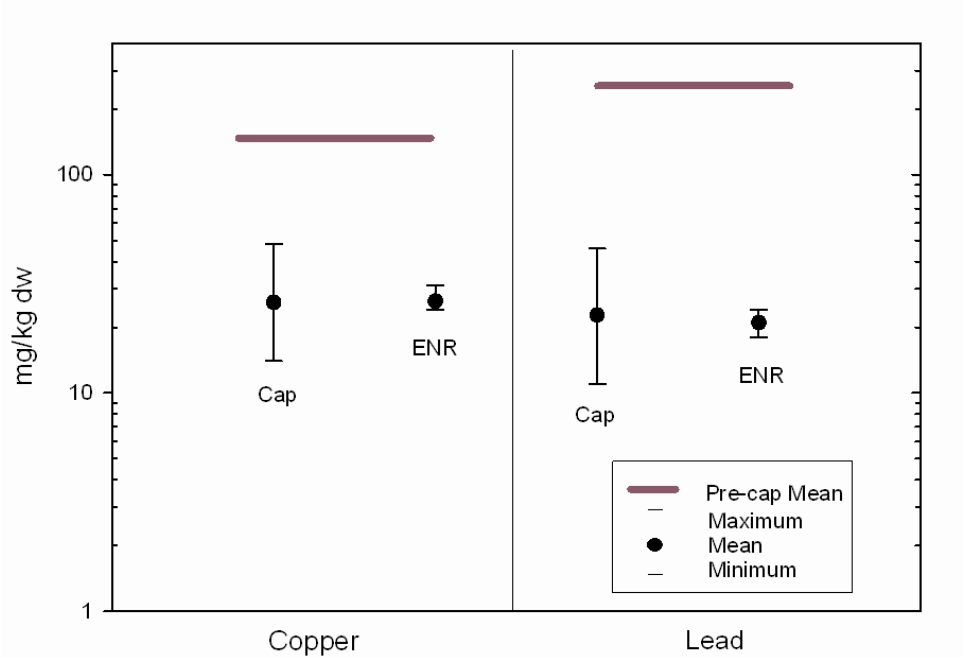


Figure 4-9. 2002 Mean Copper and Lead Concentrations in Cap and ENR Surface Sediment Samples Compared to Pre-cap

TOC and Fines Changes Over Monitoring Period

Sediment chemistry grab samples were analyzed for particle size and TOC. Table 4-6 summarizes the percent fines and TOC observed in 0-2 cm samples across all stations (VG1-7) by monitoring event[3]. Data from the Elliott Bay Recontamination Study (1995) is also presented for comparison as a larger study of Elliott Bay with higher proportions of TOC and fines. The baseline samples, demonstrating low percent fines and low TOC, confirm the expected changes due to cap placement with sand. Also, the mean of percent fines measured in following events reflects a gradual increase as finer material gets deposited on top of the cap with time. TOC frequently correlates with percent fines in a positive relationship. This relationship is generally reflected in the mean values for pre- and post-cap monitoring data, as well for mean values from the Elliott Bay Recontamination Study (1995) (Figure 4-10). The 2002 mean TOC of 1.3 percent is within the range of typical Puget Sound sediments: 0.5-3 percent (Tetra Tech 1990). An evaluation of the 0-2 cm fines compared to the deeper 0-10 cm results shows that fines are always 0-5% higher in the 0-2 cm than the deeper fraction regardless of stations, indicating that the upper 10 cm is becoming similar in grain size to what is currently being deposited (Figure 4-11). The same analysis for TOC demonstrates less spatial consistency and greater variability in the difference between 0-2 and 0-10 cm. At some stations, the 0-2 cm TOC is at a lower percentage than the deeper 0-10 cm fraction (10,000 mgTOC/kg = 1% TOC). This

[3] Because TOC was analyzed in surface chemistry samples, the 0-2 cm depth was the only depth interval with TOC results for every sampling event.

Table 4-6. Summary of percent TOC and fines in surface sediment samples (0-2 cm) over monitoring period compared to baseline and offsite data.

Sampling Year	Sample Size (n)	% Fines		% TOC	
		Mean	Range	Mean	Range
EBWRS 1994[1]	31	87.4	82.7-90.0	7.1	4.7-9.2
Pre-cap Under Piers 1992	6	54.4	45.0-62.9	5.6	1.1-9.6
Pre-cap On Site 1992	6	51.7	47.4-57.7	4.5	4.0-5.3
Baseline 1992	7	5.0	2.79-6.68	2.1	0.33-4.8
1993	8	14.7	11.1-18.1	2.2	1.1-3.5
1996	7	19.4	13.8-26.3	1.5	0.46-2.7
2002	7	15.0	12.7-16.8	1.3	0.75-2.7

[1] Elliott Bay Waterfront Recontamination Study (Ecology 1995) – sediment trap results from 9 nearshore stations in Elliott Bay
Statistics are calculated based on all surface chemistry stations
Percent TOC is based on dry weight
Means are arithmetic

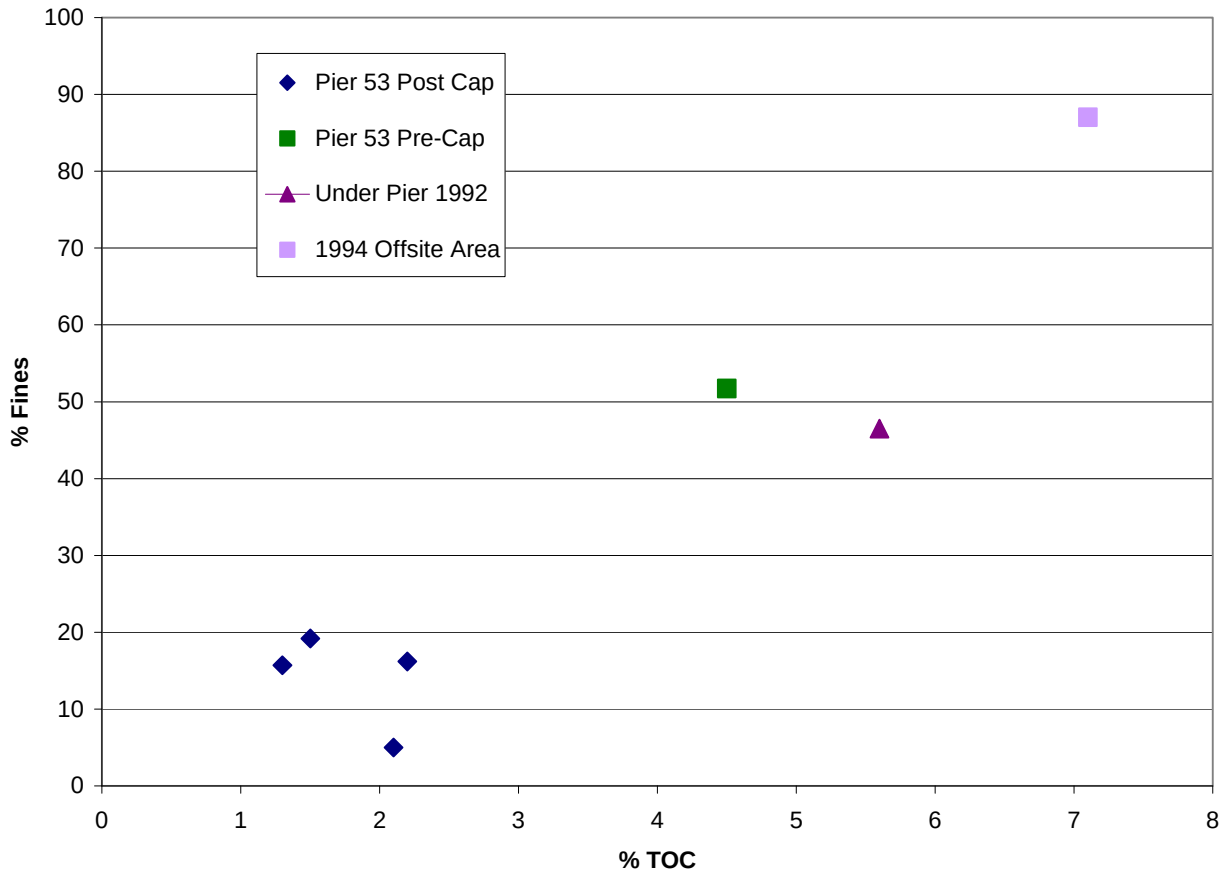


Figure 4-10. Mean Percent Fines in Relation to Mean Percent TOC in Surface Sedimente Samples Using Data from Table 4-5.

variability may be caused by bottom disturbances from vessel activity frequently redistributing deposited surficial sediments. More time may be required to reach pre-cap TOC due to a lower productivity in the recolonized benthic community, and/or less time for accumulation of detrital

and other organic rich material on the cap and thin layer. Percent fines and TOC may approach pre-cap levels over time but currently are within the range found at other Puget Sound locations.

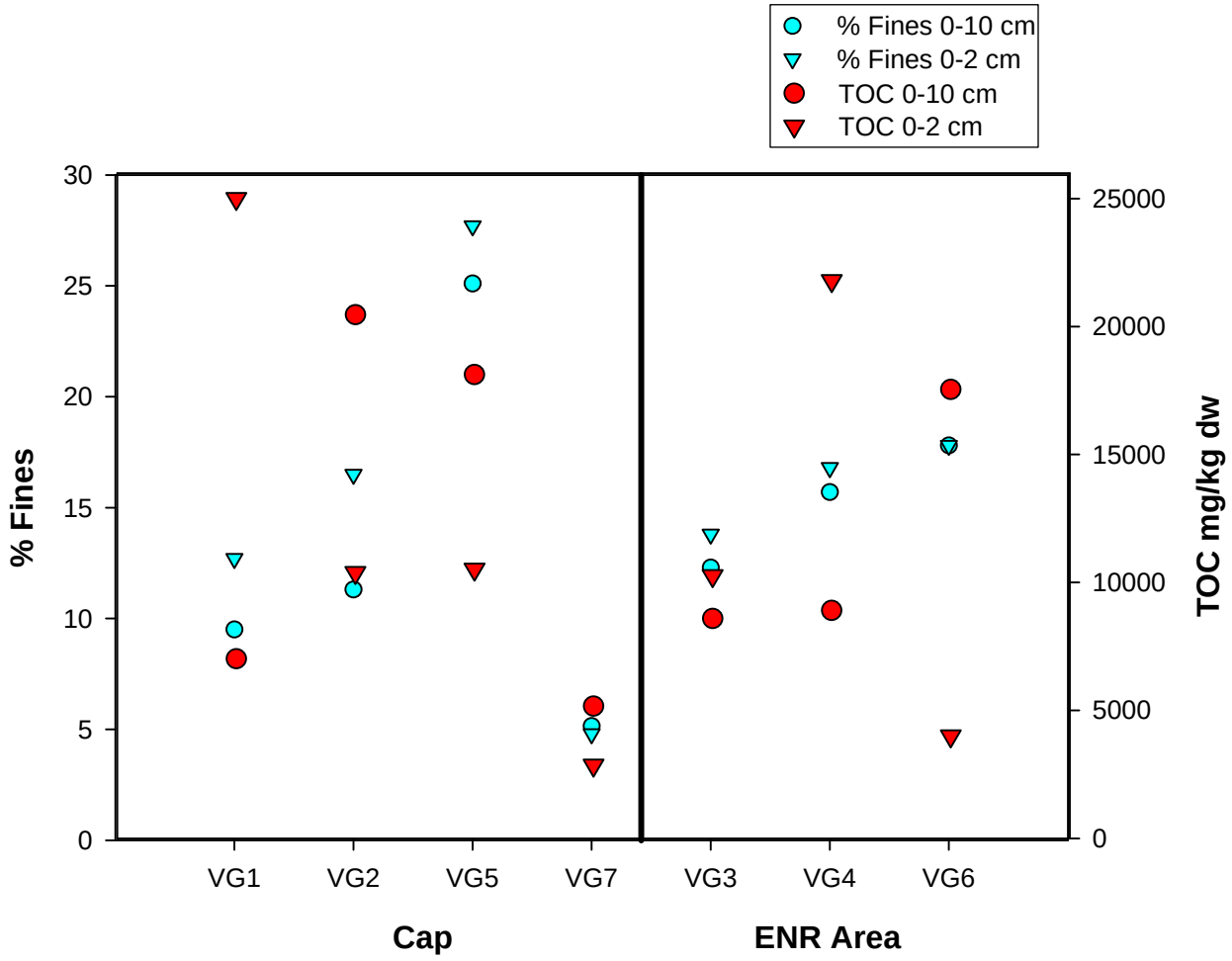


Figure 4-11. Fines and TOC in 0-2 cm Compared to 0-10 cm 2002 Grabs

SECTION 5: BENTHIC RECOLONIZATION

In September 2002, the monitoring team collected benthic taxonomy samples from the Pier 53 remediation area. The objective of benthic community monitoring was not only to document recolonization of the cap and ENR, but also to detect if the ENR functioned as designed. That is, did bioturbation of native organisms mix the underlying contaminated sediment into the cleaner ENR sediment above? This section describes the methods used and reports the results of the sampling. It also compares the results of the benthic taxonomy study with results from previous taxonomic sampling of the Pier 53 remediation area.

Methods

The monitoring plan defined four benthic invertebrate sampling stations selected to provide spatial coverage across the remediation area (Figure 5-1). Two stations are in the cap area (VG1 and VG2) and two stations are in the ENR area (VG3 and VG4). All four stations are at water depths of 9-10 meters (51-59 feet), in areas where the bottom slope is less steep than inshore, and situated near the center of the cap to minimize measurement of edge effects. Samples were collected using a 0.1 m^2 Van Veen grab sampler. Five replicates were collected at each station. Benthic invertebrate samples were analyzed for count and taxonomic identification, to species level if possible. The pre-cap samples were collected in March 1992 immediately prior to capping, and the first post-cap samples were taken in August 1992, about 4 months after capping. Subsequent sampling events were at one year (August 1993), four years (August 1996) and ten years post-cap (September 2002).

A potential benthic taxonomic reference station was identified and sampled for the first time in 1996, and was located just offshore of Richmond Beach in an area of mostly medium-grain sand, similar to the capping sand. Although initial estimates of grain size indicated a match, final grain size analysis determined that the Richmond Beach sediment was sandier than the Duwamish sediment used for capping. Thus, the Richmond Beach location was concluded to be inadequate reference for comparison to the Pier 53 site. The Elliott Bay reference station used for Denny Way in 2002 did not have comparable organic carbon or percent fines to the Pier 53 site and was not deemed suitable either. Locating a suitable reference station for the Pier 53 site was unsuccessful and no reference station was sampled in 2002.

Analyses of the 2002 benthic invertebrate taxonomic data includes summary of individual and species abundance by major taxonomic group, calculation of three indices, and t-Test comparison of ENR versus cap stations for differences in abundance of major taxa and differences within indices across stations. Ecology has developed Puget Sound reference value ranges (RVR) (10th and 90th percentiles) for multiple metrics and indices which can be used when an appropriate reference station is not available (Ecology 2003). Ranges are set for different categories of percent fines. Values below the lower reference value are considered likely to be significantly lower than reference, thereby indicating an impact. Exceedance of the upper threshold is not considered to result in impact except for polychaete abundance. Three indices were calculated using the 2002 benthic invertebrate data: Swartz's Dominance Index (SDI), Shannon Diversity (H) Index, and Pielou's Evenness Index. SDI and H indices were

selected because these two were highlighted by experts as benthic community metrics most useful for determining benthic impacts (Ecology 2003). SDI is defined as the minimum number of species comprising 75% of the total abundance in a given sample. The SDI value is positively related to diversity. The H Index characterizes diversity by accounting for both abundance and evenness of species. The H value is also positively related to diversity. Pielou's Evenness Index was selected as a measure of evenness that also has RVR available and is derived from the H index. Pielou's Evenness Index is the proportion of the observed diversity (H) over the expected maximum diversity, assumed as one individual for each species. The appropriate reference point

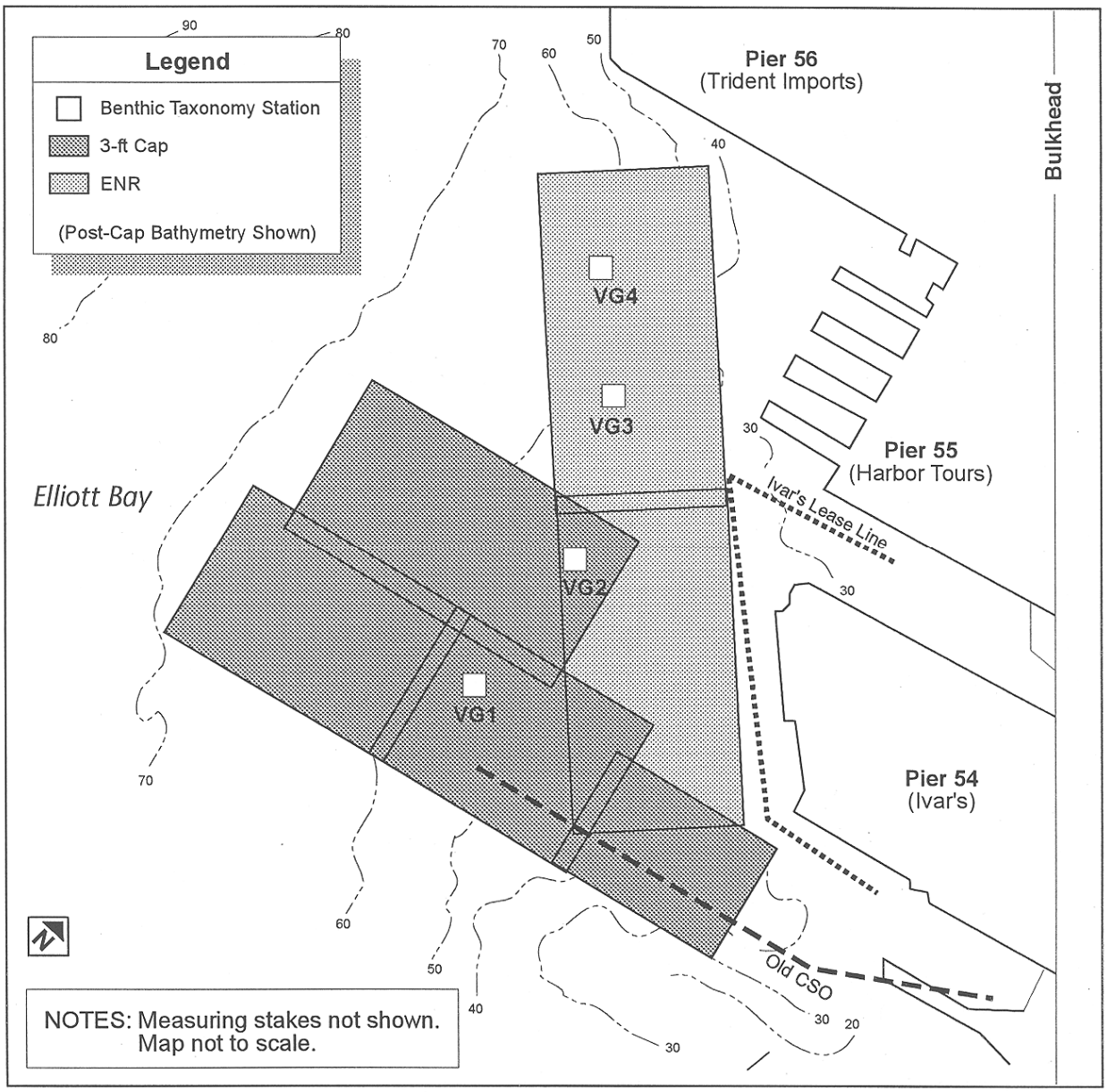


Figure 5-1. Benthic Taxonomy Stations

for comparison to benthic community data in a remediation cap can generate lengthy debate and the RVR's provided by Ecology are just one such reference point that may not be directly pertinent. However, they are included here as a piece in a weight-of-evidence discussion. Data from the Denny Way cap monitoring that spanned 10 years ending in 2000, are another reference point for discussion included herein.

To examine the changes between monitoring periods, the three indices were calculated for each previous monitoring period and their changes were graphed over time. Nonparametric tests were conducted to statistically compare differences within indices between the cap and ENR area over time. Also, two-sample t-tests were conducted on pre-cap benthic community abundance data for major taxa to test for differences between cap and ENR stations. These were compared to the results of t-tests for 2002 data to determine if significant changes occurred. A brief discussion ends this section regarding changes in pollution-tolerant and -sensitive species present before cap placement relative to 2002.

Results and Discussion

The results from the 2002 monitoring are presented first, including benthic community and biomass analyses and video survey results. Following these is a discussion of the recolonization of the cap and ENR over the monitoring period.

2002 Taxonomic Results

Complete 2002 benthic community data are provided in Appendix D and summary information for individual and species abundance are contained in Tables 5-1 and 5-2. Figure 5-2 shows that mean abundance at each station was consistently highest for polychaetes compared to mollusks, crustaceans, and other taxa. "Other" or miscellaneous taxa were consistently the least abundant of the four taxonomic groups. At the cap stations VG1 and VG2, crustaceans were the second most abundant group with mollusks not far behind. In contrast, at ENR stations VG3 and VG4, mollusks were almost as abundant on average as polychaetes and the mean abundance of crustaceans was roughly half that of polychaetes. The percent standard deviations presented in Table 5-1 demonstrate that generally greater variance between replicates was observed in the ENR area stations compared to cap stations. It is clear from Figure 5-2 that average total abundance values between stations within a treatment area (i.e. cap or ENR) were very similar.

Table 5-1. Abundance per replicate in 2002.

Station	Replicate	Polychaetes	Mollusks	Crustaceans	Other
VG1 (Cap)	1	322	146	197	36
	2	295	155	198	44
	3	297	144	183	24
	4	315	179	191	49
	5	279	128	171	35
	Average (% SD)	301.6 (5.7)	150.4 (12)	188 (6.0)	37.6 (25)
VG2 (Cap)	1	371	198	189	26
	2	299	161	178	25
	3	319	151	217	31
	4	287	158	158	17
	5	263	155	214	24
	Average (% SD)	307.8 (13)	164.6 (11)	191.2 (13)	24.6 (20)
VG3 (ENR)	1	193	200	101	36
	2	292	208	159	53
	3	228	192	103	18
	4	258	201	129	30
	5	119	178	107	21
	Average (% SD)	218 (30)	195.8 (5.8)	119.8 (20)	31.6 (44)
VG4 (ENR)	1	156	155	113	28
	2	252	185	139	53
	3	251	327	140	25
	4	226	273	166	48
	5	198	129	47	17
	Average (% SD)	216.6 (19)	213.8 (39)	121 (37)	34.2 (45)

(SD) = standard deviation

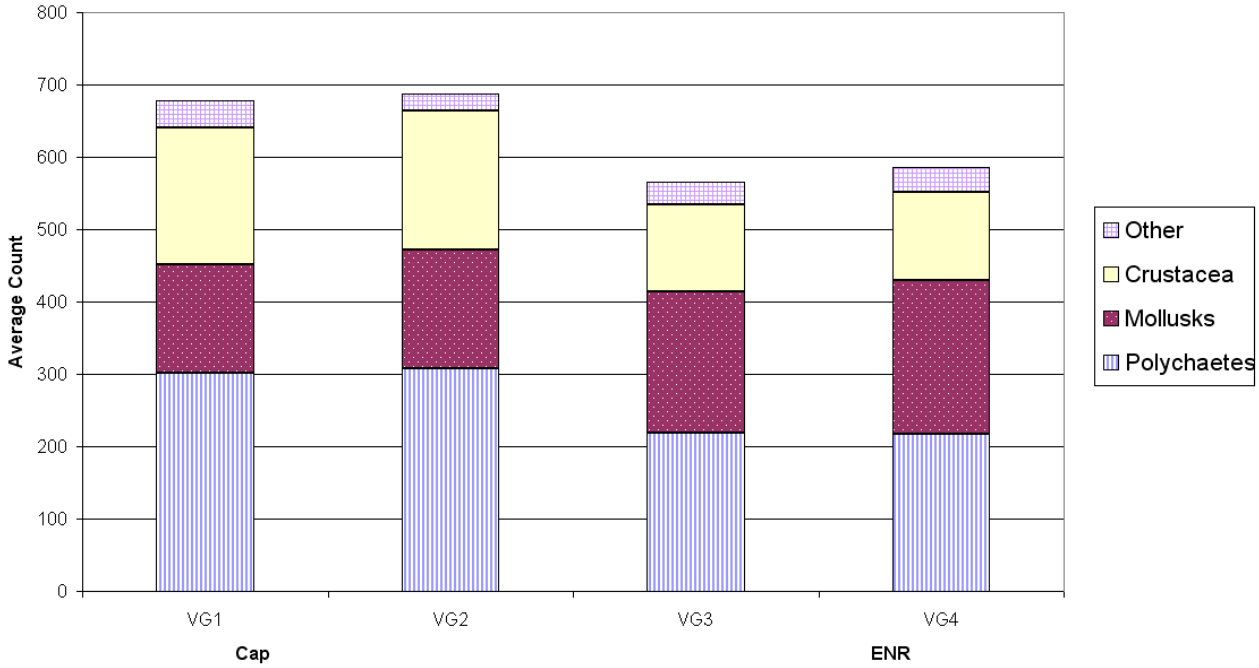


Figure 5-2. 2002 Average Counts of Major Taxa in Cap and ENR Samples

The total number of species identified at each station was very similar between stations in 2002 (Table 5-2). The variability in species abundance between replicates was usually small, less than a factor of 1.5. The large disparity between the total number of species in each replicate and the total at each station indicates that although some overlap between species found in replicates at the same station exists, there are unique species found in one replicate but not another. As with individual abundance, the number of species of major taxa was very similar within a treatment area. Considering the relative distribution of species in major taxa across both treatment areas, generally not much difference exists between stations (Figure 5-3).

Table 5-2 Species abundance per replicate in 2002

Station	Replicate	Polychaetes	Mollusks	Crustaceans	Other	Total
VG1 (Cap)	1	57	20	20	10	107
	2	56	22	19	15	112
	3	55	19	14	7	95
	4	57	24	20	12	113
	5	55	18	21	13	107
	Total	100	31	34	24	**189**
VG2 (Cap)	1	69	22	18	6	115
	2	60	20	16	10	106
	3	58	18	18	5	99
	4	67	18	16	11	112
	5	60	17	18	11	106
	Total	103	33	29	21	**186**
VG3 (ENR)	1	45	21	19	14	99
	2	60	17	22	13	112
	3	52	17	16	11	96
	4	58	20	18	8	104
	5	47	14	12	9	82
	Total	93	34	33	24	**184**
VG4 (ENR)	1	46	13	19	11	89
	2	57	18	26	11	112
	3	49	15	19	11	94
	4	58	20	21	13	112
	5	35	16	12	9	72
	Total	93	34	34	22	**183**

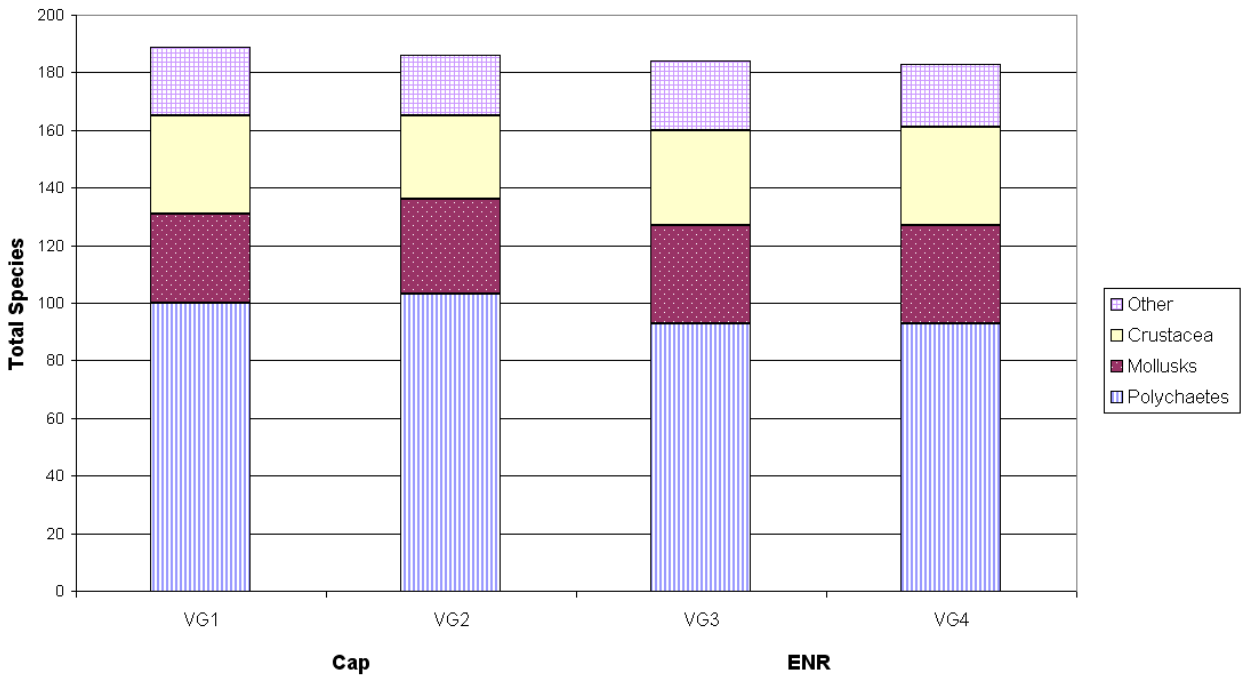


Figure 5-3. 2002 Total Species of Major Taxa Identified in Cap and ENR Samples

2002 Indices

Table 5-3 presents the calculated mean indices by station and corresponding reference value ranges (RVRs) for the 2002 benthic community data. Because the RVRs are dependent on percent fines composition, RVRs for the two ranges spanning the measured percent fines, as presented in Table5-3, were selected for comparison to benthic metrics. For SDI and H Index, values were slightly higher for cap than ENR stations. Overall, little difference exists between stations and all values are within or above the RVR's provided by Ecology. Later in this section is a discussion of these same indices in context of changes from the pre-cap community.

Table 5-3. 2002 Mean benthic indices compared to Ecology Reference Value Ranges

Area			Cap		ENR	
Station	**RVR (0-20%)**	**RVR (20-50%)**	**VG1**	**VG2**	**VG3**	**VG4**
Swartz's Dominance (SD)	5.2-24.5	7.8-19.3	26.6	24.8	22	19.8
Shannon Diversity (H')	1.0-1.6	1.1-1.5	3.7	3.7	3.5	3.5
Pielou's Evenness	0.6-0.8	0.6-0.8	0.58	0.58	0.61	0.59

RVR - Reference Value Ranges for Puget Sound Habitats based on 0-20% and 20-50% fines in units per 0.1 m^2 (Ecology 2003)

Biomass – 2002 and Overview

The mean benthic invertebrate biomass measured at each station in 2002 is summarized in Table 5-4. Polychaete, crustacean, and mollusk biomass values were very similar between stations. Mean biomass of other miscellaneous taxa varied between stations from 0.05 to 0.44 grams.

Table 5-4. 2002 Average wet weight benthic invertebrate biomass (g/0.1 m^2) per station

	Cap		ENR	
Station	**VG1**	**VG2**	**VG3**	**VG4**
Polychaetes	3.7	3.4	3.1	3.8
Crustaceans	0.51	0.43	0.4	0.27
Mollusks	2.6	3.4	2.9	3.0
Other	0.44	0.05	0.1	0.24
TOTAL	7.2	7.3	6.5	7.3

Figure 5-4 demonstrates that the mean biomass of the four major classes of invertebrates were similar between the ENR and cap stations over the monitoring period. Also, it is evident that biomass increased for polychaetes and mollusks substantially over the monitoring period. Crustacean biomass increased at a lower rate. Compared to pre-cap biomass measurements averaged across stations, the mean biomass last measured at both the ENR and cap remains lower than that of pre-cap measurements for polychaetes or mollusks (Table 5-5). The largest discrepancy appears to be for mollusks which have reached only about half the mean biomass as that measured pre-cap. The trajectory of mean biomass indicates continued increases for polychaetes and mollusks after 2002. Comparison of mean biomass values at the Denny Way cap in 2000 (Table 5-5) shows that after 10 years, the two sites have similar biomass measurements for both major taxa groups and overall, suggesting similar recolonization patterns along the Seattle waterfront..

The advanced stages of recolonization are characterized by more Stage III colonizers that have larger body mass (Zajac et al. 1998). In the pre-cap community, larger mass, late-stage colonizers would be established in the benthic community. After this community was overlaid by a cap, 3-feet or 1-foot thick, recolonization would begin from external sources, in addition to any digging invertebrates that could resurface from below. Recolonization begins with Stage I colonizers (small-bodied, opportunistic, short life cycle, high reproductive frequency, etc.) and progresses over time through to Stage III colonizers (large-bodied, slow development, low reproductive frequency, etc.). Stage I colonizers are deposit feeders that mainly feed on the sediment surface and Stage III colonizers feed within and/or on top of the sediment, or filter suspended particles (Zajac et al. 1998). Changes in sediment substrate characteristics will impact the time schedule and species composition of the recolonizing community. The high biomass of mollusks measured pre-cap at the Pier 53 Site likely reflects both the maturity of the invertebrate community characterized by Stage III colonizers, and the widely different sediment characteristics present at that time. As more sedimentation occurs on the cap and ENR, the sediment characteristics are likely to return to those of pre-cap conditions with greater proportion of percent fines and higher organic carbon content. The progressive increase of mollusk density since the caps were placed (Figure 5-4) illustrates development of the benthic community towards an advanced recolonization stage, potentially reaching a similar biomass as pre-cap in the future.

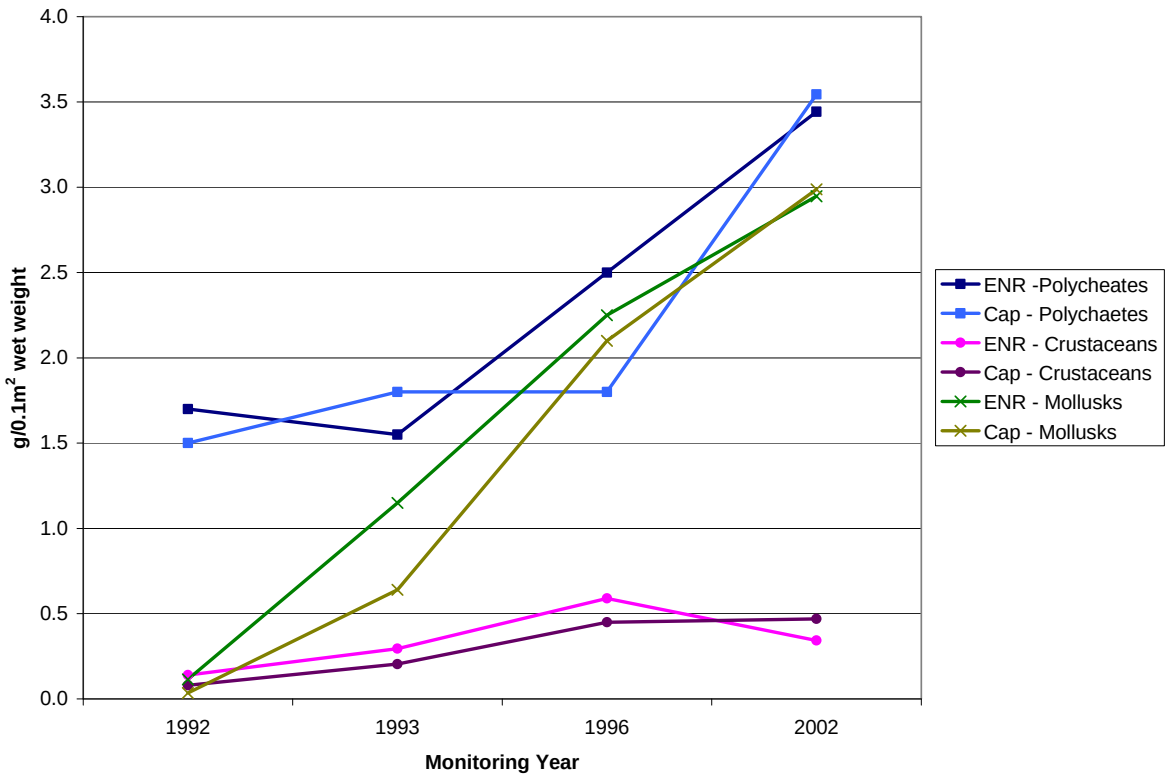


Figure 5-4. Mean Biomass of Major Taxa at Cap Compared to ENR Stations Across Monitoring Events

Table 5-5. Major taxa mean biomass (g/0.1 m^2 ww) changes with time

Area	Year	Polychaetes	Crustaceans	Mollusks	Mean Total
ENR	**Pre-cap**	5.5	0.61	7.0	13
	1992	1.7	0.14	0.12	2.2
	1993	1.6	0.3	1.2	3.0
	1996	2.5	0.59	2.3	5.8
	2002	3.4	0.34	2.9	6.9
Cap	**Pre-cap**	4.6	0.27	16	22
	1992	1.5	0.08	0.04	1.8
	1993	1.8	0.21	0.6	2.7
	1996	1.8	0.45	2.1	4.4
	2002	3.5	0.47	3.0	7.3
Denny Way	**All stations**				
	2000 (Year 10)	2.7	0.26	3.6	6.9

King County (2005) data from Denny Way cap. Pre-cap benthic community samples were not collected at Denny Way.

Video Survey Results 2002

The video survey in 2002 confirmed angled stakes at most locations. Stakes had variable degrees of encrustation from invertebrates, such as barnacles and algae, and occasionally plumose anemones.

In regard to benthic life, the deepwater area of the cap (e.g., near stakes #3, #4, #10) was relatively barren of large organic material or macroinvertebrates but showed some surficial signs of benthic invertebrate activity and spotty plant life (i.e. algae). The density of smaller organic debris and red and brown algae increased and large debris, such as submerged logs, became more prevalent as the diver traveled inshore toward stakes #1, #2, and #9. Also visible was an increase in surface irregularity indicating a more complex substrate. Occasional crabs and fish (single rockfish and schooling species) were seen in some of the shallow areas of the cap and ENR.

In some areas (e.g., between stake #4 and #3), the diver noted seeing berms and depressions, reflecting the movement of cap sediment over time due to a number of possible forces. The diver confirmed a silty sand layer on the surface of the cap.

Although the information provided by the 2002 video survey is not quantitative, it does provide information supporting other findings. The signs of benthic macroinvertebrate activity corroborate the benthic invertebrate taxonomic results showing successful recolonization. Also, surface sediment characteristics seen by the divers support the theory that sediments on the surface have been redistributed, as suggested by the cap thickness and surface sediment chemistry data.

Recolonization Over the Monitoring Period

As discussed earlier in this and in the 1993 report (EB/DRP 1993), there are generally three stages of recolonization: tube-dwelling polychaetes are Stage I colonizers, shallow-dwelling bivalves are Stage II colonizers, and the last successional stage is characterized by infaunal invertebrates that burrow below the surface. Evolution through different successional stages can occur at variable rates due to many factors such as size of the capping area, thickness of the cap, particle size characteristics of capping material, site sediment deposition rates, season, ambient fauna, etc. (Probert 1984). Because benthic community characteristics are strongly tied to sediment grain size and because the cap was intended to provide a habitat relatively clean of toxic chemicals, return of the post-cap benthic community to something resembling that of pre-cap was neither expected nor a goal. However, determination of differences between ENR and cap area recolonization and establishment of a benthic community that met or exceeded the health of pre-cap were of interest. Thus, the benthic community metrics and calculated indices over the course of the 10 year monitoring period were examined graphically and statistically with these goals in mind.

Based on the information collected after the cap was finished, recolonization occurred first from the surrounding native sediments. The video survey in 1992 (EB/DRP 1993) showed “a much richer benthic community on the edges of the cap” which follows from the movement of “external” invertebrates onto the cap and ENR. These observations were consistent for both the cap and ENR transects. The sediment–profile camera survey conducted 7 months post-cap (EB/DRP 1993) also showed that polychaetes were dominant and infaunal communities did not survive rapid burial of cap placement even in the thinner ENR area. The 1993 report concluded that recolonization appeared to be occurring from lateral migration or larval recruitment. There were no signs indicating that invertebrates from beneath the shallower ENR sand were

recolonizing the surface. Given that post-cap surveys showed the ENR thickness was sometimes greater than the targeted 30 cm, by as much as 100%, the infaunal invertebrates were not likely to avoid burial. Infauna can sometimes burrow to depths of 20-30 cm (Bolam and Rees 2003), but the shallowest measurement of the ENR was 29.6 cm (0.97 feet). Thus, the majority of the ENR was likely too deep to allow for native recolonization and a target of 15 cm may ensure more success if this goal is desired.

Mean abundance over the monitoring period generally followed expected results (Figure 5-5). At four months post-cap, mean abundance of polychaetes, mollusks and crustaceans had markedly declined. At one year post-cap, Stage I polychaetes had moved in and dominated the cap and ENR. By 1996, polychaete relative abundance had returned to 1992 pre-cap numbers and they were in more balanced competition with mollusks and crustaceans. Smaller changes in mean abundances were observed between 1996 and 2002 as the community seems to be reaching greater stability. Crustacean and "other" invertebrate abundance had surpassed pre-cap levels and polychaete abundance approached the pre-cap level. Mollusk abundance was below pre-cap but may continue to fluctuate as the community stabilizes further. The mean total abundance at the Denny Way cap after 10 years was above that at Pier 53 in 2002. Table 5-6 shows that polychaete abundance values were within the RVR for each event except 1993 when it was much higher. Ecology interprets exceedance of the RVR for this metric as indicative of impact. Abundance of mollusks and crustaceans were low 4 months after capping, but were thereafter within or higher than the RVR.

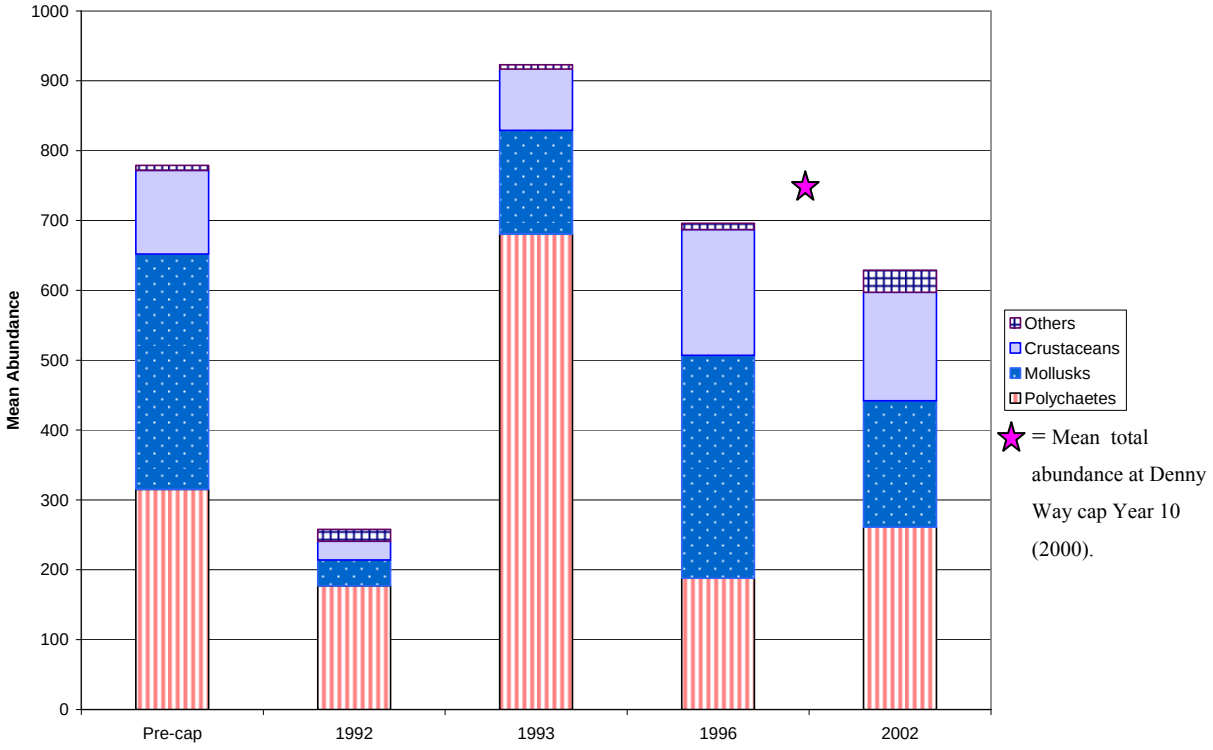


Figure 5-5. Mean Abundance (per 0.1 m^2) of Major Taxa Across All Stations Over Monitoring Period.

Table 5-6. Mean abundance (per 0.1 m^2) of benthic invertebrates over monitoring period compared to RVR.

Year			Pre-cap	1992	1993	1996	2002
Elapsed Time				4 Months	1 Year	4 Years	10 Years
# Stations			6	4	4	4	4
Taxa Group	RVR (0-20%)	RVR (50-80%)					
Mean % Fines			51	5.0	16	19	16
Polychaetes	65.2-418.8	54.2-280.8	315	177	681	188	261
Mollusks	38.3-195.7	37.1-277.4	337	37	148	319	181
Crustaceans	40.1-286	6.9-268.5	120	27	88	180	155
Others	NA	NA	7	17	6	9	32
Totals	278-764.9	120.3-736.3	781	258	923	696	629

NA = not available
RVR = Reference Value Ranges for Puget Sound Habitats based on 0-20% and 50-80% fines in units per 0.1 m^2 (Ecology 2003)

Changes in species diversity are reflected in Figure 5-6 as the number of species in each taxonomic group for each monitoring year. Similar to abundance, the number of species in all groups except "Other" declined after cap placement in 1992. Also, the number of polychaete species jumped above that of pre-cap in 1993 reflecting the influx of Stage I colonizers. Mollusk and crustacean species numbers increased to near pre-cap numbers. The only notable changes in species number between 1993 and 1996 were the increase in the miscellaneous or "Other" group to roughly double the pre-cap numbers, and the slight decrease in mollusk species abundance. Between 1996 and 2002, species diversity in polychaetes reached 40 more species than that before cap placement and the miscellaneous taxa reached nearly the same species number as those of crustaceans and mollusks. Species abundance values of major taxa groups were within or greater than RVR for each monitoring event (Table 5-7). The observed patterns reflect a greater diversity of species after recolonization of the cap and ENR than existed in the native sediments, particularly in polychaetes and miscellaneous taxa. However, the community may continue to change as fine sediment deposition continues and other local disturbances occur.

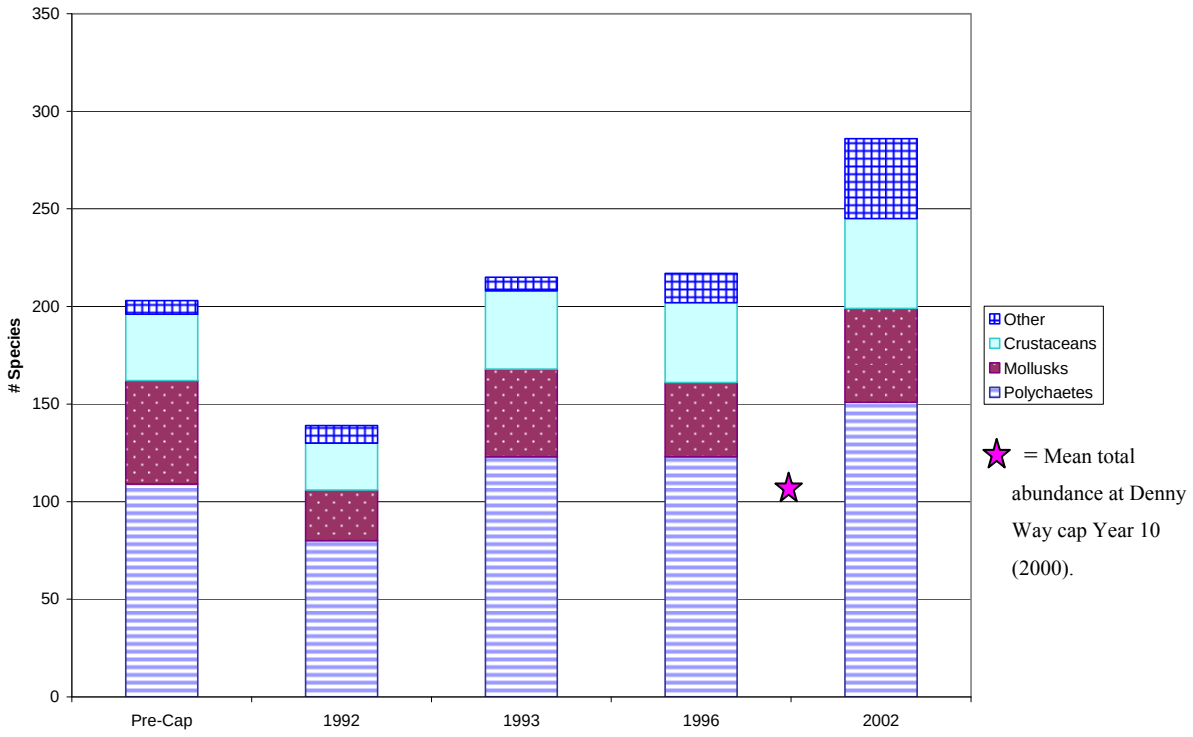


Figure 5-6. Total Species (per 0.1 m^2) Across All Stations Over Monitoring Period.

Table 5-7. Mean abundance (species per 0.1 m^2) of benthic invertebrates over monitoring period compared to RVR.

Year			**Pre-cap**	**1992**	**1993**	**1996**	**2002**
Elapsed Time				**4 Months**	**1 Year**	**4 Years**	**10 Years**
# Stations			**6**	**4**	**4**	**4**	**4**
Taxa Group	**RVR (0-20%)**	**RVR (50-80%)**					
Mean % Fines			51	5.0	16	19	16
Polychaetes	19.6-54.5	26.5-53.1	109	80	123	123	158
Mollusks	11.2-21.4	9.9-17.8	53	26	45	48	48
Crustaceans	7.8-21	6.7-17.8	34	24	40	41	46
Others	NA	NA	7	9	7	15	41
Totals	44.5-98.0	51.5-87.4	203	139	215	217	286

NA = not available
RVR = Reference Value Ranges for Puget Sound Habitats based on 0-20% and 50-80% fines in units per 0.1 m^2 (Ecology 2003)

In order to examine differences between the cap and ENR stations in major taxa composition, Pearson t-Tests (Microsoft® Access Stat Tool) were conducted grouping the replicates together from each of the ENR and cap areas for the pre-cap and 2002 monitoring events. Comparison of pre-cap ENR area (n=20) and cap (n=10) benthic invertebrate counts showed significant differences between cap and ENR areas for each major taxa group ($\alpha = 0.05$) (Table 5-8). Abundance was consistently higher for major taxa in the ENR compared to cap. Significant differences ($\alpha = 0.05$) were also found in number of polychaetes, mollusks, and crustaceans between areas for 2002 data. Significantly greater numbers of polychaetes and crustaceans and fewer numbers of mollusks were observed in the cap compared to ENR area stations. Based on

these results, abundances of major taxa were initially significantly greater in the ENR than the cap area. Ten years after the cap was placed, significant differences in abundance no longer exist between the cap and ENR among miscellaneous taxa and abundances of polychaete and crustacean taxa have shifted to be significantly lower in the ENR than the cap. The cause of this shift is unknown.

Table 5-8. Results of two-sample t-tests comparing abundance at cap and ENR stations, pre-cap and 2002

Date	Taxa Group	Cap N	ENR N	Cap Mean	ENR Mean	Mean Diff	DF	t-Value	Prob (2-tail)
Pre-cap	Polychaetes	10	20	248.9	348.9	-100.0	19	-4.292	**0.0004**
	Mollusks	10	20	230.4	390.9	-160.5	21	-2.975	**0.0072**
	Crustaceans	10	20	67.9	147.3	-79.4	21	-4.298	**0.0003**
	Other	10	20	4.7	8.6	-3.9	27	-2.807	**0.0092**
2002	Polychaetes	10	10	304.7	217.3	87.4	14	4.631	**0.0004**
	Mollusks	10	10	157.5	204.8	-47.3	11	-2.490	**0.0300**
	Crustaceans	10	10	189.6	120.4	69.2	14	5.615	**0.0001**
	Other	10	10	31.1	32.9	-1.8	16	-0.332	0.74

N = sample size
DF = Degrees of freedom
Probabilities are for separate not pooled t-test results
Mean Diff = difference between cap and ENR means
Significant probabilities are in bold ($\alpha = 0.05$)

Values for the three indices were averaged by station and graphed to compare changes over time (Figures 5-7 to 5-9). The SDI was consistently lower at all stations in the 1996 monitoring event than any other event. Variance was also consistently low between stations. In 2002, the SDI decreased from the south to north end of the site. Figure 5-7 clearly shows that the diversity of dominant species was two or more times higher in 2002 compared to pre-cap SDI values. Similar results were observed for the Shannon Diversity or H Index (Figure 5-8). Except for VG1, mean H values were lowest after capping in 1996 and mean H values at ENR stations were slightly below those of cap stations in 2002. Variance was consistently small between stations and H values in 2002 exceeded pre-cap H values at all stations. The Pielou's Evenness Index values followed a different pattern than the other two indices (Figure 5-9). All values were less than 1.0 regardless of station or year, indicating that the observed diversity was less than the expected one individual per species. According to this index, evenness increased immediately after the site was capped and then decreased to varying levels with each event afterward until it rose to its peak in 2002. Variance differed between stations and events but not in a discernible pattern. The Pielou's Evenness Index dipped below that of pre-cap in 1993 at stations VG2 (cap) and VG3 (ENR area). The final monitoring event resulted in very similar Pielou's Evenness Index values at all stations that were close to three times greater than the mean overall pre-cap values.

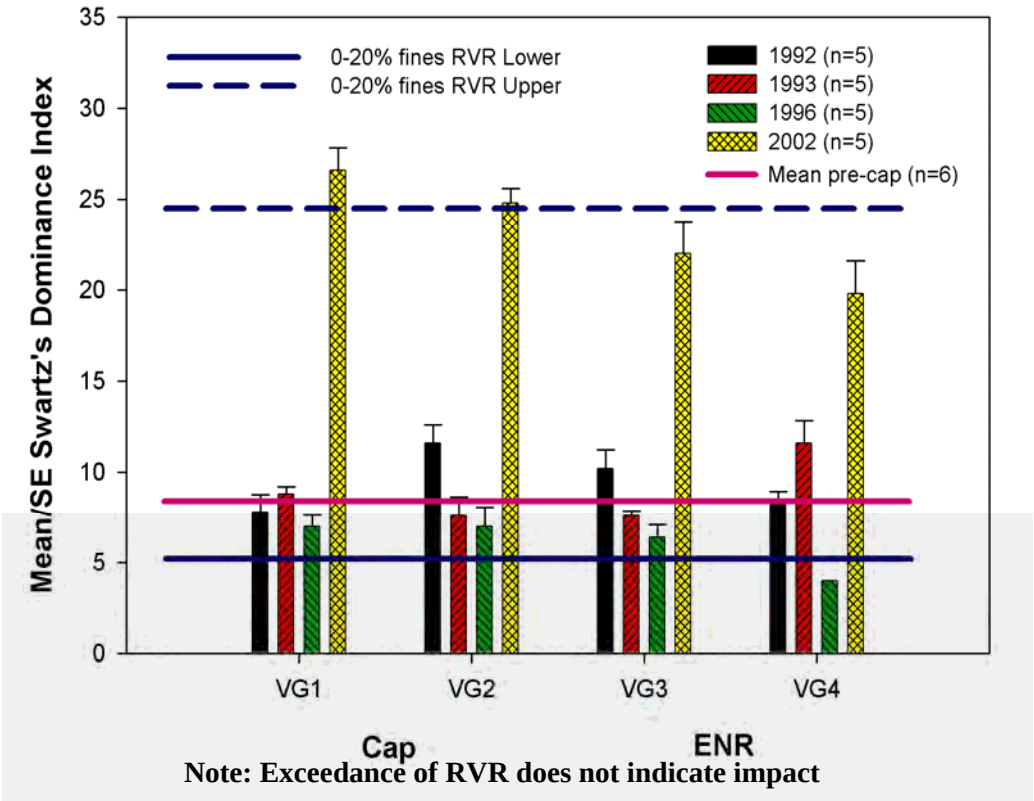


Figure 5-7. Mean Swartz's Dominance Index (SDI) Over Time.

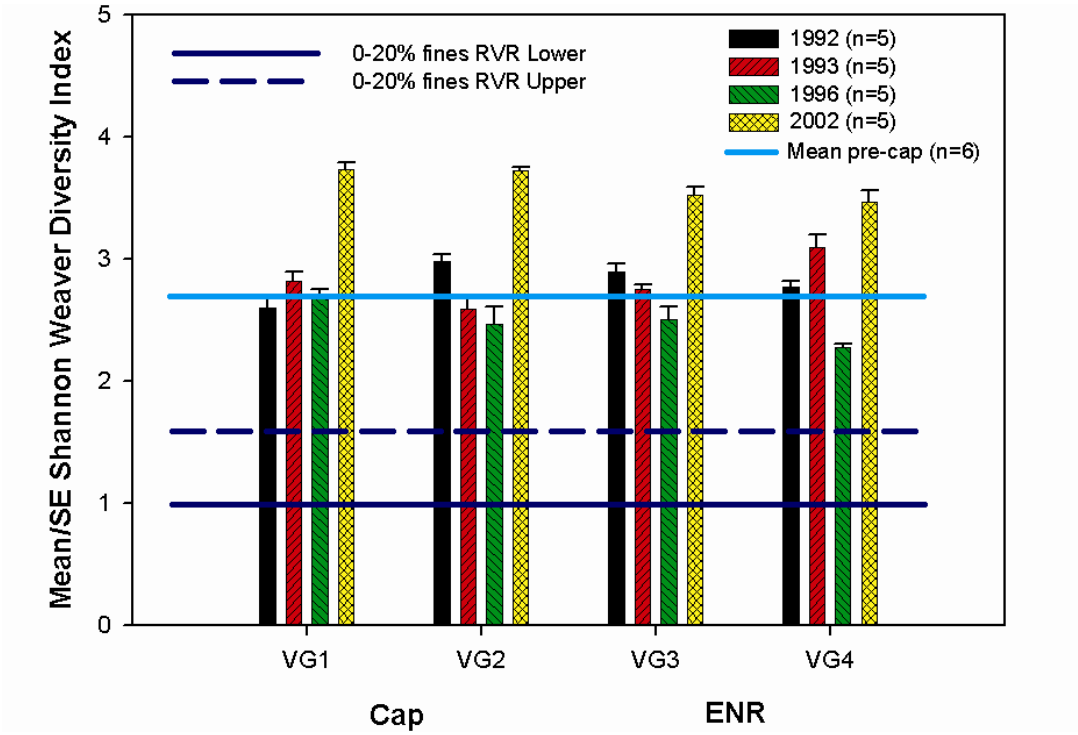
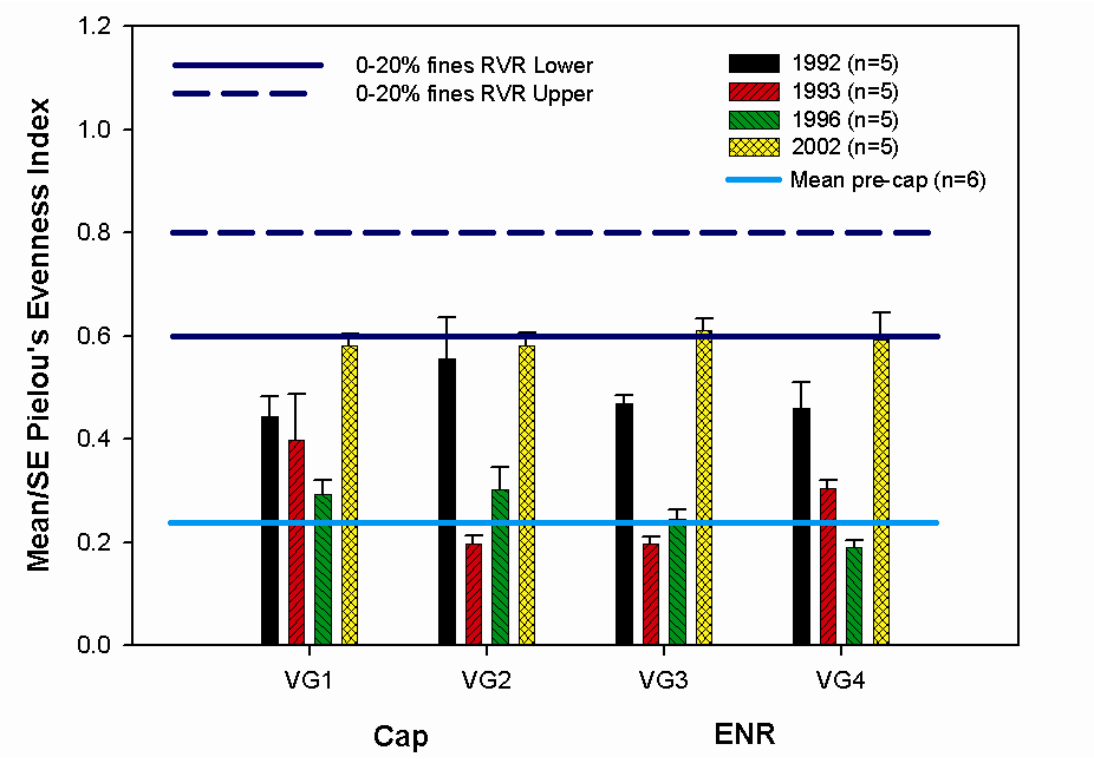


Figure 5-8. Mean Shannon Diversity Index (H) Over Time.



Note: Exceedance of RVR does not indicate impact

Figure 5-9. Mean Pielou's Evenness Index Over Time.

Statistical testing was conducted to assess differences between indices due to station location in the cap versus the ENR. None of the distributions of index values resembled a normal distribution (Crystal Ball 7.2.1 fit testing) prohibiting parametric testing. Thus, the non-parametric two-sample Mann-Whitney U test (M-W) was run to test for differences between areas in each monitoring event. Results of M-W found significant differences ($\alpha = 0.1$) for Pielou's Evenness pre-cap, and Swartz's dominance and the Shannon Diversity index in 2002 (Table 5.9). According to test results, evenness was significantly greater in the ENR compared to the cap area before cap placement, but Swartz's dominance and Shannon diversity indices were greater in the cap area in 2002 compared to ENR.

Pre-cap index and abundance differences between the cap and ENR area suggest some differences in the benthic communities perhaps due to habitat quality and/or disturbance frequency. There are many variables that impact benthic community characteristics which may have affected the ENR and cap communities and caused these results. Benthic community dynamics are complex and impacted by multiple factors. Many knowledge gaps exist limiting the multitude of possible contributing factors from being teased out.

Table 5-9. Mann-Whitney U test results Comparing Cap and ENR stations By Year

Year	Index	Cap Sum Rank	ENR Sum Rank	Cap Mean Rank	ENR Mean Rank	Ties	MW Z	MW Prob
Pre	Swartz's Dominance	184.5	280.5	18.45	14.025	27	-1.342	0.180
Pre	Shannon Diversity	205	260	20.5	13	0	-2.200	0.028
Pre	Pielou's Evenness	216	249	21.6	12.45	0	-2.684	**0.007**
1992	Swartz's Dominance	111	99	11.1	9.9	15	-0.462	0.644
1992	Shannon Diversity	101	109	10.1	10.9	0	-0.302	0.762
1992	Pielou's Evenness	105	105	10.5	10.5	0	0.000	1.000
1993	Swartz's Dominance	97	113	9.7	11.3	14	-0.619	0.536
1993	Shannon Diversity	81	129	8.1	12.9	0	-1.814	0.070
1993	Pielou's Evenness	104	106	10.4	10.6	0	-0.076	0.940
1996	Swartz's Dominance	136	74	13.6	7.4	19	-2.393	0.017
1996	Shannon Diversity	129	81	12.9	8.1	0	-1.814	0.070
1996	Pielou's Evenness	137	73	13.7	7.3	0	-2.419	0.016
2002	Swartz's Dominance	140	70	14	7	13	-2.663	**0.008**
2002	Shannon Diversity	141	69	14.1	6.9	0	-2.721	**0.007**
2002	Pielou's Evenness	94	116	9.4	11.6	0	-0.832	0.406

MW Prob = Mann-Whitney U tests probability, adjusted for ties, that samples have similarly shaped distributions.
Significant probabilities are in bold; to adjust for multiple comparison error, a Bonferroni factor of 10 was applied to $\alpha = 0.1$, making operational $\alpha = 0.01$

A brief examination of pollution-tolerant species in pre-cap compared to 2002 samples (Table 5-10) shows that the same number of pollution-tolerant species dominate in 2002 as before cap placement. This may reflect the source of recruitment for recolonization on the site being the surrounding sediments as opposed to re-emergent diggers. Living along with these pollution-tolerant species in the 2002 community are pollution-sensitive species. Echinoderms and arthropods are typically considered pollution-sensitive (Long et al. 2000). Among the miscellaneous taxa identified in 2002 (Appendix D), a high number of brittle stars, sea cucumbers, sea urchins, and a couple sea spiders were found. Most of these species were not present in the pre-cap samples. Thus, although the site appeared to have a high number of tolerant taxa both before and 10 years after cap placement, more notable is the increase in pollution-sensitive taxa that were found in 2002.

Table 5-10. Cumulative Top 5 most abundant taxa across all samples, pre-cap and 2002.

Pre-cap		2002	
Scientific Name	Common Name	Scientific Name	Common Name
Axinopsida serricata	Silky axinopsid (bivalve)	*Axinopsida serricata*	Silky axinopsid (bivalve)
Cossura sp. Indet.	Polychaete	*Dendrochirotida sp.*	Echinoderm
Euphilomedes carcharondonta	Ostracod	*Euphilomedes carcharodonta*	Ostracod
Euphilomedes producta	Ostracod	*Euphilomedes producta*	Ostracod
Exogone lourei	Polychaete	*Lumbrineris californiensis*	Polychaete
Heteromastus filobranchus	Polychaete	*Notomastus hemipodus*	Polychaete
Lumbrineris sp. Indet.	Polychaete	*Parvilucina tenuisculpta*	Fine-lined lucine (bivalve)
Macoma sp. Juv.	Macoma (bivalve)	*Pholoides asperus*	Polychaete
Mediomastus sp. Indet.	Polychaete	*Pinnixa sp.*	Crab
Notomastus tenuis	Polychaete	*Prionospio steenstrupi*	Polychaete
Nucula tenuis	Smooth nutclam	*Scoletoma luti*	Polychaete
Parvilucina tenuisculpta	Fine-lined lucine (bivalve)		
Prionospio steenstrupi	Polychaete		

Pollution tolerant species are shaded (based on Long et al. 2000)

Benthic Community Recolonization Summary

The major findings from the benthic community analysis are summarized in the following bullets:

- The site appears to have been recolonized from offsite infaunal invasion and recruitment. Native infauna appear to have been buried by both the cap sediment and the thinner ENR placement.

- Early succession on the site appears to have occurred as expected with a surge of polychaetes and a drop in crustaceans and mollusks. Individual abundances of major taxa returned to more balanced proportions by 1996. Species abundance of major taxa was similar to pre-cap by 1993. The comparison of three indices showed that SDI, diversity and evenness remained lower than mean pre-cap values in 1996 and didn't exceed this threshold until sometime between 1996 and 2002.

- Statistical testing indicates that abundances of major taxa and species, and evenness (represented by Pielou's Evenness indices) were different pre-cap between cap and ENR stations; ENR stations had greater individual and species abundance of major taxa, and evenness than cap stations. Comparable analyses of 2002 data show that some changes in major taxa and species abundance occurred between areas. The exact cause(s) for pre-cap differences between areas and the changes after capping is (are) unknown and likely complex.

- Based on comparison to Ecology RVR, the 2002 community is within the typical ranges in Puget Sound for individual and species abundance and the SDI, H, and Pielou's Evenness indices. Thus, no benthic community impacts are indicated.

- Total biomass of benthic invertebrates was low in 2002 compared to before cap placement. However, it is in agreement with that measured at the Denny Way cap after 10 years. There was similar abundance and higher diversity measured at the Pier 53 site in 2002 compared to those measured at Denny Way cap after 10 years. In addition, pollution-sensitive species were absent pre-cap but found in 2002 samples. Therefore, the Pier 53 site benthic invertebrate community appears to be similar or potentially healthier than that at a similar capping site in the region.

Benthic community recolonization and recovery after various types of disturbances has been extensively studied. Experience with dredged material disposal in coastal sites has shown that the level of stress or disturbance a habitat experiences on a routine basis affects its recovery rate. Bolam and Rees (2003) reviewed literature on macrofaunal recovery at these types of sites and found generally recovery took between one and four years in unstressed sites and nine months or less for naturally stressed sites. The goal of recovery, in this case, was defined by a return to background conditions. The remediation site is located within an urban waterfront surrounded by chemically contaminated sediments, and active sediment transport occurs along shore (EB/DRP 1995 b, c). Considering these facts, the concept of background as a natural or pristine state is not realistic or achievable. In such conditions, site characteristics tend to equilibrate with the surrounding conditions with the average condition improved due to the portion that was remediated. More relevant, is the concept of local background, which instead reflects the influences of human activity, hydrodynamics, and continuous non-local input that form the area's default state. Recovery could be defined a number of other ways, some of which are: by meeting or exceeding individual or species abundance, or biomass totals; by meeting RVR's; or by exceeding pre-cap community health as characterized by indices and metrics. If abundance metrics are examined in isolation, recovery could be concluded to have occurred at Pier 53 within 1-4 years, in agreement with the findings of Bolam and Rees (2003). Alternatively, examination of all the evidence available including comparison to a similar capping site in the area, points toward a recovery rate longer than 4 years.

The benthic community is still changing, perhaps stabilizing, and may continue to change. Different metrics are changing at different scales. This is difficult to characterize and predict; however, after 10 years it can be concluded that it has evolved into a healthier, more diverse benthic community relative to that onsite before cap placement. This improvement was observed within the first 4 years after remediation. Therefore, the overall project goal has been met based on the benthic community data.

SECTION 6: CONCLUSIONS

Cap Thickness and Settlement

Overall, the cap and ENR appear to be stable and meeting the original objectives with no signs of substantial erosion or downslope movement. Monitoring indicated that small changes in cap thickness occurred over the 10 years monitoring period and seafloor settlement was not substantial. Differences in seafloor settlement were not detected in the cap compared to the ENR area. Neither were changes in cap thickness associated with one area versus another. Overall, the cap appears stable and experiences small surficial changes in erosion and accumulation at a very local level likely due to human activities

Sediment cores and chemical isolations

In 2002, the first 6-inch section above the interface on all core samples showed the presence of more chemicals then any previous event. PCBs were detected in 2002 core samples for the first time with concentrations ranging from 14 – 39 µg/kg. This is believed to be due to MDL improvements for 2002 Aroclor analyses and not from chemical migration across the cap interface. PAH compounds were also detected in cores at the same levels as previous years. One potential identified HPAH source is the capping sand from the turning basin. Pre-dredge coring data from US ACOE confirms that HPAHs were higher in turning basin sand than core samples from the cap. This combined with some natural heterogeneity of contamination at the site, as demonstrated by the replicate sample at C4, may explain the change observed between monitoring events.

Surface sediment chemical changes

High values of PAHs and metals that occurred due to the adjacent piling removal project in 1993 dropped significantly in three years. After nine years, only the most impacted station (VG5) had concentrations that exceeded the pre-cap concentration of PAHs at the site. The PAH values at all stations were below SQS values, but remained elevated above the original baseline PAH values. The 2002 samples contained no 4-methylphenol and phenol, which were present in the 1996 samples. PCBs were detected on the cap for the first time in the 1996 samples and several stations had increased values in 2002. Increased PCB concentrations probably originated from resuspension of contaminated sediments, potentially including those located under piers where high PCB concentrations are documented. BEHP was only present at one station after one year (1993), at all stations after four years, and most values were similar after another six years. One station showed an increase in 2002 and now exceeds the SQS (VG4). The two highest BEHP values in 2002 were at VG4 and VG5, which are located on opposite ends of the cap and ENR and probably reflect input from existing contaminated sediment located beyond the cap and ENR via redistribution of resuspended sediments. Mean concentrations of the major site contaminants (PCBs, PAHs, BEHP, copper and lead) measured in 2002 were similar between the cap and ENR area stations and significantly lower than pre-cap.

Benthic community recolonization

It appears that benthic invertebrates from the surrounding area were responsible for recolonization of the cap, and the native infauna were buried under cap sediments in both the cap and ENR. The benthic community data suggest an ENR needs to be thinner than one foot to expect re-emergence of the buried community. Evidence of successional patterns based on changes in individual abundance, species abundance and dominance, and indices show the typical results after a large disturbance. Statistical analyses indicate that the benthic communities in the cap and ENR areas were significantly different from each other before cap placement and that they continue to be different in 2002, but the relationships between areas for some characteristics (i.e., individual and species abundance of major taxa) have reversed. Comparison to Ecology RVR indicates that the Pier 53 site benthic community, at 10 years after remediation, is comparable to other sites in Puget Sound that lack benthic impacts. The 2002 community at Pier 53 is also similar to that at the Denny Way cap. Overall, the various lines of evidence indicate that the 2002 benthic community at Pier 53 is healthier and more species rich than that before cap placement. The community may still change with time and as more sediment fines are deposited.

Overall, the cap and the ENR layer are both functioning to isolate contaminants and both remain stable after 10 years. There is no sign of upward migration of contaminants from underlying sediments into the cap or ENR layer. The ENR layer functioned similarly to the cap and benthic community recolonization occurred from external recruitment, not re-emergence. There is no evidence that bioturbation in the ENR layer has mixed the underlying sediments into the surface layer above. The benthic community in both areas shows characteristics of a more robust, species rich community compared to pre-cap. By these criteria, remediation of the Pier 53 site is concluded to be successful.

SECTION 7: RETROSPECTIVE ON MONITORING DESIGN

This report is the final in a series documenting a 10 year monitoring study. This section discusses the success of the program in meeting its goals and what improvements could be made in future capping projects. The discussion is organized by the program objectives presented in the Introduction.

The first objective was to provide pre-cap benthic invertebrate taxonomic data with each monitoring event. This objective was met and benthic invertebrate taxonomic data are available for all monitoring events including pre-cap.

The second objective was to guide and document the cap placement, thickness, and long-term stability. The original monitoring design called for installation of stakes and settling plate assemblies to document cap thickness and long-term stability. The equipment was successfully installed and monitored with each monitoring event. However, damage occurred to a significant number of stakes and clamps leaving spatial gaps undocumented for the remainder of the monitoring program. Where the stakes and clamps were not substantially damaged or missing, successful measurements were taken. The cause(s) of the damage are posited but uncertain and potentially unavoidable. The same method was applied at the Denny Way cap and similar damage was experienced at stakes and clamps by the end of the program. This may reflect the proximity of both sites to an active urban waterfront. In any case, it is recommended that the length of stakes protruding be reduced. On sites with steep slope concerns, staking of the cap footprint would aid in determining cap downsliding and bathymetric surveys after cap-placement would give confirmative information regarding changes in the shape of the cap. Given costs, bathymetry conducted twice, once immediately post-cap and once after 10 years, would be prudent on sites with slope issues. In addition, the regular core sampling can be used as another measure of cap thickness.

Another objective for the program was to document isolation of contaminated sediments and prevention of migration upward into the cap. The evidence from the coring chemistry results indicate that the cap contamination is isolated and migration has not occurred. The ENR layer was not designed to isolate contaminated sediments. Being a thinner layer, the ENR was designed to allow for bioturbation from re-emerging benthic invertebrates. The similarities between the cap and ENR sediment chemistry and benthic community characteristics suggest that the 1-foot layer was too thick to allow significant mixing of the ENR with the underlying sediments. Therefore, the ENR layer functioned more like a cap. The comparison of surface chemistry results in 2002 demonstrated no difference between concentrations in the cap and the ENR layer.

The program also had an objective to determine whether offsite chemicals migrated and accumulated on the surface of the cap and ENR. The initial chemical recontamination on the cap and ENR was linked to the 1993 wingwall removal project. Although this was an unusually large recontamination event, there is additional evidence that sediment has been redistributed

more recently from other off-site areas that are contaminated. Initial sampling under piers before cap placement showed high concentrations of PCBs and other contaminants. PCB sediment concentrations measured in 2002 showed increasing PCB concentrations at many stations on the cap and ENR. It is highly likely that events, such as storms and large boat or barge activity, may resuspend offsite sediments in these areas which then get redistributed to the cap and ENR. Although the exact sources of recontamination were not always identified, the monitoring design was successful in achieving its original objective. Even with this success, some improvements could be made in future projects. It is advised that the number of monitoring stations is not changed for any monitoring events as they were in this project (the number of stations was reduced one year). For this project, more evidence on possible PCB migration may have been gained from analysis of 2002 core intervals shallower than the interval immediately above the interface sample analyzed. However, the holding time window was missed. Recent cap studies have demonstrated that mixing occurs during cap placement at the sediment and capping material interface (Reible et al. 2006) within +/- 2 cm. Thus, a more accurate picture of chemical migration from the underlying sediment in this project would have been represented by analysis of the second core interval above the interface.

The benthic community data was collected with the objectives to determine the amount and type of benthic recolonization that occurs in the remediation area and whether benthic recolonization differs between the 3-foot cap and ENR. Section 5 contained an extensive discussion of benthic recolonization and an analysis comparing cap and ENR benthic community characteristics. The data collected was consistent in design and allowed for this goal to be achieved. The benthic community data analyses showed that monitoring for 10 years was long enough to demonstrate that a healthier benthic community was present relative to that before cap placement, but may not be long enough to show community stabilization. If this was to be achieved, it would require more monitoring events added between years 4 and 10 and potentially after year 10. In addition, chemical parameters and parameters which are important to benthic invertebrates, including TOC and particle size, should be measured consistently in the top 10 cm and not just the top 2 cm as occurred during the initial monitoring program. This will not only allow the comparison of chemistry results to SMS based on an appropriate depth, but will provide TOC and particle sizes for comparable depths to benthic community data.

Another objective of the monitoring program was to review and evaluate the monitoring data to determine if the cap and ENR are functioning as expected and if further actions are warranted. Considering the analytical results discussed in this report, the cap appears to be functioning well by isolating contaminants. The ENR did not facilitate mixing of contaminated sediments with the clean cap material as planned. Instead, it functioned similarly to the cap. The largest issue for both the cap and ENR is recontamination of surface sediments from off-site sources.

The last objective was to provide data that may inform and assist the Panel and other agency teams in developing future cleanup plans for Elliott Bay. Although the usefulness of these monitoring data for this objective, in part remains to be seen, the data that are supplied in this and the previous Pier 53 monitoring reports provide valuable information regarding the cap and ENR function and thickness changes, chemical recontamination, and benthic invertebrate community recolonization.

Based on the findings of this report, a thin ENR layer of 1-foot thickness functions similarly to a 3-foot cap. Thus, a thin layer of 0.5 foot is recommended for other projects desiring true benefits of enhanced natural remediation. Recontamination of the site, potentially from the contaminated waterfront areas, may necessitate further action in the future.

REFERENCES

Bolam, S.G. and H.L. Rees. 2003. Minimizing impacts of maintenance dredged material disposal in the coastal environment: A habitat approach. Environ. Manage. 3(2):171-188.

EB/DRP (Elliott Bay/Duwamish Restoration Program). 1993. Pier 53-55 Sediment Cap and Enhanced Natural Recovery Area Remediation Project. Prepared by Municipality of Metropolitan Seattle (Metro). Seattle, Washington.

EB/DRP (Elliott Bay/Duwamish Restoration Program). 1995a. Pier 53-55 Sediment Cap and Enhanced Natural Recovery Area Remediation Project, 1993 Data. Prepared by the King County Department of Metropolitan Services. Seattle, Washington.

EB/DRP (Elliott Bay/Duwamish Restoration Program). 1995b. Elliott Bay Waterfront Recontamination Study. Volume I: Field Investigation Report. Panel publication 9. Prepared by Washington Department of Ecology. Bellevue, Washington.

EB/DRP (Elliott Bay/Duwamish Restoration Program). 1995c. Elliott Bay Waterfront Recontamination Study. Volume II: Data Evaluation and Remedial Design Recommendations Report. Panel publication 10. Prepared by Washington Department of Ecology. Bellevue, Washington.

EB/DRP (Elliott Bay/Duwamish Restoration Program). 1997. Pier 53-55 Sediment Cap and Enhanced Natural Recovery Area Remediation Project, 1996 Data. Panel publication 17. Prepared by King County Water and Land Resources Division.

Ecology. 1991. Sediment Management Standards – WAC 173-204. Washington State Department of Ecology, Lacey, Washington.

Ecology 1995. Elliott Bay Waterfront Recontamination Study. Volumes I and II. Prepared for the Elliott Bay/Duwamish Restoration Program Panel by Washington State Department of Ecology, Olympia, WA. Panel Publication 9. #WA-09-0010-95-335.

Ecology. 1996. Progress Reevaluating Puget Sound Apparent Effects Thresholds (AETs). Volume 1, 1994 Amphipod and Echinoderm Larval AETs. Department of Ecology for the Puget Sound Dredged Disposal Analysis (PSDDA). Washington State Department of Ecology, Lacey, Washington.

Ecology. 2003. SEDQUAL analytical tool development support for the analysis and interpretation of benthic community data: status and recommendations. By Striplin Environmental Associates under contract to SAIC for Washington Department of Ecology, Toxics Cleanup Program, Sediment Management Unit, Lacey, Washington. Publication No. 03-09-090.

Ecology. 2008. Sediment Phthalate Workgroup homepage. http://www.ecy.wa.gov/programs/tcp/smu/phthalates/phthalates_hp.htm . Washington Department of Ecology, Toxics Cleanup Unit, Lacey, Washington.

King County. 2005. The Denny Way Sediment Cap 2000 Data Final Monitoring Report. King County Department of Natural Resources and Parks, Marine and Sediment Assessment Group.

Long, E.R, M. Dutch, S Aasen, K. Welch et al. 2000. Sediment Quality in Puget Sound: Year 2 – Central Puget Sound. U.S. Department of Commerce, National Oceanographic and Atmospheric Adm., NOS NCCOS CCMA Technical Memo No. 147 and Washington State Department of Ecology, Environmental Monitoring and Trends Section Publication No. 00-03-055.

Michelson, T. 1992. Organic carbon normalization of sediment data. Technical Information Memorandum prepared Washington Department of Ecology, Sediment Management Unit. Pub. No. 05-09-050.

Palermo, M., S. Maynord, J. Miller, and D. Reible, 1998. Guidance for In Situ Subaqueous Capping of Contaminated Sediments, EPA 905-B96-004, Great Lakes National Program Office, Chicago, IL.

Parametrix, Inc. 1992. Metro Toxic Sediment Remediation Project. Draft Final Report. Parametrix, Inc. Seattle, Washington.

PSEP 1986. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound. Prepared for the Puget Sound Estuary Program (U.S. Environmental Protection Agency Region 10) by Tetra Tech, Inc. Seattle, Washington.

PSEP 1997a. Recommended Guidelines for Measuring Metals in Puget Sound Marine Water, Sediment and Tissue Samples. Prepared for the Puget Sound Estuary Program (U.S.

Environmental Protection Agency Region 10) by the King County Environmental Laboratory. Seattle, Washington.

PSEP 1997b. Recommended Guidelines for Measuring Organic Compounds in Puget Sound Marine Water, Sediment and Tissue Samples. Prepared for the Puget Sound Estuary Program (U.S. Environmental Protection Agency Region 10) by the King County Environmental Laboratory. Seattle, Washington.

Probert, P.K. 1984. Disturbance, sediment stability, and trophic structure of soft-bottom communities. J. Mar. Res. 42: 893-921.

Reible D., D. Lampert, D. Constant, R. D. Mutch Jr., and Y. Zhu. 2006. Active capping demonstration in the Anacostia river, Washington, D.C. Remediation Journal 17 (1):39-53.

SAIC. 1992. Sediment Profile Survey of the Pier 53-55 Sediment Capping Area. Final Report by Science Applications International Corporation, Bothell, WA to Municipality of Metropolitan Seattle.

Tetra Tech, 1990. Puget Sound Ambient Monitoring Program 1989: Marine Sediment Monitoring. Prepared for the Washington Department of Ecology. Bellevue, Washington.

U.S. ACOE. 2007. A Subset of the Dredged Analysis Information System (DAIS) database queried for total PCBs, arsenic, and bis(2-ethylhexyl)phthalate in the LDW. T ransmittal of data by David Fox of the U.S. Army Corps of Engineers, Seattle, WA. March 20, 2007.

West, J. 2007. Email communication between Jim West of Washington Department of Fish and Wildlife and Jenée Colton of King County Department of Natural Resources and Parks on April 12, 2007.

Zajac, R.N., R. B. Whitlatch, and S. F. Thrush. 1998. Recolonization and succession of soft-sediment infaunal communities: the spatial scale of controlling factors. Hydrobiologia 375/376: 227-240.

APPENDIX A

MONITORING PLAN FOR PIER 53 SEDIMENT CAP

MONITORING PLAN FOR PIER 53; SEDIMENT CAPPING SITE AND ENHANCED NATURAL RECOVERY AREA SEPTEMBER 1992

CITY OF SEATTLE
DRAINAGE AND WASTEWATER UTILITY
710 SECOND AVENUE
SEATTLE 981041598

MUNICIPALITY OF METROPOLITAN SEATTLE
821 SECOND AVENUE
SEATTLE WASHINGTON 98104-1709

MONITORING PLAN FOR PIER 53;
SEDIMENT CAPPING SITE AND
ENHANCED NATURAL RECOVERY AREA
SEPTEMBER 1992

Project Description-Site Selection and Remediation Methods.,

This project site was selected as the City of Seattle's first sediment remediation site in Elliott Bay. Site selection was based on several factors including degree of contamination, completion of source control efforts, and simplification of property ownership issues (refer to unpublished draft report "Metro Toxic Sediment Remediation Project", Parametrix, August 1991). An interagency advisory panel, including EPA and Ecology was consulted to determine the criteria for site selection. One suggestion of the panel was that initial remediation efforts be confined to parcels of public ownership, in order to minimize legal disputes regarding access and responsibility. The Pier 53 site is on property owned by the Washington State Department of Natural Resources and is at the location of a former deep water sewer outfall. The deep water outfall has been abandoned. There is presently a combined sewer overflow adjacent to the site which has been controlled to a maximum of one event per year. There is also a stormwater outfall at the same location, which is at the end of Madison Street.

Potentially contaminated areas exist adjacent to the site under piers 53, 54, and 55. These areas are not accessible for capping by the proposed placement method and were not included in the project scope. During the course of project monitoring, sediment samples will be taken from adjacent properties and provided to Ecology for consideration of future remediation action. If any recontamination of the site occurs, these adjacent properties will be evaluated as potential material sources. At this time the migration effects of contaminated sediments from adjacent sites onto the clean cap material are unknown; the data collected from this site will be valuable for planning and coordinating future remediation projects along the central waterfront.

The project involves two different approaches to sediment remediation. The primary approach is to place a three foot cap of clean dredged material to isolate the contaminated sediments. This cap will be placed on the deeper portions of the project site, covering approximately 2.9 acres. The second approach involves the experimental placement of a one foot layer of clean dredged material on the near shore portion of the site, covering an area of 1.6 acres. This is referred to as enhanced natural recovery. This experimental remediation action was required by Washington State DNR as a condition of project approval in order to minimize the potential future navigational impacts of capping and also to provide some experimental data on the feasibility of using a thinner layer of material to accomplish remediation in shallower areas.

The intent of the three foot cap is to isolate the underlying contaminated sediments and to provide a clean substrate for bottom dwelling and bottom feeding organisms. A three foot cap depth is generally considered to be sufficient to prevent burrowing organisms from breaching the lower cap boundary and entering the underlying contaminated sediments. This method has been used before as a remediation technique in both Commencement Bay and Elliott Bay. The

Elliott Bay project is at the Denny Way site, which was capped by METRO in 1990. The proposed project would use clean dredged materials from the turning basin in the Duwamish River, which was also the material source for the Denny Way site. Sediment will be provided and placed by the US Army Corps of Engineers using split hull scows similar to those used at the Denny Way site.

The intent of the one foot thick enhanced natural recovery area is to attempt a recovery method that would be applicable to shallow urban areas where a thicker cap may affect navigational uses or would be logistically difficult to place, such as under piers or adjacent to bulkheads. There are three potential benefits to this approach. A one foot sediment placement would minimize the loss of navigational depth. It may also allow the larger organisms existing on the site to migrate through the sediment and to recolonize the new material. Lastly, the placement of small amounts of clean material may help accelerate the natural degradation of organic chemicals by the biological community.

Objectives

Environmental monitoring for the project involves both short term activities needed to facilitate material placement and to establish baseline information, plus longer term activities needed to document the functional success of the remediation efforts. The strategy for long term monitoring is to do a baseline monitoring within three months of placement, and to repeat monitoring both one, two, and ten years after placement. One other year of monitoring will be added, the timing of which will be decided based on the results of the first two years of monitoring.

There are seven main objectives associated with the monitoring program as listed below. A summary of the sampling activities and schedule are provided in Table 1 and sampling stations are shown in Figure 1.

OBJECTIVE 1 Provide baseline taxonomic data.

OBJECTIVE 2 Guide and document the sediment placement, thickness, and long term stability.

OBJECTIVE 3 Document how well the three foot cap and the enhanced natural recovery area function to isolate contaminated sediments from migrating upwards into the cap, and to document the extent of that contamination if it occurs.

OBJECTIVE 4 Identify whether chemicals accumulate on the remediation site such that they indicate migration of materials from off-site.

OBJECTIVE 5 Determine the amount and type of benthic recolonization that occurs on the project site and determine whether there are differences in the character and rate of recolonization between the three foot cap and the one foot thick enhanced natural recovery area.

OBJECTIVE 6 Review and evaluate the monitoring data with the regulatory agencies to determine (1) if the three foot cap is functioning as expected to isolate

contaminated sediments; (2) if a one foot layer of sediment will function as expected such that biological mixing occurs to enhance natural recovery; (3) whether further actions are warranted for either the capping site or the enhanced natural recovery area.

OBJECTIVE 7 To provide data that may inform and assist the NOAA panel and other agency teams in developing future clean up plans for Elliott Bay.

c

Cap Placement and Thickness

Bottom stakes will be used to document the placement and thickness of capping sediments. These will be set by divers inside the area of intended remediation in order to verify the thickness of the placed materials. Stake locations are shown on Figure 1. Initial readings to verify the depth of the new material will be made during the initial monitoring period. An independent check on the thickness of the "capping" materials will also be obtained when sediment cores are collected and processed during the post-placement monitoring discussed in the next section.

A sediment-profile camera survey of the project area and the adjacent seafloor will be conducted in conjunction with the benthic infaunal sampling. One objective of this survey will be to map the areal distribution of capping material at the site. Surface (0-20 cm) sediment grain-size and microstratigraphic layering will be determined from the images and mapped. -The sediment-profile surveys, consisting of approximately 100 sampling locations, will be conducted several times throughout the monitoring program, including years 1 and 2. These surveys will allow the distribution of capping material to be mapped over time. These data will supplement the stake observations and core data, and provide a measure of cap dispersal and erosion.

Two follow-up diver surveys of "cap" thickness will be conducted within the four years as summarized in Table 1. These will be conducted at approximately 27 and 51 months after the material is placed to see if there are any obvious differences in the thickness of that material. An analysis of each years data will be included in a report and discussed during a report review meeting and during the four year review. Decisions about when to conduct further bathymetricor diver surveys beyond 51 months will be made in conjunction with Ecology, DNR, EPA, and the Corps of Engineers during the four year review process.

Isolation of Contaminants

Sediment cores will be used to determine if there is any vertical migration of chemicals up into the clean "cap" material. A total of five coring stations will be established as shown in Figure 1. Three coring stations are located in the area of the three foot cap, and two coring stations are located in the area of the one foot experimental enhanced recovery area. These coring stations provide spatial coverage across the project site and are intentionally located a minimum of 50 feet away from other sampling stations so that any potential release of contaminated sediment from the cores will not affect other surface sediment sampling stations.

One core will be collected from each of the five stations. Each core will extend completely through the clean remediation material and into the underlying contaminated sediments about one

foot, as shown in Figure 3. Six-inch long sections of the cores will be retained as samples for chemical analysis. Where the three-foot cap is placed, one (1) 6-inch section will be taken below the interface and four (4) of the 6-inch core sections will be taken from above the interface, for a total of five sections. Where the one foot thick material is placed, one (1) 6-inch section will be taken below the interface but only one (1) or two (2) 6-inch sections will be taken from above the interface, depending on the actual material depth achieved by placement. Because mixing can occur around the interface due to the physical process of sediment placement, it is important to leave a space of at least one inch above the interface before taking the first sample. The exact distance will be determined after inspecting the interface of each baseline core, but will remain the same for future cores.

Sediment cores required to establish baseline data will be collected as soon as practical within three months after cap placement. All sections of each baseline core will be analyzed for metal and organic priority pollutants including as a minimum, those required by Washington State Sediment Standards (ref: WAC-173-204). Future core samples will be collected adjacent to the baseline stations to allow comparison of data. All sample sections will be collected for each core taken after the baseline cores, but initially only the first section above the interface will be analyzed for those chemicals found in the underlying contaminated sediments, to determine whether any chemical migration is evident. If chemical migration appears evident, sections further up the core will then be analyzed to determine how far chemical migration extends into the clean "cap" material. Decisions about whether to analyze additional sections will be made within the storage times established under the Puget Sound Protocols.

Additionally, if chemical contamination appears in the enhanced natural recovery area (one foot thick sediments) two avenues of contamination will be considered. If the contamination occurs at the top of the cap material, biological mixing from underlying sediment or deposition of new contamination will be suspected. If the contamination occurs in the bottom only, contamination from migration will be suspected.

Evaluation of vertical migration in the bottom of the "capping" materials will be limited to only chemicals that were present in the underlying sediments. Data will be normalized to dry weight to allow comparisons. Vertical migration from the "cap" downward will be evaluated if there is evidence of significant chemical accumulation on the project site based on surface sediment samples. Also, a direct measure of cap thickness will be made and compared to the thickness indicated by the bottom depth surveys.

Initial core sampling will be done within three months of "cap" placement. Subsequent sampling will be done one year, four years, and ten years after the initial sampling. An analysis of each years data will be included in a monitoring report and the results discussed during a report review meeting and during the four year review. Decisions regarding the possibility of an additional core sampling between the four year and ten year sampling events will be made in conjunction with Ecology, DNR, EPA, and the Corps during the four year review process scheduled for 1996.

Surface Contamination of Project Site and Adjacent Property

To provide information requested by Ecology and EPA, surface contamination of adjacent

property will be determined by collecting and analyzing samples from six stations in 1992 as shown on Figure 1 and 2. Four of these sample sites are located east of the project under the piers; samples from these sites will be collected either by diver or by small grab. Two of the stations are located south of the project site and will be collected with a Van Veen grab sampler. A stainless steel "cookie cutter" will be used to collect the top two centimeters of sediment from three replicate samples per station. These sub-samples will be composited, and then analyzed for priority pollutants, metal and organic including all the routine Ecology sediment chemical parameters. Data for all stations will be normalized to dry weight for comparison between stations and years. Data from these six stations will be provided to Ecology for comparison to other areas along the Seattle waterfront.

Accumulation of surface sediment contamination on the project site will be evaluated by collecting and analyzing samples from seven stations as shown in Figure 1. Samples will be collected with a Van Veen grab sampler. A stainless steel "cookie. cutter" will be used to collect the top two centimeters of sediment from three replicate samples per station. These sub-samples will be composited, and then analyzed for priority pollutants, metal and organic, including all the routine Ecology sediment quality chemicals. Data for all stations will also be carbon normalized for comparison to the state sediment standards.

Chemistry data will be compared to the previously collected data (baseline and 15 month) to determine whether a change has occurred. If significant accumulation has occurred, there will be an assessment of the chemistry data from adjacent sites (as noted above) to evaluate whether they are a contributing source.

Initial surface sediment samples will be taken three months after placement. Subsequent samples will be taken one year, four years, and ten years after initial sampling. An analysis of each years data will be included in the monitoring report and discussed during a report review meeting and during the four year review. Decisions about the need, the frequency, and the extent of surface sediment sampling for the period between the four year and ten year samples will be made in conjunction with Ecology, DNR, EPA, and Corps of Engineers during the four year review process in 1996.

Benthic Recolonization

Benthic conditions immediately prior to capping will be documented by collecting and analyzing sediment samples from two stations in the enhanced natural recovery area. A Van Veen sampler will be used to collect five replicates per station and samples will be processed according to Puget Sound protocols. Benthic taxonomy samples will be screened through a standard 1.0 mm mesh and all organisms identified to the lowest practical taxonomic level (preferably to species).

To evaluate recolonization of the project site, taxonomic data will be collected from two stations on the three foot cap and two stations on the enhanced natural recovery area as shown on Figure 1. This should provide a reasonable representation of the type of recolonization that occurs over the entire projet site. Also, this allows a comparison between recolonization on the three foot cap and the one foot thick enhanced natural recovery area. The first post-placement sampling will occur in summer of 1992. A Van Veen sampler will be used to collect five replicates per station

and samples will be processed according to Puget Sound protocols. Benthic taxonomy samples will be screened through a standard 1.0 mm mesh and all organisms identified to the lowest practical taxonomic level (preferably to species). Table 1 shows the schedule for benthic taxonomy sampling which will yield initial samples at about 5 months, after cap placement. Subsequent samples will be taken one year, four years and ten years after initial sampling. Decisions about taxonomy sampling between the four year and ten year sampling event will be determined in conjunction with Ecology, DNR, EPA, and the Corps of Engineers. Data will be included in a monitoring report and then discussed during a report review meeting and during the four year review. This recolonization analysis will involve comparing each years data to the previous data and at the end of four years to an appropriate reference station.

As described above, a sediment-profile survey of the site will be conducted to map the near-surface distribution of capping material at and adjacent to the site. During the first year survey, approximately 100 images will be collected and given a "quick look" analysis to determine the grain size, Redox Potential Discontinuity depth, depth of penetration, and infaunal successional stage. During subsequent years surveys, up to 24 images will be selected for a more detailed analysis of geochemical and biological parameters with a technique known as REMOTS analysis (Rhoads and Germano, 1986; 1982). These 24 images will be selected to include the three foot capping area, the natural recovery area, and the areas adjacent to the project site. The REMOTS image analysis will include the mapping of "apparent" Redox Potential Discontinuity (RPD) depths and infaunal successional stages. These data will be used, in conjunction with the benthic infaunal data, to document the pattern(s) of benthic recolonization and biogenic sediment reworking across the study area. Sediment-profile surveys will be conducted at the same intervals as the benthic taxonomy sampling.

Review and Evaluation Process

A review process will be conducted on a regular basis to evaluate the monitoring data and determine if the cap is functioning as expected. To help facilitate this review, a monitoring report will be prepared that presents and analyzes the data. The monitoring report will be produced once each year that new monitoring data is obtained. Table 2 provides an outline of the topics to be addressed in the monitoring report.

Each monitoring report will be distributed to DNR, Ecology, EPA, the Corps of Engineers, and other interested groups, including the NOAA panel that will direct the City of Seattle/Metro settlement action. A meeting will be held to discuss and evaluate the report and conclusions for each year that a report is issued. A major monitoring review will be conducted after four years and will include discussions about monitoring needs beyond four years. These discussions will consider whether the cap is functioning as expected and what contingency actions might be warranted if the cap is not functioning as expected, including whether resulting conditions at the cap surface warrant further action.

APPENDIX B

2002 QA CHEMISTRY REPORT

KING COUNTY ENVIRONMENTAL LABORATORY
QUALITY ASSURANCE REVIEW

for

PIER 53 SEDIMENT CAP MONITORING PROJECT
FINAL SAMPLING EVENT, TENTH YEAR
September 2002

July 8, 2010

King County Environmental Laboratory
322 West Ewing Street
Seattle, Washington 98119-1507
(206) 684-2300

KING COUNTY ENVIRONMENTAL LABORATORY
QUALITY ASSURANCE REVIEW

for

PIER 53 SEDIMENT CAP MONITORING PROJECT
FINAL SAMPLING EVENT, TENTH YEAR
September 2002

Prepared by:

_____
Fritz Grothkopp
Laboratory Project Manager
Environmental Lab

Reviewed by:

_____
Colin Elliott
Quality Assurance Officer
Environmental Lab

July 8, 2010

King County Environmental Laboratory
322 West Ewing Street
Seattle, Washington 98119-1507
(206) 684-2300

INTRODUCTION

This quality assurance (QA) narrative is intended to document the QA review conducted on the chemistry analyses performed for the Pier 53 Sediment Cap Monitoring Study. The QA narrative is organized into the five sections listed below.

- General Comments
- Sample Collection
- Conventional Analyses
- Metal Chemistry
- Organic Chemistry

An overview of the approach used for the QA review is detailed in the *General Comments* section. Additional information specific to each analysis is included in the appropriate section.

This QA review and narrative (specifically defined as QA1) have been conducted in accordance with guidelines established through the Puget Sound Dredged Disposal Analysis (PSDDA) program and the Sediment Management Standards (WAC 173-204-610). Other approaches incorporated in the QA review have been established through collaboration between the King County Environmental Laboratory (KC Laboratory) and the Washington State Department of Ecology (Ecology) Sediment Management Unit.

GENERAL COMMENTS

Scope of Samples Submitted

This QA review is associated with marine sediment samples collected in September 2002 as part of the Pier 53 Sediment Cap Monitoring Project. This sample set represents the tenth and final year of a ten year monitoring plan.

Except where noted in the subcontracting sections of this QA review, all analyses have been conducted by the King County Environmental Laboratory (KCEL). Sediment analytical data are reported with associated data qualifiers and have undergone QA1 review, as summarized in this narrative report.

Completeness

Completeness has been evaluated for this data submission and QA review by considering the following criteria:

- Comparing reported data to the planned project analyses summarized in Table 1.
- Compliance with storage conditions and holding times.
- Frequency of analysis of the complete set of quality control (QC) samples outlined in Table 2.

Subcontracted Analyses

Analyses that have been subcontracted and the issues associated with these subcontracted analyses are noted in this narrative.

Methods

Analytical methods are noted in the applicable analytical sections of this QA review.

Target Lists

The reported target lists have been compared to the target analytes listed in *Table 1 - Marine Sediment Quality Standards Chemical Criteria* and *Table 3 - Puget Sound Marine Sediment Cleanup Screening Levels Chemical Criteria* contained in Chapter 173-204 WAC.

Detection Limits

The KC Laboratory distinguishes between the reporting detection limit (RDL) and the method detection limit (MDL).

- The RDL is defined as *the minimum concentration of a chemical constituent that can be reliably quantified.*
- The MDL is defined as *the minimum concentration of a chemical constituent that can be detected.*

Some subcontracted laboratory data are available with an MDL only, in accordance with the subcontracting laboratory policies. All analytical parameters are reported with detection limit(s). For some methods the detection limits reported may vary from sample to sample depending on the amount of sample analyzed and any additional dilutions required.

Storage Conditions and Holding Times

Storage conditions and holding times have been evaluated using guidelines established during the Third Annual PSDDA Review Meeting. The approach used to evaluate Total Organic Carbon for holding time has been established between the KC Laboratory and Ecology during previous QA1 review efforts. Extraction and analysis holding times for each method are summarized in each analytical section.

Method Blanks
Method blank results have been used to evaluate the possible laboratory contamination of samples. Method blank results have been reviewed for the presence of analytes detected at or greater than the MDL.

Standard Reference Materials
Standard reference material (SRM) recoveries have been used to evaluate possible low or high analytical bias on a batch-specific basis. SRM analysis is included with metals and selected organic and conventional parameters (see Table 2). SRMs are purchased from outside agencies and generally have a certified analyte value. Lab Control Samples (or spiked blanks) may also be analyzed by the analytical laboratory as part of overall quality control but the results are not used to qualify the sample data.

Matrix Spikes
Matrix spike recoveries have been used to evaluate possible low or high analytical bias on a matrix and batch-specific basis. Matrix spikes are analyzed with metals, organics and selected conventionals parameters (see Table 2).

Laboratory Replicate Samples
Replicate analysis (laboratory duplicates or triplicates) is used as an indicator of method precision and is used to qualify data on an analyte and batch-specific basis. Not all replicate data are used, however, as an indicator for data qualification. Only sets of replicate results which include at least one result greater than the RDL are considered for data qualification. These guidelines have been used to account for the fact that precision obtained near the detection limit is not representative of precision obtained throughout the entire analytical range.

Surrogates
Surrogate recoveries have been used to evaluate possible low or high analytical bias on a sample-specific basis. Surrogates are only analyzed for organic parameters.

Data Qualifiers
The data qualification system used for this data submission is presented in Table 3. These data qualifiers address situations that require qualification and generally conform to QA1 guidance. Changes made to SRM data qualification have been discussed with and approved by the Sediment Management Unit of Ecology. Table 3 also shows the qualifiers used for the Sedqual electronic data format.

Units and Significant Figures
Data have been reported in accordance with laboratory policy at the time of data generation. Data generally have been reported to three significant figures if above the RDL and two significant figures if equal to or below the RDL.

SAMPLE COLLECTION

This section describes sampling activities associated with the collection of 35 grab and 13 core marine sediment samples in September 2002. These samples were collected for the Pier 53 Sediment Cap Monitoring Project. All sampling activities were conducted following guidance suggested in the Puget Sound Protocols (PSEP, 1996 and 1998).

Sampling Locations and Station Positioning

Sampling locations (stations) were selected and the prescribed coordinates determined prior to field activities. The prescribed station coordinates are presented in the following table. Also presented in the table are the actual coordinates recorded during sampling activities. All station coordinates are recorded in both latitude/longitude and state plane coordinate system North American Datum 1983 (NAD83).

Pier 53 Sediment Core & Grab Prescribed Location Coordinates

Locator Name	Northing	Easting	Sample Type
P53C1	223829	1268656	Core Sample
P53C2	223886	1268497	Core Sample
P53C3	224002	1268422	Core Sample
P53C4	224131	1268450	Core Sample
P53C5	224215	1268387	Core Sample
P53VG1	223878	1268451	Surface Sample
P53VG2	224026	1268461	Surface Sample
P53VG3	224175	1268430	Surface Sample
P53VG4	224277	1268346	Surface Sample
P53VG5	223874	1268620	Surface Sample
P53VG6	223996	1268560	Surface Sample
P53VG7	223836	1268267	Surface Sample

Pier 53 Sediment Actual and Prescribed Sample Coordinates, Sept. 2002

Core Stations

		Prescribed	Prescribed	Actual	Actual
Lab Number	Station Name	Northing	Easting	Northing	Easting
L25512-1	C-01	223829	1268656	223831	1268654
L25512-2	C-02	223886	1268497	223888	1268494
L25512-3	C-03	224002	1268422	224005	1268419
L25512-4	C-04	224131	1268450	224129	1268449
L25512-6	C-04	224131	1268450	224132	1268447
L25512-5	C-05	224215	1268387	224216	1268384

Pier 53 Sediment Actual and Prescribed Sample Coordinates, Sept. 2002

Surface Grab Station

		Prescribed	Prescribed	Actual	Actual
Lab Number	Station/Fraction	Northing	Easting	Northing	Easting
	P53VG1	223878	1268451		
L25703-1	P53VG1: 1chem			223878	1268451
L25702-1	P53VG1: 1chem			223874	1268453
L25702-1	P53VG1: 1chem			223877	1268455
L25702-2	P53VG1: 2chem			223879	1268456
L25702-2	P53VG1: 1chem			223874	1268450
	P53VG2	224026	1268461		
L25702-3	P53VG2: 1chem			224021	1268461
L25702-3	P53VG2: 1chem			224031	1268461
L25702-3	P53VG2: 1chem			224024	1268458
L25702-4	P53VG2: 2chem			224024	1268459
L25702-4	P53VG2: 1chem			224019	1268455
	P53VG3	224175	1268430		
L25702-5	P53VG3: 1chem			224180	1268430
L25702-5	P53VG3: 2chem			224175	1268427
L25702-6	P53VG3: 1chem			224175	1268430
L25702-6	P53VG3: 2chem			224171	1268435
	P53VG4	224277	1268346		
L25702-7	P53VG4: 1chem			224277	1268346
L25702-7	P53VG4: 2chem			224280	1268348
L25702-8	P53VG4: 1chem			224276	1268345
L25702-8	P53VG4: 1chem			224278	1268346
L25702-8	P53VG4: 1chem			224283	1268343
	P53VG5	223874	1268620		
L25702-9	P53VG5: 2chem			223869	1268615
L25702-9 L25702-10	P53VG5: 2chem			223871	1268616
L25702-10	P53VG5: 1chem			223878	1268629
L25702-10	P53VG5: 1chem			223883	1268619
	P53VG6	223996	1268560		
L25702-11	P53VG6: 2chem			224003	1268557
L25702-11 L25702-12	P53VG6: 2chem			223996	1268562
L25702-12	P53VG6: 2chem			223997	1268558
	P53VG7	223836	1268267		
L25702-13	P53VG7: 2chem			223827	1268264
L25702-13 L25702-14	P53VG7: 2chem			223837	1268264
L25702-14	P53VG7: 1chem			223833	1268260
L25702-14	P53VG7: 1chem			223832	1268268
L25702-15	P53VG7: 1chem			223833	1268266
L25702-15	P53VG7: 2chem			223828	1268266

Sample Description Table

Lab Number	Station	Sample Collection	Sediment Depth (from surface)	Sample Usage
L25702-1	P53VG1	Surface Grabs	2 cm	Chemistry
L25702-2	P53VG1	Surface Grabs	10 cm	Chemistry
L25702-3	P53VG2	Surface Grabs	2 cm	Chemistry
L25702-4	P53VG2	Surface Grabs	10 cm	Chemistry
L25702-5	P53VG3	Surface Grabs	2 cm	Chemistry
L25702-6	P53VG3	Surface Grabs	10 cm	Chemistry
L25702-7	P53VG4	Surface Grabs	2 cm	Chemistry
L25702-8	P53VG4	Surface Grabs	10 cm	Chemistry
L25702-9	P53VG5	Surface Grabs	2 cm	Chemistry
L25702-10	P53VG5	Surface Grabs	10 cm	Chemistry
L25702-11	P53VG6	Surface Grabs	2 cm	Chemistry
L25702-12	P53VG6	Surface Grabs	10 cm	Chemistry
L25702-13	P53VG7	Surface Grabs	2 cm	Chemistry
L25702-14	P53VG7	Surface Grabs	10 cm	Chemistry
L25702-15	P53VG7	Surface Grabs (field replicate)	10 cm	Chemistry

Sample Description Table

Lab Number	Locator	Sample Collection	Sediment Depth (from surface)	Sample Usage
L25512-1	P53C1	Core Sample	1”-6” Above	Chemistry
L25512-2	P53C2	Core Sample	1”-6” Above	Chemistry
L25512-3	P53C3	Core Sample	1”-6” Above	Chemistry
L25512-4	P53C4	Core Sample	1”-6” Above	Chemistry
L25512-5	P53C5	Core Sample	1”-6” Above	Chemistry
L25512-6	P53C4	Core Sample (field replicate)	1”-6” Above	Chemistry

Sediment grab samples were collected from the King County research vessel *Liberty*, which is equipped with a differential global positioning system (DGPS). Sediment core samples were collected from the Bio-Marine Enterprises research vessel *Kittiwake*, which is equipped with a differential global positioning system (DGPS). Field coordinates were recorded using DGPS for each deployment of the grab or core sampler as it contacted the sediment. The DGPS is a satellite-based navigation system that operates using a receiver to calculate ground position by triangulating scrambled data transmitted by a constellation of satellites operated by the Department of Defense (DOD). The ship-board "differential" receiver receives both the scrambled DOD signal and "corrected" signals originating from base stations operated by various agencies including the Coast Guard and King County. System software applies the differential correction and calculates a precise, real-time navigational position.

For the chemistry analyses, composite sediment samples were obtained from each station, comprised of sediment aliquots collected from three separate grab sampler deployments. Sediment core samples were not composites. Coordinates for each grab sampler deployment are included in the previous table.

Sample Collection and Handling

Fourty-five marine sediment grab samples in total were collected September 9, 2002 from the Pier 53 Sediment Cap Monitoring Project site. Half of the samples were collected from the top 2 cm for the chemistry aliquot and the other half from the top 10 cm. The top 10 cm of sediment was collected for the taxonomy aliquot using double, stainless steel, modified, 0.1 m^2 Van Veen grab samplers. They were deployed from the *Liberty* via hydrowire. Water depth at the seven subtidal cap sample stations ranged between 14-21 meters (not corrected for tide). Between 6-10 cm of sediment was recovered in each grab, allowing collection of a sample aliquot from the top 2 or 10 cm as necessary. When necessary, less than the top 10 cm of sediment was taken in an attempt to exclude the sediment that had touched the sides or bottom of the grab sampler.

Samples consisted of sediment aliquots collected from three individual grabs at each station with an equal amount of material collected from each grab. The top 2 cm samples were collected using a 200 cm2 “cookie cutter” and stainless steel spatula. The 10 cm samples were collected using a stainless steel spoon. Each of the aliquots was placed into a separate stainless-steel bowl, covered with foil between grab deployments. After collecting aliquots from three grabs, the sediment sample was thoroughly homogenized and sample aliquots split out into pre-labeled containers. Sample containers were supplied by the King County Environmental Laboratory and were pre-cleaned according to analytical specifications.

Six marine sediment core samples were collected September 24, 2002. Samples were collected by MCS Environmental using a diver-operated coring device deployed from the *Kittiwake*. Samples were processed onboard the *Kittiwake* by MCS and King County personnel. Water depth was between 16.5 and 19.5 meters, not corrected for tide. Between 0.77 and 1.88 meters of sediment was collected in each core. Sediment touching the sides of the core or the core catcher was excluded from the sample.

Individual sets of sample preparation equipment were dedicated to each station and sample type (chemistry grab and core). The Van Veen grab sampler was decontaminated between stations by rinsing with ambient seawater.

Samples were stored in ice-filled coolers from the time of collection until delivery to the King County Environmental Laboratory. Samples were delivered under chain-of-custody and were maintained as such throughout the analytical process. Samples were stored frozen (-18°C) by the laboratory until analysis with the exception of samples for particle size distribution (PSD) analysis. PSD samples were stored refrigerated at approximately 4°C. A more complete description of sample handling and storage can be found in each analytical chemistry section of this narrative.

Copies of chain-of-custody forms and field notes are included as an appendix to this QA review narrative.

CONVENTIONAL ANALYSES

Completeness
Conventional data are reported for all samples and parameters summarized in Table 1. These samples were analyzed in association with the complete set of QC samples outlined in Table 2. Sample L25512-1 did not have sufficient material for the sample to be analyzed for PSD.

Subcontracted Analyses
Particle Size Distribution (PSD) analysis was subcontracted to AmTest, Inc in Redmond, WA.

Methods
PSD analysis was performed in accordance with ASTM and Puget Sound Protocols methodologies (*Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound* - page 9 - PSEP, 1986). TOC analysis was performed in accordance with EPA 9060. Total solids analyses were performed in accordance with SM2540-G.

Detection Limits, Units and Significant Figures
For analyses performed at the KC Laboratory, data are reported in accordance with laboratory policy at the time the data were generated. Data are reported to three significant figures for results greater than the RDL and two significant figures for results equal to or less than the RDL. For results reported with less than two or three significant figures, significant zeroes are implied. This may not apply to subcontracted data.

Storage Conditions and Holding Times
Sample storage conditions and holding times have been evaluated using guidelines established during the Third Annual PSDDA Review Meeting. The dates and holding time criteria for the actual storage conditions used for conventional analyses are listed in the table below.

Parameter	Lab ID#	Date Collected	Date Extracted*	Date Analyzed	Sample Holding Time	Extract Holding Time
Particle Size Distribution	L25702-1 to –15 L25512-2 to -6	09-Sep-2002 24-Sep-2002	NA NA	01-Oct-2002 01-Oct-2002	6 Months at 4°C	NA
Total Solids	L25702-1 to -15 L25512-1 to -6	09-Sep-2002 24-Sep-2002	NA NA	18-Sep-2002 26-Sep-2002	6 months at -18°C	NA
Total Organic Carbon	L25702-1 to 3, -5 L25702-6 to –9 L25702-4,11 to 15 L25702-10 L25512-1 to –3 L25512-4 to -6	09-Sep-2002 09-Sep-2002 09-Sep-2002 09-Sep-2002 24-Sep-2002 24-Sep-2002	28-Oct-2002 28-Oct-2002 28-Oct-2002 29-Oct-2002 29-Oct-2002 29-Oct-2002	13-Nov-2002 14-Nov-2002 15-Nov-2002 15-Nov-2002 18-Nov-2002 19-Nov-2002	6 months at -18°C	6 months at -18°C

* Sample preparation start date for TOC

Sample storage conditions and holding times were met for all samples.

Method Blanks
Method blanks were analyzed in connection with total organic carbon analyses. All method blanks results were less than the MDL.

Standard Reference Materials
An SRM (Buffalo River Sediment) was analyzed in connection with TOC analysis. The percent recovery for the SRM analysis was within the 80 to 120% QC limits. An SRM was not available for the other methods.

Matrix Spikes
The matrix spike recovery for total organic carbon was within the 75 to 125% QC limits.

Laboratory Replicate Samples

Laboratory triplicate samples were analyzed for all conventional parameters. The percent relative standard deviations (%RSD) for all triplicate analyses were less than or equal to the 20% QC limit.

METALS CHEMISTRY

Completeness
Metals data are reported for all samples and parameters summarized in Table 1. These samples were analyzed for mercury and other metals in association with the complete set of QC samples outlined in Table 2.

Subcontracted Analyses
Metals analysis was not subcontracted for this set of samples.

Methods
Mercury analysis was performed in accordance with EPA Method 7471. Analysis for other metals was performed in accordance with EPA method 3050/6010.

Target List
The reported target list includes all metals specified in *Table 1*. Additional metals have been reported as available.

Detection Limits, Units and Significant Figures
For analyses performed at the KC Laboratory, data are reported in accordance with laboratory policy at the time the data were generated. Data are reported to three significant figures for results greater than the RDL and two significant figures for results equal to or less than the RDL. For results reported with less than two or three significant figures, significant zeroes are implied.

Storage Conditions and Holding Times
Sample storage conditions and holding times have been evaluated using guidelines established during the Third Annual PSDDA Review Meeting. Sample storage conditions and holding times have been evaluated using guidelines established during the Third Annual PSDDA Review Meeting. The dates and holding time criteria for the actual storage conditions used for metals analyses are listed in the table below.

Parameter	Lab ID#	Date Collected	Date Digested/ Extracted	Date Analyzed	Sample Holding Time	Digestate/Extract Holding Time
Total Metals	L25512-1 through 6	24-Sep-02	18-Nov-02	20-Nov-02	2 Years at -18°C	6 months
	L25702-1 through 15	09-Sep-02	18-Nov-02	20-Nov-02		
Total Mercury	L25512-1 through 6	24-Sep-02	17-Oct-02	18-Oct-02	28 days at -18°C	NA
	L25702-1 through 15	09-Sep-02	13-Sep-02	17-Sep-02		

Sample storage conditions and holding times were met for all samples in this data submission.

Method Blanks
All metals method blanks results were less than the MDL.

Standard Reference Materials
The SRM analyzed in association with samples included in this data submission is PACS-1. This SRM is not certified for Silver, Aluminum, Beryllium, Iron or Thallium. An SRM recovery less than the QC limit of 80% has not been used to qualify data because the digestion technique used for sample analysis is different from the technique used during analysis to determine the SRM values. Only SRM recoveries greater than 120% will be used to qualify data.

All metals SRM recoveries were less than the QC limit of 120%.

Matrix Spikes
All matrix spike recoveries were within the 75 to 125% QC limits with the following exceptions.

For samples L25512-1 to 6: Aluminum recovery of 254% was outside the acceptable range. Aluminum results were qualified with an “L” flag. Iron recovery of 61% was outside the acceptable range. Iron results were qualified with a “G” flag. For samples L25702-1 to 15: Aluminum recovery of 324% was outside the acceptable range. Aluminum results were qualified with an “L” flag. Iron recovery of 71% was outside the acceptable range. Iron results were qualified with a “G” flag.

Laboratory Replicate Samples
The relative percent differences (RPDs) for laboratory duplicate results for all metals were less than or equal to the QC limit of 20%.

ORGANIC CHEMISTRY

Completeness

Organics data are reported for all samples and parameters summarized in Table 1. These samples were analyzed in association with the complete set of QC samples outlined in Table 2.

Methods

BNA (including chlorobenzenes) analysis was performed in accordance with EPA method 8270. PCB and chlorinated pesticides analysis was performed in accordance with EPA methods 8082 and 8081A. Volatile Organic Analysis (VOA) was performed in accordance with EPA method 8260A.

Target List

The reported BNA target list includes all compounds specified in *Table 1 - Marine Sediment Quality Standards Chemical Criteria* and *Table 3 - Puget Sound Marine Sediment Cleanup Screening Levels Chemical Criteria* contained in Chapter 173-204 WAC with the exception of benzo(j)fluoranthene. The KC Laboratory has verified that analytical conditions are sufficient to calculate a total benzofluoranthene result using the reported *b* and *k* isomers. The reported PCB and Pesticide target list includes all compounds listed in EPA method 8082A and 8081A. The reported VOA target list includes all compounds listed in EPA method 8260A.

Detection Limits, Units and Significant Figures

For analyses performed at the KC Laboratory, data are reported in accordance with laboratory policy at the time the data were generated. Data are reported to three significant figures for results greater than the RDL and two significant figures for results equal to or less than the RDL. For results reported with less than two or three significant figures, significant zeroes are implied. This may not apply to subcontracted data.

Storage Conditions and Holding Times

Sample storage conditions and holding times have been evaluated using guidelines established during the Third Annual PSDDA Review Meeting. The dates and holding time criteria for the actual storage conditions used for conventional analyses are listed in the table below.

Parameter	Lab ID#	Date Collected	Date Extracted	Date Analyzed	Sample Holding Time	Extract Holding Time
BNA and Chlorobenzenes	L25512-1 through 6	24-Sep-02	08-Oct-02	23-Oct-02	1 year at -18°C	40 days at 4°C
	L25702-1 through 15	09-Sep-02	08-Oct-02	28-Oct-02		
CL Pesticides	L25512-1 through 6	24-Sep-02	01-Oct-02	28-Oct-02	1 year at -18°C	40 days at 4°C
	L25702-1 through 15	09-Sep-02	01-Oct-02	28-Oct-02		
PCBs	L25512-1 through 6	24-Sep-02	01-Oct-02	08-Nov-02		
	L25702-1 through 15	09-Sep-02	01-Oct-02	08-Oct-02		
VOA	L25702-1 through 15	09-Sep-02	NA	19-Sep-02 20-Sep-02	14 Days at 4°C	14 Days at 4°C

Sample storage conditions and holding times were met for all samples in this data submission.

Method Blanks

1. BNAs

The method blank analyzed with BNAs for L25512-1 to 6 and L25702-1 to 15 had a result above the MDL for Di-n-butyl Phthalate and Bis(2-Ethylhexyl)Phthalate. Sample results for Di-n-butyl Phthalate and Bis(2-Ethylhexyl)Phthalate for that batch (WG64827) have been qualified with the B flag. All Di-n-butyl Phthalate and Bis(2-Ethylhexyl)Phthalate results for these samples must be treated as estimated values.

BNA Method Blank Summary

Batch Di	-n-butyl Phthalate (MDL = 6.7 ug/L)	Bis(2-Ethylhexyl)Phthalate (MDL = 13 ug/L)
L25702-1 to 15 L25512-1 to 6	8.7 ug/L	51.5 ug/L

2. VOA

The method blank analyzed with VOAs for L25702-11, 12, 13, 14 and 15 showed a response for Methylene Chloride above the MDL. All sample results for Methylene Chloride for the aforementioned samples have been qualified with the B flag. All sample results are expected be highly biased by this blank contamination and must be treated as estimated values.

VOA Method Blank Summary

Batch Acetone/*	(MDL = 13 ug/L)	Methylene Chloride (MDL = 5 ug/L)
L25702-11, 12, 13, 14, 15	< MDL	8.4 ug/L

All other method blank results (PCB/chlorinated Pesticides) were less than the MDL.

Surrogate Recoveries

1. BNAs

BNA sample data are qualified when the average surrogate recovery for either or both the acid and base/neutral fractions are outside the 50 to 150% QC limits. The following table summarizes the average surrogate recoveries that are outside the QC limits and the appropriate flag.

Lab ID#	Average Acid Surrogate Recovery	Flag Applied to Acid Compounds	Average B/N Surrogate Recovery	Flag Applied to B/N Compounds
L25512-1	52		58	
L25512-2	51		59	
L25512-3	63		66	
L25512-4	52		67	
L25512-5	60		69	
L25512-6	62		66	
L25702-1	71		70	
L25702-2	51		57	
L25702-3	55		63	
L25702-4	52		59	
L25702-5	47	G	54	
L25702-6	46	G	53	
L25702-7	52		63	
L25702-8	46	G	58	
L25702-9	48	G	67	
L25702-10	52		64	
L25702-11	40	G	50	
L25702-12	47	G	57	
L25702-13	54		67	
L25702-14	40	G	60	
L25702-15	36	G	56	

2.PCBs and Chlorinated Pesticides

Chlorinated Pesticides and PCBs are analyzed using separate GC methods. For both methods, sample data are qualified when both surrogate recoveries are outside QC limits. For each set of analyses, at least one surrogate recovery was within the 50 to 150% QC limits for all samples in this data submission.

3. VOA

VOA sample data are qualified when any one of the three surrogate recoveries are outside QC acceptance limits. For all VOA analyses, all surrogates were within the 50 to 150% QC limits.

Standard Reference Materials

1. BNAs

The sediment SRM analyzed in association with the reported BNA results is 1944, certified by the National Institute of Standards and Technology (NIST). SRM 1944 contains a partial list of compounds for BNA analysis. Results for this partial list of compounds for the one batch of samples have been qualified based on the SRM recoveries outside the 80 to 120% QC limits. The recoveries and flags are summarized in the following table.

	WG64827	
Compound	**% Recovery**	**Flag**
Naphthalene	17	G
Phenanthrene	80	
Anthracene	57	G
Fluoranthene	105	
Pyrene	95	
Benzo(a)anthracene	93	
Chrysene	106	
Benzo(b)fluoranthene	101	
Benzo(k)fluoranthene	103	
Benzo(a)pyrene	100	
Indeno(1,2,3-c,d)pyrene	88	
Dibenzo(a,h)anthracene	82	
Benzo(g,h,i)perylene	94	

2. PCBs and Chlorinated Pesticides

The sediment SRM analyzed in association with the reported Chlorinated Pesticides results is 1944, certified by the NIST. SRM 1944 contains certified levels of DDT and alpha-Chlordane. The sediment SRM analyzed in association with the reported PCB results is HS-2, certified by the National Research Council of Canada. SRM HS-2 contains Aroclor 1254. The recovery of the certified parameters must be within 80 to 120% or the appropriate data are flagged. The SRM results for both batches of analyses are summarized below:

	WG64708		WG64709	
Compound	**% Recovery**	**Flag**	**% Recovery**	**Flag**
DDT	88		NA	
Chlordane	110		NA	
Aroclor 1254	NA		100	

Matrix Spikes

1. BNAs

By QA1 guidelines, the matrix spike recoveries for each BNA compound must be within the 50 to 150% QC limits. If not, all results for those particular compounds within the batch of samples must be flagged as follows. A G flag is applied if the recovery is between 10 and 50%, an X flag is applied if less than 10% recovery and an L flag is applied if greater than 150% recovery. The following table summarizes the matrix spike recoveries for specific compounds that are outside the QC limits and the appropriate flag.

	L25702-1	
Compound	**% Recovery**	**Flag**
Nitrosodimethylamine	45	G
Bis(2-Chloroethyl)Ether	36	G
1,3-Dichlorobenzene	41	G
1,4-Dichlorobenzene	41	G
1,2-Dichlorobenzene	42	G
Bis(2-Chloroisopropyl)Ether	44	G
N-Nitrosodi-N-Propylamine	47	G
Hexachloroethane	41	G
Nitrobenzene	48	G
2-Nitrophenol	49	G
Bis(2-Chloroethoxy)Methane	49	G
1,2,4-Trichlorobenzene	45	G
Hexachlorobutadiene	45	G
Aniline	0	X
Benzyl Alcohol	0	X
Benzoic Acid	22	G

2. PCBs and Chlorinated Pesticides

By QA1 guidelines, the matrix spike recoveries for Pesticide and PCB compounds must be within the 50 to 150% QC limits. A G flag is applied if the recovery is between 10 and 50%, an X flag is applied if less than 10% recovery and an L flag is applied if greater than 150% recovery. Aroclor 1260 and 1016 only are used as the spiking compounds for PCB analysis. The following table summarizes the matrix spike recoveries for specific compounds that are outside the QC limits and the appropriate flag.

	L25702-1	
Compound	**% Recovery**	**Flag**
Endrin Aldehyde	41	G

3. VOA

Matrix spikes were performed for the VOA method. The following table summarizes the matrix spike recoveries for specific compounds that are outside the QC limits and the appropriate flag.

	L25702-1	
Compound	**% Recovery**	**Flag**
2-Chloroethylvinyl ether	30	G
Acetone	157	L

Laboratory Replicate Samples

Lab Replicate (duplicate) samples for Organics have a target acceptance limit 100% for the Relative Percent Difference (RPD). All duplicate analyses showed acceptable RPD values.

TABLE 1
SEDIMENT SAMPLE INVENTORY

Sample	Locator	PSD	Solids	TOC	Metals[2]	VOA	BNA[1]	Cl-Pest/ PCBs	Comments
L25702-1	P53VG1	X	X	X	X	X	X	X	Grab, 0 - 2 cm
L25702-2	P53VG1	X	X	X	X	X	X	X	Grab, 0 - 10cm
L25702-3	P53VG2	X	X	X	X	X	X	X	Grab, 0 - 2 cm
L25702-4	P53VG2	X	X	X	X	X	X	X	Grab, 0 - 10cm
L25702-5	P53VG3	X	X	X	X	X	X	X	Grab, 0 - 2 cm
L25702-6	P53VG3	X	X	X	X	X	X	X	Grab, 0 - 10cm
L25702-7	P53VG4	X	X	X	X	X	X	X	Grab, 0 - 2 cm
L25702-8	P53VG4	X	X	X	X	X	X	X	Grab, 0 - 10cm
L25702-9	P53VG5	X	X	X	X	X	X	X	Grab, 0 - 2 cm
L25702-10	P53VG5	X	X	X	X	X	X	X	Grab, 0 - 10cm
L25702-11	P53VG6	X	X	X	X	X	X	X	Grab, 0 - 2 cm
L25702-12	P53VG6	X	X	X	X	X	X	X	Grab, 0 - 10cm
L25702-13	P53VG7	X	X	X	X	X	X	X	Grab, 0 - 2 cm
L25702-14	P53VG7	X	X	X	X	X	X	X	Grab, 0 - 10cm
L25702-15	P53VG7	X	X	X	X	X	X	X	Grab, 0 - 10cm, FREP
L25512-1	P53C1		X	X	X		X	X	Core, 1” to 6” above cap interface
L25512-2	P53C2	X	X	X	X		X	X	Core, 1” to 6” above cap interface
L25512-3	P53C3	X	X	X	X		X	X	Core, 1” to 6” above cap interface
L25512-4	P53C4	X	X	X	X		X	X	Core, 1” to 6” above cap interface
L25512-5	P53C5	X	X	X	X		X	X	Core, 1” to 6” above cap interface
L25512-6	P53C4	X	X	X	X		X	X	Core, 1” to 6” above cap interface, FREP

1 BNA = includes Chlorobenzenes
2 Metals = Hg, As, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, Tl, Zn, Al, Fe

TABLE 2
QC SAMPLE FREQUENCY FOR SEDIMENT CHEMICAL AND PHYSICAL PARAMETERS

Parameter	Method Blank	Duplicate	Triplicate	Matrix Spike[1]	SRM	Surrogates
PSD	No	5% minimum, 1 per QC batch	5% minimum, 1 per QC batch	No	No	No
Total Solids	1 per QC batch	5% minimum, 1 per QC batch	5% minimum, 1 per QC batch	No	No	No
TOC	1 per QC batch	5% minimum, 1 per QC batch	5% minimum, 1 per QC batch	5% minimum, 1 per QC batch	1 per QC batch	No
Metals	1 per QC batch	5% minimum, 1 per QC batch	No	5% minimum, 1 per QC batch	1 per QC batch	No
BNA & Chlorobenzenes	1 per QC batch	5% minimum, 1 per QC batch	No	5% minimum, 1 per QC batch	1 per QC batch	Yes
PCBs/Chlorinated Pesticides	1 per QC batch	5% minimum, 1 per QC batch	No	5% minimum, 1 per QC batch	1 per QC batch	Yes
VOA	1 per QC batch	5% minimum, 1 per QC batch	No	5% minimum, 1 per QC batch	No	Yes

(1) MS/MSD for organic analysis

TABLE 3 - SUMMARY OF SEDIMENT DATA QUALIFIERS

Condition to Qualify	King County Data Qualifier	Sedqual Data Qualifier	Organic QC Limits	Metal QC Limits	Conventional QC Limits	Comment
very low matrix spike recovery	X	X	< 10 %	< 10 %	< 10 %	
low matrix spike recovery	G	G	< 50%	< 75%	< 75% *	
high matrix spike recovery	L	L	> 150%	>125%	>125% *	
low standard reference material recovery	G	G	< 80%	NA	< 80%	
high standard reference material recovery	L L		>120%	>120%	>120%	
high duplicate relative percent difference	E	E	>100 %	>20%	NA	for organics and metals
high triplicate relative standard deviation	E	E	NA	NA	> 20%	for conventionals
less than the reporting detection limit	<RDL** T		NA	NA	NA	
less than the method detection limit	<MDL** U		NA	NA	NA	
Contamination reported in blank	B B		>MDL	>MDL	>MDL	
biased data based on very low surrogate recoveries	X X		all fraction surrogates <10%	NA NA		average surrogate recovery for BNAs
biased data based on low surrogate recoveries	G G		all fraction surrogates <50%	NA NA		average surrogate recovery for BNAs
biased data based on high surrogate recoveries	L L		all fraction surrogates >150%	NA NA		average surrogate recovery for BNAs
rejected - unusable for all purposes	R	J2 or J3	NA	NA	NA	
a sample handling criteria has not been met	H Q		NA	NA	NA	container, hold time, preservation
		-				

* 65% to 135% for Total Sulfides.

** For Sedqual files, <MDL uses a “U” flag, <RDL is not flagged

APPENDIX C

CHEMISTRY DATA

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53VG1	P53VG1	P53VG2	P53VG2
Descrip:	Pier 53 Van Veen 1	Pier 53 Van Veen 1	Pier 53 Van Veen 2	Pier 53 Van Veen 2
Client Loc:				
Sampled:	Sep 09, 2002	Sep 09, 2002	Sep 09, 2002	Sep 09, 2002
Lab ID:	L25702-1	L25702-2	L25702-3	L25702-4
Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED	SALTWTRSED
% Solids:	68.4	70.7	62.8	68.9

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
			- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis		
COMBINED LABS																				
M=CV ASTM D422																				
Clay *	4.3		0.1	0.1	%	2.9		0.1	0.1	%	4.9		0.1	0.1	%	4.7		0.1	0.1	%
Gravel *	1.2		0.1	0.1	%	1.5		0.1	0.1	%	2.9		0.1	0.1	%	2.3		0.1	0.1	%
p+0.00 *	2		0.1	0.1	%	2.9		0.1	0.1	%	4.7		0.1	0.1	%	5.5		0.1	0.1	%
p+1.00 *	20.7		0.1	0.1	%	23.9		0.1	0.1	%	21.2		0.1	0.1	%	36.2		0.1	0.1	%
p+10.0 *	0.7		0.1	0.1	%	0.3		0.1	0.1	%	1.1		0.1	0.1	%	1.1		0.1	0.1	%
p+10.0(more than) *	2.4		0.1	0.1	%	1.8		0.1	0.1	%	1.6		0.1	0.1	%	1.8		0.1	0.1	%
p+2.00 *	53.3		0.1	0.1	%	53.8		0.1	0.1	%	40.3		0.1	0.1	%	34.8		0.1	0.1	%
p+3.00 *	8.3		0.1	0.1	%	7		0.1	0.1	%	11.4		0.1	0.1	%	8.3		0.1	0.1	%
p+4.00 *	1.8		0.1	0.1	%	1.5		0.1	0.1	%	3.1		0.1	0.1	%	1.7		0.1	0.1	%
p+5.00 *	2.4		0.1	0.1	%		<MDL	0.1	0.1	%		<MDL	0.1	0.1	%		<MDL	0.1	0.1	%
p+6.00 *	1.9		0.1	0.1	%	2.3		0.1	0.1	%	3		0.1	0.1	%	2		0.1	0.1	%
p+7.00 *	2.5		0.1	0.1	%	1.9		0.1	0.1	%	4.2		0.1	0.1	%	2.5		0.1	0.1	%
p+8.00 *	1.6		0.1	0.1	%	2.3		0.1	0.1	%	4.3		0.1	0.1	%	2		0.1	0.1	%
p+9.00 *	1.2		0.1	0.1	%	0.8		0.1	0.1	%	2.2		0.1	0.1	%	1.8		0.1	0.1	%
p-1.00 *	0.7		0.1	0.1	%	0.7		0.1	0.1	%	1.2		0.1	0.1	%	2		0.1	0.1	%
p-2.00 *		<MDL	0.1	0.1	%	0.1	RDL	0.1	0.1	%	0.1	RDL	0.1	0.1	%	0.3		0.1	0.1	%
p-2.00(less than) *	0.5		0.1	0.1	%	0.7		0.1	0.1	%	1.6		0.1	0.1	%		<MDL	0.1	0.1	%
Sand *	86.1		0.1	0.1	%	89.1		0.1	0.1	%	80.7		0.1	0.1	%	86.5		0.1	0.1	%
Silt *	8.4		0.1	0.1	%	6.5		0.1	0.1	%	11.5		0.1	0.1	%	6.5		0.1	0.1	%
M=CV EPA9060-PSEP96 (03-04-002-002)																				
Total Organic Carbon	7280		730	1460	mg/Kg	7020		710	1410	mg/Kg	25000		1800	3500	mg/Kg	20500		2000	4060	mg/Kg
M=CV SM2540-G (03-01-007-001)																				
Total Solids *	68.4		0.005	0.01	%	70.7		0.005	0.01	%	62.8		0.005	0.01	%	68.9		0.005	0.01	%
M=MT EPA 245.5 (06-01-004-003)																				
Mercury, Total, CVAA	0.089	<RDL	0.029	0.291	mg/Kg	0.086	<RDL	0.028	0.281	mg/Kg	0.25	<RDL	0.03	0.307	mg/Kg	0.11	<RDL	0.028	0.282	mg/Kg
M=MT EPA3050A/6010B (06-02-004-002)																				
Aluminum, Total, ICP	9850	L	7	34.9	mg/Kg	9040	L	7.2	36.4	mg/Kg	11500	L	7.6	38.4	mg/Kg	10500	L	7.4	36.7	mg/Kg
Arsenic, Total, ICP	4.7	<RDL	3.5	17.4	mg/Kg	5	<RDL	3.7	18.1	mg/Kg	6.7	<RDL	3.8	19.3	mg/Kg	7.1	<RDL	3.6	18.3	mg/Kg
Beryllium, Total, ICP	0.28	<RDL	0.07	0.349	mg/Kg	0.25	<RDL	0.072	0.364	mg/Kg	0.32	<RDL	0.076	0.384	mg/Kg	0.28	<RDL	0.074	0.367	mg/Kg
Cadmium, Total, ICP		<MDL	0.2	1.05	mg/Kg		<MDL	0.21	1.09	mg/Kg		<MDL	0.22	1.15	mg/Kg	0.26	<RDL	0.22	1.1	mg/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG1				Locator:	P53VG1				Locator:	P53VG2				Locator:	P53VG2			
	Descrip:	Pier 53 Van Veen 1				Descrip:	Pier 53 Van Veen 1				Descrip:	Pier 53 Van Veen 2				Descrip:	Pier 53 Van Veen 2			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-1				Lab ID:	L25702-2				Lab ID:	L25702-3				Lab ID:	L25702-4			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	68.4				% Solids:	70.7				% Solids:	62.8				% Solids:	68.9			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Chromium, Total, ICP	15.2		0.35	1.74	mg/Kg	13.4		0.37	1.81	mg/Kg	18.3		0.38	1.93	mg/Kg	16.8		0.36	1.83	mg/Kg
Copper, Total, ICP	21.8		0.28	1.4	mg/Kg	20.4		0.3	1.46	mg/Kg	33.1		0.3	1.54	mg/Kg	25.7		0.29	1.47	mg/Kg
Iron, Total, ICP	18100	G	3.5	17.4	mg/Kg	16500	G	3.7	18.1	mg/Kg	20400	G	3.8	19.3	mg/Kg	19000	G	3.6	18.3	mg/Kg
Lead, Total, ICP	15.8		2	10.5	mg/Kg	12.5		2.1	10.9	mg/Kg	24.4		2.2	11.5	mg/Kg	16.7		2.2	11	mg/Kg
Manganese, Total, ICP	206		0.14	0.697	mg/Kg	181		0.14	0.726	mg/Kg	212		0.15	0.769	mg/Kg	197		0.15	0.734	mg/Kg
Nickel, Total, ICP	14.2		1.4	6.97	mg/Kg	13.4		1.4	7.26	mg/Kg	15.7		1.5	7.69	mg/Kg	14.4		1.5	7.34	mg/Kg
Selenium, Total, ICP		<MDL	3.5	17.4	mg/Kg		<MDL	3.7	18.1	mg/Kg		<MDL	3.8	19.3	mg/Kg		<MDL	3.6	18.3	mg/Kg
Silver, Total, ICP		<MDL	0.28	1.4	mg/Kg		<MDL	0.3	1.46	mg/Kg		<MDL	0.3	1.54	mg/Kg		<MDL	0.29	1.47	mg/Kg
Thallium, Total, ICP		<MDL	14	69.7	mg/Kg		<MDL	14	72.6	mg/Kg		<MDL	15	76.9	mg/Kg		<MDL	15	73.4	mg/Kg
Zinc, Total, ICP	58.3		0.35	1.74	mg/Kg	54		0.37	1.81	mg/Kg	70.2		0.38	1.93	mg/Kg	58.9		0.36	1.83	mg/Kg
M=OR EPA 3550B/8270C (7-3-01-004)																				
1,2,4-Trichlorobenzene		<MDL,G	0.38	0.775	ug/Kg		<MDL,G	0.37	0.75	ug/Kg		<MDL,G	0.41	0.844	ug/Kg		<MDL,G	0.38	0.769	ug/Kg
1,2-Dichlorobenzene		<MDL,G	0.38	0.775	ug/Kg		<MDL,G	0.37	0.75	ug/Kg		<MDL,G	0.41	0.844	ug/Kg		<MDL,G	0.38	0.769	ug/Kg
1,2-Diphenylhydrazine		<MDL	15	29.2	ug/Kg		<MDL	14	28.3	ug/Kg		<MDL	16	31.8	ug/Kg		<MDL	15	29	ug/Kg
1,3-Dichlorobenzene		<MDL,G	0.38	0.775	ug/Kg		<MDL,G	0.37	0.75	ug/Kg		<MDL,G	0.41	0.844	ug/Kg		<MDL,G	0.38	0.769	ug/Kg
1,4-Dichlorobenzene	1.29	G	0.19	0.386	ug/Kg	0.641	G	0.18	0.373	ug/Kg	2.21	G	0.21	0.42	ug/Kg	1.51	G	0.19	0.383	ug/Kg
2,4,5-Trichlorophenol		<MDL	18	35.1	ug/Kg		<MDL	17	33.9	ug/Kg		<MDL	19	38.2	ug/Kg		<MDL	17	34.8	ug/Kg
2,4,6-Trichlorophenol		<MDL	19	38	ug/Kg		<MDL	18	36.8	ug/Kg		<MDL	21	41.4	ug/Kg		<MDL	19	37.7	ug/Kg
2,4-Dichlorophenol		<MDL	23	46.8	ug/Kg		<MDL	23	45.3	ug/Kg		<MDL	25	51	ug/Kg		<MDL	23	46.4	ug/Kg
2,4-Dimethylphenol		<MDL	10	20.5	ug/Kg		<MDL	9.9	19.8	ug/Kg		<MDL	11	22.3	ug/Kg		<MDL	10	20.3	ug/Kg
2,4-Dinitrotoluene		<MDL	39	77.9	ug/Kg		<MDL	38	75.4	ug/Kg		<MDL	43	84.9	ug/Kg		<MDL	39	77.4	ug/Kg
2,6-Dinitrotoluene		<MDL	39	77.9	ug/Kg		<MDL	38	75.4	ug/Kg		<MDL	43	84.9	ug/Kg		<MDL	39	77.4	ug/Kg
2-Chloronaphthalene		<MDL	23	46.8	ug/Kg		<MDL	23	45.3	ug/Kg		<MDL	25	51	ug/Kg		<MDL	23	46.4	ug/Kg
2-Chlorophenol		<MDL	12	23.4	ug/Kg		<MDL	11	22.6	ug/Kg		<MDL	13	25.5	ug/Kg		<MDL	12	23.2	ug/Kg
2-Methylnaphthalene		<MDL	20	40.9	ug/Kg		<MDL	20	39.6	ug/Kg		<MDL	22	44.6	ug/Kg		<MDL	20	40.6	ug/Kg
2-Methylphenol		<MDL	28	55.6	ug/Kg		<MDL	27	53.7	ug/Kg		<MDL	30	60.5	ug/Kg		<MDL	28	55.2	ug/Kg
2-Nitrophenol		<MDL,G	22	43.9	ug/Kg		<MDL,G	21	42.4	ug/Kg		<MDL,G	24	47.8	ug/Kg		<MDL,G	22	43.5	ug/Kg
4-Bromophenyl Phenyl Ether		<MDL	13	26.3	ug/Kg		<MDL	13	25.5	ug/Kg		<MDL	14	28.7	ug/Kg		<MDL	13	26.1	ug/Kg
4-Chlorophenyl Phenyl Ether		<MDL	19	38	ug/Kg		<MDL	18	36.8	ug/Kg		<MDL	21	41.4	ug/Kg		<MDL	19	37.7	ug/Kg
4-Methylphenol		<MDL	23	46.8	ug/Kg		<MDL	23	45.3	ug/Kg		<MDL	25	51	ug/Kg		<MDL	23	46.4	ug/Kg
Acenaphthene	16	<RDL	10	20.5	ug/Kg		<MDL	9.9	19.8	ug/Kg	23.9		11	22.3	ug/Kg	17	<RDL	10	20.3	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG1				Locator:	P53VG1				Locator:	P53VG2				Locator:	P53VG2			
	Descrip:	Pier 53 Van Veen 1				Descrip:	Pier 53 Van Veen 1				Descrip:	Pier 53 Van Veen 2				Descrip:	Pier 53 Van Veen 2			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-1				Lab ID:	L25702-2				Lab ID:	L25702-3				Lab ID:	L25702-4			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	68.4				% Solids:	70.7				% Solids:	62.8				% Solids:	68.9			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Acenaphthylene		<MDL	22	43.9	ug/Kg		<MDL	21	42.4	ug/Kg		<MDL	24	47.8	ug/Kg		<MDL	22	43.5	ug/Kg
Aniline		<MDL,X	28	55.6	ug/Kg		<MDL,X	27	53.7	ug/Kg		<MDL,X	30	60.5	ug/Kg		<MDL,X	28	55.2	ug/Kg
Anthracene	93.9	G	5.8	11.7	ug/Kg	107	G	5.7	11.3	ug/Kg	234	G	6.4	12.7	ug/Kg	113	G	5.8	11.6	ug/Kg
Benzo(a)anthracene	234		2.9	5.85	ug/Kg	134		2.8	5.66	ug/Kg	468		3.2	6.37	ug/Kg	274		2.9	5.81	ug/Kg
Benzo(a)pyrene	288		4.4	8.77	ug/Kg	208		4.2	8.49	ug/Kg	608		4.8	9.55	ug/Kg	422		4.4	8.71	ug/Kg
Benzo(b)fluoranthene	287		4.4	8.77	ug/Kg	202		4.2	8.49	ug/Kg	572		4.8	9.55	ug/Kg	382		4.4	8.71	ug/Kg
Benzo(g,h,i)perylene	132		12	23.4	ug/Kg	91.7		11	22.6	ug/Kg	285		13	25.5	ug/Kg	181		12	23.2	ug/Kg
Benzo(k)fluoranthene	266		4.4	8.77	ug/Kg	173		4.2	8.49	ug/Kg	583		4.8	9.55	ug/Kg	395		4.4	8.71	ug/Kg
Benzoic Acid	123	G	39	77.9	ug/Kg	109	G	38	75.4	ug/Kg	128	G	43	84.9	ug/Kg	104	G	39	77.4	ug/Kg
Benzyl Alcohol		<MDL,X	8.8	17.5	ug/Kg		<MDL,X	8.5	17	ug/Kg		<MDL,X	9.6	19.1	ug/Kg		<MDL,X	8.7	17.4	ug/Kg
Benzyl Butyl Phthalate	25	<RDL	19	39	ug/Kg	23	<RDL	18	37.8	ug/Kg	29	<RDL	21	42.5	ug/Kg	26	<RDL	19	38.8	ug/Kg
Bis(2-Chloroethoxy)Methane		<MDL,G	25	49.7	ug/Kg		<MDL,G	24	48.1	ug/Kg		<MDL,G	27	54.1	ug/Kg		<MDL,G	25	49.3	ug/Kg
Bis(2-Chloroethyl)Ether		<MDL,G	22	43.9	ug/Kg		<MDL,G	21	42.4	ug/Kg		<MDL,G	24	47.8	ug/Kg		<MDL,G	22	43.5	ug/Kg
Bis(2-Chloroisopropyl)Ether		<MDL,G	22	43.9	ug/Kg		<MDL,G	21	42.4	ug/Kg		<MDL,G	24	47.8	ug/Kg		<MDL,G	22	43.5	ug/Kg
Bis(2-Ethylhexyl)Phthalate	121	B	19	39	ug/Kg	187	B	18	37.8	ug/Kg	229	B	21	42.5	ug/Kg	179	B	19	38.8	ug/Kg
Caffeine		<MDL	8.8	17.5	ug/Kg		<MDL	8.5	17	ug/Kg		<MDL	9.6	19.1	ug/Kg		<MDL	8.7	17.4	ug/Kg
Carbazole	20	RDL	10	20.5	ug/Kg	14	<RDL	9.9	19.8	ug/Kg	42.8		11	22.3	ug/Kg	24.2		10	20.3	ug/Kg
Chrysene	379		5.8	11.7	ug/Kg	228		5.7	11.3	ug/Kg	779		6.4	12.7	ug/Kg	480		5.8	11.6	ug/Kg
Coprostanol		<MDL	190	390	ug/Kg		<MDL	180	378	ug/Kg		<MDL	210	425	ug/Kg		<MDL	190	388	ug/Kg
Dibenzo(a,h)anthracene	53.8		10	20.5	ug/Kg	40.5		9.9	19.8	ug/Kg	107		11	22.3	ug/Kg	74.3		10	20.3	ug/Kg
Dibenzofuran		<MDL	20	40.9	ug/Kg		<MDL	20	39.6	ug/Kg		<MDL	22	44.6	ug/Kg		<MDL	20	40.6	ug/Kg
Diethyl Phthalate		<MDL	8.8	17.5	ug/Kg		<MDL	8.5	17	ug/Kg		<MDL	9.6	19.1	ug/Kg		<MDL	8.7	17.4	ug/Kg
Dimethyl Phthalate		<MDL	16	32.2	ug/Kg		<MDL	16	31.1	ug/Kg		<MDL	18	35	ug/Kg		<MDL	16	31.9	ug/Kg
Di-N-Butyl Phthalate	18	<RDL,B	9.8	19.4	ug/Kg	16	<RDL,B	9.5	18.8	ug/Kg	19	<RDL,B	11	21.2	ug/Kg	17	<RDL,B	9.7	19.3	ug/Kg
Di-N-Octyl Phthalate		<MDL	39	77.9	ug/Kg		<MDL	38	75.4	ug/Kg		<MDL	43	84.9	ug/Kg		<MDL	39	77.4	ug/Kg
Fluoranthene	365		12	23.4	ug/Kg	199		11	22.6	ug/Kg	591		13	25.5	ug/Kg	415		12	23.2	ug/Kg
Fluorene	25	<RDL	19	38	ug/Kg		<MDL	18	36.8	ug/Kg	50.6		21	41.4	ug/Kg	29	<RDL	19	37.7	ug/Kg
Hexachlorobenzene		<MDL	0.96	1.94	ug/Kg		<MDL	0.93	1.88	ug/Kg		<MDL	1.1	2.12	ug/Kg		<MDL	0.96	1.93	ug/Kg
Hexachlorobutadiene		<MDL,G	1.1	2.19	ug/Kg		<MDL,G	1.1	2.12	ug/Kg		<MDL,G	1.2	2.39	ug/Kg		<MDL,G	1.1	2.18	ug/Kg
Hexachloroethane		<MDL,G	22	43.9	ug/Kg		<MDL,G	21	42.4	ug/Kg		<MDL,G	24	47.8	ug/Kg		<MDL,G	22	43.5	ug/Kg
Indeno(1,2,3-Cd)Pyrene	136		13	26.3	ug/Kg	97.3		13	25.5	ug/Kg	295		14	28.7	ug/Kg	184		13	26.1	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG1				Locator:	P53VG1				Locator:	P53VG2				Locator:	P53VG2			
	Descrip:	Pier 53 Van Veen 1				Descrip:	Pier 53 Van Veen 1				Descrip:	Pier 53 Van Veen 2				Descrip:	Pier 53 Van Veen 2			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-1				Lab ID:	L25702-2				Lab ID:	L25702-3				Lab ID:	L25702-4			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	68.4				% Solids:	70.7				% Solids:	62.8				% Solids:	68.9			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Isophorone		<MDL	28	55.6	ug/Kg		<MDL	27	53.7	ug/Kg		<MDL	30	60.5	ug/Kg		<MDL	28	55.2	ug/Kg
Naphthalene		<MDL,G	20	40.9	ug/Kg		<MDL,G	20	39.6	ug/Kg		<MDL,G	22	44.6	ug/Kg		<MDL,G	20	40.6	ug/Kg
Nitrobenzene		<MDL,G	23	46.8	ug/Kg		<MDL,G	23	45.3	ug/Kg		<MDL,G	25	51	ug/Kg		<MDL,G	23	46.4	ug/Kg
N-Nitrosodimethylamine		<MDL,G	29	58.5	ug/Kg		<MDL,G	28	56.6	ug/Kg		<MDL,G	32	63.7	ug/Kg		<MDL,G	29	58.1	ug/Kg
N-Nitrosodi-N-Propylamine		<MDL,G	13	26.3	ug/Kg		<MDL,G	13	25.5	ug/Kg		<MDL,G	14	28.7	ug/Kg		<MDL,G	13	26.1	ug/Kg
N-Nitrosodiphenylamine		<MDL	29	58.5	ug/Kg		<MDL	28	56.6	ug/Kg		<MDL	32	63.7	ug/Kg		<MDL	29	58.1	ug/Kg
Pentachlorophenol		<MDL	19	39	ug/Kg		<MDL	18	37.8	ug/Kg		<MDL	21	42.5	ug/Kg		<MDL	19	38.8	ug/Kg
Phenanthrene	140		5.8	11.7	ug/Kg	89.5		5.7	11.3	ug/Kg	264		6.4	12.7	ug/Kg	165		5.8	11.6	ug/Kg
Phenol		<MDL	13	26.3	ug/Kg		<MDL	13	25.5	ug/Kg		<MDL	14	28.7	ug/Kg		<MDL	13	26.1	ug/Kg
Pyrene	338		5.8	11.7	ug/Kg	214		5.7	11.3	ug/Kg	578		6.4	12.7	ug/Kg	392		5.8	11.6	ug/Kg
M=OR EPA 8081A/8082 (7-3-03-002)																				
4,4'-DDD		<MDL	1.9	3.65	ug/Kg		<MDL	1.8	3.54	ug/Kg		<MDL	2.1	3.98	ug/Kg		<MDL	1.9	3.63	ug/Kg
4,4'-DDE		<MDL	1.9	3.65	ug/Kg		<MDL	1.8	3.54	ug/Kg		<MDL	2.1	3.98	ug/Kg		<MDL	1.9	3.63	ug/Kg
4,4'-DDT		<MDL	1.9	3.65	ug/Kg		<MDL	1.8	3.54	ug/Kg		<MDL	2.1	3.98	ug/Kg		<MDL	1.9	3.63	ug/Kg
Aldrin		<MDL	1.9	3.65	ug/Kg		<MDL	1.8	3.54	ug/Kg		<MDL	2.1	3.98	ug/Kg		<MDL	1.9	3.63	ug/Kg
Alpha-BHC		<MDL	0.92	1.83	ug/Kg		<MDL	0.89	1.77	ug/Kg		<MDL	1	1.99	ug/Kg		<MDL	0.91	1.81	ug/Kg
Aroclor 1016		<MDL	1.9	3.65	ug/Kg		<MDL	1.8	3.54	ug/Kg		<MDL	2.1	3.98	ug/Kg		<MDL	1.9	3.63	ug/Kg
Aroclor 1221		<MDL	3.7	7.31	ug/Kg		<MDL	3.5	7.07	ug/Kg		<MDL	4	7.96	ug/Kg		<MDL	3.6	7.26	ug/Kg
Aroclor 1232		<MDL	3.7	7.31	ug/Kg		<MDL	3.5	7.07	ug/Kg		<MDL	4	7.96	ug/Kg		<MDL	3.6	7.26	ug/Kg
Aroclor 1242		<MDL	1.9	3.65	ug/Kg		<MDL	1.8	3.54	ug/Kg		<MDL	2.1	3.98	ug/Kg		<MDL	1.9	3.63	ug/Kg
Aroclor 1248	7.65		1.9	3.65	ug/Kg	7.11		1.8	3.54	ug/Kg	12.5		2.1	3.98	ug/Kg	15.1		1.9	3.63	ug/Kg
Aroclor 1254	22.5		1.9	3.65	ug/Kg	19.1		1.8	3.54	ug/Kg	44.1		2.1	3.98	ug/Kg	35.3		1.9	3.63	ug/Kg
Aroclor 1260	21.3		1.9	3.65	ug/Kg	21.1		1.8	3.54	ug/Kg	35.4		2.1	3.98	ug/Kg	48.9		1.9	3.63	ug/Kg
Beta-BHC		<MDL	0.92	1.83	ug/Kg		<MDL	0.89	1.77	ug/Kg		<MDL	1	1.99	ug/Kg		<MDL	0.91	1.81	ug/Kg
Chlordane		<MDL	0.92	1.83	ug/Kg		<MDL	0.89	1.77	ug/Kg		<MDL	1	1.99	ug/Kg		<MDL	0.91	1.81	ug/Kg
Delta-BHC		<MDL	0.92	1.83	ug/Kg		<MDL	0.89	1.77	ug/Kg		<MDL	1	1.99	ug/Kg		<MDL	0.91	1.81	ug/Kg
Dieldrin		<MDL	1.9	3.65	ug/Kg		<MDL	1.8	3.54	ug/Kg		<MDL	2.1	3.98	ug/Kg		<MDL	1.9	3.63	ug/Kg
Endosulfan I		<MDL	1.9	3.65	ug/Kg		<MDL	1.8	3.54	ug/Kg		<MDL	2.1	3.98	ug/Kg		<MDL	1.9	3.63	ug/Kg
Endosulfan II		<MDL	1.9	3.65	ug/Kg		<MDL	1.8	3.54	ug/Kg		<MDL	2.1	3.98	ug/Kg		<MDL	1.9	3.63	ug/Kg
Endosulfan Sulfate		<MDL	1.9	3.65	ug/Kg		<MDL	1.8	3.54	ug/Kg		<MDL	2.1	3.98	ug/Kg		<MDL	1.9	3.63	ug/Kg
Endrin		<MDL	1.9	3.65	ug/Kg		<MDL	1.8	3.54	ug/Kg		<MDL	2.1	3.98	ug/Kg		<MDL	1.9	3.63	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG1				Locator:	P53VG1				Locator:	P53VG2				Locator:	P53VG2			
	Descrip:	Pier 53 Van Veen 1				Descrip:	Pier 53 Van Veen 1				Descrip:	Pier 53 Van Veen 2				Descrip:	Pier 53 Van Veen 2			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-1				Lab ID:	L25702-2				Lab ID:	L25702-3				Lab ID:	L25702-4			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	68.4				% Solids:	70.7				% Solids:	62.8				% Solids:	68.9			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Endrin Aldehyde		<MDL,G	3.7	7.31	ug/Kg		<MDL,G	3.5	7.07	ug/Kg		<MDL,G	4	7.96	ug/Kg		<MDL,G	3.6	7.26	ug/Kg
Gamma-BHC (Lindane)		<MDL	0.92	1.83	ug/Kg		<MDL	0.89	1.77	ug/Kg		<MDL	1	1.99	ug/Kg		<MDL	0.91	1.81	ug/Kg
Heptachlor		<MDL	0.92	1.83	ug/Kg		<MDL	0.89	1.77	ug/Kg		<MDL	1	1.99	ug/Kg		<MDL	0.91	1.81	ug/Kg
Heptachlor Epoxide		<MDL	0.92	1.83	ug/Kg		<MDL	0.89	1.77	ug/Kg		<MDL	1	1.99	ug/Kg		<MDL	0.91	1.81	ug/Kg
Methoxychlor		<MDL	9.2	18.3	ug/Kg		<MDL	8.9	17.7	ug/Kg		<MDL	10	19.9	ug/Kg		<MDL	9.1	18.1	ug/Kg
Toxaphene		<MDL	19	36.5	ug/Kg		<MDL	18	35.4	ug/Kg		<MDL	21	39.8	ug/Kg		<MDL	19	36.3	ug/Kg
M=OR EPA 8260B (7-3-02-002)																				
1,1,1-Trichloroethane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
1,1,2,2-Tetrachloroethane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
1,1,2-Trichloroethane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
1,1,2-Trichloroethylene		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
1,1-Dichloroethane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
1,1-Dichloroethylene		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
1,2-Dichloroethane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
1,2-Dichloropropane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
2-Butanone (MEK)		<MDL	37	73.1	ug/Kg		<MDL	35	70.7	ug/Kg		<MDL	40	79.6	ug/Kg		<MDL	36	72.6	ug/Kg
2-Chloroethylvinyl ether		<MDL,G	7.3	14.6	ug/Kg		<MDL,G	7.1	14.1	ug/Kg		<MDL,G	8	15.9	ug/Kg		<MDL,G	7.3	14.5	ug/Kg
2-Hexanone		<MDL	37	73.1	ug/Kg		<MDL	35	70.7	ug/Kg		<MDL	40	79.6	ug/Kg		<MDL	36	72.6	ug/Kg
4-Methyl-2-Pentanone (MIBK)		<MDL	37	73.1	ug/Kg		<MDL	35	70.7	ug/Kg		<MDL	40	79.6	ug/Kg		<MDL	36	72.6	ug/Kg
Acetone		<MDL,L	19	73.1	ug/Kg		<MDL,L	18	70.7	ug/Kg		<MDL,L	21	79.6	ug/Kg		<MDL,L	19	72.6	ug/Kg
Acrolein		<MDL	37	73.1	ug/Kg		<MDL	35	70.7	ug/Kg		<MDL	40	79.6	ug/Kg		<MDL	36	72.6	ug/Kg
Acrylonitrile		<MDL	37	73.1	ug/Kg		<MDL	35	70.7	ug/Kg		<MDL	40	79.6	ug/Kg		<MDL	36	72.6	ug/Kg
Benzene		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Bromodichloromethane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Bromoform		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Bromomethane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Carbon Disulfide		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Carbon Tetrachloride		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Chlorobenzene		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Chlorodibromomethane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Chloroethane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53VG1	P53VG1	P53VG2	P53VG2
Descrip:	Pier 53 Van Veen 1	Pier 53 Van Veen 1	Pier 53 Van Veen 2	Pier 53 Van Veen 2
Client Loc:				
Sampled:	Sep 09, 2002	Sep 09, 2002	Sep 09, 2002	Sep 09, 2002
Lab ID:	L25702-1	L25702-2	L25702-3	L25702-4
Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED	SALTWTRSED
% Solids:	68.4	70.7	62.8	68.9

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Chloroform		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Chloromethane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Cis-1,3-Dichloropropene		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Ethylbenzene		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Methylene Chloride		<MDL	7.3	73.1	ug/Kg		<MDL	7.1	70.7	ug/Kg		<MDL	8	79.6	ug/Kg		<MDL	7.3	72.6	ug/Kg
Styrene		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Tetrachloroethylene		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Toluene		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Total Xylenes		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Trans-1,2-Dichloroethylene		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Trans-1,3-Dichloropropene		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Trichlorofluoromethane		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg
Vinyl Acetate		<MDL	37	73.1	ug/Kg		<MDL	35	70.7	ug/Kg		<MDL	40	79.6	ug/Kg		<MDL	36	72.6	ug/Kg
Vinyl Chloride		<MDL	7.3	14.6	ug/Kg		<MDL	7.1	14.1	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	7.3	14.5	ug/Kg

* Not converted to dry weight basis for this parameter

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53VG3	P53VG3	P53VG4	P53VG4
Descrip:	Pier 53 Van Veen 3	Pier 53 Van Veen 3	Pier 53 Van Veen 4	Pier 53 Van Veen 4
Client Loc:				
Sampled:	Sep 09, 2002	Sep 09, 2002	Sep 09, 2002	Sep 09, 2002
Lab ID:	L25702-5	L25702-6	L25702-7	L25702-8
Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED	SALTWTRSED
% Solids:	71.4	73.1	69.5	70

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
			- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis		
COMBINED LABS																				
M=CV ASTM D422																				
Clay *	4.6		0.1	0.1	%	3.1		0.1	0.1	%	4.7		0.1	0.1	%	5.3		0.1	0.1	%
Gravel *	2.2		0.1	0.1	%	0.8		0.1	0.1	%	2.6		0.1	0.1	%	1.9		0.1	0.1	%
p+0.00 *	2.5		0.1	0.1	%	3.6		0.1	0.1	%	4.7		0.1	0.1	%	5		0.1	0.1	%
p+1.00 *	19		0.1	0.1	%	23.7		0.1	0.1	%	36		0.1	0.1	%	27.8		0.1	0.1	%
p+10.0 *	0.7		0.1	0.1	%	0.3		0.1	0.1	%	1.1		0.1	0.1	%	1		0.1	0.1	%
p+10.0(more than) *	2.5		0.1	0.1	%	1.9		0.1	0.1	%	1.6		0.1	0.1	%	2.2		0.1	0.1	%
p+2.00 *	52.7		0.1	0.1	%	52.2		0.1	0.1	%	33.9		0.1	0.1	%	43.7		0.1	0.1	%
p+3.00 *	7.6		0.1	0.1	%	6		0.1	0.1	%	4.7		0.1	0.1	%	3.9		0.1	0.1	%
p+4.00 *	2.2		0.1	0.1	%	1.4		0.1	0.1	%	1.3		0.1	0.1	%	2.1		0.1	0.1	%
p+5.00 *	2		0.1	0.1	%	3.1		0.1	0.1	%	3.9		0.1	0.1	%		<MDL	0.1	0.1	%
p+6.00 *	2		0.1	0.1	%	1.4		0.1	0.1	%	2.5		0.1	0.1	%	3.9		0.1	0.1	%
p+7.00 *	2.5		0.1	0.1	%	2		0.1	0.1	%	2.7		0.1	0.1	%	2.5		0.1	0.1	%
p+8.00 *	2.7		0.1	0.1	%	2.7		0.1	0.1	%	3		0.1	0.1	%	3.9		0.1	0.1	%
p+9.00 *	1.4		0.1	0.1	%	0.9		0.1	0.1	%	2		0.1	0.1	%	2.1		0.1	0.1	%
p-1.00 *	1.2		0.1	0.1	%	0.6		0.1	0.1	%	1.3		0.1	0.1	%	1.3		0.1	0.1	%
p-2.00 *	0.1	RDL	0.1	0.1	%	0.1	RDL	0.1	0.1	%	0.4		0.1	0.1	%	0.3		0.1	0.1	%
p-2.00(less than) *	0.9		0.1	0.1	%	0.1	RDL	0.1	0.1	%	0.9		0.1	0.1	%	0.3		0.1	0.1	%
Sand *	84		0.1	0.1	%	86.9		0.1	0.1	%	80.6		0.1	0.1	%	82.5		0.1	0.1	%
Silt *	9.2		0.1	0.1	%	9.2		0.1	0.1	%	12.1		0.1	0.1	%	10.3		0.1	0.1	%
M=CV EPA9060-PSEP96 (03-04-002-002)																				
Total Organic Carbon	10400		980	1960	mg/Kg	8590		680	1370	mg/Kg	10300		720	1440	mg/Kg	8900		710	1430	mg/Kg
M=CV SM2540-G (03-01-007-001)																				
Total Solids *	71.4		0.005	0.01	%	73.1		0.005	0.01	%	69.5		0.005	0.01	%	70		0.005	0.01	%
M=MT EPA 245.5 (06-01-004-003)																				
Mercury, Total, CVAA	0.15	<RDL	0.028	0.276	mg/Kg	0.093	<RDL	0.027	0.274	mg/Kg	0.13	<RDL	0.029	0.285	mg/Kg	0.14	<RDL	0.027	0.277	mg/Kg
M=MT EPA3050A/6010B (06-02-004-002)																				
Aluminum, Total, ICP	9730	L	6.9	34.3	mg/Kg	9140	L	6.7	33.2	mg/Kg	10500	L	6.9	34.7	mg/Kg	10100	L	7.4	37	mg/Kg
Arsenic, Total, ICP	4.9	<RDL	3.4	17.1	mg/Kg		<MDL	3.3	16.6	mg/Kg	8.3	<RDL	3.5	17.4	mg/Kg	5.9	<RDL	3.7	18.6	mg/Kg
Beryllium, Total, ICP	0.25	<RDL	0.069	0.343	mg/Kg	0.23	<RDL	0.067	0.332	mg/Kg	0.3	<RDL	0.069	0.347	mg/Kg	0.3	<RDL	0.074	0.37	mg/Kg
Cadmium, Total, ICP		<MDL	0.21	1.03	mg/Kg		<MDL	0.21	0.996	mg/Kg		<MDL	0.2	1.04	mg/Kg		<MDL	0.23	1.11	mg/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG3				Locator:	P53VG3				Locator:	P53VG4				Locator:	P53VG4			
	Descrip:	Pier 53 Van Veen 3				Descrip:	Pier 53 Van Veen 3				Descrip:	Pier 53 Van Veen 4				Descrip:	Pier 53 Van Veen 4			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-5				Lab ID:	L25702-6				Lab ID:	L25702-7				Lab ID:	L25702-8			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	71.4				% Solids:	73.1				% Solids:	69.5				% Solids:	70			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Chromium, Total, ICP	15.5		0.34	1.71	mg/Kg	14.1		0.33	1.66	mg/Kg	16.1		0.35	1.74	mg/Kg	18.9		0.37	1.86	mg/Kg
Copper, Total, ICP	24.2		0.28	1.37	mg/Kg	23.8		0.26	1.33	mg/Kg	30.8		0.27	1.39	mg/Kg	27.3		0.3	1.49	mg/Kg
Iron, Total, ICP	18100	G	3.4	17.1	mg/Kg	16000	G	3.3	16.6	mg/Kg	20100	G	3.5	17.4	mg/Kg	18700	G	3.7	18.6	mg/Kg
Lead, Total, ICP	18.2		2.1	10.3	mg/Kg	15.5		2.1	9.96	mg/Kg	21.2		2	10.4	mg/Kg	19.9		2.3	11.1	mg/Kg
Manganese, Total, ICP	189		0.14	0.686	mg/Kg	167		0.13	0.663	mg/Kg	200		0.14	0.695	mg/Kg	190		0.14	0.741	mg/Kg
Nickel, Total, ICP	13.8		1.4	6.86	mg/Kg	12.9		1.3	6.63	mg/Kg	15		1.4	6.95	mg/Kg	15.3		1.4	7.41	mg/Kg
Selenium, Total, ICP		<MDL	3.4	17.1	mg/Kg		<MDL	3.3	16.6	mg/Kg		<MDL	3.5	17.4	mg/Kg		<MDL	3.7	18.6	mg/Kg
Silver, Total, ICP		<MDL	0.28	1.37	mg/Kg		<MDL	0.26	1.33	mg/Kg		<MDL	0.27	1.39	mg/Kg		<MDL	0.3	1.49	mg/Kg
Thallium, Total, ICP		<MDL	14	68.6	mg/Kg		<MDL	13	66.3	mg/Kg		<MDL	14	69.5	mg/Kg		<MDL	14	74.1	mg/Kg
Zinc, Total, ICP	59.2		0.34	1.71	mg/Kg	56.2		0.33	1.66	mg/Kg	67.6		0.35	1.74	mg/Kg	65.3		0.37	1.86	mg/Kg
M=OR EPA 3550B/8270C (7-3-01-004)																				
1,2,4-Trichlorobenzene		<MDL,G	0.36	0.742	ug/Kg		<MDL,G	0.36	0.725	ug/Kg		<MDL,G	0.37	0.763	ug/Kg		<MDL,G	0.37	0.757	ug/Kg
1,2-Dichlorobenzene		<MDL,G	0.36	0.742	ug/Kg		<MDL,G	0.36	0.725	ug/Kg		<MDL,G	0.37	0.763	ug/Kg		<MDL,G	0.37	0.757	ug/Kg
1,2-Diphenylhydrazine		<MDL	14	28	ug/Kg		<MDL	14	27.4	ug/Kg		<MDL	14	28.8	ug/Kg		<MDL	14	28.6	ug/Kg
1,3-Dichlorobenzene		<MDL,G	0.36	0.742	ug/Kg		<MDL,G	0.36	0.725	ug/Kg		<MDL,G	0.37	0.763	ug/Kg		<MDL,G	0.37	0.757	ug/Kg
1,4-Dichlorobenzene	1.23	G	0.18	0.37	ug/Kg	1.31	G	0.18	0.361	ug/Kg	1.77	G	0.19	0.38	ug/Kg	1.67	G	0.19	0.377	ug/Kg
2,4,5-Trichlorophenol		<MDL,G	17	33.6	ug/Kg		<MDL,G	16	32.8	ug/Kg		<MDL	17	34.5	ug/Kg		<MDL,G	17	34.3	ug/Kg
2,4,6-Trichlorophenol		<MDL,G	18	36.4	ug/Kg		<MDL,G	18	35.6	ug/Kg		<MDL	19	37.4	ug/Kg		<MDL,G	19	37.1	ug/Kg
2,4-Dichlorophenol		<MDL,G	22	44.8	ug/Kg		<MDL,G	22	43.8	ug/Kg		<MDL	23	46	ug/Kg		<MDL,G	23	45.7	ug/Kg
2,4-Dimethylphenol		<MDL,G	9.8	19.6	ug/Kg		<MDL,G	9.6	19.2	ug/Kg		<MDL	10	20.1	ug/Kg		<MDL,G	10	20	ug/Kg
2,4-Dinitrotoluene		<MDL	38	74.6	ug/Kg		<MDL	37	72.9	ug/Kg		<MDL	39	76.7	ug/Kg		<MDL	39	76.1	ug/Kg
2,6-Dinitrotoluene		<MDL	38	74.6	ug/Kg		<MDL	37	72.9	ug/Kg		<MDL	39	76.7	ug/Kg		<MDL	39	76.1	ug/Kg
2-Chloronaphthalene		<MDL	22	44.8	ug/Kg		<MDL	22	43.8	ug/Kg		<MDL	23	46	ug/Kg		<MDL	23	45.7	ug/Kg
2-Chlorophenol		<MDL,G	11	22.4	ug/Kg		<MDL,G	11	21.9	ug/Kg		<MDL	12	23	ug/Kg		<MDL,G	11	22.9	ug/Kg
2-Methylnaphthalene		<MDL	20	39.2	ug/Kg		<MDL	19	38.3	ug/Kg		<MDL	20	40.3	ug/Kg		<MDL	20	40	ug/Kg
2-Methylphenol		<MDL,G	27	53.2	ug/Kg		<MDL,G	26	52	ug/Kg		<MDL	27	54.7	ug/Kg		<MDL,G	27	54.3	ug/Kg
2-Nitrophenol		<MDL,G	21	42	ug/Kg		<MDL,G	21	41	ug/Kg		<MDL,G	22	43.2	ug/Kg		<MDL,G	21	42.9	ug/Kg
4-Bromophenyl Phenyl Ether		<MDL	13	25.2	ug/Kg		<MDL	12	24.6	ug/Kg		<MDL	13	25.9	ug/Kg		<MDL	13	25.7	ug/Kg
4-Chlorophenyl Phenyl Ether		<MDL	18	36.4	ug/Kg		<MDL	18	35.6	ug/Kg		<MDL	19	37.4	ug/Kg		<MDL	19	37.1	ug/Kg
4-Methylphenol		<MDL,G	22	44.8	ug/Kg		<MDL,G	22	43.8	ug/Kg		<MDL	23	46	ug/Kg		<MDL,G	23	45.7	ug/Kg
Acenaphthene	21.6		9.8	19.6	ug/Kg	11	<RDL	9.6	19.2	ug/Kg	46.2		10	20.1	ug/Kg	27.3		10	20	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG3				Locator:	P53VG3				Locator:	P53VG4				Locator:	P53VG4			
	Descrip:	Pier 53 Van Veen 3				Descrip:	Pier 53 Van Veen 3				Descrip:	Pier 53 Van Veen 4				Descrip:	Pier 53 Van Veen 4			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-5				Lab ID:	L25702-6				Lab ID:	L25702-7				Lab ID:	L25702-8			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	71.4				% Solids:	73.1				% Solids:	69.5				% Solids:	70			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Acenaphthylene		<MDL	21	42	ug/Kg		<MDL	21	41	ug/Kg	33	<RDL	22	43.2	ug/Kg	31	<RDL	21	42.9	ug/Kg
Aniline		<MDL,X	27	53.2	ug/Kg		<MDL,X	26	52	ug/Kg		<MDL,X	27	54.7	ug/Kg		<MDL,X	27	54.3	ug/Kg
Anthracene	276	G	5.6	11.2	ug/Kg	356	G	5.5	10.9	ug/Kg	311	G	5.8	11.5	ug/Kg	229	G	5.7	11.4	ug/Kg
Benzo(a)anthracene	317		2.8	5.6	ug/Kg	233		2.7	5.47	ug/Kg	471		2.9	5.76	ug/Kg	337		2.9	5.71	ug/Kg
Benzo(a)pyrene	324		4.2	8.4	ug/Kg	112		4.1	8.21	ug/Kg	129		4.3	8.63	ug/Kg	90		4.3	8.57	ug/Kg
Benzo(b)fluoranthene	401		4.2	8.4	ug/Kg	249		4.1	8.21	ug/Kg	435		4.3	8.63	ug/Kg	333		4.3	8.57	ug/Kg
Benzo(g,h,i)perylene	26.3		11	22.4	ug/Kg		<MDL	11	21.9	ug/Kg		<MDL	12	23	ug/Kg		<MDL	11	22.9	ug/Kg
Benzo(k)fluoranthene	394		4.2	8.4	ug/Kg	309		4.1	8.21	ug/Kg	499		4.3	8.63	ug/Kg	391		4.3	8.57	ug/Kg
Benzoic Acid	225	G	38	74.6	ug/Kg	126	G	37	72.9	ug/Kg	153	G	39	76.7	ug/Kg	119	G	39	76.1	ug/Kg
Benzyl Alcohol		<MDL,X	8.4	16.8	ug/Kg		<MDL,X	8.2	16.4	ug/Kg		<MDL,X	8.6	17.3	ug/Kg		<MDL,X	8.6	17.1	ug/Kg
Benzyl Butyl Phthalate	24	<RDL	18	37.4	ug/Kg	22	<RDL	18	36.5	ug/Kg	27	<RDL	19	38.4	ug/Kg	27	<RDL	19	38.1	ug/Kg
Bis(2-Chloroethoxy)Methane		<MDL,G	24	47.6	ug/Kg		<MDL,G	23	46.5	ug/Kg		<MDL,G	24	48.9	ug/Kg		<MDL,G	24	48.6	ug/Kg
Bis(2-Chloroethyl)Ether		<MDL,G	21	42	ug/Kg		<MDL,G	21	41	ug/Kg		<MDL,G	22	43.2	ug/Kg		<MDL,G	21	42.9	ug/Kg
Bis(2-Chloroisopropyl)Ether		<MDL,G	21	42	ug/Kg		<MDL,G	21	41	ug/Kg		<MDL,G	22	43.2	ug/Kg		<MDL,G	21	42.9	ug/Kg
Bis(2-Ethylhexyl)Phthalate	211	B	18	37.4	ug/Kg	208	B	18	36.5	ug/Kg	420	B	19	38.4	ug/Kg	469	B	19	38.1	ug/Kg
Caffeine		<MDL	8.4	16.8	ug/Kg		<MDL	8.2	16.4	ug/Kg		<MDL	8.6	17.3	ug/Kg		<MDL	8.6	17.1	ug/Kg
Carbazole	52.5		9.8	19.6	ug/Kg	75.1		9.6	19.2	ug/Kg	53.8		10	20.1	ug/Kg	51.6		10	20	ug/Kg
Chrysene	590		5.6	11.2	ug/Kg	439		5.5	10.9	ug/Kg	751		5.8	11.5	ug/Kg	601		5.7	11.4	ug/Kg
Coprostanol		<MDL	180	374	ug/Kg		<MDL	180	365	ug/Kg		<MDL	190	384	ug/Kg		<MDL	190	381	ug/Kg
Dibenzo(a,h)anthracene	76.1		9.8	19.6	ug/Kg	60.3		9.6	19.2	ug/Kg	105		10	20.1	ug/Kg	85.1		10	20	ug/Kg
Dibenzofuran	28	<RDL	20	39.2	ug/Kg		<MDL	19	38.3	ug/Kg	37	<RDL	20	40.3	ug/Kg	31	<RDL	20	40	ug/Kg
Diethyl Phthalate		<MDL	8.4	16.8	ug/Kg		<MDL	8.2	16.4	ug/Kg		<MDL	8.6	17.3	ug/Kg		<MDL	8.6	17.1	ug/Kg
Dimethyl Phthalate		<MDL	15	30.8	ug/Kg		<MDL	15	30.1	ug/Kg		<MDL	16	31.7	ug/Kg		<MDL	16	31.4	ug/Kg
Di-N-Butyl Phthalate	20.4	B	9.4	18.6	ug/Kg	16	<RDL,B	9.2	18.2	ug/Kg	21.9	B	9.6	19.1	ug/Kg	20.1	B	9.6	19	ug/Kg
Di-N-Octyl Phthalate		<MDL	38	74.6	ug/Kg		<MDL	37	72.9	ug/Kg		<MDL	39	76.7	ug/Kg		<MDL	39	76.1	ug/Kg
Fluoranthene	529		11	22.4	ug/Kg	356		11	21.9	ug/Kg	862		12	23	ug/Kg	740		11	22.9	ug/Kg
Fluorene	59		18	36.4	ug/Kg	48.8		18	35.6	ug/Kg	69.9		19	37.4	ug/Kg	45.6		19	37.1	ug/Kg
Hexachlorobenzene		<MDL	0.92	1.86	ug/Kg		<MDL	0.9	1.82	ug/Kg		<MDL	0.95	1.91	ug/Kg		<MDL	0.94	1.9	ug/Kg
Hexachlorobutadiene		<MDL,G	1.1	2.1	ug/Kg		<MDL,G	1	2.05	ug/Kg		<MDL,G	1.1	2.16	ug/Kg		<MDL,G	1.1	2.14	ug/Kg
Hexachloroethane		<MDL,G	21	42	ug/Kg		<MDL,G	21	41	ug/Kg		<MDL,G	22	43.2	ug/Kg		<MDL,G	21	42.9	ug/Kg
Indeno(1,2,3-Cd)Pyrene	183		13	25.2	ug/Kg	76.9		12	24.6	ug/Kg	87.3		13	25.9	ug/Kg	65.1		13	25.7	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG3				Locator:	P53VG3				Locator:	P53VG4				Locator:	P53VG4			
	Descrip:	Pier 53 Van Veen 3				Descrip:	Pier 53 Van Veen 3				Descrip:	Pier 53 Van Veen 4				Descrip:	Pier 53 Van Veen 4			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-5				Lab ID:	L25702-6				Lab ID:	L25702-7				Lab ID:	L25702-8			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	71.4				% Solids:	73.1				% Solids:	69.5				% Solids:	70			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Isophorone		<MDL	27	53.2	ug/Kg		<MDL	26	52	ug/Kg		<MDL	27	54.7	ug/Kg		<MDL	27	54.3	ug/Kg
Naphthalene		<MDL,G	20	39.2	ug/Kg		<MDL,G	19	38.3	ug/Kg		<MDL,G	20	40.3	ug/Kg		<MDL,G	20	40	ug/Kg
Nitrobenzene		<MDL,G	22	44.8	ug/Kg		<MDL,G	22	43.8	ug/Kg		<MDL,G	23	46	ug/Kg		<MDL,G	23	45.7	ug/Kg
N-Nitrosodimethylamine		<MDL,G	28	56	ug/Kg		<MDL,G	27	54.7	ug/Kg		<MDL,G	29	57.6	ug/Kg		<MDL,G	29	57.1	ug/Kg
N-Nitrosodi-N-Propylamine		<MDL,G	13	25.2	ug/Kg		<MDL,G	12	24.6	ug/Kg		<MDL,G	13	25.9	ug/Kg		<MDL,G	13	25.7	ug/Kg
N-Nitrosodiphenylamine		<MDL	28	56	ug/Kg		<MDL	27	54.7	ug/Kg		<MDL	29	57.6	ug/Kg		<MDL	29	57.1	ug/Kg
Pentachlorophenol		<MDL,G	18	37.4	ug/Kg		<MDL,G	18	36.5	ug/Kg		<MDL	19	38.4	ug/Kg		<MDL,G	19	38.1	ug/Kg
Phenanthrene	266		5.6	11.2	ug/Kg	181		5.5	10.9	ug/Kg	412		5.8	11.5	ug/Kg	436		5.7	11.4	ug/Kg
Phenol		<MDL,G	13	25.2	ug/Kg		<MDL,G	12	24.6	ug/Kg		<MDL	13	25.9	ug/Kg		<MDL,G	13	25.7	ug/Kg
Pyrene	450		5.6	11.2	ug/Kg	213		5.5	10.9	ug/Kg	337		5.8	11.5	ug/Kg	231		5.7	11.4	ug/Kg
M=OR EPA 8081A/8082 (7-3-03-002)																				
4,4'-DDD		<MDL	1.8	3.5	ug/Kg		<MDL	1.8	3.42	ug/Kg	5.74		1.9	3.6	ug/Kg	2.7	<RDL	1.9	3.57	ug/Kg
4,4'-DDE		<MDL	1.8	3.5	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.9	3.6	ug/Kg		<MDL	1.9	3.57	ug/Kg
4,4'-DDT		<MDL	1.8	3.5	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.9	3.6	ug/Kg		<MDL	1.9	3.57	ug/Kg
Aldrin		<MDL	1.8	3.5	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.9	3.6	ug/Kg		<MDL	1.9	3.57	ug/Kg
Alpha-BHC		<MDL	0.88	1.75	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.91	1.8	ug/Kg		<MDL	0.9	1.79	ug/Kg
Aroclor 1016		<MDL	1.8	3.5	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.9	3.6	ug/Kg		<MDL	1.9	3.57	ug/Kg
Aroclor 1221		<MDL	3.5	7	ug/Kg		<MDL	3.4	6.84	ug/Kg		<MDL	3.6	7.19	ug/Kg		<MDL	3.6	7.14	ug/Kg
Aroclor 1232		<MDL	3.5	7	ug/Kg		<MDL	3.4	6.84	ug/Kg		<MDL	3.6	7.19	ug/Kg		<MDL	3.6	7.14	ug/Kg
Aroclor 1242		<MDL	1.8	3.5	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.9	3.6	ug/Kg		<MDL	1.9	3.57	ug/Kg
Aroclor 1248	11.1		1.8	3.5	ug/Kg	6.36		1.8	3.42	ug/Kg	6.12		1.9	3.6	ug/Kg		<MDL	1.9	3.57	ug/Kg
Aroclor 1254	27		1.8	3.5	ug/Kg	17.5		1.8	3.42	ug/Kg	15.1		1.9	3.6	ug/Kg	5.06		1.9	3.57	ug/Kg
Aroclor 1260	27.3		1.8	3.5	ug/Kg	19.3		1.8	3.42	ug/Kg	5.84		1.9	3.6	ug/Kg	6.31		1.9	3.57	ug/Kg
Beta-BHC		<MDL	0.88	1.75	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.91	1.8	ug/Kg		<MDL	0.9	1.79	ug/Kg
Chlordane		<MDL	0.88	1.75	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.91	1.8	ug/Kg		<MDL	0.9	1.79	ug/Kg
Delta-BHC		<MDL	0.88	1.75	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.91	1.8	ug/Kg		<MDL	0.9	1.79	ug/Kg
Dieldrin		<MDL	1.8	3.5	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.9	3.6	ug/Kg		<MDL	1.9	3.57	ug/Kg
Endosulfan I		<MDL	1.8	3.5	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.9	3.6	ug/Kg		<MDL	1.9	3.57	ug/Kg
Endosulfan II		<MDL	1.8	3.5	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.9	3.6	ug/Kg		<MDL	1.9	3.57	ug/Kg
Endosulfan Sulfate		<MDL	1.8	3.5	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.9	3.6	ug/Kg		<MDL	1.9	3.57	ug/Kg
Endrin		<MDL	1.8	3.5	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.9	3.6	ug/Kg		<MDL	1.9	3.57	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG3				Locator:	P53VG3				Locator:	P53VG4				Locator:	P53VG4			
	Descrip:	Pier 53 Van Veen 3				Descrip:	Pier 53 Van Veen 3				Descrip:	Pier 53 Van Veen 4				Descrip:	Pier 53 Van Veen 4			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-5				Lab ID:	L25702-6				Lab ID:	L25702-7				Lab ID:	L25702-8			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	71.4				% Solids:	73.1				% Solids:	69.5				% Solids:	70			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Endrin Aldehyde		<MDL,G	3.5	7	ug/Kg		<MDL,G	3.4	6.84	ug/Kg		<MDL,G	3.6	7.19	ug/Kg		<MDL,G	3.6	7.14	ug/Kg
Gamma-BHC (Lindane)		<MDL	0.88	1.75	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.91	1.8	ug/Kg		<MDL	0.9	1.79	ug/Kg
Heptachlor		<MDL	0.88	1.75	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.91	1.8	ug/Kg		<MDL	0.9	1.79	ug/Kg
Heptachlor Epoxide		<MDL	0.88	1.75	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.91	1.8	ug/Kg		<MDL	0.9	1.79	ug/Kg
Methoxychlor		<MDL	8.8	17.5	ug/Kg		<MDL	8.6	17.1	ug/Kg		<MDL	9.1	18	ug/Kg		<MDL	9	17.9	ug/Kg
Toxaphene		<MDL	18	35	ug/Kg		<MDL	18	34.2	ug/Kg		<MDL	19	36	ug/Kg		<MDL	19	35.7	ug/Kg
M=OR EPA 8260B (7-3-02-002)																				
1,1,1-Trichloroethane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
1,1,2,2-Tetrachloroethane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
1,1,2-Trichloroethane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
1,1,2-Trichloroethylene		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
1,1-Dichloroethane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
1,1-Dichloroethylene		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
1,2-Dichloroethane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
1,2-Dichloropropane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
2-Butanone (MEK)		<MDL	35	70	ug/Kg		<MDL	34	68.4	ug/Kg		<MDL	36	71.9	ug/Kg		<MDL	36	71.4	ug/Kg
2-Chloroethylvinyl ether		<MDL,G	7	14	ug/Kg		<MDL,G	6.8	13.7	ug/Kg		<MDL,G	7.2	14.4	ug/Kg		<MDL,G	7.1	14.3	ug/Kg
2-Hexanone		<MDL	35	70	ug/Kg		<MDL	34	68.4	ug/Kg		<MDL	36	71.9	ug/Kg		<MDL	36	71.4	ug/Kg
4-Methyl-2-Pentanone (MIBK)		<MDL	35	70	ug/Kg		<MDL	34	68.4	ug/Kg		<MDL	36	71.9	ug/Kg		<MDL	36	71.4	ug/Kg
Acetone		<MDL,L	18	70	ug/Kg		<MDL,L	18	68.4	ug/Kg		<MDL,L	19	71.9	ug/Kg		<MDL,L	19	71.4	ug/Kg
Acrolein		<MDL	35	70	ug/Kg		<MDL	34	68.4	ug/Kg		<MDL	36	71.9	ug/Kg		<MDL	36	71.4	ug/Kg
Acrylonitrile		<MDL	35	70	ug/Kg		<MDL	34	68.4	ug/Kg		<MDL	36	71.9	ug/Kg		<MDL	36	71.4	ug/Kg
Benzene		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Bromodichloromethane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Bromoform		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Bromomethane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Carbon Disulfide		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Carbon Tetrachloride		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Chlorobenzene		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Chlorodibromomethane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Chloroethane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53VG3	P53VG3	P53VG4	P53VG4
Descrip:	Pier 53 Van Veen 3	Pier 53 Van Veen 3	Pier 53 Van Veen 4	Pier 53 Van Veen 4
Client Loc:				
Sampled:	Sep 09, 2002	Sep 09, 2002	Sep 09, 2002	Sep 09, 2002
Lab ID:	L25702-5	L25702-6	L25702-7	L25702-8
Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED	SALTWTRSED
% Solids:	71.4	73.1	69.5	70

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Chloroform		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Chloromethane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Cis-1,3-Dichloropropene		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Ethylbenzene		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Methylene Chloride		<MDL	7	70	ug/Kg		<MDL	6.8	68.4	ug/Kg		<MDL	7.2	71.9	ug/Kg		<MDL	7.1	71.4	ug/Kg
Styrene		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Tetrachloroethylene		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Toluene		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Total Xylenes		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Trans-1,2-Dichloroethylene		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Trans-1,3-Dichloropropene		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Trichlorofluoromethane		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg
Vinyl Acetate		<MDL	35	70	ug/Kg		<MDL	34	68.4	ug/Kg		<MDL	36	71.9	ug/Kg		<MDL	36	71.4	ug/Kg
Vinyl Chloride		<MDL	7	14	ug/Kg		<MDL	6.8	13.7	ug/Kg		<MDL	7.2	14.4	ug/Kg		<MDL	7.1	14.3	ug/Kg

* Not converted to dry weight basis for this parameter

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG5				Locator:	P53VG5				Locator:	P53VG6				Locator:	P53VG6			
	Descrip:	Pier 53 Van Veen 5				Descrip:	Pier 53 Van Veen 5				Descrip:	Pier 53 Van Veen 6				Descrip:	Pier 53 Van Veen 6			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-9				Lab ID:	L25702-10				Lab ID:	L25702-11				Lab ID:	L25702-12			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	54.6				% Solids:	57.4				% Solids:	68.2				% Solids:	62.7			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
			- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis		
COMBINED LABS																				
M=CV ASTM D422																				
Clay *	8.6		0.1	0.1	%	9.3		0.1	0.1	%	6		0.1	0.1	%	8.8		0.1	0.1	%
Gravel *	1.6		0.1	0.1	%	0.8		0.1	0.1	%	1.6		0.1	0.1	%	2.7		0.1	0.1	%
p+0.00 *	2		0.1	0.1	%	2.4		0.1	0.1	%	1.8		0.1	0.1	%	1.7		0.1	0.1	%
p+1.00 *	15.1		0.1	0.1	%	23.7		0.1	0.1	%	24.6		0.1	0.1	%	23.6		0.1	0.1	%
p+10.0 *	1.7		0.1	0.1	%	1.4		0.1	0.1	%	0.4		0.1	0.1	%	0.8		0.1	0.1	%
p+10.0(more than) *	3.5		0.1	0.1	%	4.9		0.1	0.1	%	4.4		0.1	0.1	%	6.3		0.1	0.1	%
p+2.00 *	40.9		0.1	0.1	%	34.9		0.1	0.1	%	42.8		0.1	0.1	%	41.8		0.1	0.1	%
p+3.00 *	8.5		0.1	0.1	%	9.5		0.1	0.1	%	9.6		0.1	0.1	%	10.5		0.1	0.1	%
p+4.00 *	4.2		0.1	0.1	%	3.7		0.1	0.1	%	1.8		0.1	0.1	%	2		0.1	0.1	%
p+5.00 *	4.1		0.1	0.1	%		<MDL	0.1	0.1	%		<MDL	0.1	0.1	%		<MDL	0.1	0.1	%
p+6.00 *	4.8		0.1	0.1	%	3.9		0.1	0.1	%	3.6		0.1	0.1	%	2.3		0.1	0.1	%
p+7.00 *	4.4		0.1	0.1	%	4.7		0.1	0.1	%	3.6		0.1	0.1	%	3.4		0.1	0.1	%
p+8.00 *	5.8		0.1	0.1	%	7.1		0.1	0.1	%	4.5		0.1	0.1	%	3.2		0.1	0.1	%
p+9.00 *	3.4		0.1	0.1	%	3		0.1	0.1	%	1.2		0.1	0.1	%	1.7		0.1	0.1	%
p-1.00 *	0.7		0.1	0.1	%	0.6		0.1	0.1	%	0.5		0.1	0.1	%	0.8		0.1	0.1	%
p-2.00 *	0.2		0.1	0.1	%		<MDL	0.1	0.1	%	0.5		0.1	0.1	%	0.7		0.1	0.1	%
p-2.00(less than) *	0.7		0.1	0.1	%	0.2		0.1	0.1	%	0.6		0.1	0.1	%	1.2		0.1	0.1	%
Sand *	70.7		0.1	0.1	%	74.2		0.1	0.1	%	80.6		0.1	0.1	%	79.6		0.1	0.1	%
Silt *	19.1		0.1	0.1	%	15.7		0.1	0.1	%	11.7		0.1	0.1	%	8.9		0.1	0.1	%
M=CV EPA9060-PSEP96 (03-04-002-002)																				
Total Organic Carbon	21800		1800	3660	mg/Kg	18100		1200	2440	mg/Kg	10500		730	1470	mg/Kg	17500		1100	2230	mg/Kg
M=CV SM2540-G (03-01-007-001)																				
Total Solids *	54.6		0.005	0.01	%	57.4		0.005	0.01	%	68.2		0.005	0.01	%	62.7		0.005	0.01	%
M=MT EPA 245.5 (06-01-004-003)																				
Mercury, Total, CVAA	0.31	<RDL	0.037	0.357	mg/Kg	0.33	<RDL	0.035	0.348	mg/Kg	0.14	<RDL	0.029	0.293	mg/Kg	0.15	<RDL	0.032	0.321	mg/Kg
M=MT EPA3050A/6010B (06-02-004-002)																				
Aluminum, Total, ICP	12200	L	9.2	46.2	mg/Kg	12900	L	8.7	43.4	mg/Kg	10600	L	7.3	37	mg/Kg	11000	L	7.8	38.9	mg/Kg
Arsenic, Total, ICP	10	<RDL	4.6	23.1	mg/Kg	7.7	<RDL	4.4	21.8	mg/Kg	7.3	<RDL	3.7	18.5	mg/Kg	6.7	<RDL	3.8	19.5	mg/Kg
Beryllium, Total, ICP	0.37	<RDL	0.092	0.462	mg/Kg	0.35	<RDL	0.087	0.434	mg/Kg	0.29	<RDL	0.073	0.37	mg/Kg	0.32	<RDL	0.078	0.389	mg/Kg
Cadmium, Total, ICP	0.31	<RDL	0.27	1.38	mg/Kg	0.42	<RDL	0.26	1.3	mg/Kg		<MDL	0.22	1.11	mg/Kg		<MDL	0.24	1.17	mg/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG5				Locator:	P53VG5				Locator:	P53VG6				Locator:	P53VG6			
	Descrip:	Pier 53 Van Veen 5				Descrip:	Pier 53 Van Veen 5				Descrip:	Pier 53 Van Veen 6				Descrip:	Pier 53 Van Veen 6			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-9				Lab ID:	L25702-10				Lab ID:	L25702-11				Lab ID:	L25702-12			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	54.6				% Solids:	57.4				% Solids:	68.2				% Solids:	62.7			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Chromium, Total, ICP	23.4		0.46	2.31	mg/Kg	30.1		0.44	2.18	mg/Kg	18.6		0.37	1.85	mg/Kg	18.8		0.38	1.95	mg/Kg
Copper, Total, ICP	48.4		0.37	1.85	mg/Kg	52.1		0.35	1.74	mg/Kg	31.8		0.29	1.48	mg/Kg	34.1		0.3	1.55	mg/Kg
Iron, Total, ICP	22000	G	4.6	23.1	mg/Kg	21600	G	4.4	21.8	mg/Kg	18200	G	3.7	18.5	mg/Kg	19600	G	3.8	19.5	mg/Kg
Lead, Total, ICP	46.2		2.7	13.8	mg/Kg	74.4		2.6	13	mg/Kg	23.9		2.2	11.1	mg/Kg	24.2		2.4	11.7	mg/Kg
Manganese, Total, ICP	220		0.18	0.921	mg/Kg	209		0.17	0.869	mg/Kg	189		0.15	0.74	mg/Kg	206		0.15	0.777	mg/Kg
Nickel, Total, ICP	20.3		1.8	9.21	mg/Kg	21.6		1.7	8.69	mg/Kg	15.2		1.5	7.4	mg/Kg	16.1		1.5	7.77	mg/Kg
Selenium, Total, ICP		<MDL	4.6	23.1	mg/Kg		<MDL	4.4	21.8	mg/Kg		<MDL	3.7	18.5	mg/Kg		<MDL	3.8	19.5	mg/Kg
Silver, Total, ICP	0.57	<RDL	0.37	1.85	mg/Kg	0.82	<RDL	0.35	1.74	mg/Kg	0.34	<RDL	0.29	1.48	mg/Kg		<MDL	0.3	1.55	mg/Kg
Thallium, Total, ICP		<MDL	18	92.1	mg/Kg		<MDL	17	86.9	mg/Kg		<MDL	15	74	mg/Kg		<MDL	15	77.7	mg/Kg
Zinc, Total, ICP	85.9		0.46	2.31	mg/Kg	110		0.44	2.18	mg/Kg	66.9		0.37	1.85	mg/Kg	69.2		0.38	1.95	mg/Kg
M=OR EPA 3550B/8270C (7-3-01-004)																				
1,2,4-Trichlorobenzene		<MDL,G	0.48	0.971	ug/Kg		<MDL,G	0.45	0.923	ug/Kg		<MDL,G	0.38	0.777	ug/Kg		<MDL,G	0.41	0.845	ug/Kg
1,2-Dichlorobenzene		<MDL,G	0.48	0.971	ug/Kg		<MDL,G	0.45	0.923	ug/Kg		<MDL,G	0.38	0.777	ug/Kg		<MDL,G	0.41	0.845	ug/Kg
1,2-Diphenylhydrazine		<MDL	18	36.6	ug/Kg		<MDL	17	34.8	ug/Kg		<MDL	15	29.3	ug/Kg		<MDL	16	31.9	ug/Kg
1,3-Dichlorobenzene		<MDL,G	0.48	0.971	ug/Kg		<MDL,G	0.45	0.923	ug/Kg		<MDL,G	0.38	0.777	ug/Kg		<MDL,G	0.41	0.845	ug/Kg
1,4-Dichlorobenzene	2.05	G	0.24	0.484	ug/Kg	2.18	G	0.23	0.46	ug/Kg	1.29	G	0.19	0.387	ug/Kg	1.61	G	0.21	0.421	ug/Kg
2,4,5-Trichlorophenol		<MDL,G	22	44	ug/Kg		<MDL	21	41.8	ug/Kg		<MDL,G	18	35.2	ug/Kg		<MDL,G	19	38.3	ug/Kg
2,4,6-Trichlorophenol		<MDL,G	24	47.6	ug/Kg		<MDL	23	45.3	ug/Kg		<MDL,G	19	38.1	ug/Kg		<MDL,G	21	41.5	ug/Kg
2,4-Dichlorophenol		<MDL,G	29	58.6	ug/Kg		<MDL	28	55.7	ug/Kg		<MDL,G	23	46.9	ug/Kg		<MDL,G	26	51	ug/Kg
2,4-Dimethylphenol		<MDL,G	13	25.6	ug/Kg		<MDL	12	24.4	ug/Kg		<MDL,G	10	20.5	ug/Kg		<MDL,G	11	22.3	ug/Kg
2,4-Dinitrotoluene		<MDL	49	97.6	ug/Kg		<MDL	47	92.9	ug/Kg		<MDL	40	78.2	ug/Kg		<MDL	43	85	ug/Kg
2,6-Dinitrotoluene		<MDL	49	97.6	ug/Kg		<MDL	47	92.9	ug/Kg		<MDL	40	78.2	ug/Kg		<MDL	43	85	ug/Kg
2-Chloronaphthalene		<MDL	29	58.6	ug/Kg		<MDL	28	55.7	ug/Kg		<MDL	23	46.9	ug/Kg		<MDL	26	51	ug/Kg
2-Chlorophenol		<MDL,G	15	29.3	ug/Kg		<MDL	14	27.9	ug/Kg		<MDL,G	12	23.5	ug/Kg		<MDL,G	13	25.5	ug/Kg
2-Methylnaphthalene		<MDL	26	51.3	ug/Kg		<MDL	24	48.8	ug/Kg		<MDL	21	41.1	ug/Kg		<MDL	22	44.7	ug/Kg
2-Methylphenol		<MDL,G	35	69.6	ug/Kg		<MDL	33	66.2	ug/Kg		<MDL,G	28	55.7	ug/Kg		<MDL,G	30	60.6	ug/Kg
2-Nitrophenol		<MDL,G	27	54.9	ug/Kg		<MDL,G	26	52.3	ug/Kg		<MDL,G	22	44	ug/Kg		<MDL,G	24	47.8	ug/Kg
4-Bromophenyl Phenyl Ether		<MDL	16	33	ug/Kg		<MDL	16	31.4	ug/Kg		<MDL	13	26.4	ug/Kg		<MDL	14	28.7	ug/Kg
4-Chlorophenyl Phenyl Ether		<MDL	24	47.6	ug/Kg		<MDL	23	45.3	ug/Kg		<MDL	19	38.1	ug/Kg		<MDL	21	41.5	ug/Kg
4-Methylphenol		<MDL,G	29	58.6	ug/Kg		<MDL	28	55.7	ug/Kg		<MDL,G	23	46.9	ug/Kg		<MDL,G	26	51	ug/Kg
Acenaphthene	72.2		13	25.6	ug/Kg	85.5		12	24.4	ug/Kg	22.4		10	20.5	ug/Kg	29.2		11	22.3	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG5				Locator:	P53VG5				Locator:	P53VG6				Locator:	P53VG6			
	Descrip:	Pier 53 Van Veen 5				Descrip:	Pier 53 Van Veen 5				Descrip:	Pier 53 Van Veen 6				Descrip:	Pier 53 Van Veen 6			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-9				Lab ID:	L25702-10				Lab ID:	L25702-11				Lab ID:	L25702-12			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	54.6				% Solids:	57.4				% Solids:	68.2				% Solids:	62.7			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Acenaphthylene	121		27	54.9	ug/Kg	127		26	52.3	ug/Kg	40	<RDL	22	44	ug/Kg	70.7		24	47.8	ug/Kg
Aniline		<MDL,X	35	69.6	ug/Kg		<MDL,X	33	66.2	ug/Kg		<MDL,X	28	55.7	ug/Kg		<MDL,X	30	60.6	ug/Kg
Anthracene	632	G	7.3	14.7	ug/Kg	545	G	7	13.9	ug/Kg	217	G	5.9	11.7	ug/Kg	344	G	6.4	12.8	ug/Kg
Benzo(a)anthracene	973		3.7	7.33	ug/Kg	763		3.5	6.97	ug/Kg	333		2.9	5.87	ug/Kg	510		3.2	6.38	ug/Kg
Benzo(a)pyrene	182		5.5	11	ug/Kg	185		5.2	10.5	ug/Kg	94.7		4.4	8.8	ug/Kg	123		4.8	9.57	ug/Kg
Benzo(b)fluoranthene	762		5.5	11	ug/Kg	786		5.2	10.5	ug/Kg	343		4.4	8.8	ug/Kg	475		4.8	9.57	ug/Kg
Benzo(g,h,i)perylene		<MDL	15	29.3	ug/Kg		<MDL	14	27.9	ug/Kg		<MDL	12	23.5	ug/Kg		<MDL	13	25.5	ug/Kg
Benzo(k)fluoranthene	817		5.5	11	ug/Kg	916		5.2	10.5	ug/Kg	371		4.4	8.8	ug/Kg	512		4.8	9.57	ug/Kg
Benzoic Acid	175	G	49	97.6	ug/Kg	140	G	47	92.9	ug/Kg	116	G	40	78.2	ug/Kg	159	G	43	85	ug/Kg
Benzyl Alcohol		<MDL,X	11	22	ug/Kg		<MDL,X	10	20.9	ug/Kg		<MDL,X	8.8	17.6	ug/Kg		<MDL,X	9.6	19.1	ug/Kg
Benzyl Butyl Phthalate	40	<RDL	24	48.9	ug/Kg	37	<RDL	23	46.5	ug/Kg	31	<RDL	19	39.1	ug/Kg	37	<RDL	21	42.6	ug/Kg
Bis(2-Chloroethoxy)Methane		<MDL,G	31	62.3	ug/Kg		<MDL,G	30	59.2	ug/Kg		<MDL,G	25	49.9	ug/Kg		<MDL,G	27	54.2	ug/Kg
Bis(2-Chloroethyl)Ether		<MDL,G	27	54.9	ug/Kg		<MDL,G	26	52.3	ug/Kg		<MDL,G	22	44	ug/Kg		<MDL,G	24	47.8	ug/Kg
Bis(2-Chloroisopropyl)Ether		<MDL,G	27	54.9	ug/Kg		<MDL,G	26	52.3	ug/Kg		<MDL,G	22	44	ug/Kg		<MDL,G	24	47.8	ug/Kg
Bis(2-Ethylhexyl)Phthalate	348	B	24	48.9	ug/Kg	427	B	23	46.5	ug/Kg	183	B	19	39.1	ug/Kg	169	B	21	42.6	ug/Kg
Caffeine		<MDL	11	22	ug/Kg		<MDL	10	20.9	ug/Kg		<MDL	8.8	17.6	ug/Kg		<MDL	9.6	19.1	ug/Kg
Carbazole	109		13	25.6	ug/Kg	93.7		12	24.4	ug/Kg	36.5		10	20.5	ug/Kg	61.4		11	22.3	ug/Kg
Chrysene	1320		7.3	14.7	ug/Kg	1070		7	13.9	ug/Kg	545		5.9	11.7	ug/Kg	721		6.4	12.8	ug/Kg
Coprostanol		<MDL	240	489	ug/Kg		<MDL	230	465	ug/Kg		<MDL	190	391	ug/Kg		<MDL	210	426	ug/Kg
Dibenzo(a,h)anthracene	183		13	25.6	ug/Kg	174		12	24.4	ug/Kg	87.4		10	20.5	ug/Kg	114		11	22.3	ug/Kg
Dibenzofuran	80.6		26	51.3	ug/Kg	78.2		24	48.8	ug/Kg		<MDL	21	41.1	ug/Kg	24	<RDL	22	44.7	ug/Kg
Diethyl Phthalate		<MDL	11	22	ug/Kg		<MDL	10	20.9	ug/Kg		<MDL	8.8	17.6	ug/Kg		<MDL	9.6	19.1	ug/Kg
Dimethyl Phthalate		<MDL	20	40.3	ug/Kg		<MDL	19	38.3	ug/Kg		<MDL	16	32.3	ug/Kg		<MDL	18	35.1	ug/Kg
Di-N-Butyl Phthalate	28	B	12	24.4	ug/Kg	32.2	B	12	23.2	ug/Kg	21.3	B	9.8	19.5	ug/Kg	23.8	B	11	21.2	ug/Kg
Di-N-Octyl Phthalate		<MDL	49	97.6	ug/Kg		<MDL	47	92.9	ug/Kg		<MDL	40	78.2	ug/Kg		<MDL	43	85	ug/Kg
Fluoranthene	1180		15	29.3	ug/Kg	990		14	27.9	ug/Kg	446		12	23.5	ug/Kg	620		13	25.5	ug/Kg
Fluorene	167		24	47.6	ug/Kg	132		23	45.3	ug/Kg	41.6		19	38.1	ug/Kg	62.2		21	41.5	ug/Kg
Hexachlorobenzene		<MDL	1.2	2.44	ug/Kg		<MDL	1.1	2.32	ug/Kg		<MDL	0.97	1.95	ug/Kg		<MDL	1.1	2.12	ug/Kg
Hexachlorobutadiene		<MDL,G	1.4	2.75	ug/Kg		<MDL,G	1.3	2.61	ug/Kg		<MDL,G	1.1	2.2	ug/Kg		<MDL,G	1.2	2.39	ug/Kg
Hexachloroethane		<MDL,G	27	54.9	ug/Kg		<MDL,G	26	52.3	ug/Kg		<MDL,G	22	44	ug/Kg		<MDL,G	24	47.8	ug/Kg
Indeno(1,2,3-Cd)Pyrene	126		16	33	ug/Kg	112		16	31.4	ug/Kg	64.7		13	26.4	ug/Kg	71.8		14	28.7	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG5				Locator:	P53VG5				Locator:	P53VG6				Locator:	P53VG6			
	Descrip:	Pier 53 Van Veen 5				Descrip:	Pier 53 Van Veen 5				Descrip:	Pier 53 Van Veen 6				Descrip:	Pier 53 Van Veen 6			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-9				Lab ID:	L25702-10				Lab ID:	L25702-11				Lab ID:	L25702-12			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	54.6				% Solids:	57.4				% Solids:	68.2				% Solids:	62.7			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Isophorone		<MDL	35	69.6	ug/Kg		<MDL	33	66.2	ug/Kg		<MDL	28	55.7	ug/Kg		<MDL	30	60.6	ug/Kg
Naphthalene	64.7	G	26	51.3	ug/Kg	69.2	G	24	48.8	ug/Kg		<MDL,G	21	41.1	ug/Kg		<MDL,G	22	44.7	ug/Kg
Nitrobenzene		<MDL,G	29	58.6	ug/Kg		<MDL,G	28	55.7	ug/Kg		<MDL,G	23	46.9	ug/Kg		<MDL,G	26	51	ug/Kg
N-Nitrosodimethylamine		<MDL,G	37	73.3	ug/Kg		<MDL,G	35	69.7	ug/Kg		<MDL,G	29	58.7	ug/Kg		<MDL,G	32	63.8	ug/Kg
N-Nitrosodi-N-Propylamine		<MDL,G	16	33	ug/Kg		<MDL,G	16	31.4	ug/Kg		<MDL,G	13	26.4	ug/Kg		<MDL,G	14	28.7	ug/Kg
N-Nitrosodiphenylamine		<MDL	37	73.3	ug/Kg		<MDL	35	69.7	ug/Kg		<MDL	29	58.7	ug/Kg		<MDL	32	63.8	ug/Kg
Pentachlorophenol		<MDL,G	24	48.9	ug/Kg		<MDL	23	46.5	ug/Kg		<MDL,G	19	39.1	ug/Kg		<MDL,G	21	42.6	ug/Kg
Phenanthrene	632		7.3	14.7	ug/Kg	441		7	13.9	ug/Kg	204		5.9	11.7	ug/Kg	274		6.4	12.8	ug/Kg
Phenol		<MDL,G	16	33	ug/Kg		<MDL	16	31.4	ug/Kg		<MDL,G	13	26.4	ug/Kg		<MDL,G	14	28.7	ug/Kg
Pyrene	436		7.3	14.7	ug/Kg	551		7	13.9	ug/Kg	204		5.9	11.7	ug/Kg	219		6.4	12.8	ug/Kg
M=OR EPA 8081A/8082 (7-3-03-002)																				
4,4'-DDD		<MDL	2.4	4.58	ug/Kg	3	<RDL	2.3	4.36	ug/Kg		<MDL	1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
4,4'-DDE		<MDL	2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg		<MDL	1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
4,4'-DDT		<MDL	2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg		<MDL	1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
Aldrin		<MDL	2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg		<MDL	1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
Alpha-BHC		<MDL	1.2	2.29	ug/Kg		<MDL	1.1	2.18	ug/Kg		<MDL	0.92	1.83	ug/Kg		<MDL	1	1.99	ug/Kg
Aroclor 1016		<MDL	2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg		<MDL	1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
Aroclor 1221		<MDL	4.6	9.16	ug/Kg		<MDL	4.4	8.71	ug/Kg		<MDL	3.7	7.33	ug/Kg		<MDL	4	7.97	ug/Kg
Aroclor 1232		<MDL	4.6	9.16	ug/Kg		<MDL	4.4	8.71	ug/Kg		<MDL	3.7	7.33	ug/Kg		<MDL	4	7.97	ug/Kg
Aroclor 1242		<MDL	2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg		<MDL	1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
Aroclor 1248		<MDL	2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg	4.96		1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
Aroclor 1254	9.14		2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg	9.33		1.9	3.67	ug/Kg	5.58		2.1	3.99	ug/Kg
Aroclor 1260	16.4		2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg	5.28		1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
Beta-BHC		<MDL	1.2	2.29	ug/Kg		<MDL	1.1	2.18	ug/Kg		<MDL	0.92	1.83	ug/Kg		<MDL	1	1.99	ug/Kg
Chlordane		<MDL	1.2	2.29	ug/Kg		<MDL	1.1	2.18	ug/Kg		<MDL	0.92	1.83	ug/Kg		<MDL	1	1.99	ug/Kg
Delta-BHC		<MDL	1.2	2.29	ug/Kg		<MDL	1.1	2.18	ug/Kg		<MDL	0.92	1.83	ug/Kg		<MDL	1	1.99	ug/Kg
Dieldrin		<MDL	2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg		<MDL	1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
Endosulfan I		<MDL	2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg		<MDL	1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
Endosulfan II		<MDL	2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg		<MDL	1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
Endosulfan Sulfate		<MDL	2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg		<MDL	1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg
Endrin		<MDL	2.4	4.58	ug/Kg		<MDL	2.3	4.36	ug/Kg		<MDL	1.9	3.67	ug/Kg		<MDL	2.1	3.99	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG5				Locator:	P53VG5				Locator:	P53VG6				Locator:	P53VG6			
	Descrip:	Pier 53 Van Veen 5				Descrip:	Pier 53 Van Veen 5				Descrip:	Pier 53 Van Veen 6				Descrip:	Pier 53 Van Veen 6			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002			
	Lab ID:	L25702-9				Lab ID:	L25702-10				Lab ID:	L25702-11				Lab ID:	L25702-12			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	54.6				% Solids:	57.4				% Solids:	68.2				% Solids:	62.7			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Endrin Aldehyde		<MDL,G	4.6	9.16	ug/Kg		<MDL,G	4.4	8.71	ug/Kg		<MDL,G	3.7	7.33	ug/Kg		<MDL,G	4	7.97	ug/Kg
Gamma-BHC (Lindane)		<MDL	1.2	2.29	ug/Kg		<MDL	1.1	2.18	ug/Kg		<MDL	0.92	1.83	ug/Kg		<MDL	1	1.99	ug/Kg
Heptachlor		<MDL	1.2	2.29	ug/Kg		<MDL	1.1	2.18	ug/Kg		<MDL	0.92	1.83	ug/Kg		<MDL	1	1.99	ug/Kg
Heptachlor Epoxide		<MDL	1.2	2.29	ug/Kg		<MDL	1.1	2.18	ug/Kg		<MDL	0.92	1.83	ug/Kg		<MDL	1	1.99	ug/Kg
Methoxychlor		<MDL	12	22.9	ug/Kg		<MDL	11	21.8	ug/Kg		<MDL	9.2	18.3	ug/Kg		<MDL	10	19.9	ug/Kg
Toxaphene		<MDL	24	45.8	ug/Kg		<MDL	23	43.6	ug/Kg		<MDL	19	36.7	ug/Kg		<MDL	21	39.9	ug/Kg
M=OR EPA 8260B (7-3-02-002)																				
1,1,1-Trichloroethane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
1,1,2,2-Tetrachloroethane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
1,1,2-Trichloroethane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
1,1,2-Trichloroethylene		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
1,1-Dichloroethane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
1,1-Dichloroethylene		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
1,2-Dichloroethane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
1,2-Dichloropropane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
2-Butanone (MEK)		<MDL	46	91.6	ug/Kg		<MDL	44	87.1	ug/Kg		<MDL	37	73.3	ug/Kg		<MDL	40	79.7	ug/Kg
2-Chloroethylvinyl ether		<MDL,G	9.2	18.3	ug/Kg		<MDL,G	8.7	17.4	ug/Kg		<MDL,G	7.3	14.7	ug/Kg		<MDL,G	8	15.9	ug/Kg
2-Hexanone		<MDL	46	91.6	ug/Kg		<MDL	44	87.1	ug/Kg		<MDL	37	73.3	ug/Kg		<MDL	40	79.7	ug/Kg
4-Methyl-2-Pentanone (MIBK)		<MDL	46	91.6	ug/Kg		<MDL	44	87.1	ug/Kg		<MDL	37	73.3	ug/Kg		<MDL	40	79.7	ug/Kg
Acetone		<MDL,L	24	91.6	ug/Kg		<MDL,L	23	87.1	ug/Kg		<MDL,L	19	73.3	ug/Kg		<MDL,L	21	79.7	ug/Kg
Acrolein		<MDL	46	91.6	ug/Kg		<MDL	44	87.1	ug/Kg		<MDL	37	73.3	ug/Kg		<MDL	40	79.7	ug/Kg
Acrylonitrile		<MDL	46	91.6	ug/Kg		<MDL	44	87.1	ug/Kg		<MDL	37	73.3	ug/Kg		<MDL	40	79.7	ug/Kg
Benzene		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Bromodichloromethane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Bromoform		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Bromomethane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Carbon Disulfide		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Carbon Tetrachloride		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Chlorobenzene		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Chlorodibromomethane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Chloroethane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53VG5	P53VG5	P53VG6	P53VG6
Descrip:	Pier 53 Van Veen 5	Pier 53 Van Veen 5	Pier 53 Van Veen 6	Pier 53 Van Veen 6
Client Loc:				
Sampled:	Sep 09, 2002	Sep 09, 2002	Sep 09, 2002	Sep 09, 2002
Lab ID:	L25702-9	L25702-10	L25702-11	L25702-12
Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED	SALTWTRSED
% Solids:	54.6	57.4	68.2	62.7

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Chloroform		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Chloromethane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Cis-1,3-Dichloropropene		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Ethylbenzene		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Methylene Chloride		<MDL	9.2	91.6	ug/Kg		<MDL	8.7	87.1	ug/Kg	8.9	<RDL,B	7.3	73.3	ug/Kg		<MDL,B	8	79.7	ug/Kg
Styrene		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Tetrachloroethylene		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Toluene		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Total Xylenes		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Trans-1,2-Dichloroethylene		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Trans-1,3-Dichloropropene		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Trichlorofluoromethane		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg
Vinyl Acetate		<MDL	46	91.6	ug/Kg		<MDL	44	87.1	ug/Kg		<MDL	37	73.3	ug/Kg		<MDL	40	79.7	ug/Kg
Vinyl Chloride		<MDL	9.2	18.3	ug/Kg		<MDL	8.7	17.4	ug/Kg		<MDL	7.3	14.7	ug/Kg		<MDL	8	15.9	ug/Kg

* Not converted to dry weight basis for this parameter

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG7				Locator:	P53VG7				Locator:	P53VG7				Locator:	P53C1			
	Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Core 1			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 24, 2002			
	Lab ID:	L25702-13				Lab ID:	L25702-14				Lab ID:	L25702-15				Lab ID:	L25512-1			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	75				% Solids:	74.3				% Solids:	73.1				% Solids:	75.1			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
M=CV ASTM D422																				
Clay *	2.7		0.1	0.1	%	2.9		0.1	0.1	%	1.5		0.1	0.1	%					
Gravel *	2.4		0.1	0.1	%	2.5		0.1	0.1	%	2.6		0.1	0.1	%					
p+0.00 *	6.8		0.1	0.1	%	7.8		0.1	0.1	%	7.7		0.1	0.1	%					
p+1.00 *	32.8		0.1	0.1	%	36		0.1	0.1	%	36.5		0.1	0.1	%					
p+10.0 *	0.6		0.1	0.1	%	0.3		0.1	0.1	%		<MDL	0.1	0.1	%					
p+10.0(more than) *	1		0.1	0.1	%	1.9		0.1	0.1	%	1.3		0.1	0.1	%					
p+2.00 *	48.5		0.1	0.1	%	44.5		0.1	0.1	%	44.4		0.1	0.1	%					
p+3.00 *	4.2		0.1	0.1	%	3.7		0.1	0.1	%	3.3		0.1	0.1	%					
p+4.00 *	0.5		0.1	0.1	%	0.4		0.1	0.1	%	0.5		0.1	0.1	%					
p+5.00 *		<MDL	0.1	0.1	%		<MDL	0.1	0.1	%	0.8		0.1	0.1	%					
p+6.00 *	0.7		0.1	0.1	%	0.4		0.1	0.1	%		<MDL	0.1	0.1	%					
p+7.00 *	0.7		0.1	0.1	%	0.7		0.1	0.1	%	1.1		0.1	0.1	%					
p+8.00 *	0.6		0.1	0.1	%	1.2		0.1	0.1	%	1.4		0.1	0.1	%					
p+9.00 *	1.1		0.1	0.1	%	0.7		0.1	0.1	%	0.2		0.1	0.1	%					
p-1.00 *	1.6		0.1	0.1	%	2.2		0.1	0.1	%	2		0.1	0.1	%					
p-2.00 *	0.3		0.1	0.1	%		<MDL	0.1	0.1	%	0.5		0.1	0.1	%					
p-2.00(less than) *	0.5		0.1	0.1	%	0.3		0.1	0.1	%	0.1	RDL	0.1	0.1	%					
Sand *	92.8		0.1	0.1	%	92.4		0.1	0.1	%	92.4		0.1	0.1	%					
Silt *	2		0.1	0.1	%	2.3		0.1	0.1	%	3.3		0.1	0.1	%					
M=CV EPA9060-PSEP96 (03-04-002-002)																				
Total Organic Carbon	4000		670	1330	mg/Kg	3060		670	1350	mg/Kg	2860		680	1370	mg/Kg	6960		670	1330	mg/Kg
M=CV SM2540-G (03-01-007-001)																				
Total Solids *	75		0.005	0.01	%	74.3		0.005	0.01	%	73.1		0.005	0.01	%	75.1		0.005	0.01	%
M=MT EPA 245.5 (06-01-004-003)																				
Mercury, Total, CVAA	0.04	<RDL	0.027	0.261	mg/Kg	0.05	<RDL	0.026	0.26	mg/Kg	0.033	<RDL	0.026	0.263	mg/Kg		<MDL	0.025	0.254	mg/Kg
M=MT EPA3050A/6010B (06-02-004-002)																				
Aluminum, Total, ICP	8050	L	6.7	33.2	mg/Kg	8630	L	6.7	33.6	mg/Kg	8960	L	6.8	34.1	mg/Kg	9690	L	6.4	32.1	mg/Kg
Arsenic, Total, ICP	8.3	<RDL	3.3	16.7	mg/Kg	7.1	<RDL	3.4	16.8	mg/Kg	5.9	<RDL	3.4	17.1	mg/Kg	5.2	<RDL	3.2	16	mg/Kg
Beryllium, Total, ICP	0.24	<RDL	0.067	0.332	mg/Kg	0.24	<RDL	0.067	0.336	mg/Kg	0.25	<RDL	0.068	0.341	mg/Kg	0.28	<RDL	0.064	0.321	mg/Kg
Cadmium, Total, ICP		<MDL	0.2	0.996	mg/Kg		<MDL	0.2	1.01	mg/Kg		<MDL	0.21	1.02	mg/Kg		<MDL	0.19	0.963	mg/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG7				Locator:	P53VG7				Locator:	P53VG7				Locator:	P53C1			
	Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Core 1			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 24, 2002			
	Lab ID:	L25702-13				Lab ID:	L25702-14				Lab ID:	L25702-15				Lab ID:	L25512-1			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	75				% Solids:	74.3				% Solids:	73.1				% Solids:	75.1			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
			- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis		
COMBINED LABS																				
Chromium, Total, ICP	12.4		0.33	1.67	mg/Kg	14.3		0.34	1.68	mg/Kg	12		0.34	1.71	mg/Kg	12.7		0.32	1.6	mg/Kg
Copper, Total, ICP	14.3		0.27	1.33	mg/Kg	15.7		0.27	1.35	mg/Kg	16.3		0.27	1.36	mg/Kg	13.7		0.25	1.28	mg/Kg
Iron, Total, ICP	18000	G	3.3	16.7	mg/Kg	19500	G	3.4	16.8	mg/Kg	19200	G	3.4	17.1	mg/Kg	19400	G	3.2	16	mg/Kg
Lead, Total, ICP	10.8		2	9.96	mg/Kg	9.4	<RDL	2	10.1	mg/Kg	8.3	<RDL	2.1	10.2	mg/Kg	9.2	<RDL	1.9	9.63	mg/Kg
Manganese, Total, ICP	271		0.13	0.664	mg/Kg	237		0.13	0.673	mg/Kg	223		0.14	0.681	mg/Kg	221		0.13	0.642	mg/Kg
Nickel, Total, ICP	11.4		1.3	6.64	mg/Kg	12.5		1.3	6.73	mg/Kg	13.8		1.4	6.81	mg/Kg	13.8		1.3	6.42	mg/Kg
Selenium, Total, ICP		<MDL	3.3	16.7	mg/Kg		<MDL	3.4	16.8	mg/Kg		<MDL	3.4	17.1	mg/Kg		<MDL	3.2	16	mg/Kg
Silver, Total, ICP		<MDL	0.27	1.33	mg/Kg		<MDL	0.27	1.35	mg/Kg		<MDL	0.27	1.36	mg/Kg		<MDL	0.25	1.28	mg/Kg
Thallium, Total, ICP		<MDL	13	66.4	mg/Kg		<MDL	13	67.3	mg/Kg		<MDL	14	68.1	mg/Kg		<MDL	13	64.2	mg/Kg
Zinc, Total, ICP	45.7		0.33	1.67	mg/Kg	49.5		0.34	1.68	mg/Kg	48.7		0.34	1.71	mg/Kg	50.3		0.32	1.6	mg/Kg
M=OR EPA 3550B/8270C (7-3-01-004)																				
1,2,4-Trichlorobenzene		<MDL,G	0.35	0.707	ug/Kg		<MDL,G	0.35	0.713	ug/Kg		<MDL,G	0.36	0.725	ug/Kg		<MDL,G	0.35	0.706	ug/Kg
1,2-Dichlorobenzene		<MDL,G	0.35	0.707	ug/Kg		<MDL,G	0.35	0.713	ug/Kg		<MDL,G	0.36	0.725	ug/Kg		<MDL,G	0.35	0.706	ug/Kg
1,2-Diphenylhydrazine		<MDL	13	26.7	ug/Kg		<MDL	13	26.9	ug/Kg		<MDL	14	27.4	ug/Kg		<MDL	13	26.6	ug/Kg
1,3-Dichlorobenzene		<MDL,G	0.35	0.707	ug/Kg		<MDL,G	0.35	0.713	ug/Kg		<MDL,G	0.36	0.725	ug/Kg		<MDL,G	0.35	0.706	ug/Kg
1,4-Dichlorobenzene		<MDL,G	0.17	0.352	ug/Kg		<MDL,G	0.17	0.355	ug/Kg	0.657	G	0.18	0.361	ug/Kg	0.782	G	0.17	0.352	ug/Kg
2,4,5-Trichlorophenol		<MDL	16	32	ug/Kg		<MDL,G	16	32.3	ug/Kg		<MDL,G	16	32.8	ug/Kg		<MDL	16	32	ug/Kg
2,4,6-Trichlorophenol		<MDL	17	34.7	ug/Kg		<MDL,G	17	35	ug/Kg		<MDL,G	18	35.6	ug/Kg		<MDL	17	34.6	ug/Kg
2,4-Dichlorophenol		<MDL	21	42.7	ug/Kg		<MDL,G	22	43.1	ug/Kg		<MDL,G	22	43.8	ug/Kg		<MDL	21	42.6	ug/Kg
2,4-Dimethylphenol		<MDL	9.3	18.7	ug/Kg		<MDL,G	9.4	18.8	ug/Kg		<MDL,G	9.6	19.2	ug/Kg		<MDL	9.3	18.6	ug/Kg
2,4-Dinitrotoluene		<MDL	36	71.1	ug/Kg		<MDL	36	71.7	ug/Kg		<MDL	37	72.9	ug/Kg		<MDL	36	71	ug/Kg
2,6-Dinitrotoluene		<MDL	36	71.1	ug/Kg		<MDL	36	71.7	ug/Kg		<MDL	37	72.9	ug/Kg		<MDL	36	71	ug/Kg
2-Chloronaphthalene		<MDL	21	42.7	ug/Kg		<MDL	22	43.1	ug/Kg		<MDL	22	43.8	ug/Kg		<MDL	21	42.6	ug/Kg
2-Chlorophenol		<MDL	11	21.3	ug/Kg		<MDL,G	11	21.5	ug/Kg		<MDL,G	11	21.9	ug/Kg		<MDL	11	21.3	ug/Kg
2-Methylnaphthalene		<MDL	19	37.3	ug/Kg		<MDL	19	37.7	ug/Kg		<MDL	19	38.3	ug/Kg		<MDL	19	37.3	ug/Kg
2-Methylphenol		<MDL	25	50.7	ug/Kg		<MDL,G	26	51.1	ug/Kg		<MDL,G	26	52	ug/Kg		<MDL	25	50.6	ug/Kg
2-Nitrophenol		<MDL,G	20	40	ug/Kg		<MDL,G	20	40.4	ug/Kg		<MDL,G	21	41	ug/Kg		<MDL,G	20	39.9	ug/Kg
4-Bromophenyl Phenyl Ether		<MDL	12	24	ug/Kg		<MDL	12	24.2	ug/Kg		<MDL	12	24.6	ug/Kg		<MDL	12	24	ug/Kg
4-Chlorophenyl Phenyl Ether		<MDL	17	34.7	ug/Kg		<MDL	17	35	ug/Kg		<MDL	18	35.6	ug/Kg		<MDL	17	34.6	ug/Kg
4-Methylphenol		<MDL	21	42.7	ug/Kg		<MDL,G	22	43.1	ug/Kg		<MDL,G	22	43.8	ug/Kg		<MDL	21	42.6	ug/Kg
Acenaphthene		<MDL	9.3	18.7	ug/Kg		<MDL	9.4	18.8	ug/Kg		<MDL	9.6	19.2	ug/Kg		<MDL	9.3	18.6	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG7				Locator:	P53VG7				Locator:	P53VG7				Locator:	P53C1			
	Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Core 1			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 24, 2002			
	Lab ID:	L25702-13				Lab ID:	L25702-14				Lab ID:	L25702-15				Lab ID:	L25512-1			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	75				% Solids:	74.3				% Solids:	73.1				% Solids:	75.1			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Acenaphthylene		<MDL	20	40	ug/Kg		<MDL	20	40.4	ug/Kg		<MDL	21	41	ug/Kg		<MDL	20	39.9	ug/Kg
Aniline		<MDL,X	25	50.7	ug/Kg		<MDL,X	26	51.1	ug/Kg		<MDL,X	26	52	ug/Kg		<MDL,X	25	50.6	ug/Kg
Anthracene	85.3	G	5.3	10.7	ug/Kg	36.1	G	5.4	10.8	ug/Kg	41.7	G	5.5	10.9	ug/Kg		<MDL,G	5.3	10.7	ug/Kg
Benzo(a)anthracene	201		2.7	5.33	ug/Kg	42.4		2.7	5.38	ug/Kg	75.4		2.7	5.47	ug/Kg	9.52		2.7	5.33	ug/Kg
Benzo(a)pyrene	41.2		4	8	ug/Kg	21.7		4	8.08	ug/Kg	45.1		4.1	8.21	ug/Kg	8.03		4	7.99	ug/Kg
Benzo(b)fluoranthene	203		4	8	ug/Kg	72.8		4	8.08	ug/Kg	97.7		4.1	8.21	ug/Kg	10.2		4	7.99	ug/Kg
Benzo(g,h,i)perylene		<MDL	11	21.3	ug/Kg		<MDL	11	21.5	ug/Kg		<MDL	11	21.9	ug/Kg		<MDL	11	21.3	ug/Kg
Benzo(k)fluoranthene	187		4	8	ug/Kg	97.2		4	8.08	ug/Kg	120		4.1	8.21	ug/Kg	8.38		4	7.99	ug/Kg
Benzoic Acid	191	G	36	71.1	ug/Kg	111	G	36	71.7	ug/Kg	150	G	37	72.9	ug/Kg	81	G	36	71	ug/Kg
Benzyl Alcohol		<MDL,X	8	16	ug/Kg		<MDL,X	8.1	16.2	ug/Kg		<MDL,X	8.2	16.4	ug/Kg		<MDL,X	8	16	ug/Kg
Benzyl Butyl Phthalate	20	<RDL	17	35.6	ug/Kg		<MDL	17	35.9	ug/Kg	19	<RDL	18	36.5	ug/Kg		<MDL	17	35.6	ug/Kg
Bis(2-Chloroethoxy)Methane		<MDL,G	23	45.3	ug/Kg		<MDL,G	23	45.8	ug/Kg		<MDL,G	23	46.5	ug/Kg		<MDL,G	23	45.3	ug/Kg
Bis(2-Chloroethyl)Ether		<MDL,G	20	40	ug/Kg		<MDL,G	20	40.4	ug/Kg		<MDL,G	21	41	ug/Kg		<MDL,G	20	39.9	ug/Kg
Bis(2-Chloroisopropyl)Ether		<MDL,G	20	40	ug/Kg		<MDL,G	20	40.4	ug/Kg		<MDL,G	21	41	ug/Kg		<MDL,G	20	39.9	ug/Kg
Bis(2-Ethylhexyl)Phthalate	36.5	B	17	35.6	ug/Kg	44.1	B	17	35.9	ug/Kg	85.5	B	18	36.5	ug/Kg	37.7	B	17	35.6	ug/Kg
Caffeine		<MDL	8	16	ug/Kg		<MDL	8.1	16.2	ug/Kg		<MDL	8.2	16.4	ug/Kg		<MDL	8	16	ug/Kg
Carbazole		<MDL	9.3	18.7	ug/Kg		<MDL	9.4	18.8	ug/Kg		<MDL	9.6	19.2	ug/Kg		<MDL	9.3	18.6	ug/Kg
Chrysene	187		5.3	10.7	ug/Kg	80.3		5.4	10.8	ug/Kg	119		5.5	10.9	ug/Kg	8.8	<RDL	5.3	10.7	ug/Kg
Coprostanol		<MDL	170	356	ug/Kg		<MDL	170	359	ug/Kg		<MDL	180	365	ug/Kg		<MDL	170	356	ug/Kg
Dibenzo(a,h)anthracene		<MDL	9.3	18.7	ug/Kg	19.4		9.4	18.8	ug/Kg	43.5		9.6	19.2	ug/Kg		<MDL	9.3	18.6	ug/Kg
Dibenzofuran		<MDL	19	37.3	ug/Kg		<MDL	19	37.7	ug/Kg		<MDL	19	38.3	ug/Kg		<MDL	19	37.3	ug/Kg
Diethyl Phthalate		<MDL	8	16	ug/Kg		<MDL	8.1	16.2	ug/Kg		<MDL	8.2	16.4	ug/Kg		<MDL	8	16	ug/Kg
Dimethyl Phthalate		<MDL	15	29.3	ug/Kg		<MDL	15	29.6	ug/Kg		<MDL	15	30.1	ug/Kg		<MDL	15	29.3	ug/Kg
Di-N-Butyl Phthalate	15	<RDL,B	8.9	17.7	ug/Kg	15	<RDL,B	9	17.9	ug/Kg	15	<RDL,B	9.2	18.2	ug/Kg	15	<RDL,B	8.9	17.7	ug/Kg
Di-N-Octyl Phthalate		<MDL	36	71.1	ug/Kg		<MDL	36	71.7	ug/Kg		<MDL	37	72.9	ug/Kg		<MDL	36	71	ug/Kg
Fluoranthene	95.2		11	21.3	ug/Kg	89.4		11	21.5	ug/Kg	120		11	21.9	ug/Kg	21.7		11	21.3	ug/Kg
Fluorene		<MDL	17	34.7	ug/Kg		<MDL	17	35	ug/Kg		<MDL	18	35.6	ug/Kg		<MDL	17	34.6	ug/Kg
Hexachlorobenzene		<MDL	0.88	1.77	ug/Kg		<MDL	0.89	1.79	ug/Kg		<MDL	0.9	1.82	ug/Kg		<MDL	0.88	1.77	ug/Kg
Hexachlorobutadiene		<MDL,G	1	2	ug/Kg		<MDL,G	1	2.02	ug/Kg		<MDL,G	1	2.05	ug/Kg		<MDL,G	1	2	ug/Kg
Hexachloroethane		<MDL,G	20	40	ug/Kg		<MDL,G	20	40.4	ug/Kg		<MDL,G	21	41	ug/Kg		<MDL,G	20	39.9	ug/Kg
Indeno(1,2,3-Cd)Pyrene		<MDL	12	24	ug/Kg	15	<RDL	12	24.2	ug/Kg	36.9		12	24.6	ug/Kg		<MDL	12	24	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG7				Locator:	P53VG7				Locator:	P53VG7				Locator:	P53C1			
	Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Core 1			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 24, 2002			
	Lab ID:	L25702-13				Lab ID:	L25702-14				Lab ID:	L25702-15				Lab ID:	L25512-1			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	75				% Solids:	74.3				% Solids:	73.1				% Solids:	75.1			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Isophorone		<MDL	25	50.7	ug/Kg		<MDL	26	51.1	ug/Kg		<MDL	26	52	ug/Kg		<MDL	25	50.6	ug/Kg
Naphthalene		<MDL,G	19	37.3	ug/Kg		<MDL,G	19	37.7	ug/Kg		<MDL,G	19	38.3	ug/Kg		<MDL,G	19	37.3	ug/Kg
Nitrobenzene		<MDL,G	21	42.7	ug/Kg		<MDL,G	22	43.1	ug/Kg		<MDL,G	22	43.8	ug/Kg		<MDL,G	21	42.6	ug/Kg
N-Nitrosodimethylamine		<MDL,G	27	53.3	ug/Kg		<MDL,G	27	53.8	ug/Kg		<MDL,G	27	54.7	ug/Kg		<MDL,G	27	53.3	ug/Kg
N-Nitrosodi-N-Propylamine		<MDL,G	12	24	ug/Kg		<MDL,G	12	24.2	ug/Kg		<MDL,G	12	24.6	ug/Kg		<MDL,G	12	24	ug/Kg
N-Nitrosodiphenylamine		<MDL	27	53.3	ug/Kg		<MDL	27	53.8	ug/Kg		<MDL	27	54.7	ug/Kg		<MDL	27	53.3	ug/Kg
Pentachlorophenol		<MDL	17	35.6	ug/Kg		<MDL,G	17	35.9	ug/Kg		<MDL,G	18	36.5	ug/Kg		<MDL	17	35.6	ug/Kg
Phenanthrene	55.7		5.3	10.7	ug/Kg	30.4		5.4	10.8	ug/Kg	36.8		5.5	10.9	ug/Kg	12.7		5.3	10.7	ug/Kg
Phenol		<MDL	12	24	ug/Kg		<MDL,G	12	24.2	ug/Kg		<MDL,G	12	24.6	ug/Kg		<MDL	12	24	ug/Kg
Pyrene	50.1		5.3	10.7	ug/Kg	53.4		5.4	10.8	ug/Kg	150		5.5	10.9	ug/Kg	9.7	<RDL	5.3	10.7	ug/Kg
M=OR EPA 8081A/8082 (7-3-03-002)																				
4,4'-DDD		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.7	3.33	ug/Kg
4,4'-DDE		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.7	3.33	ug/Kg
4,4'-DDT		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.7	3.33	ug/Kg
Aldrin		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.7	3.33	ug/Kg
Alpha-BHC		<MDL	0.84	1.67	ug/Kg		<MDL	0.85	1.68	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.84	1.66	ug/Kg
Aroclor 1016		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.7	3.33	ug/Kg
Aroclor 1221		<MDL	3.3	6.67	ug/Kg		<MDL	3.4	6.73	ug/Kg		<MDL	3.4	6.84	ug/Kg		<MDL	3.3	6.66	ug/Kg
Aroclor 1232		<MDL	3.3	6.67	ug/Kg		<MDL	3.4	6.73	ug/Kg		<MDL	3.4	6.84	ug/Kg		<MDL	3.3	6.66	ug/Kg
Aroclor 1242		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.7	3.33	ug/Kg
Aroclor 1248		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg	4.95		1.8	3.42	ug/Kg	5.11		1.7	3.33	ug/Kg
Aroclor 1254	5.01		1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg	8.51		1.8	3.42	ug/Kg	9.12		1.7	3.33	ug/Kg
Aroclor 1260		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg	12.1		1.8	3.42	ug/Kg	10.7		1.7	3.33	ug/Kg
Beta-BHC		<MDL	0.84	1.67	ug/Kg		<MDL	0.85	1.68	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.84	1.66	ug/Kg
Chlordane		<MDL	0.84	1.67	ug/Kg		<MDL	0.85	1.68	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.84	1.66	ug/Kg
Delta-BHC		<MDL	0.84	1.67	ug/Kg		<MDL	0.85	1.68	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.84	1.66	ug/Kg
Dieldrin		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.7	3.33	ug/Kg
Endosulfan I		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.7	3.33	ug/Kg
Endosulfan II		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.7	3.33	ug/Kg
Endosulfan Sulfate		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.7	3.33	ug/Kg
Endrin		<MDL	1.7	3.33	ug/Kg		<MDL	1.7	3.36	ug/Kg		<MDL	1.8	3.42	ug/Kg		<MDL	1.7	3.33	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53VG7				Locator:	P53VG7				Locator:	P53VG7				Locator:	P53C1			
	Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Van Veen 7				Descrip:	Pier 53 Core 1			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 09, 2002				Sampled:	Sep 24, 2002			
	Lab ID:	L25702-13				Lab ID:	L25702-14				Lab ID:	L25702-15				Lab ID:	L25512-1			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	75				% Solids:	74.3				% Solids:	73.1				% Solids:	75.1			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Endrin Aldehyde		<MDL,G	3.3	6.67	ug/Kg		<MDL,G	3.4	6.73	ug/Kg		<MDL,G	3.4	6.84	ug/Kg		<MDL,G	3.3	6.66	ug/Kg
Gamma-BHC (Lindane)		<MDL	0.84	1.67	ug/Kg		<MDL	0.85	1.68	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.84	1.66	ug/Kg
Heptachlor		<MDL	0.84	1.67	ug/Kg		<MDL	0.85	1.68	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.84	1.66	ug/Kg
Heptachlor Epoxide		<MDL	0.84	1.67	ug/Kg		<MDL	0.85	1.68	ug/Kg		<MDL	0.86	1.71	ug/Kg		<MDL	0.84	1.66	ug/Kg
Methoxychlor		<MDL	8.4	16.7	ug/Kg		<MDL	8.5	16.8	ug/Kg		<MDL	8.6	17.1	ug/Kg		<MDL	8.4	16.6	ug/Kg
Toxaphene		<MDL	17	33.3	ug/Kg		<MDL	17	33.6	ug/Kg		<MDL	18	34.2	ug/Kg		<MDL	17	33.3	ug/Kg
M=OR EPA 8260B (7-3-02-002)																				
1,1,1-Trichloroethane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
1,1,2,2-Tetrachloroethane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
1,1,2-Trichloroethane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
1,1,2-Trichloroethylene		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
1,1-Dichloroethane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
1,1-Dichloroethylene		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
1,2-Dichloroethane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
1,2-Dichloropropane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
2-Butanone (MEK)		<MDL	33	66.7	ug/Kg		<MDL	34	67.3	ug/Kg		<MDL	34	68.4	ug/Kg					
2-Chloroethylvinyl ether		<MDL,G	6.7	13.3	ug/Kg		<MDL,G	6.7	13.5	ug/Kg		<MDL,G	6.8	13.7	ug/Kg					
2-Hexanone		<MDL	33	66.7	ug/Kg		<MDL	34	67.3	ug/Kg		<MDL	34	68.4	ug/Kg					
4-Methyl-2-Pentanone (MIBK)		<MDL	33	66.7	ug/Kg		<MDL	34	67.3	ug/Kg		<MDL	34	68.4	ug/Kg					
Acetone		<MDL,L	17	66.7	ug/Kg		<MDL,L	17	67.3	ug/Kg		<MDL,L	18	68.4	ug/Kg					
Acrolein		<MDL	33	66.7	ug/Kg		<MDL	34	67.3	ug/Kg		<MDL	34	68.4	ug/Kg					
Acrylonitrile		<MDL	33	66.7	ug/Kg		<MDL	34	67.3	ug/Kg		<MDL	34	68.4	ug/Kg					
Benzene		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Bromodichloromethane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Bromoform		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Bromomethane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Carbon Disulfide		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Carbon Tetrachloride		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Chlorobenzene		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Chlorodibromomethane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Chloroethane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53VG7	P53VG7	P53VG7	P53C1
Descrip:	Pier 53 Van Veen 7	Pier 53 Van Veen 7	Pier 53 Van Veen 7	Pier 53 Core 1
Client Loc:				
Sampled:	Sep 09, 2002	Sep 09, 2002	Sep 09, 2002	Sep 24, 2002
Lab ID:	L25702-13	L25702-14	L25702-15	L25512-1
Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED	SALTWTRSED
% Solids:	75	74.3	73.1	75.1

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Chloroform		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Chloromethane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Cis-1,3-Dichloropropene		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Ethylbenzene		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Methylene Chloride		<MDL,B	6.7	66.7	ug/Kg		<MDL,B	6.7	67.3	ug/Kg		<MDL,B	6.8	68.4	ug/Kg					
Styrene		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Tetrachloroethylene		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Toluene		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Total Xylenes		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Trans-1,2-Dichloroethylene		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Trans-1,3-Dichloropropene		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Trichlorofluoromethane		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					
Vinyl Acetate		<MDL	33	66.7	ug/Kg		<MDL	34	67.3	ug/Kg		<MDL	34	68.4	ug/Kg					
Vinyl Chloride		<MDL	6.7	13.3	ug/Kg		<MDL	6.7	13.5	ug/Kg		<MDL	6.8	13.7	ug/Kg					

* Not converted to dry weight basis for this parameter

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53C2	P53C3	P53C4	P53C5
Descrip:	Pier 53 Core 2	Pier 53 Core 3	Pier 53 Core 4	Pier 53 Core 5
Client Loc:				
Sampled:	Sep 24, 2002	Sep 24, 2002	Sep 24, 2002	Sep 24, 2002
Lab ID:	L25512-2	L25512-3	L25512-4	L25512-5
Matrix:	SALTWTRSED	SALTWTRSED	SALTWTRSED	SALTWTRSED
% Solids:	80.8	74.1	78.5	76.9

Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
			- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis		
COMBINED LABS																				
M=CV ASTM D422																				
Clay *		<MDL	0.1	0.1	%	1.5		0.1	0.1	%		<MDL	0.1	0.1	%	0.8		0.1	0.1	%
Gravel *	2.3		0.1	0.1	%	5.5		0.1	0.1	%	1.3		0.1	0.1	%	6.9		0.1	0.1	%
p+0.00 *	9		0.1	0.1	%	2.7		0.1	0.1	%	5.6		0.1	0.1	%	5.8		0.1	0.1	%
p+1.00 *	53.6		0.1	0.1	%	23.2		0.1	0.1	%	29.8		0.1	0.1	%	40.3		0.1	0.1	%
p+10.0 *		<MDL	0.1	0.1	%		<MDL	0.1	0.1	%		<MDL	0.1	0.1	%	0.3		0.1	0.1	%
p+10.0(more than) *		<MDL	0.1	0.1	%	1.3		0.1	0.1	%		<MDL	0.1	0.1	%		<MDL	0.1	0.1	%
p+2.00 *	29.7		0.1	0.1	%	52		0.1	0.1	%	56.6		0.1	0.1	%	39.9		0.1	0.1	%
p+3.00 *	2.2		0.1	0.1	%	6.6		0.1	0.1	%	4.3		0.1	0.1	%	3.2		0.1	0.1	%
p+4.00 *	0.4		0.1	0.1	%	1.3		0.1	0.1	%	0.6		0.1	0.1	%	0.4		0.1	0.1	%
p+5.00 *	2		0.1	0.1	%	4.5		0.1	0.1	%	0.5		0.1	0.1	%	1.6		0.1	0.1	%
p+6.00 *	0.3		0.1	0.1	%	0.3		0.1	0.1	%		<MDL	0.1	0.1	%	0.5		0.1	0.1	%
p+7.00 *	0.6		0.1	0.1	%	1.1		0.1	0.1	%	1.1		0.1	0.1	%	0.1	RDL	0.1	0.1	%
p+8.00 *		<MDL	0.1	0.1	%	1.3		0.1	0.1	%	0.2		0.1	0.1	%	0.5		0.1	0.1	%
p+9.00 *		<MDL	0.1	0.1	%	0.2		0.1	0.1	%		<MDL	0.1	0.1	%	0.5		0.1	0.1	%
p-1.00 *	1.8		0.1	0.1	%	0.8		0.1	0.1	%	0.7		0.1	0.1	%	1.5		0.1	0.1	%
p-2.00 *		<MDL	0.1	0.1	%		<MDL	0.1	0.1	%	0.4		0.1	0.1	%		<MDL	0.1	0.1	%
p-2.00(less than) *	0.5		0.1	0.1	%	4.7		0.1	0.1	%	0.2		0.1	0.1	%	5.4		0.1	0.1	%
Sand *	94.9		0.1	0.1	%	85.8		0.1	0.1	%	96.9		0.1	0.1	%	89.6		0.1	0.1	%
Silt *	2.9		0.1	0.1	%	7.2		0.1	0.1	%	1.8		0.1	0.1	%	2.7		0.1	0.1	%
M=CV EPA9060-PSEP96 (03-04-002-002)																				
Total Organic Carbon	3600		620	1240	mg/Kg	5560		670	1350	mg/Kg	6990		640	1270	mg/Kg	3810		650	1300	mg/Kg
M=CV SM2540-G (03-01-007-001)																				
Total Solids *	80.8		0.005	0.01	%	74.1		0.005	0.01	%	78.5		0.005	0.01	%	76.9		0.005	0.01	%
M=MT EPA 245.5 (06-01-004-003)																				
Mercury, Total, CVAA	0.038	<RDL	0.022	0.226	mg/Kg	0.038	<RDL	0.027	0.267	mg/Kg		<MDL	0.024	0.238	mg/Kg	0.026	<RDL	0.025	0.243	mg/Kg
M=MT EPA3050A/6010B (06-02-004-002)																				
Aluminum, Total, ICP	8320	L	6.3	31.8	mg/Kg	9700	L	6.7	33.7	mg/Kg	8570	L	6.5	32.4	mg/Kg	9090	L	6.4	32	mg/Kg
Arsenic, Total, ICP	5.2	<RDL	3.2	15.8	mg/Kg	5.5	<RDL	3.4	16.9	mg/Kg	3.4	<RDL	3.2	16.2	mg/Kg	5.6	<RDL	3.3	16	mg/Kg
Beryllium, Total, ICP	0.22	<RDL	0.063	0.318	mg/Kg	0.27	<RDL	0.067	0.337	mg/Kg	0.24	<RDL	0.065	0.324	mg/Kg	0.25	<RDL	0.064	0.32	mg/Kg
Cadmium, Total, ICP		<MDL	0.19	0.953	mg/Kg		<MDL	0.2	1.01	mg/Kg		<MDL	0.19	0.969	mg/Kg		<MDL	0.2	0.96	mg/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53C2				Locator:	P53C3				Locator:	P53C4				Locator:	P53C5			
	Descrip:	Pier 53 Core 2				Descrip:	Pier 53 Core 3				Descrip:	Pier 53 Core 4				Descrip:	Pier 53 Core 5			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 24, 2002				Sampled:	Sep 24, 2002				Sampled:	Sep 24, 2002				Sampled:	Sep 24, 2002			
	Lab ID:	L25512-2				Lab ID:	L25512-3				Lab ID:	L25512-4				Lab ID:	L25512-5			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	80.8				% Solids:	74.1				% Solids:	78.5				% Solids:	76.9			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Chromium, Total, ICP	13		0.32	1.58	mg/Kg	12.6		0.34	1.69	mg/Kg	11.5		0.32	1.62	mg/Kg	16.1		0.33	1.6	mg/Kg
Copper, Total, ICP	12.6		0.26	1.27	mg/Kg	14		0.27	1.35	mg/Kg	11.2		0.25	1.29	mg/Kg	13.9		0.26	1.28	mg/Kg
Iron, Total, ICP	17800	G	3.2	15.8	mg/Kg	18500	G	3.4	16.9	mg/Kg	17600	G	3.2	16.2	mg/Kg	17800	G	3.3	16	mg/Kg
Lead, Total, ICP	6.2	<RDL	1.9	9.53	mg/Kg	6.1	<RDL	2	10.1	mg/Kg	5.4	<RDL	1.9	9.69	mg/Kg	5.3	<RDL	2	9.6	mg/Kg
Manganese, Total, ICP	182		0.12	0.635	mg/Kg	198		0.13	0.675	mg/Kg	185		0.13	0.646	mg/Kg	178		0.13	0.64	mg/Kg
Nickel, Total, ICP	12.1		1.2	6.35	mg/Kg	12.7		1.3	6.75	mg/Kg	12.6		1.3	6.46	mg/Kg	15.5		1.3	6.4	mg/Kg
Selenium, Total, ICP		<MDL	3.2	15.8	mg/Kg		<MDL	3.4	16.9	mg/Kg		<MDL	3.2	16.2	mg/Kg		<MDL	3.3	16	mg/Kg
Silver, Total, ICP		<MDL	0.26	1.27	mg/Kg		<MDL	0.27	1.35	mg/Kg		<MDL	0.25	1.29	mg/Kg		<MDL	0.26	1.28	mg/Kg
Thallium, Total, ICP		<MDL	12	63.5	mg/Kg		<MDL	13	67.5	mg/Kg		<MDL	13	64.6	mg/Kg		<MDL	13	64	mg/Kg
Zinc, Total, ICP	45.2		0.32	1.58	mg/Kg	49.4		0.34	1.69	mg/Kg	47		0.32	1.62	mg/Kg	45.90		0.33	1.6	mg/Kg
M=OR EPA 3550B/8270C (7-3-01-004)																				
1,2,4-Trichlorobenzene		<MDL,G	0.32	0.656	ug/Kg		<MDL,G	0.35	0.715	ug/Kg		<MDL,G	0.33	0.675	ug/Kg		<MDL,G	0.34	0.689	ug/Kg
1,2-Dichlorobenzene		<MDL,G	0.32	0.656	ug/Kg		<MDL,G	0.35	0.715	ug/Kg	0.883	G	0.33	0.675	ug/Kg		<MDL,G	0.34	0.689	ug/Kg
1,2-Diphenylhydrazine		<MDL	12	24.8	ug/Kg		<MDL	13	27	ug/Kg		<MDL	13	25.5	ug/Kg		<MDL	13	26	ug/Kg
1,3-Dichlorobenzene		<MDL,G	0.32	0.656	ug/Kg		<MDL,G	0.35	0.715	ug/Kg		<MDL,G	0.33	0.675	ug/Kg		<MDL,G	0.34	0.689	ug/Kg
1,4-Dichlorobenzene		<MDL,G	0.16	0.327	ug/Kg		<MDL,G	0.18	0.356	ug/Kg	1.43	G	0.17	0.336	ug/Kg		<MDL,G	0.17	0.343	ug/Kg
2,4,5-Trichlorophenol		<MDL	15	29.7	ug/Kg		<MDL	16	32.4	ug/Kg		<MDL	15	30.6	ug/Kg		<MDL	16	31.2	ug/Kg
2,4,6-Trichlorophenol		<MDL	16	32.2	ug/Kg		<MDL	18	35.1	ug/Kg		<MDL	17	33.1	ug/Kg		<MDL	17	33.8	ug/Kg
2,4-Dichlorophenol		<MDL	20	39.6	ug/Kg		<MDL	22	43.2	ug/Kg		<MDL	20	40.8	ug/Kg		<MDL	21	41.6	ug/Kg
2,4-Dimethylphenol		<MDL	8.7	17.3	ug/Kg		<MDL	9.4	18.9	ug/Kg		<MDL	8.9	17.8	ug/Kg		<MDL	9.1	18.2	ug/Kg
2,4-Dinitrotoluene		<MDL	33	66	ug/Kg		<MDL	36	71.9	ug/Kg		<MDL	34	67.9	ug/Kg		<MDL	35	69.3	ug/Kg
2,6-Dinitrotoluene		<MDL	33	66	ug/Kg		<MDL	36	71.9	ug/Kg		<MDL	34	67.9	ug/Kg		<MDL	35	69.3	ug/Kg
2-Chloronaphthalene		<MDL	20	39.6	ug/Kg		<MDL	22	43.2	ug/Kg		<MDL	20	40.8	ug/Kg		<MDL	21	41.6	ug/Kg
2-Chlorophenol		<MDL	9.9	19.8	ug/Kg		<MDL	11	21.6	ug/Kg		<MDL	10	20.4	ug/Kg		<MDL	10	20.8	ug/Kg
2-Methylnaphthalene	39.6		17	34.7	ug/Kg		<MDL	19	37.8	ug/Kg		<MDL	18	35.7	ug/Kg		<MDL	18	36.4	ug/Kg
2-Methylphenol		<MDL	24	47	ug/Kg		<MDL	26	51.3	ug/Kg		<MDL	24	48.4	ug/Kg		<MDL	25	49.4	ug/Kg
2-Nitrophenol		<MDL,G	19	37.1	ug/Kg		<MDL,G	20	40.5	ug/Kg		<MDL,G	19	38.2	ug/Kg		<MDL,G	20	39	ug/Kg
4-Bromophenyl Phenyl Ether		<MDL	11	22.3	ug/Kg		<MDL	12	24.3	ug/Kg		<MDL	11	22.9	ug/Kg		<MDL	12	23.4	ug/Kg
4-Chlorophenyl Phenyl Ether		<MDL	16	32.2	ug/Kg		<MDL	18	35.1	ug/Kg		<MDL	17	33.1	ug/Kg		<MDL	17	33.8	ug/Kg
4-Methylphenol		<MDL	20	39.6	ug/Kg		<MDL	22	43.2	ug/Kg		<MDL	20	40.8	ug/Kg		<MDL	21	41.6	ug/Kg
Acenaphthene	46.9		8.7	17.3	ug/Kg		<MDL	9.4	18.9	ug/Kg		<MDL	8.9	17.8	ug/Kg		<MDL	9.1	18.2	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53C2					Locator:	P53C3				Locator:	P53C4				Locator:	P53C5			
Descrip:	Pier 53 Core 2					Descrip:	Pier 53 Core 3				Descrip:	Pier 53 Core 4				Descrip:	Pier 53 Core 5			
Client Loc:						Client Loc:					Client Loc:					Client Loc:				
Sampled:	Sep 24, 2002					Sampled:	Sep 24, 2002				Sampled:	Sep 24, 2002				Sampled:	Sep 24, 2002			
Lab ID:	L25512-2					Lab ID:	L25512-3				Lab ID:	L25512-4				Lab ID:	L25512-5			
Matrix:	SALTWTRSED					Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
% Solids:	80.8					% Solids:	74.1				% Solids:	78.5				% Solids:	76.9			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Acenaphthylene		<MDL	19	37.1	ug/Kg		<MDL	20	40.5	ug/Kg		<MDL	19	38.2	ug/Kg		<MDL	20	39	ug/Kg
Aniline		<MDL,X	24	47	ug/Kg		<MDL,X	26	51.3	ug/Kg		<MDL,X	24	48.4	ug/Kg		<MDL,X	25	49.4	ug/Kg
Anthracene	24.4	G	5	9.9	ug/Kg	11	<RDL,G	5.4	10.8	ug/Kg		<MDL,G	5.1	10.2	ug/Kg	8.1	<RDL,G	5.2	10.4	ug/Kg
Benzo(a)anthracene	37.5		2.5	4.95	ug/Kg	32.8		2.7	5.4	ug/Kg	5.1	RDL	2.5	5.1	ug/Kg	18.9		2.6	5.2	ug/Kg
Benzo(a)pyrene	6.6	<RDL	3.7	7.43	ug/Kg				8.1	ug/Kg	6.5	<RDL	3.8	7.64	ug/Kg	29.6		3.9	7.8	ug/Kg
Benzo(b)fluoranthene	23.6		3.7	7.43	ug/Kg	39.1		4	8.1	ug/Kg	7.4	<RDL	3.8	7.64	ug/Kg	29.8		3.9	7.8	ug/Kg
Benzo(g,h,i)perylene		<MDL	9.9	19.8	ug/Kg		<MDL	11	21.6	ug/Kg		<MDL	10	20.4	ug/Kg	14	<RDL	10	20.8	ug/Kg
Benzo(k)fluoranthene	16.2		3.7	7.43	ug/Kg	30.9		4	8.1	ug/Kg	7.3	<RDL	3.8	7.64	ug/Kg	19.4		3.9	7.8	ug/Kg
Benzoic Acid	69.6	G	33	66	ug/Kg	85.7	G	36	71.9	ug/Kg	90.1	G	34	67.9	ug/Kg	79.1	G	35	69.3	ug/Kg
Benzyl Alcohol		<MDL,X	7.4	14.9	ug/Kg		<MDL,X	8.1	16.2	ug/Kg		<MDL,X	7.6	15.3	ug/Kg		<MDL,X	7.8	15.6	ug/Kg
Benzyl Butyl Phthalate		<MDL	16	33	ug/Kg	19	<RDL	18	36	ug/Kg		<MDL	17	34	ug/Kg	18	<RDL	17	34.7	ug/Kg
Bis(2-Chloroethoxy)Methane		<MDL,G	21	42.1	ug/Kg		<MDL,G	23	45.9	ug/Kg		<MDL,G	22	43.3	ug/Kg		<MDL,G	22	44.2	ug/Kg
Bis(2-Chloroethyl)Ether		<MDL,G	19	37.1	ug/Kg		<MDL,G	20	40.5	ug/Kg		<MDL,G	19	38.2	ug/Kg		<MDL,G	20	39	ug/Kg
Bis(2-Chloroisopropyl)Ether		<MDL,G	19	37.1	ug/Kg		<MDL,G	20	40.5	ug/Kg		<MDL,G	19	38.2	ug/Kg		<MDL,G	20	39	ug/Kg
Bis(2-Ethylhexyl)Phthalate	28	<RDL,B	16	33	ug/Kg	49.5	B	18	36	ug/Kg	25	<RDL,B	17	34	ug/Kg	475	B	17	34.7	ug/Kg
Caffeine		<MDL	7.4	14.9	ug/Kg		<MDL	8.1	16.2	ug/Kg		<MDL	7.6	15.3	ug/Kg		<MDL	7.8	15.6	ug/Kg
Carbazole		<MDL	8.7	17.3	ug/Kg		<MDL	9.4	18.9	ug/Kg		<MDL	8.9	17.8	ug/Kg		<MDL	9.1	18.2	ug/Kg
Chrysene	18.8		5	9.9	ug/Kg	34.3		5.4	10.8	ug/Kg	6.1	<RDL	5.1	10.2	ug/Kg	30.7		5.2	10.4	ug/Kg
Coprostanol		<MDL	160	330	ug/Kg		<MDL	180	360	ug/Kg		<MDL	170	340	ug/Kg		<MDL	170	347	ug/Kg
Dibenzo(a,h)anthracene		<MDL	8.7	17.3	ug/Kg		<MDL	9.4	18.9	ug/Kg		<MDL	8.9	17.8	ug/Kg		<MDL	9.1	18.2	ug/Kg
Dibenzofuran	57.8		17	34.7	ug/Kg		<MDL	19	37.8	ug/Kg		<MDL	18	35.7	ug/Kg		<MDL	18	36.4	ug/Kg
Diethyl Phthalate		<MDL	7.4	14.9	ug/Kg		<MDL	8.1	16.2	ug/Kg		<MDL	7.6	15.3	ug/Kg		<MDL	7.8	15.6	ug/Kg
Dimethyl Phthalate		<MDL	14	27.2	ug/Kg		<MDL	15	29.7	ug/Kg		<MDL	14	28	ug/Kg		<MDL	14	28.6	ug/Kg
Di-N-Butyl Phthalate	16.8	B	8.3	16.5	ug/Kg	13	<RDL,B	9	17.9	ug/Kg	13	<RDL,B	8.5	16.9	ug/Kg	16	<RDL,B	8.7	17.3	ug/Kg
Di-N-Octyl Phthalate		<MDL	33	66	ug/Kg		<MDL	36	71.9	ug/Kg		<MDL	34	67.9	ug/Kg		<MDL	35	69.3	ug/Kg
Fluoranthene	131		9.9	19.8	ug/Kg	72.2		11	21.6	ug/Kg	14	<RDL	10	20.4	ug/Kg	26.8		10	20.8	ug/Kg
Fluorene	93.6		16	32.2	ug/Kg		<MDL	18	35.1	ug/Kg		<MDL	17	33.1	ug/Kg		<MDL	17	33.8	ug/Kg
Hexachlorobenzene		<MDL	0.82	1.65	ug/Kg		<MDL	0.89	1.79	ug/Kg		<MDL	0.84	1.69	ug/Kg		<MDL	0.86	1.73	ug/Kg
Hexachlorobutadiene		<MDL,G	0.93	1.86	ug/Kg		<MDL,G	1	2.02	ug/Kg		<MDL,G	0.96	1.91	ug/Kg		<MDL,G	0.98	1.95	ug/Kg
Hexachloroethane		<MDL,G	19	37.1	ug/Kg		<MDL,G	20	40.5	ug/Kg		<MDL,G	19	38.2	ug/Kg		<MDL,G	20	39	ug/Kg
Indeno(1,2,3-Cd)Pyrene		<MDL	11	22.3	ug/Kg	16	<RDL	12	24.3	ug/Kg		<MDL	11	22.9	ug/Kg	16	<RDL	12	23.4	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53C2				Locator:	P53C3				Locator:	P53C4				Locator:	P53C5			
	Descrip:	Pier 53 Core 2				Descrip:	Pier 53 Core 3				Descrip:	Pier 53 Core 4				Descrip:	Pier 53 Core 5			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 24, 2002				Sampled:	Sep 24, 2002				Sampled:	Sep 24, 2002				Sampled:	Sep 24, 2002			
	Lab ID:	L25512-2				Lab ID:	L25512-3				Lab ID:	L25512-4				Lab ID:	L25512-5			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	80.8				% Solids:	74.1				% Solids:	78.5				% Solids:	76.9			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Isophorone		<MDL	24	47	ug/Kg		<MDL	26	51.3	ug/Kg		<MDL	24	48.4	ug/Kg		<MDL	25	49.4	ug/Kg
Naphthalene	58.3	G	17	34.7	ug/Kg		<MDL,G	19	37.8	ug/Kg		<MDL,G	18	35.7	ug/Kg		<MDL,G	18	36.4	ug/Kg
Nitrobenzene		<MDL,G	20	39.6	ug/Kg		<MDL,G	22	43.2	ug/Kg		<MDL,G	20	40.8	ug/Kg		<MDL,G	21	41.6	ug/Kg
N-Nitrosodimethylamine		<MDL,G	25	49.5	ug/Kg		<MDL,G	27	54	ug/Kg		<MDL,G	25	51	ug/Kg		<MDL,G	26	52	ug/Kg
N-Nitrosodi-N-Propylamine		<MDL,G	11	22.3	ug/Kg		<MDL,G	12	24.3	ug/Kg		<MDL,G	11	22.9	ug/Kg		<MDL,G	12	23.4	ug/Kg
N-Nitrosodiphenylamine		<MDL	25	49.5	ug/Kg		<MDL	27	54	ug/Kg		<MDL	25	51	ug/Kg		<MDL	26	52	ug/Kg
Pentachlorophenol		<MDL	16	33	ug/Kg		<MDL	18	36	ug/Kg		<MDL	17	34	ug/Kg		<MDL	17	34.7	ug/Kg
Phenanthrene	166		5	9.9	ug/Kg	50.6		5.4	10.8	ug/Kg	5.9	<RDL	5.1	10.2	ug/Kg	13.4		5.2	10.4	ug/Kg
Phenol		<MDL	11	22.3	ug/Kg		<MDL	12	24.3	ug/Kg		<MDL	11	22.9	ug/Kg		<MDL	12	23.4	ug/Kg
Pyrene	26		5	9.9	ug/Kg	57.6		5.4	10.8	ug/Kg	17.7		5.1	10.2	ug/Kg	34.2		5.2	10.4	ug/Kg
M=OR EPA 8081A/8082 (7-3-03-002)																				
4,4'-DDD		<MDL	1.6	3.09	ug/Kg		<MDL	1.8	3.37	ug/Kg		<MDL	1.7	3.18	ug/Kg		<MDL	1.7	3.25	ug/Kg
4,4'-DDE		<MDL	1.6	3.09	ug/Kg		<MDL	1.8	3.37	ug/Kg		<MDL	1.7	3.18	ug/Kg		<MDL	1.7	3.25	ug/Kg
4,4'-DDT		<MDL	1.6	3.09	ug/Kg		<MDL	1.8	3.37	ug/Kg		<MDL	1.7	3.18	ug/Kg		<MDL	1.7	3.25	ug/Kg
Aldrin		<MDL	1.6	3.09	ug/Kg		<MDL	1.8	3.37	ug/Kg		<MDL	1.7	3.18	ug/Kg		<MDL	1.7	3.25	ug/Kg
Alpha-BHC		<MDL	0.78	1.55	ug/Kg		<MDL	0.85	1.69	ug/Kg		<MDL	0.8	1.59	ug/Kg		<MDL	0.82	1.63	ug/Kg
Aroclor 1016		<MDL	1.6	3.09	ug/Kg		<MDL	1.8	3.37	ug/Kg	8.78		1.7	3.18	ug/Kg		<MDL	1.7	3.25	ug/Kg
Aroclor 1221		<MDL	3.1	6.19	ug/Kg		<MDL	3.4	6.75	ug/Kg		<MDL	3.2	6.37	ug/Kg		<MDL	3.3	6.5	ug/Kg
Aroclor 1232		<MDL	3.1	6.19	ug/Kg		<MDL	3.4	6.75	ug/Kg		<MDL	3.2	6.37	ug/Kg		<MDL	3.3	6.5	ug/Kg
Aroclor 1242		<MDL	1.6	3.09	ug/Kg		<MDL	1.8	3.37	ug/Kg		<MDL	1.7	3.18	ug/Kg		<MDL	1.7	3.25	ug/Kg
Aroclor 1248		<MDL	1.6	3.09	ug/Kg	5.18		1.8	3.37	ug/Kg	6.08		1.7	3.18	ug/Kg	6.44		1.7	3.25	ug/Kg
Aroclor 1254	6.36		1.6	3.09	ug/Kg	15.7		1.8	3.37	ug/Kg	12.9		1.7	3.18	ug/Kg	11.8		1.7	3.25	ug/Kg
Aroclor 1260	7.8		1.6	3.09	ug/Kg	17		1.8	3.37	ug/Kg	11		1.7	3.18	ug/Kg	13.7		1.7	3.25	ug/Kg
Beta-BHC		<MDL	0.78	1.55	ug/Kg		<MDL	0.85	1.69	ug/Kg		<MDL	0.8	1.59	ug/Kg		<MDL	0.82	1.63	ug/Kg
Chlordane		<MDL	0.78	1.55	ug/Kg		<MDL	0.85	1.69	ug/Kg		<MDL	0.8	1.59	ug/Kg		<MDL	0.82	1.63	ug/Kg
Delta-BHC		<MDL	0.78	1.55	ug/Kg		<MDL	0.85	1.69	ug/Kg		<MDL	0.8	1.59	ug/Kg		<MDL	0.82	1.63	ug/Kg
Dieldrin		<MDL	1.6	3.09	ug/Kg		<MDL	1.8	3.37	ug/Kg		<MDL	1.7	3.18	ug/Kg		<MDL	1.7	3.25	ug/Kg
Endosulfan I		<MDL	1.6	3.09	ug/Kg		<MDL	1.8	3.37	ug/Kg		<MDL	1.7	3.18	ug/Kg		<MDL	1.7	3.25	ug/Kg
Endosulfan II		<MDL	1.6	3.09	ug/Kg		<MDL	1.8	3.37	ug/Kg		<MDL	1.7	3.18	ug/Kg		<MDL	1.7	3.25	ug/Kg
Endosulfan Sulfate		<MDL	1.6	3.09	ug/Kg		<MDL	1.8	3.37	ug/Kg		<MDL	1.7	3.18	ug/Kg		<MDL	1.7	3.25	ug/Kg
Endrin		<MDL	1.6	3.09	ug/Kg		<MDL	1.8	3.37	ug/Kg		<MDL	1.7	3.18	ug/Kg		<MDL	1.7	3.25	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30																				
	Locator:	P53C2				Locator:	P53C3				Locator:	P53C4				Locator:	P53C5			
	Descrip:	Pier 53 Core 2				Descrip:	Pier 53 Core 3				Descrip:	Pier 53 Core 4				Descrip:	Pier 53 Core 5			
	Client Loc:					Client Loc:					Client Loc:					Client Loc:				
	Sampled:	Sep 24, 2002				Sampled:	Sep 24, 2002				Sampled:	Sep 24, 2002				Sampled:	Sep 24, 2002			
	Lab ID:	L25512-2				Lab ID:	L25512-3				Lab ID:	L25512-4				Lab ID:	L25512-5			
	Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED				Matrix:	SALTWTRSED			
	% Solids:	80.8				% Solids:	74.1				% Solids:	78.5				% Solids:	76.9			
Parameters	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis					- Dry Weight Basis			
COMBINED LABS																				
Endrin Aldehyde		<MDL,G	3.1	6.19	ug/Kg		<MDL,G	3.4	6.75	ug/Kg		<MDL,G	3.2	6.37	ug/Kg		<MDL,G	3.3	6.5	ug/Kg
Gamma-BHC (Lindane)		<MDL	0.78	1.55	ug/Kg		<MDL	0.85	1.69	ug/Kg		<MDL	0.8	1.59	ug/Kg		<MDL	0.82	1.63	ug/Kg
Heptachlor		<MDL	0.78	1.55	ug/Kg		<MDL	0.85	1.69	ug/Kg		<MDL	0.8	1.59	ug/Kg		<MDL	0.82	1.63	ug/Kg
Heptachlor Epoxide		<MDL	0.78	1.55	ug/Kg		<MDL	0.85	1.69	ug/Kg		<MDL	0.8	1.59	ug/Kg		<MDL	0.82	1.63	ug/Kg
Methoxychlor		<MDL	7.8	15.5	ug/Kg		<MDL	8.5	16.9	ug/Kg		<MDL	8	15.9	ug/Kg		<MDL	8.2	16.3	ug/Kg
Toxaphene		<MDL	16	30.9	ug/Kg		<MDL	18	33.7	ug/Kg		<MDL	17	31.8	ug/Kg		<MDL	17	32.5	ug/Kg
M=OR EPA 8260B (7-3-02-002)																				
1,1,1-Trichloroethane																				
1,1,2,2-Tetrachloroethane																				
1,1,2-Trichloroethane																				
1,1,2-Trichloroethylene																				
1,1-Dichloroethane																				
1,1-Dichloroethylene																				
1,2-Dichloroethane																				
1,2-Dichloropropane																				
2-Butanone (MEK)																				
2-Chloroethylvinyl ether																				
2-Hexanone																				
4-Methyl-2-Pentanone (MIBK)																				
Acetone																				
Acrolein																				
Acrylonitrile																				
Benzene																				
Bromodichloromethane																				
Bromoform																				
Bromomethane																				
Carbon Disulfide																				
Carbon Tetrachloride																				
Chlorobenzene																				
Chlorodibromomethane																				
Chloroethane																				

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53C4
Descrip:	Pier 53 Core 4
Client Loc:	
Sampled:	Sep 24, 2002
Lab ID:	L25512-6
Matrix:	SALTWTRSED
% Solids:	74.7

Parameters	Value	Qual	MDL	RDL	Units
			- Dry Weight Basis		
COMBINED LABS					
M=CV ASTM D422					
Clay *	2		0.1	0.1	%
Gravel *	1.8		0.1	0.1	%
p+0.00 *	3.7		0.1	0.1	%
p+1.00 *	28		0.1	0.1	%
p+10.0 *	0.3		0.1	0.1	%
p+10.0(more than) *	1.1		0.1	0.1	%
p+2.00 *	53.9		0.1	0.1	%
p+3.00 *	4.8		0.1	0.1	%
p+4.00 *	1		0.1	0.1	%
p+5.00 *	2.3		0.1	0.1	%
p+6.00 *	0.5		0.1	0.1	%
p+7.00 *	1.2		0.1	0.1	%
p+8.00 *	0.7		0.1	0.1	%
p+9.00 *	0.6		0.1	0.1	%
p-1.00 *	1.3		0.1	0.1	%
p-2.00 *	0.1	RDL	0.1	0.1	%
p-2.00(less than) *	0.4		0.1	0.1	%
Sand *	91.4		0.1	0.1	%
Silt *	4.7		0.1	0.1	%
M=CV EPA9060-PSEP96 (03-04-002-002)					
Total Organic Carbon	6510		670	1340	mg/Kg
M=CV SM2540-G (03-01-007-001)					
Total Solids *	74.7		0.005	0.01	%
M=MT EPA 245.5 (06-01-004-003)					
Mercury, Total, CVAA	0.396		0.025	0.26	mg/Kg
M=MT EPA3050A/6010B (06-02-004-002)					
Aluminum, Total, ICP	9450	L	6.4	32	mg/Kg
Arsenic, Total, ICP	3.5	<RDL	3.2	16.1	mg/Kg
Beryllium, Total, ICP	0.25	<RDL	0.064	0.32	mg/Kg
Cadmium, Total, ICP		<MDL	0.19	0.961	mg/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53C4
Descrip:	Pier 53 Core 4
Client Loc:	
Sampled:	Sep 24, 2002
Lab ID:	L25512-6
Matrix:	SALTWTRSED
% Solids:	74.7

Parameters	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis			
COMBINED LABS					
Chromium, Total, ICP	12.5		0.32	1.61	mg/Kg
Copper, Total, ICP	15		0.25	1.28	mg/Kg
Iron, Total, ICP	18200	G	3.2	16.1	mg/Kg
Lead, Total, ICP	8.8	<RDL	1.9	9.61	mg/Kg
Manganese, Total, ICP	189		0.13	0.641	mg/Kg
Nickel, Total, ICP	12.6		1.3	6.41	mg/Kg
Selenium, Total, ICP		<MDL	3.2	16.1	mg/Kg
Silver, Total, ICP		<MDL	0.25	1.28	mg/Kg
Thallium, Total, ICP		<MDL	13	64.1	mg/Kg
Zinc, Total, ICP	50.2		0.32	1.61	mg/Kg
M=OR EPA 3550B/8270C (7-3-01-004)					
1,2,4-Trichlorobenzene		<MDL,G	0.35	0.71	ug/Kg
1,2-Dichlorobenzene		<MDL,G	0.35	0.71	ug/Kg
1,2-Diphenylhydrazine		<MDL	13	26.8	ug/Kg
1,3-Dichlorobenzene		<MDL,G	0.35	0.71	ug/Kg
1,4-Dichlorobenzene	1.32	G	0.17	0.353	ug/Kg
2,4,5-Trichlorophenol		<MDL	16	32.1	ug/Kg
2,4,6-Trichlorophenol		<MDL	17	34.8	ug/Kg
2,4-Dichlorophenol		<MDL	21	42.8	ug/Kg
2,4-Dimethylphenol		<MDL	9.4	18.7	ug/Kg
2,4-Dinitrotoluene		<MDL	36	71.4	ug/Kg
2,6-Dinitrotoluene		<MDL	36	71.4	ug/Kg
2-Chloronaphthalene		<MDL	21	42.8	ug/Kg
2-Chlorophenol		<MDL	11	21.4	ug/Kg
2-Methylnaphthalene		<MDL	19	37.5	ug/Kg
2-Methylphenol		<MDL	25	50.9	ug/Kg
2-Nitrophenol		<MDL,G	20	40.2	ug/Kg
4-Bromophenyl Phenyl Ether		<MDL	12	24.1	ug/Kg
4-Chlorophenyl Phenyl Ether		<MDL	17	34.8	ug/Kg
4-Methylphenol		<MDL	21	42.8	ug/Kg
Acenaphthene		<MDL	9.4	18.7	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53C4
Descrip:	Pier 53 Core 4
Client Loc:	
Sampled:	Sep 24, 2002
Lab ID:	L25512-6
Matrix:	SALTWTRSED
% Solids:	74.7

Parameters	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis			
COMBINED LABS					
Acenaphthylene		<MDL	20	40.2	ug/Kg
Aniline		<MDL,X	25	50.9	ug/Kg
Anthracene	13.7	G	5.4	10.7	ug/Kg
Benzo(a)anthracene	30.7		2.7	5.35	ug/Kg
Benzo(a)pyrene	48.9		4	8.03	ug/Kg
Benzo(b)fluoranthene	50.9		4	8.03	ug/Kg
Benzo(g,h,i)perylene	27		11	21.4	ug/Kg
Benzo(k)fluoranthene	34.7		4	8.03	ug/Kg
Benzoic Acid	88.5	G	36	71.4	ug/Kg
Benzyl Alcohol		<MDL,X	8	16.1	ug/Kg
Benzyl Butyl Phthalate	21	<RDL	17	35.7	ug/Kg
Bis(2-Chloroethoxy)Methane		<MDL,G	23	45.5	ug/Kg
Bis(2-Chloroethyl)Ether		<MDL,G	20	40.2	ug/Kg
Bis(2-Chloroisopropyl)Ether		<MDL,G	20	40.2	ug/Kg
Bis(2-Ethylhexyl)Phthalate	51.4	B	17	35.7	ug/Kg
Caffeine		<MDL	8	16.1	ug/Kg
Carbazole		<MDL	9.4	18.7	ug/Kg
Chrysene	45.4		5.4	10.7	ug/Kg
Coprostanol		<MDL	170	357	ug/Kg
Dibenzo(a,h)anthracene	10	<RDL	9.4	18.7	ug/Kg
Dibenzofuran		<MDL	19	37.5	ug/Kg
Diethyl Phthalate		<MDL	8	16.1	ug/Kg
Dimethyl Phthalate		<MDL	15	29.5	ug/Kg
Di-N-Butyl Phthalate	16	<RDL,B	9	17.8	ug/Kg
Di-N-Octyl Phthalate		<MDL	36	71.4	ug/Kg
Fluoranthene	56.1		11	21.4	ug/Kg
Fluorene		<MDL	17	34.8	ug/Kg
Hexachlorobenzene		<MDL	0.88	1.78	ug/Kg
Hexachlorobutadiene		<MDL,G	1	2.01	ug/Kg
Hexachloroethane		<MDL,G	20	40.2	ug/Kg
Indeno(1,2,3-Cd)Pyrene	26		12	24.1	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30

Locator:	P53C4
Descrip:	Pier 53 Core 4
Client Loc:	
Sampled:	Sep 24, 2002
Lab ID:	L25512-6
Matrix:	SALTWTRSED
% Solids:	74.7

Parameters	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis			
COMBINED LABS					
Isophorone		<MDL	25	50.9	ug/Kg
Naphthalene		<MDL,G	19	37.5	ug/Kg
Nitrobenzene		<MDL,G	21	42.8	ug/Kg
N-Nitrosodimethylamine		<MDL,G	27	53.5	ug/Kg
N-Nitrosodi-N-Propylamine		<MDL,G	12	24.1	ug/Kg
N-Nitrosodiphenylamine		<MDL	27	53.5	ug/Kg
Pentachlorophenol		<MDL	17	35.7	ug/Kg
Phenanthrene	25.7		5.4	10.7	ug/Kg
Phenol		<MDL	12	24.1	ug/Kg
Pyrene	82.1		5.4	10.7	ug/Kg
M=OR EPA 8081A/8082 (7-3-03-002)					
4,4'-DDD		<MDL	1.7	3.35	ug/Kg
4,4'-DDE		<MDL	1.7	3.35	ug/Kg
4,4'-DDT		<MDL	1.7	3.35	ug/Kg
Aldrin		<MDL	1.7	3.35	ug/Kg
Alpha-BHC		<MDL	0.84	1.67	ug/Kg
Aroclor 1016		<MDL	1.7	3.35	ug/Kg
Aroclor 1221		<MDL	3.3	6.69	ug/Kg
Aroclor 1232		<MDL	3.3	6.69	ug/Kg
Aroclor 1242		<MDL	1.7	3.35	ug/Kg
Aroclor 1248	6.13		1.7	3.35	ug/Kg
Aroclor 1254	16.7		1.7	3.35	ug/Kg
Aroclor 1260	15.8		1.7	3.35	ug/Kg
Beta-BHC		<MDL	0.84	1.67	ug/Kg
Chlordane		<MDL	0.84	1.67	ug/Kg
Delta-BHC		<MDL	0.84	1.67	ug/Kg
Dieldrin		<MDL	1.7	3.35	ug/Kg
Endosulfan I		<MDL	1.7	3.35	ug/Kg
Endosulfan II		<MDL	1.7	3.35	ug/Kg
Endosulfan Sulfate		<MDL	1.7	3.35	ug/Kg
Endrin		<MDL	1.7	3.35	ug/Kg

King County Environmental Lab Analytical Report

PROJECT: 423056-30	Locator:	P53C4
	Descrip:	Pier 53 Core 4
	Client Loc:	
	Sampled:	Sep 24, 2002
	Lab ID:	L25512-6
	Matrix:	SALTWTRSED
	% Solids:	74.7

Parameters	Value	Qual	MDL	RDL	Units
		- Dry Weight Basis			
COMBINED LABS					
Endrin Aldehyde		<MDL,G	3.3	6.69	ug/Kg
Gamma-BHC (Lindane)		<MDL	0.84	1.67	ug/Kg
Heptachlor		<MDL	0.84	1.67	ug/Kg
Heptachlor Epoxide		<MDL	0.84	1.67	ug/Kg
Methoxychlor		<MDL	8.4	16.7	ug/Kg
Toxaphene		<MDL	17	33.5	ug/Kg
M=OR EPA 8260B (7-3-02-002)					
1,1,1-Trichloroethane					
1,1,2,2-Tetrachloroethane					
1,1,2-Trichloroethane					
1,1,2-Trichloroethylene					
1,1-Dichloroethane					
1,1-Dichloroethylene					
1,2-Dichloroethane					
1,2-Dichloropropane					
2-Butanone (MEK)					
2-Chloroethylvinyl ether					
2-Hexanone					
4-Methyl-2-Pentanone (MIBK)					
Acetone					
Acrolein					
Acrylonitrile					
Benzene					
Bromodichloromethane					
Bromoform					
Bromomethane					
Carbon Disulfide					
Carbon Tetrachloride					
Chlorobenzene					
Chlorodibromomethane					
Chloroethane					

APPENDIX D

BENTHIC COMMUNITY DATA

Pier53 2002 taxonomy														
Site			**P53VG1**			Individual	Average			**P53VG2**			Individual	Average
Replicate	1	2	3	4	5	Species	Individ	1	2	3	4	5	Species	Individ
Taxon						Totals	Species						Totals	Species
ANNELIDA														
Amage anops														
Amphicteis mucronata				1		1	0.20							
Ampharete finmarchica						0	0							
Amphitritinae juvenile	0	0	1	0	0	1	0.2							
Amphitrite sp juv						0	0		1				1	0.2
Anobothrus gracilis				2	2	4	0.8	4	1			2	7	1.4
Aphelochaeta monilaris	3	9	2	1		15	3	2			1		3	0.6
Aphelochaeta sp						0		2					2	0.4
Aphelochaeta sp N1						0								0
Apistobranchus ornatus			1			1	0.2							0
Aricidea lopezi	1		1			2	0.4		1	2			3	0.6
Armandia brevis				2		2	0.4			1		1	2	0.4
Asabellides lineata						0								0
Barantolla nr americana		1			2	3	0.6							0
Boccardia pugettensis			4		2	6	1.2	5		1	1		7	1.4
Boccardiella hamata				1	1	2	0.4	3	2	3	1	1	10	2
Caulleriella pacifica	7	1	2	3	5	18	3.6				2	1	3	0.6
Chaetozone acuta						0					2	1	3	0.6
Chaetozone nr setosa	5	3	3	1	7	19	3.8	1	3	2	3	4	13	2.6
Chaetozone sp		1			1	2	0.4							0
Cirratulidae				2	1	3	0.6	1	3	1			5	1
Chone magna						0								0
Circeis spirillum						0								0
Cirratulus spectabilis						0			1				1	0.2
Clymenura gracilis	4	5	4		6	19	3.8	7	1	5	6	2	21	4.2
Cossura pygodactylata		5	3	1		9	1.8	3	2	4	1	1	11	2.2
Demonax sp						0		1					1	0.2
Demonax medius		1				1								0
Diopatra ornata	9	7	1	8	10	35	7	2	4	2	5	1	14	2.8
Dipolydora akaina			1			1	0.2							0
Dipolydora cardalia	4	2	4	1		11	2.2	5	1	1	3	2	12	2.4
Dipolydora caulleryi	4	3		3	4	14	2.8	2			1	1	4	0.8
Dipolydora socialis	1			2		3	0.6			1	3		4	0.8
Dorvillea pseudorubrovitata	3					3	0.6		1				1	0.2
Dorvillea (Schistomeringos) sp		1				1	0.2							0
Dorvilleidae			1			1	0.2	1		1		1	3	0.6
Eteone nr pigmentata			1			1	0.2						0	0
Eteone sp	3	1	3	1	5	13	2.6	4	5	2	3	2	16	3.2
Eteone spilotus						0					1		1	0.2
Euchone incolor		4	1		3	8	1.6	9		4	4	3	20	4
Euclymeninae	2	1	1			4	0.8	2			3	3	8	1.6
Eulalia californiensis	3	2	7		1	13	2.6	1	2			2	5	1
Eumida longicornuta				1	1	2	0.4							0
Eusyllis habei						0					1	1	2	0.4
Exogoninae						0								0
Exogone dwisula				1		1	0.2				1	1	2	0.4
Exogone lourei	2	3	2	1		8	1.6	1	4	1		3	9	1.8
Galathowenia oculata					1	1	0.2							0
Gattyana cirrosa	9	9	11	10	3	42	8.4	11	8	6	7	16	48	9.6
Gattyana treadwelli						0		1					1	0.2
Glycera americana						0		1					1	0.2
Glycera nana	16	14	15	10	11	66	13.2	12	12	9	9	8	50	10

Site			P53VG1			Individual	Average			P53VG2			Individual	Average
Replicate	1	2	3	4	5	Species	Individ	1	2	3	4	5	Species	Individ
Taxon						Totals	Species						Totals	Species
Glycinde armigera	1	1	5		2	9	1.8		1	2	1	1	5	1
Goniada maculata						0		1				1	2	0.4
Gyptis sp 1						0					1		1	0.2
Harmothoe multisetosa	3	2		4	2	11	2.2	1	1		1	1	4	0.8
Harmothoe sp						0		1					1	0.2
Hesionidae						0						1	1	0.2
Heteromastus filobranchus						0								0
Heteromastus sp						0				3			3	0.6
Lanassa venusta						0							0	0
Laonice cirrata					1	1	0.2	2	1	2	2	1	8	1.6
Laonice pugettensis	1					1	0.2							0
Laonice sp juv						0						1	1	0.2
Leitoscoloplos pugettensis		1				1	0.2	1	2		1		4	0.8
Levinsenis gracilis	5	4	3	5	2	19	3.8	10	6	4	4	7	31	6.2
Lumbrineris sp juv	4	6	2	2	4	18	3.6	2	1	1	4	5	13	2.6
Lumbrineris californiensis	32	14	17	31	21	115	23	29	24	19	31	13	116	23.2
Lumbrineris cruzensis		2				2	0.4							0
Lumbrineris latreilli	1	1		2		4	0.8	1	2		1	1	5	1
Magelona longicornis	4	5	6	3	14	32	6.4	1	4	1	1	2	9	1.8
Maldanidae spp. juv						0		1					1	0.2
Malmgreniella bansei				3		3	0.6	2	2	2	3	2	11	2.2
Mediomastus ambiseta	1					1	0.2							0
Mediomastus californiensis	2			1	1	4	0.8	2		1	3		6	1.2
Mediomastus sp	3	1	2	4		10	2	10	4	8	3		25	5
Melinna oculata						0					1		1	0.2
Microclymene caudata						0								0
Micropodarke dubia	1	2				3	0.6	1	3	2	2		8	1.6
Monticellina serratiseta	1	3	3	2	1	10	2	1	3	1		2	7	1.4
Monticellina sp N1	13	13	12	12	15	65	13	17	10	8	7	9	51	10.2
Monticellina tesselata	2				2	4	0.8	3	5	1	3		12	2.4
Neosabellaria cementarium				1		1	0.2		1				1	0.2
Nephtys cornuta	1	4		8	1	14	2.8	7	2	1	1	1	12	2.4
Nephtys ferruginea	16	16	10	13	9	64	12.8	10	15	20	12	13	70	14
Nephtys sp	1	12	7	2	4	26	5.2	8	9	11	5	3	36	7.2
Nereis procera	3	2	1	1	2	9	1.8	4	4	1	1	3	13	2.6
Notocirrus californiensis						0	0							0
Notomastus hemipodus	15	15	17	26	8	81	16.2	15	20	18	19	17	89	17.8
Notomastus latericeus		1			2	3	0.6				1		1	0.2
Oligochaeta						0	0	1					1	0.2
Onuphis juv						0	0							0
Onuphis elegans		1	5		1	7	1.4							0
Onuphis iridescens						0	0							0
Ophelina acuminata			2	1		3	0.6		2				2	0.4
Owenia fusiformis						0	0							0
Paleanotus bellis						0	0							0
Paranaitis polynoides						0	0	1					1	0.2
Parandalia fauveli	1	2	3	3	1	10	2			1	3	2	6	1.2
Paraprionospio pinnata	2	2	1	2	2	9	1.8	2	4	4	2	3	15	3
Pectinaria californiensis						0	0	2		1	1	1	5	1
Pectinaria granulata	15	19	16	22	12	84	16.8	16	24	12	8	20	80	16
Pherusa plumosa			1			1	0.2							0
Pholoe sp.						0	0							0

Site			P53VG1			Individual	Average			P53VG2			Individual	Average
Replicate	1	2	3	4	5	Species	Individ	1	2	3	4	5	Species	Individ
Taxon						Totals	Species						Totals	Species
Pholoides asperus	2	23	2	9	2	38	7.6	2	1	5	2	6	16	3.2
Phyllodoce cuspidata			1			1	0.2							0
Phyllodoce groenlandica	1	5	1		4	11	2.2		2	6	1	1	10	2
Phyllodoce hartmanae						0	0	1						0.2
Phyllodoce longipes			1			1	0.2	1						0.2
Phyllodoce williamsi				1		1	0.2							0
Phylo felix	1			1		2	0.4		1		1		2	0.4
Pilargis maculata	1	5	7	2	1	16	3.2	5	3	2		4	14	2.8
Pista bansei		3				3	0.6							0
Pista elongata					1	1	0.2							0
Pista estevanica				1		1	0.2		1		1	2	4	0.8
Pista sp juv			1			1	0.2	1					1	0.2
Platynereis bicanaliculata						0	0							0
Ophiodromus pugettensis						0	0							0
Podarkeopsis glabrus						0	0	3	3			1	7	1.4
Polycirrus californicus					1	1	0.2							0
Polycirrus sp	3	6	5	8	7	29	5.8	8	7	9	5	3	32	6.4
Polydora limicola	2	3	1	2	2	10	2	1			3		4	0.8
Polydora sp juv	1					1	0.2							0
Prionospio lighti						0	0	2		1		1	4	0.8
Prionospio multibranchiata		3				3	0.6		1		1	1	3	0.6
Prionospio steenstrupi	59	7	69	64	47	246	49.2	82	43	58	52	45	280	56
Proceraea cornuta						0	0	1		1	1		3	0.6
Proclea graffi						0	0	1		2	4	2	9	1.8
Protodorvillea gracilis		1	1			2	0.4			1			1	0.2
Rhodine bitorquata	5				1	6	1.2	1	1	2	2		6	1.2
Scionella japonica					1	1	0.2							0
Scoletoma luti	13	13	10	11	13	60	12	14	11	15	10	14	64	12.8
Sabellidae spp. juv.						0	0							0
Sphaerodoropsis sphaerulifer	1		2	1		4	0.8	5	2	10	1		18	3.6
Sphaerosyllis ranunculus				1		1	0.2		1				1	0.2
Spio cirrifera	3		2		4	9	1.8		1	2	2		5	1
Spio filicornis						0	0					1	1	0.2
Spiochaetopterus costarum						0	0							0
Spiophanes berkeleyorum	5	4	1	7	1	18	3.6	1	6	8	5	8	28	5.6
Streblosoma bairdi						0	0							0
Sthenelais berkeleyi		1				1	0.2							0
Tenonia priops			2		1	3	0.6							0
Terebellidae spp. juv						0	0	1					1	0.2
Terebellides californica						0	0				1		1	0.2
Terebellides reishi						0	0			1		1	2	0.4
Terebellides sp juv						0	0					1	1	0.2
Travisia brevis	1					1	0.2		1				1	0.2
Trochochaeta multisetosa	2	2		1	1	6	1.2		1	3	1		5	1
Typosyllis cornuta	2					2	0.4			2	2		4	0.8
Typosyllis heterochaeta	1			1		2	0.4				1		1	0.2
Typosyllis caeca	15	17	9	5	19	65	13	8	11	21	11	5	56	11.2
Biomass	3.5	5.4	3.7	3.3	2.4			3.8	3.2	4.0	2.7	3.6		
Total						1508	301.4						1537	307.8
Number of species						100							103	

Site			P53VG1			Individual	Average			P53VG2			Individual	Average
Replicate	1	2	3	4	5	Species	Individ	1	2	3	4	5	Species	Individ
Taxon						Totals	Species						Totals	Species
CRUSTACEA														
Bathyleberis sp.	2			1	1	4	0.8	1	1			1	3	0.6
Euphilomedes carcharodonta	89	110	127	129	96	551	110.2	70	76	105	90	103	444	88.8
Euphilomedes producta	24	29	20	8	21	102	20.4	42	41	51	21	46	201	40.2
Rutiderma lomae	2	1	3		1	7	1.4	5	7	2		5	19	3.8
Podocopida sp.				1		1	0.2						0	0
Nebalia sp.						0	0	1					1	0.2
Leptochelia dubia		7	1	4	1	13	2.6		8	3	4	8	23	4.6
Diastylis santamariensis		2				2	0.4		1	1	1		3	0.6
Eudorella pacifica	2	3	2	6	1	14	2.8	3	2	5	4	3	17	3.4
Eudorellopsis longirostris						0	0						0	0
Haliophasma geminatum						0	0	1					1	0.2
Ampelisca lobata	5	1		2	1	9	1.8						0	0
Byblis millsi	14	10	11	5	11	51	10.2	10	16	13	12	13	64	12.8
Aoroides sp.			2	1	2	5	1		1	1		2	4	0.8
Argissa hamatipes				1		1	0.2	1					1	0.2
Calliopiidae sp.						0	0						0	0
Corophium sp.		1				1	0.2						0	0
Protomedeia sp.						0	0			1			1	0.2
Erichthonius brasiliensis	3	1	1	6		11	2.2						0	0
Hippomedon coecus	1			3		4	0.8				1	1	2	0.4
Orchomene decipiens	2					2	0.4						0	0
Pachynus barnardi		1				1	0.2	2					2	0.4
Melphisana bola						0	0					1	1	0.2
Americhelidium rectipalmum						0	0						0	0
Americhelidium variabilum		1				1	0.2			2			2	0.4
Deflexilodes sp.	1				1	2	0.4						0	0
Westwoodilla caecula	1	4		2	2	9	1.8	3	4	2	3		12	2.4
Heterophoxus conlanae	10	8	2	9	7	36	7.2	15	2	6	5	8	36	7.2
Metaphoxus frequens	1	2				3	0.6	4	2	4		1	11	2.2
Parametaphoxus quaylei	4	5	2	3	1	15	3	6	7	8	7	3	31	6.2
Podoceridae spp.						0	0						0	0
Stenothoides bicoma						0	0						0	0
Caprella sp.						0	0						0	0
Caridea sp.				1		1	0.2						0	0
Mesocrangon munitella	1				2	3	0.6						0	0
Crangon sp.				3		3	0.6	3	3	1	1	4	12	2.4
Crangon alaskensis			1		2	3	0.6					1	1	0.2
Eualus subtilis				1	1	2	0.4						0	0
Spirontocaris snyderi	1		1	2	3	7	1.4				1		1	0.2
Cancer oregonensis		1			1	2	0.4		1		1		2	0.4
Oregonia gracilis						0	0						0	0
Pinnotheridae sp.					1	1	0.2						0	0
Pinnixa occidentalis						0	0						0	0
Pinnixa schmitti	2	2				4	0.8	4			2	2	8	1.6
Pinnixa sp.	30	9	6	3	10	58	11.6	16	6	8	4	11	45	9
Pagurus sp.	2		4		5	11	2.2			1	1	1	3	0.6
Pagurus capillatus						0	0						0	0
Neotrypaea sp.						0	0	2		3			5	1
Biomass	0.5	0.5	0.5	0.5	0.6			0.3	0.4	0.5	0.5	0.5		
Total						940	188						956	191.2
Number of species						34							29	

Site			P53VG1			Individual	Average			P53VG2			Individual	Average
Replicate	1	2	3	4	5	Species	Individ	1	2	3	4	5	Species	Individ
Taxon						Totals	Species						Totals	Species
MOLLUSCA														
Acila castrensis		1				1	0.2			1		1	2	0.4
Adontorhina cyclia	1					1	0.2			1	1		2	0.4
Alvania compacta		4	3	3	2	12	2.4	5	2	1	2	2	12	2.4
Alvania rosana	6	1	1	7	5	20	4	4	4	1	3	4	16	3.2
Astyris gausapata	11	12	9	8	15	55	11	12	17	12	19	4	64	12.8
Axinopsida serricata	10	31	26	29	20	116	23.2	45	52	37	40	34	208	41.6
Cardiidae spp. juv.	1	2	4	2	1	10	2	1			1	3	5	1
Cardiomya pectinata						0	0		1				1	0.2
Chlamys hastata				1		1	0.2						0	0
Chlamys sp. juv.						0	0						0	0
Clinocardium blandum						0	0						0	0
Compsomyax subdiaphana						0	0		1		1		2	0.4
Crepipatella lingulata						0	0						0	0
Cryptonatica affinis			1			1	0.2						0	0
Ennucula tenuis	2		1	1	2	6	1.2	1	1	1			3	0.6
Gastropteron pacificum		4		1		5	1	1		3	1	4	9	1.8
Hiatella arctica	1		1			2	0.4	1					1	0.2
Kurtziella plumbea	1	1		1	1	4	0.8	1	1				2	0.4
Lucinoma annulatum	4	2	2	2	2	12	2.4	2	3		2	1	8	1.6
Lyonsia californica	6	3		1	5	15	3	4	5	8	1	6	24	4.8
Macoma carlottensis	8	7	7	13	3	38	7.6	3	1	9	4	3	20	4
Macoma elimata	5	5	8	3	4	25	5	3	1				4	0.8
Macoma golikovi						0	0	1					1	0.2
Macoma yoldiformis						0	0						0	0
Macoma sp. juv.		4	4	6	3	17	3.4	10	3		5	8	26	5.2
Margarites pupillus		1				1	0.2	1				1	2	0.4
Melanella montereyensis				1		1	0.2						0	0
Modiolus modiolus	2			1		3	0.6		1				1	0.2
Mya arenaria	1	1	5	3		10	2		1	1			2	0.4
Mytilus sp. juv.						0	0						0	0
Nemocardium centifilosum				1		1	0.2						0	0
Nuculana hamata						0	0	2					2	0.4
Nudibranchia sp. unid.						0	0				1		1	0.2
Nutricola lordi						0	0				1		1	0.2
Odostomia sp.	8	5	8	1	1	23	4.6	8	1	3		1	13	2.6
Oenopota sp.						0	0						0	0
Pandora filosa	1	1	1	1	1	5	1	1	1		1		3	0.6
Parvilucina tenuisculpta	66	60	46	74	53	299	59.8	79	55	56	60	72	322	64.4
Philine alba	3		1	2	1	7	1.4			1		1	2	0.4
Pododesmus macroschisma		1				1	0.2						0	0
Polygireulima rutila						0	0						0	0
Rochefortia tumida		1				1	0.2			1			1	0.2
Solamen columbianum	6	5	13	13	4	41	8.2	10	7	11	7	4	39	7.8
Thracia trapezoides						0	0			1			1	0.2
Thyasira flexuosa	3	3	3	4	5	18	3.6	3	3	3	8	6	23	4.6
Trichotropis cancellata						0	0						0	0
Biomass	2.5	2.8	2.2	3.3	2.2			2.9	4.2	3.5	2.9	3.3		
Total						752	150.4						823	164.6
Number of species						31							33	

Site			P53VG1			Individual	Average			P53VG2			Individual	Average
Replicate	1	2	3	4	5	Species	Individ	1	2	3	4	5	Species	Individ
Taxon						Totals	Species						Totals	Species
MISCELLANEOUS														
Alcyonidium gelatinosum						0	0						0	0
Amphiodia sp.														
Amphipholis sp.				1		1	0.2							
Amphipholis squamata														
Amphiporus spp.		1				1	0.2		1				1	0.2
Amphiuridae sp.												1	1	0.2
Ascidiacea sp.														
Barentsia benedeni		P			P									
Bowerbankia gracilis	P	P	P		P						P	P		
Bugulidae sp.												P		
Calycella syringa														
Campanulariidae sp.														
Crossaster papposus				1		1	0.2							
Dendrochirotida sp.	6	3	4	16	3	32	6.4	3	1	2	3	7	16	3.2
Edwardsia sipunculoides	1				1	2	0.4		1		1	1	3	0.6
Edwardsiidae sp.											1		1	0.2
Golfingiidae sp.	1	4	4		2	11	2.2					1	1	0.2
Hoplonemertea spp.		1		1	1	3	0.6						0	
invertebrate egg cocoon												1	1	0.2
Leptoplanidae spp.														
Lineidae spp.		2		4	1	7	1.4	5	3		1	1	10	2
Loxosomatidae sp.						0					1		1	0.2
Nemertea spp.	1					1	0.2							
Nymphon pixellae		1				1	0.2					1	1	0.2
Nynantheae spp.	4	4	5	4	7	24	4.8		4	5		2	11	2.2
Ophiura luetkenii					1	1	0.2				1		1	0.2
Ophiura sp.														
Ophiurida spp.	14	13	9	11	12	59	11.8	14	9	21	4	9	57	11.4
Paleonemertea spp.								1					1	0.2
Pentamera sp. B														
Phoronis sp.	1					1	0.2							
Polycladida spp.											2		2	0.4
Solasteridae sp.		1				1	0.2							
Strongylocentrotus droebachiensis				2		2	0.4							
Strongylocentrotus sp.		1				1	0.2							
Tetrastemma spp.	7	9	1	1	3	21	4.2	2	2	2	2		8	1.6
Thysanocardia nigra			1	3		4	0.8		1	1	1		3	0.6
Tubulanus pellucidus/polymorphus									1				1	0.2
Tubulanus sexlineatus	1					1	0.2							
Tubulanus spp.		3		2	2	7	1.4	1	2				3	0.6
Terebratalia transversa		1		3	2	6	1.2							
Biomass	1.2	0.2	0.1	0.5	0.2			0.0	0.0	0.1	0.1	0.01		
Total						188	37.6						123	24.6
Number of species						24							21	

Pier53 2002 taxonomy															
Site			**P53VG3**			Individual	Average			**P53VG4**			Individual	Average	**Total**
Replicate	1	2	3	4	5	Species	Individ	1	2	3	4	5	Species	Individ	**Number**
Taxon						Totals	Species						Totals	Species	
ANNELIDA															
Amage anops		2		1		3	0.6								3
Amphicteis mucronata		2				2	0.4								3
Ampharete finmarchica							0				1		1	0.2	1
Amphitritinae juvenile							0							0	1
Amphitrite sp juv		1				1	0.2							0	2
Anobothrus gracilis				2		2	0.4		4	2	1		7	1.4	20
Aphelochaeta monilaris	2	3	1	1	5	12	2.4			1	2		3	0.6	33
Aphelochaeta sp							0							0	2
Aphelochaeta sp N1							0	1					1	0.2	1
Apistobranchus ornatus					1	1	0.2		1				1	0.2	3
Aricidea lopezi				1		1	0.2				1		1	0.2	7
Armandia brevis	1					1	0.2		1				1	0.2	6
Asabellides lineata							0		1				1	0.2	1
Barantolla nr americana							0							0	3
Boccardia pugettensis	1	5		1	3	10	2							0	23
Boccardiella hamata							0		3		4	1	8	1.6	20
Caulleriella pacifica		2			1	3	0.6	1			1		2	0.4	26
Chaetozone acuta							0							0	3
Chaetozone nr setosa	5	2	5	3		15	3	4	3	3	2		12	2.4	59
Chaetozone sp			1			1	0.2							0	3
Cirratulidae							0	2					2	0.4	10
Chone magna							0				1		1	0.2	1
Circeis spirillum							0					1	1	0.2	1
Cirratulus spectabilis							0							0	1
Clymenura gracilis	4	1	3	6	5	19	3.8	4	4	3	2	5	18	3.6	77
Cossura pygodactylata				1		1	0.2			4	1	1	6	1.2	27
Demonax sp							0							0	1
Demonax medius							0							0	1
Diopatra ornata	6	7	3	7	3	26	5.2	12	8	4	8	5	37	7.4	112
Dipolydora akaina							0							0	1
Dipolydora cardalia		3	1	1		5	1	2	1				3	0.6	31
Dipolydora caulleryi	1	1	1	2	2	7	1.4	1	2	2	4		9	1.8	34
Dipolydora socialis		1	1		3	5	1				1	3	4	0.8	16
Dorvillea pseudorubrovitata							0							0	4
Dorvillea (Schistomeringos) sp							0							0	1
Dorvilleidae				1		1	0.2			1			1	0.2	6
Eteone nr pigmentata							0							0	1
Eteone sp							0	2	2	1	1		6	1.2	35
Eteone spilotus							0							0	1
Euchone incolor	1		1	6		8	1.6	2	7	6		1	16	3.2	52
Euclymeninae				2	1	3	0.6		2		1	1	4	0.8	19
Eulalia californiensis		1	2	2		5	1	2		1			3	0.6	26
Eumida longicornuta		2		1		3	0.6							0	5
Eusyllis habei		1		1		2	0.4	1			1		2	0.4	6
Exogoninae							0	1					1	0.2	1
Exogone dwisula			1			1	0.2							0	4
Exogone lourei		1	2			3	0.6	1	2	1	3		7	1.4	27
Galathowenia oculata							0							0	1
Gattyana cirrosa	5	5	2	6	3	21	4.2	1	1	4	5	2	13	2.6	124
Gattyana treadwelli							0							0	1
Glycera americana							0							0	1
Glycera nana	7	13	6	8	3	37	7.4	6	7	8	8	1	30	6	183

Site				P53VG3			Individual	Average			P53VG4			Individual	Average	Total
Replicate		1	2	3	4	5	Species	Individ	1	2	3	4	5	Species	Individ	Number
Taxon							Totals	Species						Totals	Species	
Glycinde armigera		2	3	1		3	9	1.8		3	2	2	2	9	1.8	32
Goniada maculata				1	5	1	7	1.4	1	2			1	4	0.8	13
Gyptis sp 1								0							0	1
Harmothoe multisetosa			5		1		6	1.2		6	5	1	2	14	2.8	35
Harmothoe sp								0	1			4		5	1	6
Hesionidae								0							0	1
Heteromastus filobranchus								0		1	2			3	0.6	3
Heteromastus sp		1				1	2	0.4							0	5
Lanassa venusta								0					2	2	0.4	2
Laonice cirrata		1	2		1	1	5	1			1	2		3	0.6	17
Laonice pugettensis								0							0	1
Laonice sp juv								0							0	1
Leitoscoloplos pugettensis			3		2		5	1	1	2	2	1		6	1.2	16
Levinsenis gracilis		1	2	7	1	3	14	2.8	3	4	5	5	3	20	4	84
Lumbrineris sp juv		8	14	3	6	2	33	6.6		3	1	2	1	7	1.4	71
Lumbrineris californiensis		18	15	40	16	11	100	20	8	32	20	18	16	94	18.8	425
Lumbrineris cruzensis		1	5	1	2		9	1.8	4	5	1	2	2	14	2.8	25
Lumbrineris latreilli		1		1		1	3	0.6							0	12
Magelona longicornis		2	2	3	1	4	12	2.4		2		5	1	8	1.6	61
Maldanidae spp. juv								0							0	1
Malmgreniella bansei								0		1	1			2	0.4	16
Mediomastus ambiseta								0							0	1
Mediomastus californiensis				1			1	0.2	3	1	1	2		7	1.4	18
Mediomastus sp		2	1			6	9	1.8		11	1	6		18	3.6	62
Melinna oculata								0							0	1
Microclymene caudata			1				1	0.2							0	1
Micropodarke dubia		1	3	1	1	1	7	1.4			1			1	0.2	19
Monticellina serratiseta		3	2	4	4	3	16	3.2		1			1	2	0.4	35
Monticellina sp N1		5	5	19	12	9	50	10	12	9	5	12	2	40	8	206
Monticellina tesselata								0		1		1		2	0.4	18
Neosabellaria cementarium								0							0	2
Nephtys cornuta		2		1	1		4	0.8		2	9		1	12	2.4	42
Nephtys ferruginea		1	5	7	4	7	24	4.8	9	8	15	8	4	44	8.8	202
Nephtys sp			3	2	5	2	12	2.4	1	1				2	0.4	76
Nereis procera		2	2	3	1	2	10	2	2	3	2			7	1.4	39
Notocirrus californiensis								0		1				1	0.2	1
Notomastus hemipodus		13	24	25	18	26	106	21.2	25	26	15	25	12	103	20.6	379
Notomastus latericeus						1	1	0.2	1					1	0.2	6
Oligochaeta					1		1	0.2							0	2
Onuphis juv								0		1				1	0.2	1
Onuphis elegans						1	1	0.2					1	1	0.2	9
Onuphis iridescens			1				1	0.2	2	1	1	1		5	1	6
Ophelina acuminata		1	1	3		2	7	1.4	2			2		4	0.8	16
Owenia fusiformis								0				1		1	0.2	1
Paleanotus bellis				1	1		2	0.4							0	2
Paranaitis polynoides								0							0	1
Parandalia fauveli			1				1	0.2				1	1	2	0.4	19
Paraprionospio pinnata		2	2	5	2	1	12	2.4	2		5	2		9	1.8	45
Pectinaria californiensis								0		1				1	0.2	6
Pectinaria granulata		4	9	2	6	4	25	5	9	14	18	15	8	64	12.8	253
Pherusa plumosa								0			1			1	0.2	2
Pholoe sp.		1					1	0.2							0	1

Site				P53VG3			Individual	Average			P53VG4			Individual	Average	Total
Replicate		1	2	3	4	5	Species	Individ	1	2	3	4	5	Species	Individ	Number
Taxon							Totals	Species						Totals	Species	
Pholoides asperus		1	4	1	3		9	1.8	2			1		3	0.6	66
Phyllodoce cuspidata								0						0	0	1
Phyllodoce groenlandica			2	2	2	2	8	1.6	1	2	1	2		6	1.2	35
Phyllodoce hartmanae		2					2	0.4	1				1	2	0.4	4
Phyllodoce longipes								0							0	1
Phyllodoce williamsi								0							0	1
Phylo felix				3	3		6	1.2							0	10
Pilargis maculata		3	5	1		2	11	2.2		2	2	4		8	1.6	49
Pista bansei								0	1					1	0.2	4
Pista elongata			1				1	0.2							0	2
Pista estevanica								0							0	5
Pista sp juv		1			1		2	0.4							0	4
Platynereis bicanaliculata			2				2	0.4							0	2
Ophiodromus pugettensis			1				1	0.2		1				1	0.2	2
Podarkeopsis glabrus					1		1	0.2		1				1	0.2	9
Polycirrus californicus								0							0	1
Polycirrus sp		3	4	6	5	13	31	6.2	4	11	7	10	6	38	7.6	130
Polydora limicola				2			2	0.4				2	1	3	0.6	19
Polydora sp juv								0							0	1
Prionospio lighti								0		1	5			6	1.2	10
Prionospio multibranchiata			2	1	5		8	1.6							0	14
Prionospio steenstrupi		17	31	45	33	18	144	28.8	26	27	26	32	10	121	24.2	791
Proceraea cornuta						1	1	0.2							0	4
Proclea graffi		1	3	3	2	4	13	2.6	1	2	1	2	2	8	1.6	30
Protodorvillea gracilis					1		1	0.2			3		2	5	1	9
Rhodine bitorquata				2		2	4	0.8	2	1	2	2		7	1.4	23
Scionella japonica								0							0	1
Scoletoma luti		10	11	9	14	21	65	13	9	24	12	17	8	70	14	259
Sabellidae spp. juv.		2					2	0.4				1		1	0.2	3
Sphaerodoropsis sphaerulifer		2	5		1	1	9	1.8	1	3	3	2		9	1.8	40
Sphaerosyllis ranunculus			1				1	0.2							0	3
Spio cirrifera			1	2	1	1	5	1	1	1			1	3	0.6	22
Spio filicornis								0							0	1
Spiochaetopterus costarum			1				1	0.2				1		1	0.2	2
Spiophanes berkeleyorum		4	5	6	5	3	23	4.6	3	6	4	4		17	3.4	86
Streblosoma bairdi		1					1	0.2							0	1
Sthenelais berkeleyi								0							0	1
Tenonia priops			1		1		2	0.4							0	5
Terebellidae spp. juv								0							0	1
Terebellides californica		1				1	2	0.4				1		1	0.2	4
Terebellides reishi								0							0	2
Terebellides sp juv								0				1		1	0.2	2
Travisia brevis								0							0	2
Trochochaeta multisetosa				2	1	1	4	0.8		2				2	0.4	17
Typosyllis cornuta			1	1			2	0.4			2			2	0.4	10
Typosyllis heterochaeta				1	1		2	0.4				1		1	0.2	6
Typosyllis caeca		3	7	3	2	6	21	4.2	12	17	5	9	7	50	10	192
Biomass		1.8	3.9	3.7	2.3	3.7			5.5	4.6	3.0	4.0	1.9			
Total							1083	216.6						1090	218	
Number of species							93							93		

Site			P53VG3			Individual	Average			P53VG4			Individual	Average	Total
Replicate	1	2	3	4	5	Species	Individ	1	2	3	4	5	Species	Individ	Number
Taxon						Totals	Species						Totals	Species	
CRUSTACEA															
Bathyleberis sp.	1	2	1	1		5	1		1	1	2	2	6	1.2	18
Euphilomedes carcharodonta	51	78	47	56	45	277	55.4	54	44	58	62	22	240	48	1512
Euphilomedes producta	7	11	11	11	9	49	9.8	8	11	22	10	3	54	10.8	406
Rutiderma lomae		2	3		1	6	1.2		5		3	1	9	1.8	41
Podocopida sp.						0	0						0	0	1
Nebalia sp.						0	0						0	0	1
Leptochelia dubia		4	1	2	2	9	1.8						0	0	45
Diastylis santamariensis		2			1	3	0.6		2	2	1		5	1	13
Eudorella pacifica	3	3	3			9	1.8	2	1				3	0.6	43
Eudorellopsis longirostris						0	0	1					1	0.2	1
Haliophasma geminatum	1				2	3	0.6						0	0	4
Ampelisca lobata	3		2	2		7	1.4	3	2	4	3	1	13	2.6	29
Byblis millsi	3	8	12	14	18	55	11	20	21	18	24	7	90	18	260
Aoroides sp.		3	1			4	0.8	2	1	1	3		7	1.4	20
Argissa hamatipes						0	0		1				1	0.2	3
Calliopiidae sp.						0	0					1	1	0.2	1
Corophium sp.						0	0		1				1	0.2	2
Protomedeia sp.						0	0						0	0	1
Erichthonius brasiliensis	11	2	1	8		22	4.4	2			1		3	0.6	36
Hippomedon coecus	3			3		6	1.2	1	8	1	1		11	2.2	23
Orchomene decipiens						0	0		2				2	0.4	4
Pachynus barnardi						0	0						0	0	3
Melphisana bola						0	0				1		1	0.2	2
Americhelidium rectipalmum		1				1	0.2						0	0	1
Americhelidium variabilum						0	0						0	0	3
Deflexilodes sp.						0	0						0	0	2
Westwoodilla caecula	1	1		3	5	10	2	2	2	2	2	1	9	1.8	40
Heterophoxus conlanae	1		6	2	8	17	3.4	4	9	11	4	2	30	6	119
Metaphoxus frequens						0	0			2	1		3	0.6	17
Parametaphoxus quaylei	2	3	5	2		12	2.4		4	1	7	1	13	2.6	71
Podoceridae spp.						0	0		1				1	0.2	1
Stenothoides bicoma				1		1	0.2						0	0	1
Caprella sp.	1					1	0.2		5				5	1	6
Caridea sp.			2			2	0.4	1	2	1	5		9	1.8	12
Mesocrangon munitella		2				2	0.4		1				1	0.2	6
Crangon sp.	3	2				5	1	1		1	2		4	0.8	24
Crangon alaskensis						0	0						0	0	4
Eualus subtilis		14		1		15	3	1	6	5	14		26	5.2	43
Spirontocaris snyderi	3	4				7	1.4		1	1	1		3	0.6	18
Cancer oregonensis	2	2	1			5	1	2		1			3	0.6	12
Oregonia gracilis		1				1	0.2						0	0	1
Pinnotheridae sp.	2					2	0.4	2	1				3	0.6	6
Pinnixa occidentalis		2		1		3	0.6						0	0	3
Pinnixa schmitti				1		1	0.2		1				1	0.2	14
Pinnixa sp.	2	10	2	19	13	46	9.2	4	4	7	17	5	37	7.4	186
Pagurus sp.				1	1	2	0.4	2		1			3	0.6	19
Pagurus capillatus				1		1	0.2						0	0	1
Neotrypaea sp.	1	2	5		2	10	2	1	2		2	1	6	1.2	21
Biomass	0.2	0.6	0.3	0.8	0.3			0.3	0.3	0.4	0.4	0.1			
Total						599	119.8						605	121	
Number of species						33							34		

Site				P53VG3			Individual	Average			P53VG4			Individual	Average	Total
Replicate		1	2	3	4	5	Species	Individ	1	2	3	4	5	Specie	Individ	Number
Taxon							Totals	Species						Totals	Specie	
MOLLUSCA																
Acila castrensis						1	1	0.2					1	1	0.2	5
Adontorhina cyclia					2		2	0.4	2	1	1			4	0.8	9
Alvania compacta		3	8	3	1		15	3		2	15	7	2	26	5.2	65
Alvania rosana			1	1	2	1	5	1	1	1	5		1	8	1.6	49
Astyris gausapata		1		1		7	9	1.8					1	1	0.2	129
Axinopsida serricata		53	43	60	64	50	270	54	52	63	120	72	36	343	68.6	937
Cardiidae spp. juv.		1					1	0.2				1		1	0.2	17
Cardiomya pectinata		1					1	0.2						0	0	2
Chlamys hastata							0	0						0	0	1
Chlamys sp. juv.							0	0		1				1	0.2	1
Clinocardium blandum							0	0				1		1	0.2	1
Compsomyax subdiaphana		1					1	0.2	1			2		3	0.6	6
Crepipatella lingulata		1	4				5	1	1	3	1	1	1	7	1.4	12
Cryptonatica affinis							0	0						0	0	1
Ennucula tenuis		1	3	1	1	1	7	1.4	1	3	2		1	7	1.4	23
Gastropeteron pacificum		1		4	3		8	1.6				1		1	0.2	23
Hiatella arctica		1	1		3		5	1	1	1		3		5	1	13
Kurtziella plumbea							0	0		1	1	2	1	5	1	11
Lucinoma annulatum		1	1		2	1	5	1	1		4	2	2	9	1.8	34
Lyonsia californica		3	3	2	2	1	11	2.2	2					2	0.4	52
Macoma carlottensis		7	5	1	4		17	3.4		4	2	5		11	2.2	86
Macoma elimata		3				2	5	1		1			1	2	0.4	36
Macoma golikovi		1		1			2	0.4						0	0	3
Macoma yoldiformis					1		1	0.2						0	0	1
Macoma sp. juv.		3	11	3	2		19	3.8		3		2		5	1	67
Margarites pupillus		1	1		1		3	0.6			1	2		3	0.6	9
Melanella montereyensis							0	0						0	0	1
Modiolus modiolus							0	0		1				1	0.2	5
Mya arenaria		1				1	2	0.4		1		1		2	0.4	16
Mytilus sp. juv.				1			1	0.2				1		1	0.2	2
Nemocardium centifilosum							0	0						0	0	1
Nuculana hamata					1		1	0.2				1	1	2	0.4	5
Nudibranchia sp. unid.							0	0						0	0	1
Nutricola lordi							0	0						0	0	1
Odostomia sp.			3		1		4	0.8			1			1	0.2	41
Oenopota sp.							0	0	1					1	0.2	1
Pandora filosa					2	1	3	0.6						0	0	11
Parvilucina tenuisculpta		108	110	106	101	98	523	104.6	88	89	163	156	78	574	114.8	1718
Phline alba			1	1		1	3	0.6				1	1	2	0.4	14
Pododesmus macroschisma					1		1	0.2			2			2	0.4	4
Polygireulima rutila				1			1	0.2		1				1	0.2	2
Rochefortia tumida				1			1	0.2						0	0	3
Solamen columbianum		2	6	1	4	5	18	3.6	2	5	4	4	1	16	3.2	114
Thracia trapezoides			1				1	0.2						0	0	2
Thyasira flexuosa		6	6	4	3	8	27	5.4	2	4	5	8	1	20	4	88
Trichotropis cancellata							0	0					1	1	0.2	1
Biomass		3.9	2.9	2.7	2.9	2.2			1.8	2.3	4.8	4.2	1.9			
Total							979	195.8						1070	214	
Number of species							34							34		

Site			P53VG3			Individual	Average			P53VG4			Individual	Average	Total
Replicate	1	2	3	4	5	Species	Individ	1	2	3	4	5	Species	Individ	Number
Taxon						Totals	Species						Totals	Species	
MISCELLANEOUS															
Alcyonidium gelatinosum						0	0					P	0		P
Amphiodia sp.										2			2	0.4	2
Amphipholis sp.															1
Amphipholis squamata											1		1	0.2	1
Amphiporus spp.	1					1	0.2			1			1	0.2	4
Amphiuridae sp.															1
Ascidiacea sp.								1					1	0.2	1
Barentsia benedeni			P												P
Bowerbankia gracilis	P	P	P												P
Bugulidae sp.															P
Calycella syringa	P														P
Campanulariidae sp.	P														P
Crossaster papposus		1				1	0.2	1	1	1	1		4	0.8	6
Dendrochirotida sp.	16	30	1	10		57	11.4	7	13		16	7	43	8.6	148
Edwardsia sipunculoides	1		1		1	3	0.6								8
Edwardsiidae sp.															1
Golfingiidae sp.	1	2	1	2	1	7	1.4			2		1	3	0.6	22
Hoplonemertea spp.	5	2	1	4		12	2.4	1	1				2	0.4	17
invertebrate egg cocoon															1
Leptoplanidae spp.									2	1	3	3	9	1.8	9
Lineidae spp.		1	1		3	5	1	1	3	2	2	1	9	1.8	31
Loxosomatidae sp.		1	1	2		4	0.8	1	3	2	1	1	8	1.6	13
Nemertea spp.	1	2				3	0.6								4
Nymphon pixellae															2
Nynantheae spp.	3	1	2	1	6	13	2.6	4	3		4		11	2.2	59
Ophiura luetkenii	1					1	0.2				1		1	0.2	4
Ophiura sp.					1	1	0.2								1
Ophiurida spp.	4	8	9	6	6	33	6.6	6	24	9	9	2	50	10	199
Paleonemertea spp.		1			1	2	0.4								3
Pentamera sp. B								2	1		4		7	1.4	7
Phoronis sp.															1
Polycladida spp.		1				1	0.2								3
Solasteridae sp.															1
Strongylocentrotus droebachiensis	1					1	0.2			1	1		2	0.4	5
Strongylocentrotus sp.															1
Tetrastemma spp.		3				3	0.6					2	2	0.4	34
Thysanocardia nigra	2			4		6	1.2		1				1	0.2	14
Tubulanus pellucidus/polymorphus										1	1		2	0.4	3
Tubulanus sexlineatus					1	1	0.2								2
Tubulanus spp.			1	1	1	3	0.6	3					3	0.6	16
Terebratalia transversa								1	1	3	4		9	1.8	15
Biomass	0.2	0.1	0.0	0.1	0.1			0.1	0.5	0.3	0.3	0.0			
Total						158	31.6						171	34.2	
Number of species						24							22		