RESULTS OF YEAR 2 OPERATIONS, MAINTENANCE, AND MONITORING PLAN SAMPLING

Head of the Thea Foss Waterway Remediation, Tacoma, WA

Prepared for

PacifiCorp Environmental Remediation Company
and
Puget Sound Energy

Prepared by

TETRA TECH

November 2006

ISO 14001

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TABLES

FIGURES

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ACRONYMS AND ABBREVIATIONS

ARI	Analytical Resources, Inc.
BEHP	bis(2-Ethylhexyl)phthalate
cm	centimeter
Corps	U.S. Army Corps of Engineers
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DOF	Dalton, Olmstead & Fuglevand
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
ft	foot
G&A	Germano & Associates, Inc.
HDPE	high density polyethylene
HPAH	high molecular weight polycyclic aromatic hydrocarbon
ICP	Institutional Control Plan
LPAH	low molecular weight polycyclic aromatic hydrocarbon
µg	microgram
µg/kg	microgram per kilogram
m	meter
mg	milligram
MLLW	mean lower low water
MOA	Memorandum of Agreement
OMMP	Operation, Maintenance, and Monitoring Plan
OSI	organism sediment index
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
ppb	parts per billion
PSDDA	Puget Sound Dredged Disposal Analysis

ACRONYMS AND ABBREVIATIONS (continued)

PSEP	Puget Sound Estuary Program
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
ROD	Record of Decision
RPD	redox potential discontinuity
SAP	sampling and analysis plan
SMS	Sediment Management Standard
SPI	Sediment Profile Imagery
SQO	Sediment Quality Objective
SR	State Route
SVOC	semivolatile organic compound

1. INTRODUCTION

This report was prepared on behalf of the Advance Ross Sub Company, PacifiCorp, and Puget Sound Energy (the Utilities) and presents the results of Year 2 Operations, Maintenance, and Monitoring Plan (OMMP) observation and sampling for the southern portion of the Thea Foss Waterway. The waterway is part of the Commencement Bay Nearshore/Tideflats Superfund Site in Tacoma Washington (Figure 1-1). The sampling and analyses were accomplished in accordance with the requirements of the OMMP prepared by Tetra Tech et al. (2003) with amendments in March and April 2006 (PERCo 2006). The Utilities are responsible for Remedial Action Areas 23 and 24 consistent with the Consent Decree and portions of RAs 19b, 20, and 22 as described in a confidential agreement with the City of Tacoma (the City). Portions of the waterway south of a sheet pile wall installed at Station 70+10 are the responsibility of the Utilities; this area is referred to in the remainder of the document as the Utilities' Work Area.

Construction of the remedy for the Utilities' Work Area was completed in February 2004 (DOF 2004a). The selected remedy for the Utilities' area of responsibility was containment of contaminated sediments south of waterway station 70+10. The primary components of the remedy are:

- Installation of a sheet pile wall at waterway station 70+10.
- Dredging beneath the current location of the scour protection apron at the head of the waterway and placement of capping and scour protection material where stormwater discharges from outfalls known as the Twin 96 outfalls.
- Placement of a high-density polyethylene (HDPE) cap over the former location of the SR 509 seep.
- Placement of a sand cap over contaminated sediments and over the HDPE cap.
- Placement of slope cap and armor material on waterway slopes.

In addition to the physical remedy components described above, the Utilities' remedy also includes the following:

- **Deauthorization of the navigation channel south of 70+10.** This requires an act of Congress and representatives of the Utilities are working with congressional staff to achieve deauthorization. As an interim step, the Utilities entered into a Memorandum of Agreement (MOA) with the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (Corps) on September 29, 2006, regarding the presence of the cap in the Head of the Waterway. The MOA describes the actions to be taken if the cap is deemed to be an obstruction to navigation. The City also signed the MOA as a sponsor.

- **Institutional Control Plan.** On September 29, 2006, EPA provided final approval for the Utilities' Institutional Control Plan (ICP) for the long-term maintenance of the Head of the Waterway. EPA, the Utilities, and the City plan to continue to discuss the wording of the draft restrictive covenant language. As soon as the language is finalized, the Utilities will pursue obtaining signatures on the individual property restrictive covenants.

- **Consent Decree Milestones**. The Utilities completed remedial action construction in Remedial Action Areas 23 and 24 and received a Certification of Completion of Remedial Action Construction from the EPA on September 29, 2006 in compliance with Paragraph 50 of the Utilities' May 9, 2003 Consent Decree with EPA.

  The next milestone for the project, as set forth in Paragraph 51 of the Consent Decree, is completion of remedial action for Remedial Action Areas 23 and 24. The Utilities submitted the Draft RA Completion Report to EPA on October 11, 2004; we received EPA comments on the text on February 15, 2005, and submitted responses on March 21, 2005. EPA has indicated that to receive a Certificate of Completion pursuant to Paragraph 51.B, the Utilities must demonstrate that all restrictive covenants have been recorded. The Utilities will be prepared to submit the final Remedial Action Completion Report that demonstrates that the performance standards have been attained as soon as all of the individual restrictive covenants for the Head of the Waterway are in place.

The City is responsible for remediation north of the sheet pile wall installed at waterway station 70+10. Immediately north of the Utilities' Work Area, the City's selected remedy consisted of dredging and capping to maintain the required navigation depth of –19 feet mean lower low water (MLLW). During the 2004 to 2005 construction season, the City completed dredging and partial capping in part of the area next to the sheet pile wall (RA-20 and RA-22). Dredging by the City's contractor (Manson) in the adjacent remediation areas (RA-20 and RA-22) was completed between August 31 and September 17, 2004. Placement of a grout mat and final cap was completed in RA-19B (also adjacent to the sheet pile wall) during the previous 2003 to 2004 construction season. Additional cap placement was conducted by the City in December of 2005 in the Utilities' Work Area north of the State Route (SR) 509 bridge in the area of the Utilities' cap that was recontaminated during the City's remedial construction activities.

The City completed remedial action construction in the rest of the Waterway (area north of the sheet pile wall) and received a Certification of Completion of Remedial Action Construction from EPA on September 29, 2006.

1.1 PURPOSE AND OBJECTIVES

As part of the remedial design work, the Utilities prepared an OMMP that was approved by EPA (Tetra Tech et al. 2003) and amended in March and April 2006 (PERCo 2006). The objectives of the Utilities' OMMP are as follows:

- Confirm long-term attainment of Sediment Quality Objectives (SQOs) specified in the Record of Decision (ROD) (EPA 1989) and Explanation of Significant Differences (ESDs) (EPA 1997, 2000).
- Evaluate the effectiveness of source control.
- Evaluate the enhancement of habitat function and fisheries resources.

In addition, the Year 2 monitoring will assess the area of recontamination resulting from the City's dredging activities.

Head of Thea Foss Waterway
Remediation Project

FIGURE 1-1
VICINITY MAP

2. OMMP ACTIVITIES

To meet the OMMP objectives, monitoring includes physical cap integrity, recolonization monitoring, and recontamination sampling. Table 2-1 is the schedule for OMMP monitoring as revised in April 2006. Physical observations include a visual inspection of the cap and hydrographic survey. Recolonization includes assessment using SPI as well as collection of benthic abundance samples. Sediment sampling includes collection of samples for chemical and toxicity testing. Three types of sediment samples are being collected as part of the OMMP:

- **Compliance Samples.** These are surface sediment samples collected from the depth interval of 0 to 10 cm. This is the point of compliance for application of the SQOs.
- **Early-Warning Recontamination Samples.** Early-warning samples are being collected to provide warning from possible "top-down" recontamination of the cap from sources such as stormwater. The early-warning samples are being collected from depths of 0 to 2 cm from the cap surface. At any given point in time, this sediment represents the newest deposited sediment for the sample location.
- **Core Samples.** Core samples are being collected to provide data to evaluate possible future "bottom-up" recontamination of the waterway cap.

In March 2006, the Utilities worked with the City to develop two sampling plan proposals for EPA's consideration. The first plan was developed to monitor the effectiveness of the additional capping material placed in the Head of the Waterway by the City in December 2005 to address contamination associated with the City's dredging operations. The sampling plan modified the existing OMMP for the Utilities' Work Area and increased sampling in the area of recontamination. The second plan was developed in response to SQOs exceedances for bis(2-ethylhexyl)phthalate (BEHP) in the Head of the Waterway; it outlined a proposed approach for biological testing. The City submitted the proposed plans to EPA on March 23, 2006.

In April 2006, the Utilities and the City worked with EPA and the Corps to adequately respond to EPA and Corps comments on the sampling plans. The Utilities submitted a revised plan for sampling the area of additional cap material placement to EPA on April 28, 2006 (PERCo 2006). The revised plan was approved by EPA on May 4, 2006. EPA approved the March 23, 2006 Biological Testing Sampling Plan on May 1, 2006.

The EPA-approved revision to the OMMP monitoring schedule in April 2006 (PERCo 2006) outlines the schedule for physical cap integrity monitoring and recontamination sampling. This revised table replaces Table 2-2 of the OMMP. Monitoring is to be completed on an annual basis for the first 5 years and in years 7 and 10. The specific monitoring tasks vary between years.

2.1 YEAR 0 OMMP ACTIVITIES

The results of physical observations and sediment sampling completed in the period from February to July 2004 are documented in the Year 0 OMMP report (DOF 2004b). Physical observations were made in May and July 2004 and sediment sampling (surface and core sampling) was completed in April 2004. The April 2004 sampling provides baseline data on the condition of the Utilities' cap soon after the cap was completed in February 2004. Analysis of the April 2004 data indicated that stormwater constituents were accumulating on the Utilities' cap and that concentrations of high molecular weight polycyclic aromatic hydrocarbons (HPAHs) and BEHP were highly correlated (R=0.99) indicating a common source.

2.2 YEAR 1 ACTIVITIES

In March 2004, EPA requested that the Utilities' make more frequent physical observation of the Utilities' Work Area than anticipated by the EPA-approved OMMP (EPA 2004). Physical observations that were made in May, July, September, and December 2004 and April 2005 are discussed in the *Assessment of Utilities' Cap Recontamination and Data Summary* (DOF and Tetra Tech EC 2005). Because of the severe recontamination of the sediment surface on top of the Utilities' cap discovered in September 2004, supplemental sampling was completed that was not part of the Year 1 OMMP monitoring schedule. The physical observations that were made in September and December 2004 and April 2005 as part of EPA's OMMP requirements were also used to assess the sources of sediment recontamination on the cap. Sediment and cap sampling (including both surface and core sampling) was completed in August, September, November, and December 2004. The results of the physical observations and sampling completed between August 2004 and April 2005 are documented in DOF and Tetra Tech EC (2005) and indicated that the cause of recontamination (primarily north of the SR 509 Bridge) was City remedial construction work largely completed between September and December 2004. Recontamination constituents included polycyclic aromatic hydrocarbons (PAHs), phthalates, pesticides, and polychlorinated biphenyls (PCBs).

The results of physical observations and sediment sampling completed in May 2005 are documented in the Year 1 OMMP report (DOF 2005). The OMMP monitoring schedule for Year 1 called for visual monitoring of the former SR 509 seep area and collection of top-down, early-warning sediment samples (0 to 2 cm) from the 14 established OMMP sampling locations (RC-1 to RC-14). Physical observation of the former SR 509 seep area was completed on June 22, 2005 and collection of the early-warning sediment samples was completed on May 11 and 12, 2005.

In addition to the samples specified in the Utilities' OMMP, supplemental "compliance" samples (0 to 10 cm) were obtained in the area of recontamination north of the bridge and analyzed by the Utilities and the City. The City also collected sediment samples from their work area in RA-19B, RA-20, and RA-22.

The sampling results indicated that SQOs were exceeded in one or more compliance (0 to 10 cm) samples. They include individual PAHs, total low molecular weight polycyclic aromatic hydrocarbons (LPAHs), total HPAHs, BEHP, 4'4-Dichlorodiphenyldichloroethylene (DDE), 4'4- Dichlorodiphenyldichloroethane (DDD), and total PCBs. The highest exceedance factors were detected in samples from stations S-15 and WC-11 located near the sheet pile wall. SQO exceedance factors ranged between 1.4 (naphthalene and 4,4'-DDD) and 8.4 (acenaphthene).

Sediment concentrations were higher than the SQOs in one or more early-warning (0 to 2 cm) samples. They include mercury, individual PAHs, total LPAHs, total HPAHs, dimethylphthalate, BEHP, 4'4-DDD, and total PCBs. The highest exceedance factors were detected in samples from stations RC-1, RC-9, RC-11, and RC-12. SQO exceedance factors ranged between 1.3 (total PCBs) and 6.3 (BEHP).

2.3 POST CITY REMEDIAL ACTION

Due to recontamination of the Utilities' cap by the City's construction activities, the City placed additional cap material in the northern section of the Head of the Thea Foss in December 2005 (shown in Figure 2-1). Details of the observations made and the confirmation sampling is included in Appendix A. Photos associated with the Observations Report are included on CD.

2.3.1 City Capping Activities

Capping operations lasted from approximately December 3 to December 12, 2005. Capping operations were conducted on behalf of the City by Manson Construction Company and

Brundage-Bone Concrete Pumping. Tetra Tech EC performed oversight of the capping activities on behalf of the Utilities.

Sediment placement began between the piers of the Foss Landing boat lift. The sediment was composed of clean sand. Cap material was placed according to a system of 50-foot cells. The volume of cap material placed in a cell was used as a proxy for cap thickness. Periodic checks with leadline and underwater video camera showed the cap to be of the correct thickness where it was measured and to be smooth and uniform. It was originally calculated that 1,830 cubic yards of cap material would be required. However, 1,975 cubic yards were actually used. Capping material was fed to the Telebelt through a hopper by a front-end loader. Material volumes were tracked by recording the number of loader buckets of a known volume that were placed in a cell.

In summary, the capping operation went smoothly. The Telebelt was particularly well-suited to deliver discrete volumes of sediment in a controlled manner. It appeared that reasonable efforts were made to ensure that the desired thicknesses were obtained throughout the entire capping area. Observations made with a leadline and underwater camera during the operation seemed to confirm this. However, removal of a high spot under the Foss Landing boat lift was completed on May 26, 2006 (Appendix A.2).

2.3.2 Cap Confirmation Results

Cap placement was completed on December 12, 2005 and surface samples of the cap were collected on December 14, 2005. Surface samples were collected by Parametrix on behalf of the City. Tetra Tech EC accompanied the City sampling crew to observe and collect splits from the samples. Eleven samples were collected with a Van Veen grab sampler. Samples were collected at stations S-15, S-16, S-17, S-19, S-20, S-24, WC-8, WC-9, WC-10, WC-11, and WC-12. In most cases, the grab samples were composed entirely of the sand cap material covered with a thin layer of silt. This silt layer was homogenized with the sand. Within the capping area, only the sample from S-16 had a layer of sand less than the required 6 inches. In this case the sand layer was 4 inches thick. In the sample collected at WC-8 there was a 1-cm-thick layer of brown silt over a 6-cm-thick layer of gray silt overlying fine sand; at WC-9 there was a 0.5–cm-thick layer of light brown silt over a 4-cm-thick layer of dark olive silt overlying gray sand. These samples were collected from the area adjacent to the City capping area, and the sand overlain by the silt layers was not the sand placed during the capping operation but was part of the Utilties'previously installed cap.

The daily capping observation reports with photo logs, the sample collection forms, the sampling logbook pages, and the Tetra Tech EC split sample chain-of-custody forms are included as Attachments to Appendix A. In addition, a CD of the photos and the movies is also included.

2.4 YEAR 2 ACTIVITIES

Tetra Tech EC was contracted by the Utilities to implement the second year of the OMMP program by making physical observations, conducting recolonization monitoring, and collecting sediment samples in the Head of the Thea Foss Waterway. The May 2006 monitoring was proposed to meet the following objectives for Year 2 OMMP:

1. Assess the cap integrity with physical monitoring consisting of visual observations and a hydrographic survey.
2. Assess the effectiveness of the City's placement of the additional capping material in the area of recontamination within the Utilities' Work Area.
3. Provide data to assess the chemical quality of in-place capping materials with respect to the SQOs performance standards. Assess the overall change in contaminant concentrations in surface sediment since the baseline conditions were established in April 2004.
4. Determine the approximate area where SQOs are exceeded at the point of compliance (0 to 10 cm).
5. Provide additional data to assess possible recontamination of capping materials from underlying contaminated materials (bottom-up recontamination) and other sources such as stormwater discharge (top-down recontamination) (i.e., a comparison between the fine-grained 0 to 2 cm surface sediments and the 0 to 10 cm compliance samples).
6. Assess the ecological performance of mitigation/restoration activities by monitoring the natural recolonization of the capped areas with Sediment Profile Imagery (SPI) and benthic community sampling.

Objective No 1 was met with a visual observation of the former SR 509 seep area, scour protection apron, and slope cap performed on June 14, 2006. The assessment of the waterway cap was conducted with a hydrographic survey on May 10, 2006. Details of physical monitoring are discussed in Section 3.

Objectives 2 through 5 were met with the successful collection of sediment samples collected May 11 through May 18, 2006 as follows:

- Fourteen compliance (0 to 10 cm) samples (WC01 to WC14) with collection of extra material for bioassay testing at 11 stations south of the bridge,
- Four supplemental samples from the City recontamination capping area (S-15, S-17, S-19, S-24),
- Fourteen early-warning samples (0 to 2 cm) (RC01 to RC14),
- Six cores (WC01, WC04, WC05, WC06, WC10, and WC12), and
- Thirteen discrete slope cap locations (0 to 10 cm from fine-grained areas between -1 and +6 MLLW) composited into samples SC01 to SC04.

Details of sediment sampling and analysis are discussed in Section 4.

Objective No 6 was met with the collection of:

- Eighteen SPI stations (WC01 to WC14 and S-15, S-17, S-19, S-24), and
- Four benthic infauna stations (R-1 to R-4).

Details of the recolonization monitoring are included in Section 5. An evaluation of recontamination is summarized in Section 6. An overall summary of the Year 2 data interpretation is included in Section 7.

Table 2-1. OMMP Schedule

	Year 0[b,f]	**Year 1[f]**	**Year 2[c,f]**	**Year 3[f]**	**Year 4[f]**	**Year 5[f]**	**Year 6[f]**	**Year 7[d,f]**	**Year 8[f]**	**Year 9[f]**	**Year 10[f]**
Assumed Sediment Deposition											
Amount (cm)[a]	0	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15
MONITORING TASK											
Physical Cap Integrity	x		x		x			x			x
Recontamination Sampling											
Compliance Sampling (0-10cm)	x		x[g]	x[h]	x[g,i]			x			x
"Top Down" (0-2cm)	x	x	x	x	x	x		x			x
"Bottom Up" Migration (0-3ft)	x		x		x			x			x
"Visual" SR509 Seep Monitoring [e]		x	x	x	x	x		x			x
Recolonization Monitoring			x		x			x			x

Notes:(a) - Work completed by Hart Crowser suggests a sediment deposition rate of 1 to 2 cm/year.

(b) - Completed soon after cap placement as part of CQAP and OMMP.

(c) - First 5-year review (Based on EPS's review cycle). Adjust monitoring schedule based on first five years of data.

(d) - Second 5-year review

(e) - To be completed during daylight low tides (June/July)

(f) - Significant natural events may trigger additional monitoring activity. These events include a 50-year 24-hour storm event, one percent flood discharge (commonly called the 100-year flood event) or greater, or the occurrence of a design level seismic event (i.e., 4.5 magnitude or greater)

(g) – Samples will be collected and analyzed from four additional locations (i.e., S-15, S-17, S-19, and S-24) within the area of additional cap material placement during Year 2 and Year 4 monitoring. The additional samples from Stations S-15, S-17, S-19, and S-24 are in addition to the three samples that are to be collected from the existing sample stations (i.e. WC-10, WC-11, and WC-12) within the area of additional cap material placement. Results from the four additional sample locations together with three existing sample locations will be used to monitor the effectiveness of the additional cap material placement.

(h) – Compliance monitoring samples will only be collected and analyzed from the four additional locations (i.e., S-15, S-17, S-19, and S-24) and three existing sample locations (i.e. WC-10, WC-11, and WC-12) within the additional cap material placement area to monitor the effectiveness of the additional cap placement during Year 3 monitoring. Compliance monitoring samples will not be collected at any other OMMP monitoring locations during Year 3 monitoring.

(i) – The results from compliance sampling and analysis within the area of additional cap material placement during Year 2, 3, and 4 will be used to evaluate whether sample collection and analysis from the additional locations (i.e. footnote g) or additional monitoring events (i.e. footnote h) are warranted during subsequent monitoring years.

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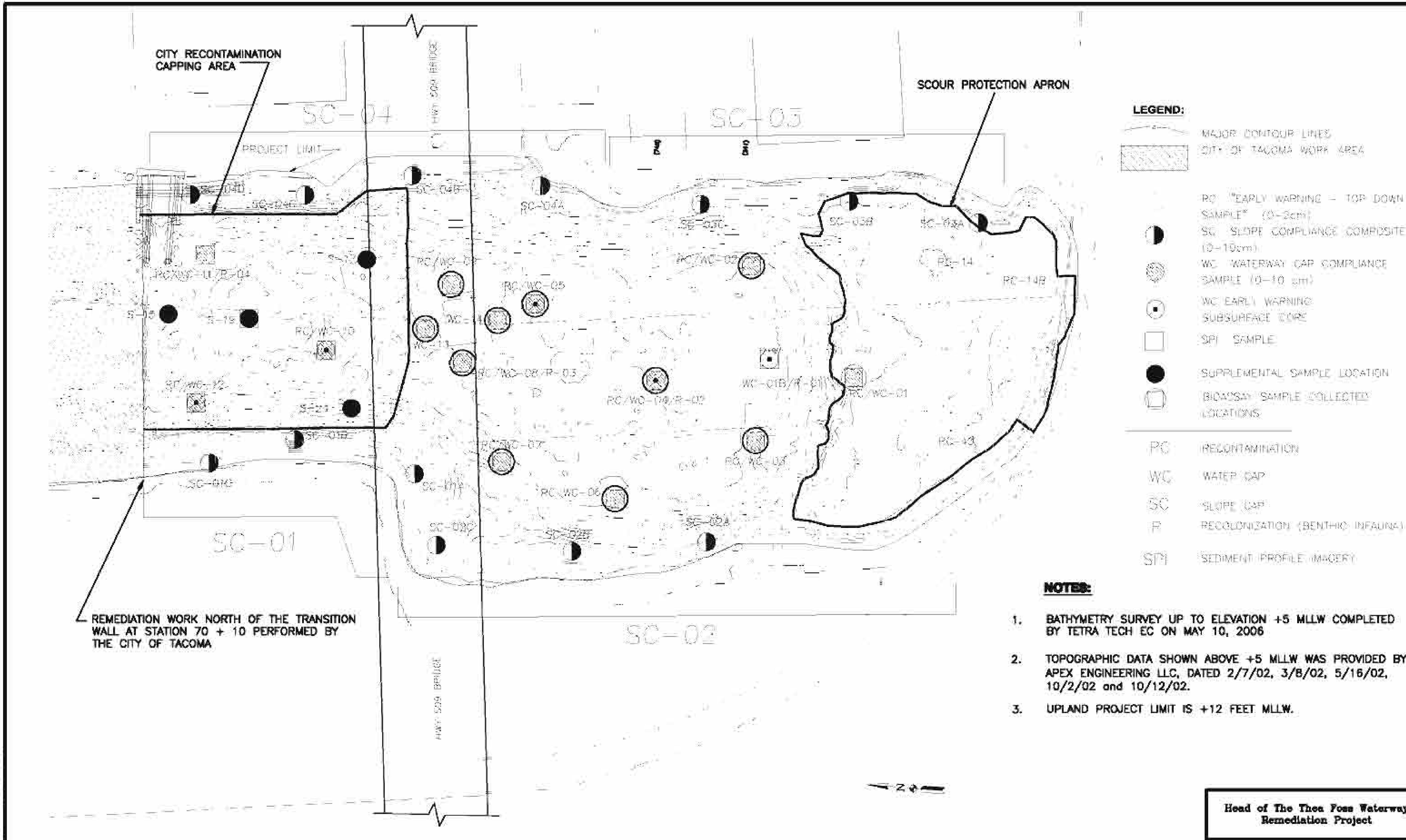


NOTES:

1. BATHYMETRY SURVEY UP TO ELEVATION +5 MLLW COMPLETED BY TETRA TECH EC ON MAY 10, 2006
2. TOPOGRAPHIC DATA SHOWN ABOVE +5 MLLW WAS PROVIDED BY APEX ENGINEERING LLC, DATED 2/7/02, 3/8/02, 5/16/02, 10/2/02 and 10/12/02.
3. UPLAND PROJECT LIMIT IS +12 FEET MLLW.

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 2-1
OMMP Monitoring Location Plan
May 2006

Thea Foss Waterway

P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE2-1.DWG
PLOT/UPDATE: NOV 1 2006 14:18:09

3. PHYSICAL OBSERVATIONS

Physical observations for Year 2 OMMP monitoring included a visual inspection of the cap at low tide and a hydrographic survey. The purpose of the physical observations was to assess the cap integrity. The visual inspection assessed the slope cap and outfall scour cap protection. The hydrographic survey assessed the waterway cap integrity.

3.1 VISUAL INSPECTION

A visual inspection of the cap was made on June 14, 2006 during a predicted low tide of -2.93 feet MLLW and the physical observations are documented in Appendix B. Overall, the June 2006 observations were similar to previous site visits that indicated the following:

- The scour protection apron is functioning as intended. No obvious signs of significant erosion were observed. As previously noted in the Year 0 and Year 1 observations, a small, shallow channel is present in the apron near the southeast corner of the waterway.
- Side slopes show no visible evidence of slope erosion, sloughing etc.
- Gas bubbles occur throughout the head of the waterway during lower tides; however, no rising non-aqueous phase liquid sheens were observed in the former SR 509 seep area or elsewhere in the Utilities' Work Area.
- While surface sheens were observed at times in the vicinity of the Foss Landing Marina and City's Project Area during the City's dredging and capping remedial work (2004 to 2005 construction seasons), no sheens were observed during the sampling activities in May or during the site visit on June 14, 2006.

3.2 HYDROGRAPHIC SURVEY

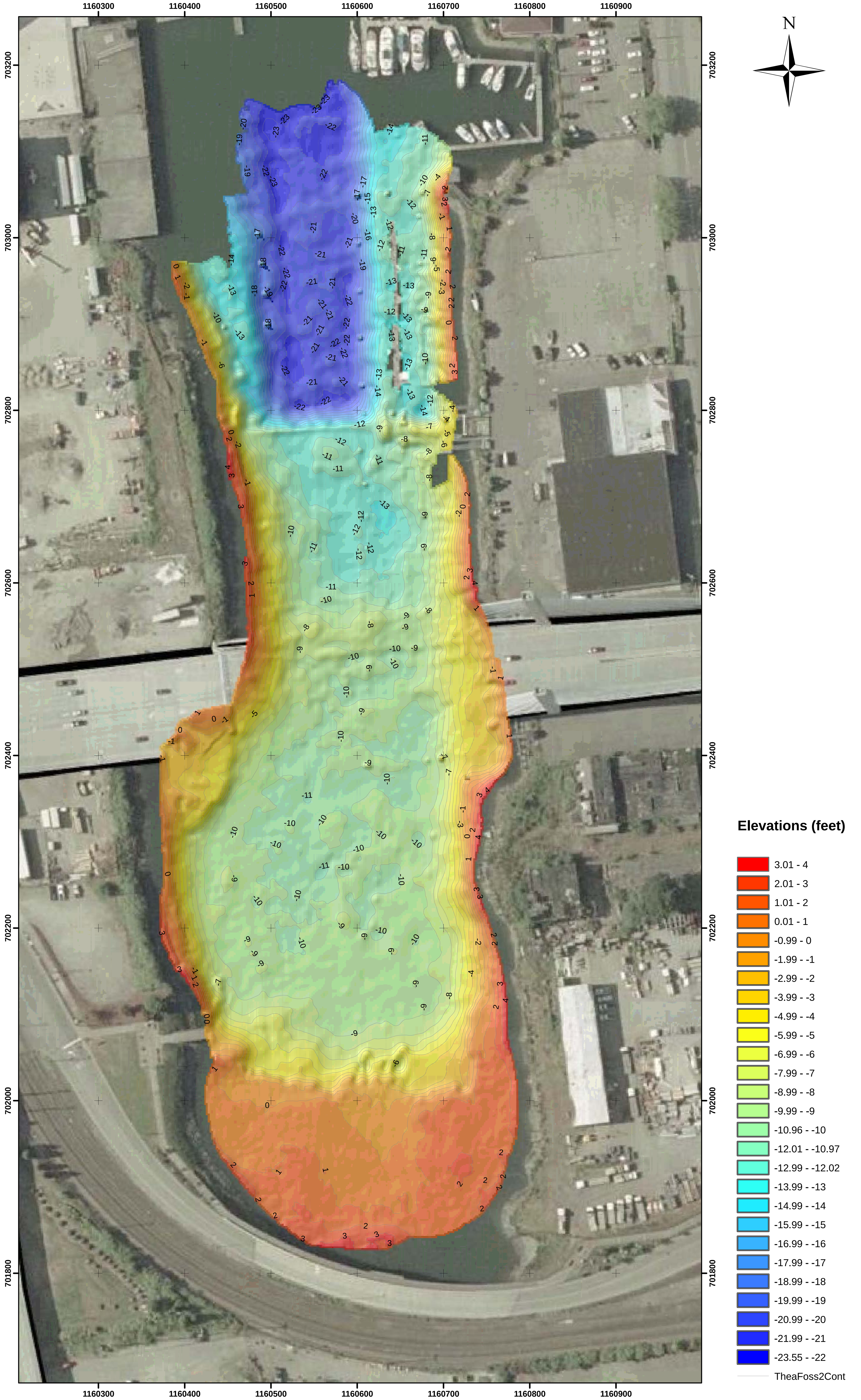
Tetra Tech EC, Inc. conducted a bathymetry survey for Puget Sound Energy and PacifiCorp Environmental Remediation Company on May 10, 2006. The purpose of the survey was to document the changes in elevation (specifically consolidation of the cap) compared to the baseline survey conducted in February 2004 at the completion of the remedy. The primary survey equipment was a multibeam sonar system. This system was used to provide a high-resolution, full bottom coverage bathymetry map. The results from the multibeam bathymetry survey are shown in Figure 3-1. A full bathymetry report is included in Appendix C.

The May 2006 multibeam survey was compared to the baseline single-beam survey conducted in February 2004. Figure 3-1 shows the difference in elevation from the two surveys and identifies three profiles that were analyzed in cross section. Both the plan view and the cross sections show increases and decreases in elevations throughout the waterway.

There was an increase in elevation where capping material was placed by the City in December 2005, after the single-beam survey was conducted at the north end of the project area (Profile 1 in Figure 3-1). There was a decrease in elevation in an area that had capping material placed a short time prior to the single-beam survey in February 2004 (Profile 2). The reduction in elevations in this area is most likely due to consolidation of the deposited sand and gravel capping material and/or the underlying sediment over the last 1.5 years, and is consistent with the consolidation calculations made during design. Profile 3 is in the southern portion of the project area through the scour protection apron. This area was capped with slope armor material (e.g. rock) placed to the design grades. Consolidation calculations during design in this area predicted less than 3 inches of consolidation. This is consistent with the bathymetry results. The minimal differences along the western half of the profile along the slope cap are probably due to the differences in the equipment and procedures between the surveys (refer to Section 4.2 of Appendix C). The increase in elevation just east of center in Profile 3 may be a result of sediment deposits from the outfall at the south end of the waterway.

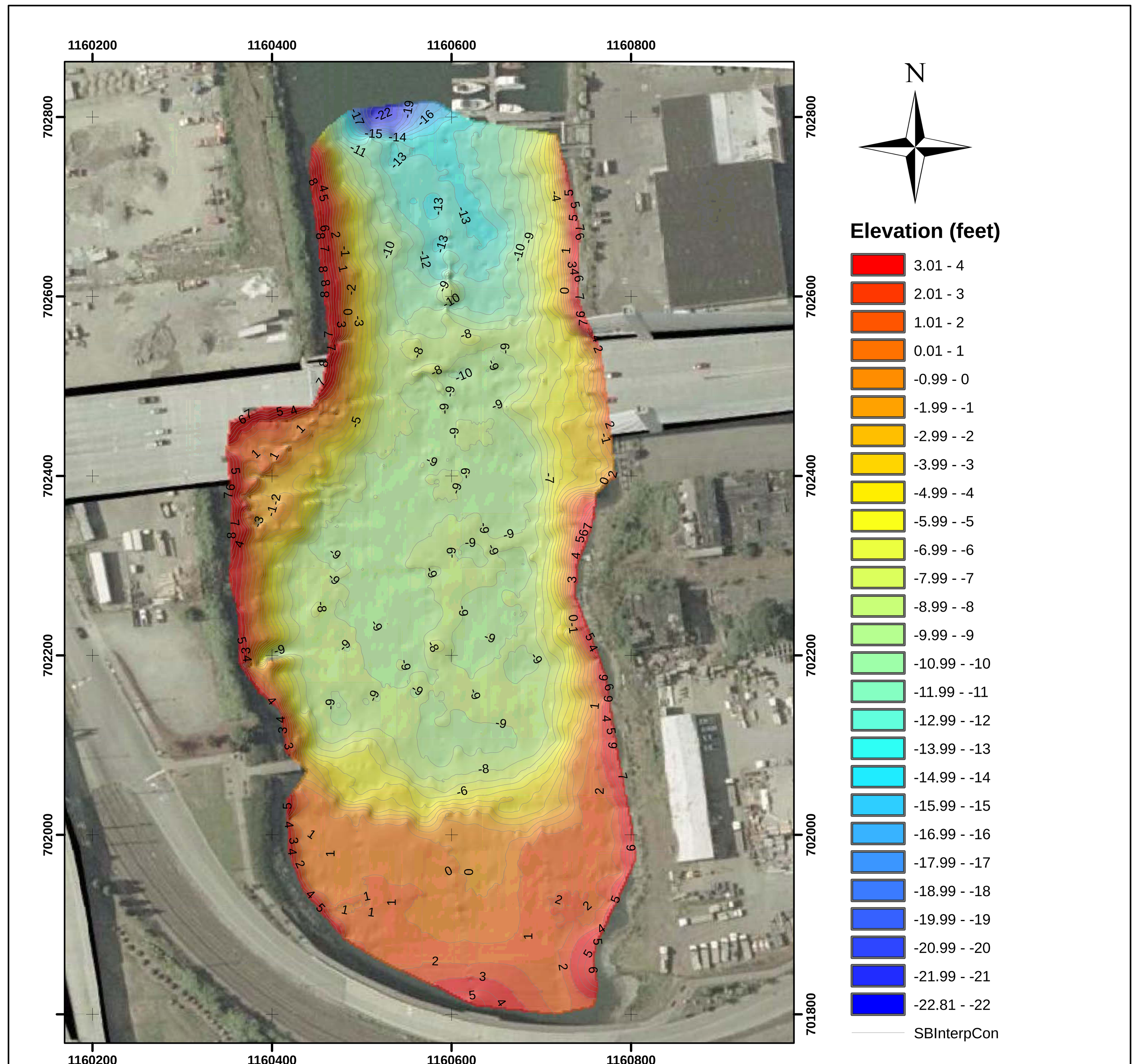
OMMP Year 2 - Thea Foss Bathymetry Survey
Survey Report - Appendix A

PACIFICORP — 10 May 2006 — PUGET SOUND ENERGY

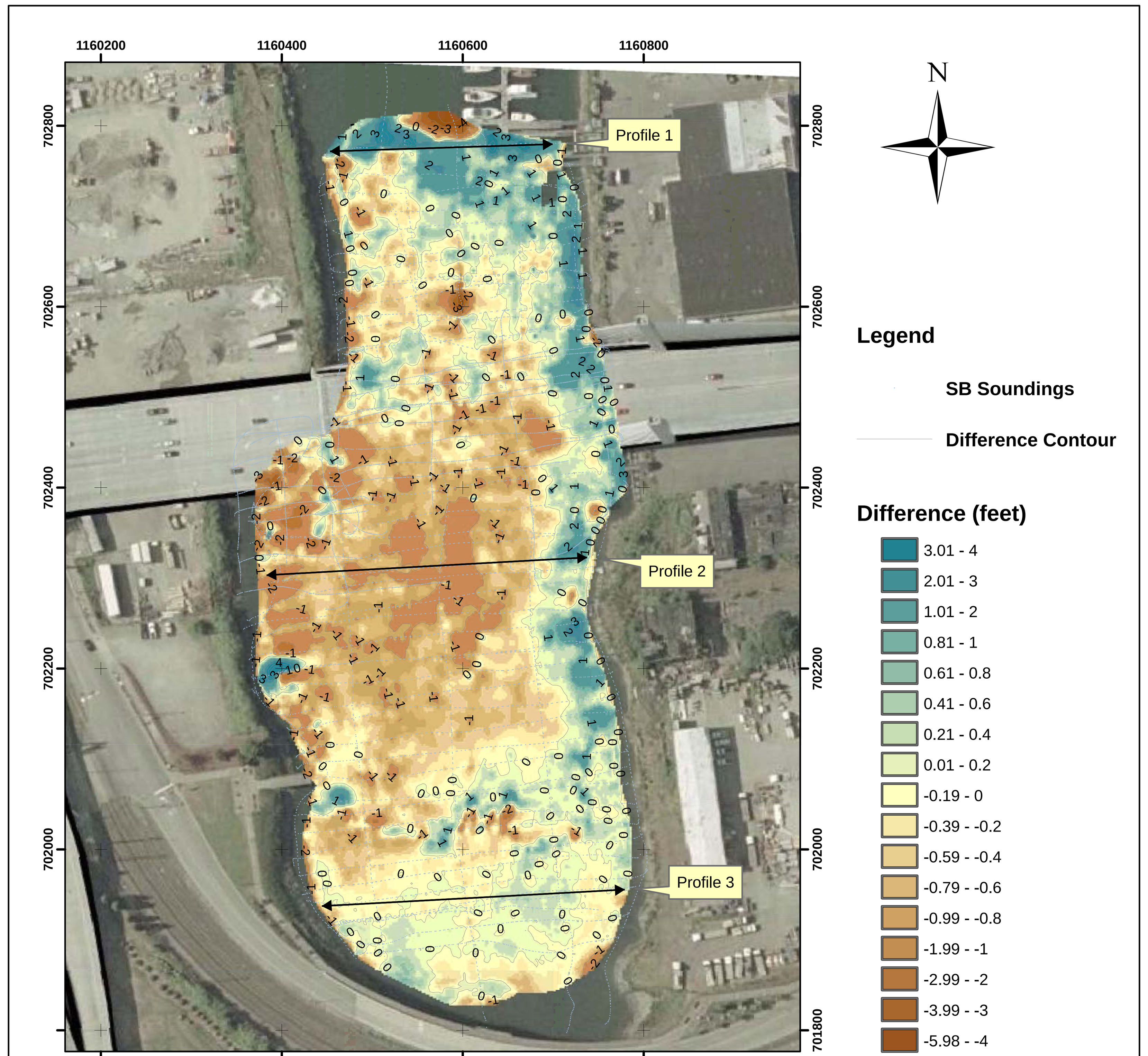


May 2006 Multibeam Bathymetry Survey

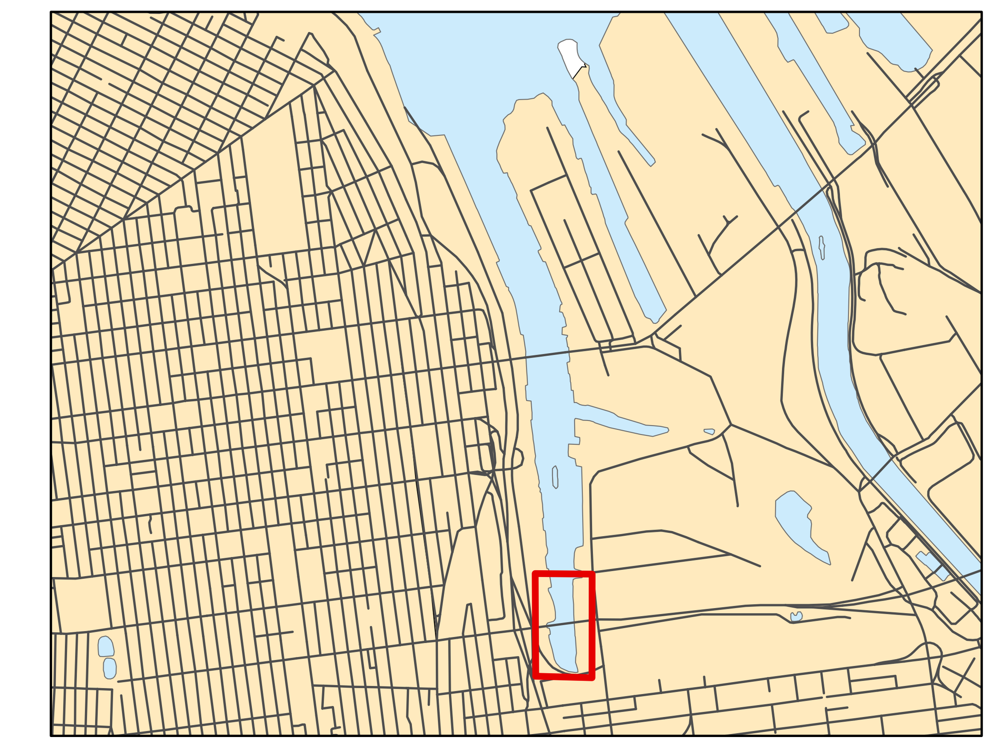
P:\projects_2006\Thea Foss\maps\Thea Foss Ver1.mxd



February 2004 Single Beam Bathymetry Survey

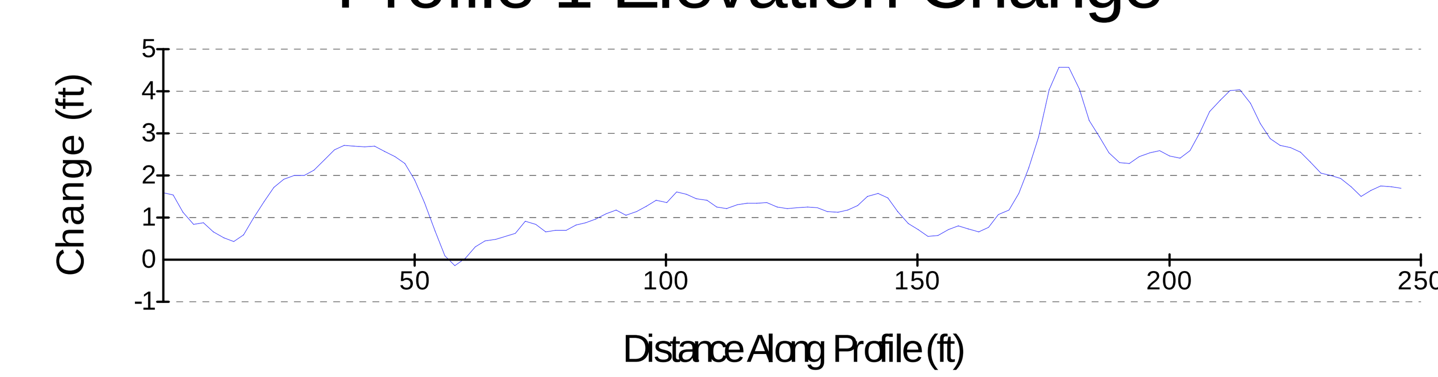


May 2006 Elevation Minus Feb. 2004 Elevation

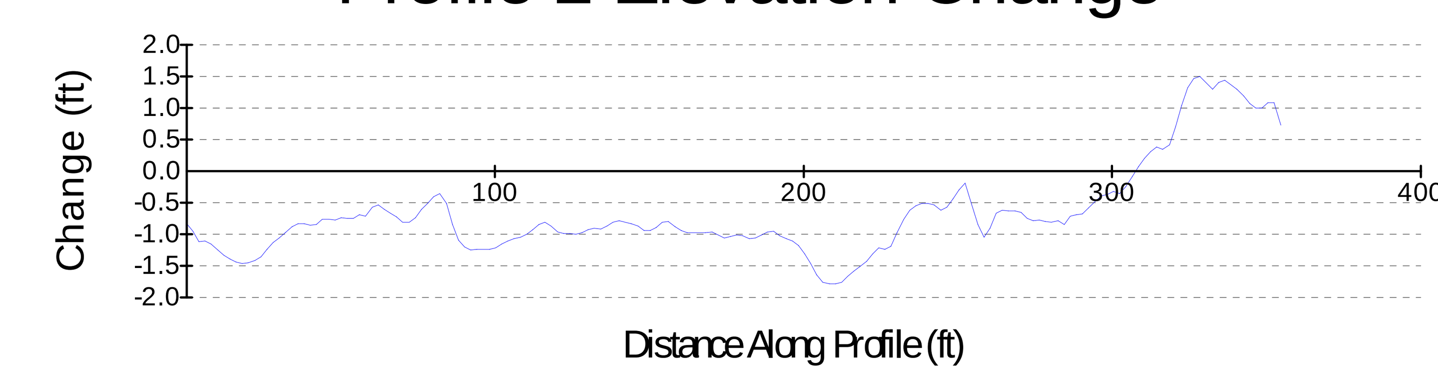


Survey Location - Thea Foss Waterway, Tacoma, WA

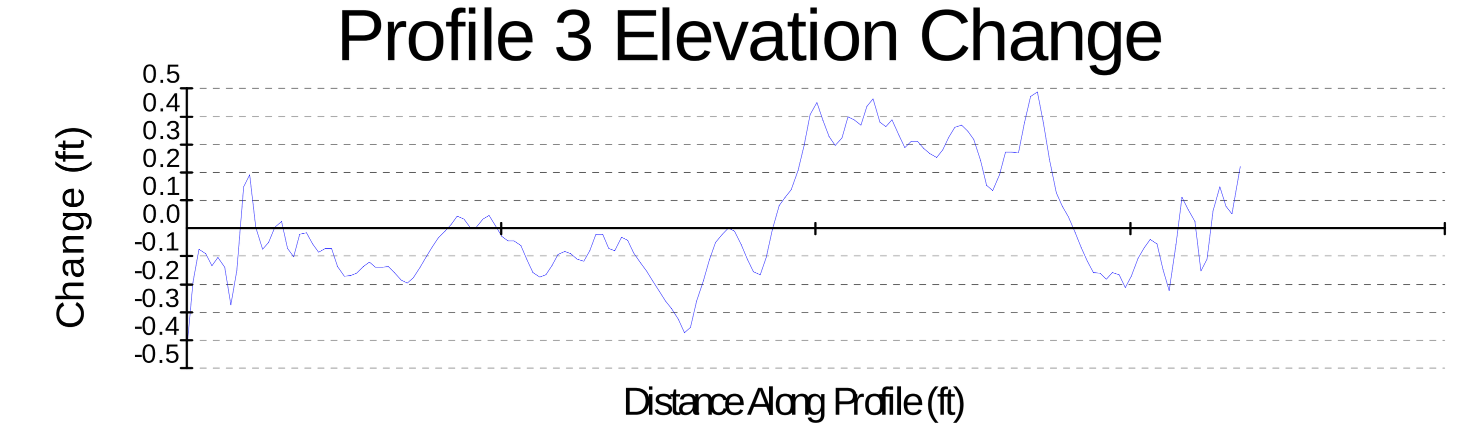
Profile 1 Elevation Change



Profile 2 Elevation Change



Profile 3 Elevation Change



Geodetic Settings		Survey Equipment	
Datum	State Plane NAD-83	Multibeam Sonar	RESON SeaBat 8101
Projection	WA-4602 Washington South	Positioning System	Applanix Wave Master
Horizontal Units	US Survey Feet	Heading Sensor	Applanix WaveMaster
Vertical Units	US Survey Feet	Motion Sensor	Applanix WaveMaster
Vertical Datum	MLLW Epoch 1960-1978 (NGVD29-6.33')	Tide Sensor	Leica 1230 RTK GPS
Horizontal Control	Coast Guard Differential RTCM	Sound Speed Profiler	Seabird SBE-19 CTD
Vertical Control	WA DOT IS27-119	GPS Differential Beacon Receiver	Trimble AG-132

TetraTech EC, Inc.
12100 NE 195th St. Suite 200
Bothell, WA 98011
1 (425) 482 7600

Survey Engineer: Burton Bridge	Signature	Plate: **1**
Drafted by: Burton Bridge	Signature	
Checked by: Robert Feldpausch	Signature	Sheet: **1 of 1**
Approved by: Pamela Sargent	Signature	

4. SEDIMENT SAMPLES

Tetra Tech EC collected surface sediment samples from OMMP locations (RC/WC-01 through RC/WC-12, RC-13, RC-14, WC-13, and WC-14) and four supplemental locations (S-15, S-17, S-19, and S-24). During the Year 1 OMMP sampling, RC-14B was established as a temporary location to investigate the presence of a sheen at the time of sampling, approximately 50 yards south of RC-14. A top-down 0 to 2 cm sediment sample was collected at this location during Year 2 to assess potential elevated concentrations as compared to RC-14. Because RC/WC-01/R-01 was positioned at the edge of the scour protection apron, Year 2 monitoring established a new location, WC-01B/R-01B, 100 feet north of RC/WC-01 at waterway station 77+00 to assess the waterway cap integrity. The core, SPI, and benthic abundance grab sample were collected at WC-01B/R-01B where there was sufficient unconsolidated sediment to penetrate the sediments. The 0 to 10 cm and 0 to 2 cm surface samples for chemical analysis were collected at RC/WC-01 on the scour protection apron in order to compare with Year 0 and Year 1 results. Sample locations are shown in Figure 2-1.

Summary of Year 2 OMMP Samples

Sample	Full SQO Chemical Analytes[1/]	Partial SQO list (PAHs and phthalates)[2/]	Bioassay	Benthic Community (Archived)	SPI
Waterway Cap Compliance (WC; 0-10 cm grab)	14		11		
"Top-Down" (RC; 0 to 2 cm grab)		15			
"Bottom-up" (WC; 0-3 ft cores) [3/]	6				
Slope Cap (SC; composites)	4				
Recolonization Monitoring (WC; R grabs)				4	14
City Cap Area (0 to 10 cm grabs)	4				4

[1] Semivolatile Organic Chemicals; Metals (Mercury, Zinc, Lead); DDT Compounds; PCBs; TOC; Grain Size
[2] PAHs; BEHP
[3] Two to three samples were collected from each of the six cores. The bottom increment was analyzed.

4.1 SAMPLING AND ANALYSIS

In all, 58 samples were obtained, including quality control (QC) and reference samples, and were hand delivered to Analytical Resources Inc. (ARI) for possible analysis. Scott Henderson of Floyd Snider, a representative from the City, was on the boat May 12, 15, and 16, 2006, collecting splits from surface sediment samples. Split samples were collected from all surface and slope compliance samples.

4.1.1 Field Methods

Sampling was conducted from a vessel using a 0.1 m^2 van Veen stainless-steel grab sampler for surface samples (early-warning and waterway cap compliance), a petite ponar stainless-steel sampler for benthic infauna samples, and a vibracorer for core samples, which were deployed from an A-frame. The van Veen, petite ponar, and vibracore samplers retrieved relatively undisturbed sediment samples representative of *in situ* sediment conditions. The vessel was provided and operated by Sound Vessels, Inc.

Surface sediment was collected following Puget Sound Estuary Program (PSEP)/Puget Sound Dredged Disposal Analysis (PSDDA) procedures, including collecting sediment from the center of the sampler, avoiding material that touched the sampler sides, and homogenizing each sample in a stainless-steel bowl using a stainless-steel spoon. Samples at RC/WC-01, SC-01a through SC-04d, RC-13, RC-14, and RC-14B were collected at low tide using stainless-steel bowls and spoons following PSEP procedures. Sampling equipment was provided by Tetra Tech EC and was decontaminated in the field. A separate set of decontaminated sampling equipment (i.e., stainless-steel bowls and spoons) was used at each location. The grab sampler was decontaminated before and after each sample location with Alconox®, site water, and distilled water rinse. Samples and split samples were collected from the homogenized sediment in the stainless-steel bowl.

Sample information was recorded for each sample on log sheets, included as Appendix D. Sample collection data and sediment descriptions are summarized in Appendix E.

Two samples, early-warning samples (0 to 2 cm) and waterway cap compliance samples (0 to 10 cm), were both collected at 12 OMMP locations (RC/WC-01 through RC/WC-12). Early-warning samples (0 to 2 cm) were collected at three additional OMMP locations (RC-13, RC-14, and RC-14B). Waterway cap compliance samples (0 to 10 cm) were collected at two additional OMMP locations (WC-13 and WC-14) and four City Project Area supplemental locations (S-15, S-17, S-19, and S-24) (Figure 2-1).

To minimize the number of field mobilizations required, sufficient material (approximately 5 liters) was collected at waterway cap compliance sample locations WC-01 to WC-09, WC-13, and WC-14 in the event that bioassay testing was required. Based on data collected during the Year 1 OMMP sampling program as well as sampling associated with the 2004 recontamination event, the Utilities felt that it was likely that there would be SQO exceedances in compliance samples located south of the bridge. If the chemical SQOs were exceeded in any compliance sample, bioassay testing was considered to confirm whether the sediment meets or exceeds the biological no adverse effects threshold. Bioassay testing includes two acute effects and one chronic effects biological test.

Four slope compliance composite (0 to 10 cm) samples were collected from 13 discrete locations (SC-01a through SC-04d) (see Figure 2-1) and analyzed for chemicals listed in the sampling and analysis plan (SAP). Slope cap samples were collected by collecting material finer than gravel at three to four discrete locations along the slope cap at low tide with stainless-steel bowls and spoons. The material from the discrete locations was composited into one sample.

Six cores (WC-01B, WC-04, WC-05, WC-06, WC-10, and WC-12) were collected. Two cores collected (WC-05 and WC-12) penetrated 2.5 to 2.8 feet. The remaining cores penetrated a minimum of 3 feet. Each core was visually inspected and divided up into two to three samples for laboratory analysis. Three samples representing 1-ft increments were collected in cores WC-01B and WC-06 (-C1, -C2, and –C3 from top to bottom, respectively). The other four cores yielded two samples: -C1, representing the top foot, and -C3, representing the bottom of the core. Material designated for the middle increment (-C2) was combined with the bottom increment to supply sufficient volume of material for full analysis. The lowest increment (-C3) from each core was analyzed for chemicals listed in the SAP. The remaining samples were archived.

SPI photos were taken at 18 locations (WC02 through WC14, WC-01B, S-15, S-17, S-19, and S-24). The SPI methods and results are summarized in Section 5. The full SPI report with photos is included as Appendix F.

Benthic infauna community samples were collected at four locations (WC-01B/R-01B, RC/WC-04/R-02, RC/WC-08/R-03, and RC/WC-11/R-04). The field sampling methods used to collect the benthic infauna samples were outlined in the EPA-approved OMMP and the PSEP protocols. These samples were archived for potential future analysis.

Two reference samples that contained approximately 40% and 60% fines were collected from Carr Inlet for potential bioassay testing.

Digital pictures were taken during field efforts of sampling and procedures. Pictures and descriptions are included in Appendix D

To verify the performance of field sampling activities, QC samples were collected for laboratory analysis. Field QC sampling, field duplicates, and rinsate blanks were collected to check sampling and analytical accuracy and precision. A total of two field duplicates were collected at location RC/WC-11/R-04 and RC/WC-06: one duplicate for the early-warning samples and one duplicate for the compliance samples. Field duplicates were sampled from the same stainless-steel bowl as the original sample. Three rinsate blanks were collected to represent each sample method (i.e., bowl and spoon, van Veen, and core catcher).

4.1.2 Chemistry Analysis

All chemical analyses were conducted at ARI. Raleigh Farlow at DMD, Inc oversaw and resolved any quality assurance (QA)/QC issues. Analyses included full and partial lists of semivolatile organic compounds, (i.e., partial list included PAHs and BEHP only), metals (lead, zinc, mercury as primary metals, with results also reported for antimony, arsenic, cadmium, copper, mercury, nickel, and silver), PCBs, DDT compounds, total organic carbon, and grain size. Two field duplicates were collected at the required frequency of 1 per 20 samples: one top-down sample (0 to 2 cm RC sample) was collected as a duplicate of RC-06, and one compliance sample (0 to 10 cm WC sample) was collected as a duplicate of WC-11. Insufficient material was available to collect duplicates of core increments.

4.1.3 Data Validation of Chemistry Results

R. Farlow of DMD, Inc. validated chemistry data results from ARI. The validation report is included in Appendix G.1. This analytical/validation team has been responsible for the sediment analyses since implementation of the Utilities' OMMP in April 2004. Consistent analytical protocols and the same instruments were used from April 2004 to the present. For the May 2006 OMMP analyses, DMD completed the equivalent of a QA-1 review.

Sample results reported in Appendix H are determined to be in general compliance with method and quality assurance project plan (QAPP) requirements. Some deviations from specified performance goals are associated with matrix effects from contaminated samples. Sample extracts/digestates were rerun/reanalyzed when QC performance goals were not initially met. Continuing deviations in subsequent analyses were identified and flagged, generally resulting in identifying associated values as estimates with the "J" qualifier code. All reported data for Year 2 OMMP results listed in Appendix H are considered usable for the intended purposes of the project.

4.2 SEDIMENT SAMPLE DESCRIPTIONS

Visual inspection of surface samples indicates that fine-grained material has been deposited on top of the Utilities' cap since completion of remedial construction. Appendix E summarizes the locations and descriptions for each grab and core sample collected.

Representative photos are included in Appendix D.

4.2.1 Compliance Samples

Waterway Cap Compliance Samples (0 to 10 cm)

Fourteen samples consisting of the top 0 to 10 cm were collected at OMMP locations in the waterway cap. These compliance samples generally consisted of olive black silt over either sand or gravel (see Appendix D). The portion of silt versus sand or gravel in the samples varied depending on the thickness of the accumulated fine-grained deposits. A silt layer of light olive color overlying a dark olive, gray to black silt layer was observed at most locations. Benthic fauna and flora (i.e., worms, shell fragments and/or kelp) were observed at all locations.

Descriptions and thickness of fine-grained material were documented on each of the log sheets included in Appendix D. Oily sheens and sheen spots were noted in the top silt layer at two locations RC/WC-04 and RC/WC-14 (Appendix E). The thickness of fine-grained material ranged from 0.5 to 17 cm throughout the waterway cap area (Figure 4-1). The deposition of fine-grained material was greatest in the central areas south of the SR 509 Bridge and north of the scour protection apron with up to 17 cm of deposition. The compliance sample locations within the City recontamination capping area (RC/WC-11 and RC/WC-12) have accumulated 1 cm of fine-grained material on top of the cap material placed in December 2005.

The fines content of the surface compliance samples ranged between 5% and 57% (Appendix H). Based on the stratigraphy of the grab samples, it is evident that the fine-grained material has accumulated on top of the sand cap and is increasing in depth each year. The source of the fine-grained material is from the stormwater outfalls.

City Cap Area Supplemental Samples

Four supplemental samples were collected from the City's cap area during Year 2 OMMP sampling (S-15, S-17, S-19, and S-24). No oily sheens or sheen spots were observed in these 0 to 10 cm samples. The thickness of fine-grained material ranged from 0.5 cm to 2 cm overlying coarse sand cap material. Benthic fauna and flora were not observed at locations S-17, S-19, and S-24. Mussels were observed at S-15.

Slope Cap Samples

A total of four composite slope cap samples were collected. The slope cap areas do not accumulate much silt; therefore, most of the material consisted of coarse gray and brown sand (sand cap material). Several locations had mixed in silt with the sand in the top 2 cm showing a layer of dark olive gray silty sand over the sand and gravel cap material. Both

SC-03 and SC-04 had 2 cm of olive silt deposited on top of the cap material. The percent fines ranged from 1.7% at SC-01 to 21% at SC-03.

4.2.2 Recontamination

Early-Warning Samples (0 to 2 cm)

Early-warning samples were obtained from 15 locations within the Utilities' Work Area. Sampling occurred at OMMP locations RC-1 to RC-14 and from an additional station (RC-14B) on the scour protection apron (Figure 2-1). The samples generally consisted of olive to black silt with percent fines ranging between 7.5% and 57% (Appendices E and H).

Core Samples

Cores were collected at six OMMP locations. Cores consisted of dark olive gray silt overlying coarse sand cap material. The core collected at WC-04 contained 18 cm of silt on top of the sand cap. The bottom increments contained sand cap material with very little fine-grained material; percent fines ranged from 1% at WC-10 to 3.7% at WC-06.

4.3 CHEMICAL QUALITY

The following discussion summarizes the analytical results of sediment samples collected in May 2006 and compares those results to the SQOs. Table 4-1 includes Year 2 sample results that exceed the SQOs as well as the exceedance factor (the ratio of the result to the SQO). Results that were equal to the SQO are considered exceedances. Non-detected results with detection limits at or above the SQO were not were not included in Table 4-1. The samples with detection limits at or above SQOs also contained detected results for other analytes.

Appendix H includes all sediment sample results from all monitoring years with detected results that exceed the SQOs in bold font. Exceedances include concentrations rounded to two significant figures that are equal to the SQO.

4.3.1 Compliance Samples

Compliance samples include the surface (0 to 10 cm) grabs from all WC locations as well as the slope cap composites.

4.3.1.1 Waterway Cap Compliance Samples

All of the waterway cap compliance samples (0 to 10 cm) south of the SR 509 Bridge (11 samples) and the two slope cap composites on the east side of the waterway contained samples with one or more sediment chemistry result exceeding an SQO. SQOs were exceeded in one or more compliance samples south of the bridge for individual PAHs, total HPAH, BEHP, and phenol. BEHP concentrations were higher than the SQO of 1,300 μg/kg in all the compliance samples collected south of the bridge in May 2006.

Most of the maximum exceedance factors were detected in the sample from station WC-02 located in the southeast corner of the Head of the Waterway. This is a depositional area adjacent to the scour protection apron from the Twin 96ers. SQO exceedance factors ranged between 1.0 (benzo(a)pyrene, total HPAH, and phenanthrene) and 5.9 (BEHP).

4.3.1.2 Slope Cap Samples

Slope cap sample results were below SQOs except for SC-03 and SC-04 for BEHP. Of the two slope cap samples that contained SQO exceedances, SC-03 contained the maximum concentration for BEHP with an exceedance factor of 2.6. SC-03 is the slope cap composite on the southeast end of the waterway, adjacent to RC/WC-02.

4.3.2 Recontamination

Recontamination samples include the top-down surface (0 to 2 cm) grabs from all RC locations as well as the bottom-up core samples.

4.3.2.1 Early-Warning Samples

All 15 of the early-warning samples (0 tp 2 cm) contained BEHP above the SQO of 1,300 μg/kg (Table 4-1). The early-warning samples were collected from locations both south and north of the SR 509 Bridge. Samples collected at RC-01, RC-02, RC-04, and RC-13 contained concentrations of individual PAHs and/or total HPAH that exceeded the SQOs.. Consistently, the concentrations of contaminants were higher in the 0 to 2 cm sample than in the 0 to 10 cm sample.

The exceedance factor for each SQO exceedance is included in Table 4-1. The highest exceedance factors were detected in the sample from stations RC-02. SQO exceedance factors ranged between 1.0 (Benzo(a)anthracene) and 6.7 (BEHP).

4.3.2.2 Core Samples

All six of the core samples contained concentrations well below the SQOs. Therefore, the remaining core samples were not analyzed.

4.3.3 Contaminant Distribution and Trends

Since the Utilities' cap was installed, fine-grained sediment has accumulated on the top of cap. Table 4-2 includes the thicknesses of fine-grained material during the baseline OMMP monitoring in April 2004 through Year 2 OMMP monitoring in May 2006. By May 2006, approximately 7 to 19 cm of fine-grained sediment had accumulated within the small boat turning basin south of the bridge as illustrated on Figure 4-1. Thinner layers of fine-grained material (0.5 to 2 cm) were deposited on the scour protection apron and within the area capped by the City in December 2005.

Associated with the thicker layers of fine-grained material are higher concentrations of contaminants. Over time, for any sample type, most concentrations of contaminants have been increasing. The early-warning samples tend to have higher concentrations than the compliance samples. Year 2 samples, both early-warning and compliance, generally had higher concentrations of contaminants compared to early-warning and compliance sample results from previous years. The exception to the trend in increasing concentrations is the City recontamination capping area. The three OMMP locations and four supplemental locations within this area contained lower concentrations of contaminants during Year 2 monitoring than found in previous years due to the recent capping completed in December 2005.

BEHP plumes have grown in magnitude both spatially and in concentration over the last 2 years. Table 4-3 shows BEHP concentrations increasing at each location. Figures 4-2 and 4-3 show the concentration patterns and extent of SQO exceedances for BEHP in the early-warning (0 to 2 cm) and compliance (0 to 10) samples collected in May 2006. The SQO for BEHP was exceeded at all OMMP stations south of the SR 509 Bridge. Elevated concentrations of BEHP above 3,900 µg/kg extend over a larger area in the 0 to 2 cm samples than in the 0 to 10 cm samples. Figure 4-4 shows the BEHP concentrations in the bottom core increment. There are no SQO exceedances in any of the bottom core samples. BEHP was measured at concentrations just above the detection limits at all six locations.

Total HPAH shows a similar pattern to BEHP: the extent of the SQO exceedances has grown in magnitude over the last 2 years. Total HPAH concentrations have been increasing at most stations over the years as summarized in Table 4-4. Although fewer samples contain concentrations of total HPAH above the SQO exceedances as compared to BHEP, the early-warning (0 to 2 cm) and compliance (0 to 10 cm) samples show a similar pattern for total HPAH (See Figures 4-5 and 4-6). The highest concentrations were found at RC/WC-02. SQO exceedances were found at most locations south of the SR 509 Bridge. Figure 4-6 shows concentrations for the bottom core samples. There are no SQO exceedances for total HPAH in the bottom core samples (Figure 4-7). Total HPAHs were measured at concentrations just above the detection limit at four of the six locations.

Table 4-5 summarizes total LPAH concentrations in early-warning and waterway cap compliance samples in the last 2 years of monitoring. Total LPAH concentrations are greater in the Year 2 samples as compared to previous results. Figures 4-8 and 4-9 show patterns of total LPAH concentrations in the early-warning and compliance samples, respectively. There are no SQO exceedances, but sample locations approaching the SQO of 5,200 µg/kg are in the same area as the BEHP and total LPAH SQO exceedances. Consistently, the early-warning samples contain higher concentrations of total LPAH than the compliance samples.

Table 4-6 summarizes total PCB concentrations in early-warning and waterway cap compliance samples. The early-warning samples are consistently higher than the compliance samples. Figures 4-10 and 4-11 show the spatial distribution of Year 2 total PCB concentrations in the early-warning and compliance samples, respectively. There are no total PCB concentrations exceeding the SQO of 300 µg, and the highest concentrations are located at RC/WC-09 for the early-warning sample and WC-14 for the compliance sample. Both locations are under the SR 509 Bridge.

Table 4-7 summarizes lead concentrations from Year 0 to Year 2. The early-warning samples are consistently higher than the compliance samples, with concentrations generally increasing. The area capped by the City in December 2005 contained low concentrations of lead in May 2006 Year 2 monitoring. Figures 4-12 and 4-13 show the spatial distribution of Year 2 lead concentrations in the early-warning and compliance samples, respectively. There are no SQO exceedances and the highest concentrations are located at RC/WC-02.

Table 4-8 summarizes zinc concentrations from Year 0 to Year 2. The early-warning samples are consistently higher than the compliance samples. The area capped by the City in December 2005 contained low concentrations of zinc in May 2006 Year 2 monitoring. Figures 4-14 and 4-15 include concentrations of zinc in the early-warning and compliance samples, respectively. There are no SQO exceedances, and the highest concentrations are located at RC/WC-01 for both the early-warning and compliance samples.

4.4 TOXICITY

This section describes the bioassay sampling and testing that was conducted as part of the Utilities' OMMP activities in response to the detection of BEHP at concentrations greater than the SQO. The Utilities' OMMP (Tetra Tech et al. 2003) states that if chemical SQO exceedances are observed or predicted to occur, a plan will be developed and submitted to the EPA that identifies additional field sampling to be performed to evaluate the nature, extent, and severity of SQO exceedances. A plan for bioassay sampling and testing to be performed by the City and Utilities in response to predicted/observed SQO exceedances in compliance samples was submitted to, and approved by, EPA after receipt of the surface sediment chemistry data.

As discussed above, during the Year 2 monitoring event, samples were collected and analyzed from Waterway Cap Compliance sample locations WC-01 through WC-14 within the Utilities' Work Area. Based on the recent post-construction sampling results, the sampling locations in the northern portion of the Utilities' Work Area, where additional response actions were completed by the City in December 2005 (i.e., WC-10, WC-11, and WC-12), were not anticipated to contain chemical concentrations that exceed the SQOs. The December 2005 sampling confirmed that this portion of the Utilities' Work Area is below the SQOs and therefore, bioassay sampling and testing was not performed in this part of the Utilities' Work Area.

In the southern part of the Utilities' Work Area, BEHP has been detected at concentrations greater than the SQO. The chemical exceedences were detected at sampling locations WC-02, WC-04, and WC-05 in May 2005 and WC-08 and WC-09 in December 2005. Based on these results, SQO exceedences for BEHP were anticipated in this portion of the Utilities' Work Area during the Year 2 monitoring. As a result, sampling at these and other WC locations beneath and south of the SR 509 Bridge included collection of an adequate quantity of material to perform bioassay testing. At Stations WC-01 through WC-09, WC-13, and WC-14 an additional quantity of sample material was collected for bioassay testing.

The material collected for bioassay testing was sent to Northwestern Aquatic Sciences in Newport, Oregon, and stored pending the results of chemical analyses and subsequent selection of locations to be tested for biological toxicity. All samples were collected, processed, and documented in accordance with the Utilities OMMP (Tetra Tech et al. 2003).

During the week of June 5, 2006, the Utilities and the City reviewed the preliminary Year 2 OMMP compliance data to select samples for submission for bioassay testing. The preliminary selection of samples was based on comparison of the compliance data to the criteria outlined in the March 23, 2006 Biological Testing Sampling Plan.

Four samples were selected for bioassay testing based on the following criteria:

- Criteria #1: The sample with the highest detected BEHP concentration greater than the SQO: Sample WC-02 = 7700 μg/kg BEHP

- Criteria #2: The sample with the lowest detected BEHP concentration greater than the SQO: Sample WC-06 = 1600 μg/kg BEHP
- Criteria #3: The sample or samples that best represents the range of BEHP concentrations between the lowest and highest concentrations:
  - Sample WC-04 = 4600 μg/kg BEHP (represents samples that are 3 to 4 times the SQO)
  - Sample WC-05 = 3600 μg/kg BEHP (represents samples that are 2 to 3 times the SQO)
- Samples WC-02 and WC-05 are locations with multiple SQO exceedances

The four locations provide good spatial coverage of the area south of the SR 509 Bridge.

On June 13, 2006, The Utilities, the City, EPA, and the Corps agreed to conduct the biological testing on four locations (WC-02, WC-04, WC-05, and WC-06) within the Head of the Waterway.

Selected samples were subjected to two acute biological effects tests and one chronic biological effects test in accordance with the QAPP (Tetra Tech et al. 2003) provided in the Utilities' OMMP.

4.4.1 Bioassay Testing Methods

Sediment for potential bioassay testing was collected in conjunction with the collection of chemistry compliance samples (0 to 10 cm). Tetra Tech EC collected the test sediment samples on May 12 and 15, 2006, submitted them to NAS Laboratory for potential toxicity testing on May 16, 2006. Tetra Tech EC collected reference sediments from Carr Inlet on May 18, 2006, and submitted them to NAS Laboratory for toxicity testing on May 23, 2006. Sediments were stored in the dark at 4^{o} Centigrade until testing was initiated. Bioassays included the 10-day acute amphipod, acute larval, and 20-day chronic juvenile polychaete tests and were conducted as described in the EPA-approved bioassay testing plan. The Carr Inlet reference sediments were included in the amphipod, larval, and polychaete test series, as were the required controls. Bioassays were conducted in accordance with the protocols outlined in the EPA-approved OMMP and QAPP (Tetra Tech et al. 2003). Testing followed protocols recommended by the PSEP (1995). The holding time for initiating bioassay testing is 56 days from sediment collection; therefore, the decision to initiate tests was made in a timely manner, soon after chemistry results from the laboratory were received. All bioassay tests were initiated within the 56-day holding times. Gary Braun at Tetra Tech, EC coordinated with the bioassay laboratory to initiate bioassay tests.

Sediment toxicity was determined statistically for each location through pairwise comparisons with data from appropriate reference sites. Following transformation and determination of normality and homogeneity of variance for each endpoint, one-tailed homoscedastic or heteroscedastic t-tests were conducted at the appropriate level of significance (i.e., 0.05 or 0.1). Sample means were then compared with interpretive criteria for biological effects to yield toxicity evaluations for each sample.

4.4.2 Quality Assurance/Quality Control of Bioassay Testing

The bioassays were deemed acceptable for use as outlined in the EPA-approved QAPP (Tetra Tech et al. 2003) and the quality assurance memorandum (Appendix G.2) and met applicable performance criteria for all tests.

4.4.3 Results

The comparative grain size data, biological effects data, and the results of comparisons with biological effects interpretive criteria are summarized in Tables 4-9 through 4-13. Reference sites for comparison with test sediments were selected based on the percentage of fine-grained sediments in the samples (Table 4-9). Tables 4-10, 4-11, and 4-12 summarize the results of the toxicity tests using *Rhepoxynius abronius* (Amphipod: sand flea), *Mytilus galloprovincialis* (Larval: mussel), and *Neanthes arenaceodentata* (Juvenile polychaete: worm), respectively. These tables list the locations tested, the corresponding reference site (based on grain size), the test endpoint with standard deviation, results of the one-tailed t-test comparisons with the reference sediment, and whether the results exceed the biological effects interpretive criteria.

Test statistics and comparisons were interpreted according to the biological effects interpretive criteria presented in the EPA-approved QAPP (Tetra Tech et al. 2003). Table 4-13 summarizes the biological effects interpretive criteria. Adverse biological effects are indicated if:

- Two of the biological tests exceed the no adverse effects biological criteria presented in Table 4-13; or
- One of the biological tests exceeds the minor adverse biological criteria presented in Table 4-13.

The mean mortality of the 10-day amphipod test with *R. abronius* ranged from 12 to 42 percent. Station WC-02 exceeded both the no adverse and minor adverse effects criteria.

Stations WC-04, WC-05, and WC-06 were below both the no adverse and minor adverse effects criteria (Table 4-10).

The percent normal survival for the bivalve larval development test with *M. galloprovincialis* (mussel) compared to reference sediments ranged from 48.8 to 95.9 percent. Station WC-02 exceeded both the no adverse and minor adverse effects criteria. Depending on the reference station used, Station WC-04 exceeded the no adverse effects criteria when compared to CI-1 and exceeded both criteria when compared to CI-02. Station WC-05 was below both the no adverse and minor adverse effects criteria and Station WC-06 exceeded the no adverse effects criteria (Table 4-11).

The mean individual growth rates for the 20-day juvenile polychaete test with *N. arenaceodentata* for all four test stations ranged from 0.89 to 0.95 mg/organism/day, and all results were below the no adverse and minor adverse effects criteria (Table 4-12).

4.4.4 Summary of Toxicity Results

Three of the four waterway cap compliance locations tested exhibited some level of biological effect according to criteria presented in Table 4-13. Table 4-14 summarizes the surface sediment SQO exceedances and the comparisons between sediment biological tests and the biological effects interpretive criteria. Final determination of the status of a sediment sample must take into account the results of chemical analyses in addition to the results of the toxicity tests. Of the four locations where toxicity testing was performed, only the sediment sample results from WC-05 were below criteria in all three bioassays, indicating that the chemical concentrations associated with this location do not adversely affect the benthic community. Sediment chemical concentrations for WC-05 exceeded the SQOs for BEHP (EF = 2.8), flouranthene (EF = 1.1), and phenanthrene (EF = 1.0).

The results for the WC-02 sample, located closest to the stormwater outfalls, exceeded both the no adverse and minor adverse effects criteria for both the amphipod and larval acute bioassays. WC-02 had multiple SQO exceedances and had an SQO exceedance ratio for BEHP of 5.9.

The WC-04 sample results exceeded the no adverse effects criteria for the larval bioassay. WC-04 also exceeded the minor adverse effects criterion for the larval test when compared to the reference CI-02. WC-04 exceeded the BEHP SQO by 3.5 times. WC-04 (when compared to CI-02) exceeded both the two-hit rule (multiple no adverse effect exceedances) and the one-hit rule (exceedance of the minor adverse effects criteria in a single test) for determining adverse effects. WC-04 (when compared to CI-01) exceeded the no adverse effects criteria, but did not demonstrate biological effects in multiple tests.

WC-06 sample results exceeded the no adverse effects criteria for the larval bioassay. WC-06 had the lowest sediment BEHP concentration of the stations tested. Station WC-06 exceeded the no adverse effects criteria, but did not demonstrate biological effects in multiple tests.

Table 4-1. SQO Exceedances Year 2 OMMP May 2006

Location	Sample ID	Depth Below Mudline	Phenol (EF)	Phenanthrene (EF)	Fluoranthene (EF)	Pyrene (EF)	Benzo(a) anthracene (EF)	Benzo(b+k) fluoranthenes (EF)	Benzo(a) pyrene (EF)	Benzo (g,h,i) perylene (EF)	Total HPAH (EF)	bis(2-Ethylhexyl) phthalate (EF)
		SQO	**420.0**	**1500**	**2500**	**3300**	**1600**	**3600**	**1600**	**720**	**17000**	**1300**
Early Warning:												
RC/WC-01	Y2-RC01-S	0-2 cm		1600 (1.1)	3900 (1.6)							8300 (6.4)
RC/WC-02	Y2-RC02-S	0-2 cm		1700 (1.1)	5300 (2.1)	3500 (1.1)	1600 (1.0)	5000 (1.4)	2100 (1.3)	790 (1.1)	22000 J (1.3)	8700 (6.7)
RC/WC-03	Y2-RC03-S	0-2 cm										5100 (3.9)
RC/WC-04/R-02	Y2-RC04-S	0-2 cm			2900 (1.2)					910 (1.3)		5900 (4.5)
RC/WC-05	Y2-RC05-S	0-2 cm										5400 (4.2)
RC/WC-06	Y2-RC06-S	0-2 cm										3900 (3.0)
RC/WC-07	Y2-RC07-S	0-2 cm										5400 (4.2)
RC/WC-08/R-03	Y2-RC08-S	0-2 cm										5400 (4.2)
RC/WC-09	Y2-RC09-S	0-2 cm										4700 (3.6)
RC/WC-12	Y2-RC12-S	0-2 cm										1300 (1.0)
RC-13	Y2-RC13-S	0-2 cm			2600 (1.0)							3700 (2.8)
RC-14	Y2-RC14-S	0-2 cm										3600 (2.8)
RC-14B	Y2-RC14B-S	0-2 cm										3800 (2.9)
Waterway Cap:												
RC/WC-01	Y2-WC01-S	0-10 cm	650 (1.5)									4300 (3.3)
RC/WC-02	Y2-WC02-S	0-10 cm			4200 (1.7)			4000 (1.1)	1600 (1.0)		17000 J (1.0)	7700 (5.9)
RC/WC-03	Y2-WC03-S	0-10 cm										2300 (1.8)
RC/WC-04/R-02	Y2-WC04-S	0-10 cm										4600 (3.5)
RC/WC-05	Y2-WC05-S	0-10 cm		1500 (1.0)	2700 (1.1)							3600 (2.8)
RC/WC-06	Y2-WC06-S	0-10 cm										1600 (1.2)
RC/WC-07	Y2-WC07-S	0-10 cm										1800 (1.4)
RC/WC-08/R-03	Y2-WC08-S	0-10 cm										3400 (2.6)
RC/WC-09	Y2-WC09-S	0-10 cm										4700 (3.6)
WC-13	Y2-WC13-S	0-10 cm										2000 (1.5)
WC-14	Y2-WC14-S	0-10 cm										3700 (2.8)
Slope Cap:												
SC-03	Y2-SC03-S	0-10 cm										3400 (2.6)
SC-04	Y2-SC04-S	0-10 cm										1500 (1.2)

Notes:
(EF)- Exceedance Factor Value

Table 4-2. Thickness of Fine-Grained Material (cm)

Early Warning (0 - 2 cm unless otherwise noted)

Date	RC-01	RC-02	RC-03	RC-04	RC-05	RC-06	RC-07	RC-08	RC-09	RC-10	RC-11	RC-12	RC-13	RC-14	RC-14B
Apr-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1 to 3 (City)/ 1 to 3 (UTL)	N/A	N/A	N/A	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3 (City) / 3 (UTL)	N/A	N/A	N/A	N/A
Dec-04	1	8 (0-8 cm)	12 (0-12 cm)	9 (0-9 cm)	11 (0-11 cm)	5 (0-5 cm)	4 (0-4 cm)	5 (0-5 cm)	6 (0-6 cm)	3 (0-3 cm)	N/A	3 (0-3 cm)	1	1	N/A
May-05	1.5	9	10	13	10	4.5	3	4	5.5	5	10.5	5	1	1.5	1.5
May-06	N/A	16	11	9 to 17	12	1 to 10	6	7	7	0.5	1	1	2	2	1

Waterway Cap (0 - 10 cm unless otherwise noted)

Date	WC-01	WC-02	WC-03	WC-04	WC-05	WC-06	WC-07	WC-08	WC-09	WC-10	WC-11	WC-12	WC-13	WC-14
Apr-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5 (City)	5 (City)	N/A	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3 (City)	3	N/A	N/A
Nov-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7 (UTL) / 7 (City)	N/A	N/A	N/A
Dec-04	1	8 (City)	12 (City)	9	11	N/A	4	N/A	6	3	N/A	3 / 3 (City)	N/A	N/A
May-05	N/A	9	N/A	13	10	N/A	2	4	5.5	3 (City)	10.5	5	N/A	N/A
May-06	N/A	16	11	9 to 17	12	1 to 10	6	7	7	0.5	1	1	7	14

Core Samples

Date	Depth Below Mudline	WC-01B	Depth Below Mudline	WC-04	Depth Below Mudline	WC-05	Depth Below Mudline	WC-06	Depth Below Mudline	WC-10	Depth Below Mudline	WC-12
Apr-04	N/A	N/A	0-1 ft	N/A	0-1.3 ft	N/A	0-1 ft	N/A	0-1 ft	N/A	0-1.7 ft	N/A
Apr-04	N/A	N/A	1-2 ft	N/A	N/A	N/A	1-2 ft	N/A	1-2 ft	N/A	N/A	N/A
Apr-04	N/A	N/A	2-3 ft	N/A	N/A	N/A	N/A	N/A	2-3.3 ft	N/A	N/A	N/A
May-06	2-3 ft	19	1.5-3 ft	N/A	1-2.5 ft	N/A	2-3 ft	N/A	1-3 ft	N/A	1-2 ft	N/A

Slope Cap

Date	Depth Below Mudline	SC-01	SC-02	SC-03	SC-04
Apr-04	0-10 cm	N/A	N/A	N/A	N/A
May-06	0-10 cm	N/A	N/A	N/A	N/A

Supplemental Locations

Date	Depth	S-15	S-16	S-17	S-18	S-19	S-20	S-21	S-22	S-23	S-24	S-29	S-30
Aug-04	0-2 cm	1 to 2 (City)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-2 cm	3 to 5 (UTL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	N/A	N/A	N/A	2	N/A	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-3 cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3	2	N/A	N/A
Aug-04	0-10 cm	1 to 2 (UTL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-10 cm	3 to 5 (City)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-10 cm	12 (UTL) / 12 (City)	5	2 (City)	N/A	4	2 (City)	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-7 cm	N/A	N/A	N/A	7	N/A	N/A	7	8 (0-8 cm)	N/A	N/A	N/A	N/A
Dec-04	0-10 cm	N/A	N/A	N/A	7 (City)	N/A	N/A	7	8 (City)	N/A	2 (City)	4 (City)	N/A
May-05	0-10 cm	N/A	5	6	N/A	8	3.5	N/A	N/A	N/A	6	5	3
May-06	0-10 cm	2	N/A	0.5	N/A	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 4-3. Bis(2-Ethylhexyl) phthalate) Concentration in µg/kg

Early Warning (0 - 2 cm unless otherwise noted)

Date	RC-01	RC-02	RC-03	RC-04	RC-05	RC-06	RC-07	RC-08	RC-09	RC-10	RC-11	RC-12	RC-13
Apr-04	**1300**	470	1100	360	110	500	180	110	230	80	280	60	**1400**
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**1600 (City) / 940 (UTL)**	N/A	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**12000 (City) / 6400 (UTL)**	N/A	N/A
Dec-04	**1300 B**	**2700 B (0-8 cm)**	940 B (0-12cm)	**1800 B (0-9 cm)**	940 B (0-11 cm)	**1700 B (0-5 cm)**	**4500 B (0-4 cm)**	**3100 B (0-5 cm)**	**2600 B (0-6 cm)**	**2800 B (0-3 cm)**	N/A	**1800 B (0-3 cm)**	830 B
May-05	**8200**	**7300**	**3200**	**6700**	**5600**	**4400**	**4400**	**3500**	**3500**	**3600**	**3500**	**3800**	**2100**
May-06	**8300**	**8700**	**5100**	**5900**	**5400**	**3900**	**5400**	**5400**	**4700**	420	1100	**1300**	**3700**

Waterway Cap (0 - 10 cm uless otherwise noted)

Date	WC-01	WC-02	WC-03	WC-04	WC-05	WC-06	WC-07	WC-08	WC-09	WC-10	WC-11	WC-12	WC-13
Apr-04	550	330	240	260	76	160	19 U	49	120	63	220	19 U	100
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	447 B (City)	171 B (City)	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**4300 (City)**	N/A	N/A
Nov-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**1500 (UTL)/ 675 (City)**	N/A	N/A
Dec-04	810 B	371 J (City)	275 B (City)	1000 B	**1300 B**	N/A	**3800 B**	N/A	900 B	620 B	N/A	880 B / 309 (City)	N/A
May-05	N/A	**2700**	N/A	**1700**	**2200**	N/A	730	220	289	464 (City)	**3500**	823	N/A
May-06	**4300**	**7700**	**2300**	**4600**	**3600**	**1600**	**1800**	**3400**	**4700**	460	960	590	**2000**

Core Samples

Date	Depth Below Mudline	WC-01B	Depth Below Mudline	WC-04	Depth Below Mudline	WC-05	Depth Below Mudline	WC-06	Depth Below Mudline	WC-10	Depth Below Mudline	WC-12
Apr-04	N/A	N/A	0-1 ft	73	0-1.3 ft	46	0-1 ft	92	0-1 ft	69	0-1.7 ft	49
Apr-04	N/A	N/A	1-2 ft	19 U	N/A	N/A	1-2 ft	63	1-2 ft	20 U	N/A	N/A
Apr-04	N/A	N/A	2-3 ft	19 U	N/A	N/A	N/A	N/A	2-3.3 ft	37	N/A	N/A
May-06	2-3 ft	20	1.5-3 ft	120	1-2.5 ft	63	2-3 ft	29	1-3 ft	38	1-2 ft	20 J

Slope Cap

Date	Depth Below Mudline	SC-01	SC-02	SC-03	SC-04
Apr-04	0-10 cm	26	31	91	94
May-06	0-10 cm	85	1000	**3400**	**1500**

Supplemental Locations

Date	Depth	S-15	S-16	S-17	S-18	S-19	S-20	S-21	S-22	S-23	S-24	S-29	S-30
Aug-04	0-2 cm	**3100 (City)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-2 cm	**5100 (UTL)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-2 cm	N/A	N/A	**2900**	N/A	N/A	**1500**	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-3 cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**1500 B**	**2000 B**	N/A	N/A
Aug-04	0-10 cm	980 (UTL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-10 cm	**4500 (City)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-10 cm	1100 (UTL) / 1250 (City)	**3600**	698 J (City)	N/A	**3200**	674 (City)	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-7 cm	N/A	N/A	N/A	**2000 B**	N/A	N/A	**2000 B**	**2200 B (0-8 cm)**	N/A	N/A	N/A	N/A
Dec-04	0-10 cm	N/A	N/A	N/A	313 B (City)	N/A	N/A	652	**1310 (City)**	N/A	558 (City)	**1940 (City)**	N/A
May-05	0-10 cm	**3000**	629	**2000**	N/A	601	965	N/A	N/A	N/A	**2000**	687	224
May-06	0-10 cm	930	N/A	570	N/A	880	N/A	N/A	N/A	N/A	550	N/A	N/A

Note: Bold = SQO exceendance

Table 4-4. Total HPAH Concentrations (µg/kg)

Early Warning (0 - 2 cm unless otherwise noted)

Date	RC-01	RC-02	RC-03	RC-04	RC-05	RC-06	RC-07	RC-08	RC-09	RC-10	RC-11	RC-12	RC-13	RC-14
Apr-04	2700	1000	2300	870	260	1100	270	210	580	390	880	22	4200	7400
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4000 (City) /1300 (UTL)	N/A	N/A	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**55000 (City)/ 50000 (UTL)**	N/A	N/A	N/A
Dec-04	3200	6600 (0-8 cm)	2500 (0-12 cm)	5900 (0-9 cm)	2600 (0-11 cm)	5400 (0-5 cm)	14000 (0-4 cm)	14000 (0-5 cm)	10000 (0-6 cm)	**23000 (0-3 cm)**	N/A	15000 (0-3 cm)	2000	2500
May-05	**19000**	**17000**	8600	**20000**	**20000**	14000	9800	**17000**	**20000**	**25000**	**25000**	**40000**	5800	8700
May-06	15000	**22000 J**	10000	13000	8400	6800	9400	11000	11000	760	1200	2400 J	10000	7200

Waterway Cap (0 - 10 cm unless otherwise noted)

Date	WC-01	WC-02	WC-03	WC-04	WC-05	WC-06	WC-07	WC-08	WC-09	WC-10	WC-11	WC-12	WC-13	WC-14
Apr-04	1200	720	540	690	220	350	19 U	26	260	190	410	19 U	160	66
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2000 (City)	730 (City)	N/A	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**27000 (City)**	N/A	N/A	N/A
Nov-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8900 (UTL)/ 4000 (City)	N/A	N/A	N/A
Dec-04	2300	2500 (City)	1600 (City)	3800	4800	N/A	2200	N/A	4000	4000	N/A	8100 / 3500(City)	N/A	N/A
May-05	8400	7300	N/A	5300	6900	N/A	2600	2500	3700	2800 (City)	**27000**	8600	N/A	N/A
May-06	N/A	**17000 J**	5200	9800 J	11000	3300	3800	8000	7100	1600	1000 J	980	5500	8000

Core Samples

Date	Depth Below Mudline	WC-01B	Depth Below Mudline	WC-04	Depth Below Mudline	WC-05	Depth Below Mudline	WC-06	Depth Below Mudline	WC-10	Depth Below Mudline	WC-12
Apr-04	N/A	N/A	0-1 ft	190	0-1.3 ft	19 U	0-1 ft	71	0-1 ft	20 U	0-1.7 ft	20 U
Apr-04	N/A	N/A	1-2 ft	19 U	N/A	N/A	1-2 ft	20 U	1-2 ft	20 U	1-2 ft	15 J
Apr-04	N/A	N/A	2-3 ft	19 U	N/A	N/A	N/A	N/A	2-3.3 ft	19 U	N/A	N/A
May-06	2-3 ft	20 U	1.5-3 ft	310 J	1-2.5 ft	130 J	2-3 ft	54 J	1-3 ft	20 U	N/A	15 J

Slope Cap

Date	Depth Below Mudline	SC-01	SC-02	SC-03	SC-04
Apr-04	0-10 cm	19 U	19 U	170	19 U
May-06	0-10 cm	320	2100 J	7300	3600

Supplemental Locations

Date	Depth	S-15	S-16	S-17	S-18	S-19	S-20	S-21	S-22	S-23	S-24	S-29	S-30
Aug-04	0-2 cm	4300 (City)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-2 cm	**95000 (UTL)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-2 cm	N/A	N/A	14000	N/A	N/A	8100	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-3 cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11000	10000	N/A	N/A
Aug-04	0-10 cm	3800 (UTL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-10 cm	**81000 (City)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-10 cm	**19000 (UTL) / 35000 (City)**	9300	3600 (City)	N/A	**26000**	7600 (City)	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-7 cm	N/A	N/A	N/A	7600	N/A	N/A	**26000**	16000 (0-8 cm)	N/A	N/A	N/A	N/A
Dec-04	0-10 cm	N/A	N/A	N/A	2000 (City)	N/A	N/A	**18000 (City)**	7500 (City)	N/A	2600 (City)	8900 (City)	N/A
May-05	0-10 cm	**46000**	4200	10000	N/A	5700	7100	N/A	N/A	N/A	6700	4900	2300
Jan-07	0-10 cm	1200 J	N/A	820 J	N/A	1600	N/A	N/A	N/A	N/A	1100 J	N/A	N/A

Note: Bold = SQO exceedance

Table 4-5. Total LPAH Concentrations (µg/kg)

Early Warning (0 - 2 cm unless otherwise noted)

Date	RC-01	RC-02	RC-03	RC-04	RC-05	RC-06	RC-07	RC-08	RC-09	RC-10	RC-11	RC-12
Apr-04	160	200	590	190	74	160	26	28	130	160	340	20 U
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	920(City) / 240(UTL)	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**31000(City)/ 35000(UTL)**	N/A
Dec-04	550	1000 (0-8 cm)	510 (0-12 cm)	1200 (0-9 cm)	580 (0-11 cm)	1800 (0-5 cm)	4600 (0-4 cm)	**5500 (0-5 cm)**	3300 (0-6 cm)	**11000 (0-3 cm)**	N/A	**7000 (0-3 cm)**
May-05	2300	2800	1700	4700	5100	3100	2400	4600	5000	**9600**	**9900**	**19000**
May-06	1900 J	2600 J	1200	2100 J	910	740	1400 J	2100 J	1900	79 J	110	400 J

Waterway Cap (0 -10 cm unless otherwise noted)

Date	WC-01	WC-02	WC-03	WC-04	WC-05	WC-06	WC-07	WC-08	WC-09	WC-10	WC-11	WC-12
Apr-04	85	70	200	340	64	33	19 U	19 U	57	88	94	19 U
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	800 (City)	280 (City)
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	**13000 (City)**	N/A
Nov-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4300 (UTL) / 1600 (City)	N/A
Dec-04	220	480 (City)	380(City)	730	1200	N/A	590	N/A	1000	1700 / 1500(City)	N/A	4000 / 2200 (City)
May-05	N/A	1200	1700	950	1500	N/A	500	760	1300	N/A	**9200**	4100
May-06	970 J	2300 J	1200	1500	2300	440	560 J	1700 J	1700	970 J	91	120 J

Core Samples

Date	Depth Below Mudline	WC-01B	Depth Below Mudline	WC-04	Depth Below Mudline	WC-05	Depth Below Mudline	WC-06	Depth Below Mudline	WC-10	Depth Below Mudline	WC-12
Apr-04	N/A	N/A	0-1 ft	33	0-1.3 ft	19 U	0-1 ft	30	0-1 ft	20 U	0-1.7 ft	20 U
Apr-04	N/A	N/A	1-2 ft	19 U	N/A	N/A	1-2 ft	20 U	1-2 ft	20 U	N/A	N/A
Apr-04	N/A	N/A	2-3 ft	19 U	N/A	N/A	N/A	N/A	2-3.3 ft	19 U	N/A	N/A
May-06	2-3 ft	20 U	1.5-3 ft	36	1-2.5 ft	11 J	2-3 ft	20 U	1-3 ft	20 U	1-2 ft	20 U

Slope Cap

Date	Depth Below Mudline	SC-01	SC-02	SC-03	SC-04
Apr-04	0-10 cm	19 U	19 U	20 U	19 U
May-06	0-10 cm	30	390 J	850	600 J

Supplemental Locations

Date	Depth	S-15	S-16	S-17	S-18	S-19	S-20	S-21	S-22	S-23	S-24	S-29
Aug-04	0-2 cm	**5400 (City)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-2 cm	**84000 (UTL)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-2 cm	N/A	N/A	5000	N/A	N/A	2800	N/A	N/A	N/A	N/A	N/A
Dec-04	0-3 cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4500	**7400**	N/A
Aug-04	0-10 cm	**5600 (UTL)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-10 cm	**62000 (City)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-10 cm	**13000 (UTL) / 24000 (City)**	**8900**	1300 (City)	N/A	4900	4000 (City)	N/A	N/A	N/A	N/A	N/A
Dec-04	0-7 cm	N/A	N/A	N/A	1900	N/A	N/A	**17000**	**7500 (0-8 cm)**	N/A	N/A	N/A
Dec-04	0-10 cm	N/A	N/A	N/A	640 (City)	2400	N/A	**12000 (City)**	3700 (City)	N/A	1000 (City)	4300 (City)
May-05	0-10 cm	**22000**	1500	2500	N/A	2400	2400	N/A	N/A	N/A	2000	1900
May-06	0-10 cm	120	N/A	71	N/A	N/A	N/A	N/A	N/A	N/A	120 J	N/A

Note: Bold = SQO exceedance

Table 4-6. Total PCB Concentrations (µg/kg)

Early Warning (0 - 2 cm unless otherwise noted)

Date	RC-01	RC-02	RC-03	RC-04	RC-05	RC-06	RC-07	RC-08	RC-09	RC-10	RC-11	RC-12	RC-13	RC-14	RC-14B
Apr-04	5.7	6.3	7.2	5.7	4.3	9.2	7.6 U	7.7 U	6.5	7.8 U	11	7.9 U	7.8 U	7.7 U	N/A
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	62 (City) / 32 U (UTL)	N/A	N/A	N/A	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	300 (City) / 280 (UTL)	N/A	N/A	N/A	N/A
Dec-04	39 U	53 (0-8 cm)	20 U (0-12 cm)	22 (0-9 cm)	20 U (0-11 cm)	58 (0-5 cm)	54 (0-4 cm)	78 (0-5 cm)	94 (0-6 cm)	120 (0-3 cm)	N/A	210 (0-3 cm)	20 U	19 U	N/A
May-05	200 J	**300 J**	180 J	170 J	270 J	190 J	120 J	190 J	220 J	270 J	**380 J**	280 J	80 J	110 J	19 J
May-06	95 J	170	130 J	110	140 J	110 J	97 J	110	230 J	28 J	9.8 U	43 J	98 J	62 J	81 J

Waterway Cap (0 - 10 cm unless otherwise noted)

Date	WC-01	WC-02	WC-03	WC-04	WC-05	WC-06	WC-07	WC-08	WC-09	WC-10	WC-11	WC-12	WC-13	WC-14
Apr-04	7.8 U	7.8 U	5.7	5.4	7.8 U	8 U	7.8 U	7.6 U	7.9 U	7.9 U	7.6 U	7.7 U	7.8 U	7.7 U
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	94 (City)	28 (City)	N/A	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	190 (City)	N/A	N/A	N/A
Nov-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	99 (UTL) / 210 (City)	N/A	N/A	N/A
Dec-04	20 U	66 (City)	56 J (City)	22	24	N/A	21	N/A	64	19	N/A	'92 / 160 (City)	N/A	N/A
May-05	N/A	130 J	N/A	89 J	84 J	N/A	20 U	67 J	110 J	73 (City)	**620**	**310**	N/A	N/A
May-06	72 J	160	110	86	140 J	44	88 J	110	140 J	18 J	9.7 U	12 J	130	190 J

Core Samples

Date	Depth Below Mudline	WC-01B	Depth Below Mudline	WC-04	Depth Below Mudline	WC-05	Depth Below Mudline	WC-06	Depth Below Mudline	WC-10	Depth Below Mudline	WC-12
Apr-04	N/A	N/A	0-1 ft	7.6 U	0-1.3 ft	7.8 U	0-1 ft	8 U	0-1 ft	7.8 U	0-1.7 ft	7.9 U
Apr-04	N/A	N/A	1-2 ft	7.8 U	N/A	N/A	1-2 ft	8 U	1-2 ft	7.9 U	N/A	N/A
Apr-04	N/A	N/A	2-3 ft	7.8 U	N/A	N/A	N/A	N/A	2-3.3 ft	7.7 U	N/A	N/A
May-06	2-3 ft	9.7 U	1.5-3 ft	9.8 U	1-2.5 ft	9.6 U	2-3 ft	9.7 U	1-3 ft	9.8 U	1-2 ft	9.7 U

Slope Cap

Date	Depth Below Mudline	SC-01	SC-02	SC-03	SC-04
Apr-04	0-10 cm	7.7 U	7.9 U	8 U	7.7 U
May-06	0-10 cm	9.7 U	60 J	71 J	75 J

Supplemental Locations

Date	Depth	S-15	S-16	S-17	S-18	S-19	S-20	S-21	S-22	S-23	S-24	S-29	S-30
Aug-04	0-2 cm	94 (City)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-2 cm	**540 (UTL)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-2 cm	88	N/A	N/A	N/A	N/A	18	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-3 cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	96	130	N/A	N/A
Aug-04	0-10 cm	35 (UTL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-10 cm	**530 (City)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-10 cm	280 (UTL)	N/A	88	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-10 cm	**280 (UTL) / 340 (City)**	220	76(City)	N/A	140	120 (City)	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-7 cm	N/A	N/A	N/A	80	N/A	N/A	**370**	74 (0-8 cm)	N/A	N/A	N/A	N/A
Dec-04	0-10 cm	N/A	N/A	N/A	70 (City)	N/A	N/A	290 (City)	110 (City)	N/A	56 (City)	120 (City)	N/A
May-05	0-10 cm	**460 J**	200	59 J	N/A	**400**	180	N/A	N/A	N/A	130 J	270	33 J
May-06	0-10 cm	23	N/A	15 U	N/A	23 J	N/A	N/A	N/A	N/A	9.9 U	N/A	N/A

Note: Bold = SQO exceedance

Table 4-7. Lead Concentrations (mg/kg)

Early Warning (0 - 2 cm unless otherwise noted)

Date	Depth Below Mudline	RC-01	Depth Below Mudline	RC-02	RC-03	RC-04	RC-05	RC-06	RC-07	RC-08	RC-09	RC-10	RC-11	RC-12	RC-13	RC-14
Apr-04	0-2 cm	25	0-2 cm	20	44	19	19	18	6	5	15	11	35	4	42	54
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	45.7 (City) / 30 (UTL)	N/A	N/A	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	160 (City) / 238 (UTL)	N/A	N/A	N/A
Dec-04	0-2 cm	27	0-8 cm	70	34 (0-12 cm)	49 (0-9 cm)	54 (0-11 cm)	83 (0-5 cm)	140 (0-4 cm)	100 (0-5 cm)	64 (0-6 cm)	123 (0-3 cm)	N/A	190 (0-3 cm)	23	52
May-05	0-2 cm	104	0-2 cm	122	55	140	108	114	70	145	144	159	178	186	38	58
May-06	0-2 cm	90	0-2 cm	97	62	44	76	47	70	73	76	15	13	19	73	67

Waterway Cap (0 - 10 cm unless otherwise noted)

Date	WC-01	WC-02	WC-03	WC-04	WC-05	WC-06	WC-07	WC-08	WC-09	WC-10	WC-11	WC-12	WC-13	WC-14
Apr-04	6	15	20	13	10	7	2	4	7	4	14	3	4	4
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	43.7 (City)	14.5 (City)	N/A	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	167 (City)	N/A	N/A	N/A
Nov-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	91 (UTL) / 158 (City)	N/A	N/A	N/A
Dec-04	22	49.4 (City)	42 (City)	35	70	N/A	42	N/A	32	27	N/A	68 / 71.9 (City)	N/A	N/A
May-05	N/A	54	N/A	50	54	N/A	23	N/A	N/A	30.8 (City)	212	N/A	N/A	N/A
May-06	86	92	37	54	29	28	45	64	66	12	11	10	51	70

Core Samples

Date	Depth Below Mudline	WC-01B	Depth Below Mudline	WC-04	Depth Below Mudline	WC-05	Depth Below Mudline	WC-06	Depth Below Mudline	WC-10	Depth Below Mudline	WC-12
Apr-04	N/A	N/A	0-1 ft	3	0-1.3 ft	2 U	0-1 ft	3	0-1 ft	3	0-1.7 ft	2
Apr-04	N/A	N/A	1-2 ft	5 U	N/A	N/A	1-2 ft	3	1-2 ft	2	N/A	N/A
Apr-04	N/A	N/A	2-3 ft	2 U	N/A	N/A	N/A	N/A	2-3.3 ft	2 U	N/A	N/A
May-06	2-3 ft	3	1.5-3 ft	5	1-2.5 ft	3	2-3 ft	3	1-3 ft	2	1-2 ft	3

Slope Cap

Date	Depth Below Mudline	SC-01	SC-02	SC-03	SC-04
Apr-04	0-10 cm	3	2 U	4	4
May-06	0-10 cm	5	36	58	44

Supplemental Locations

Date	Depth	S-15	S-16	S-17	S-18	S-19	S-20	S-21	S-22	S-23	S-24	S-29	S-30
Aug-04	0-2 cm	72.1 (City)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-2 cm	335 (UTL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-2 cm	N/A	N/A	125	N/A	N/A	74	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-3 cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	98	113	N/A	N/A
Aug-04	0-10 cm	80 (UTL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-10 cm	296(City)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-10 cm	140 (UTL) / 240 (City)	220	38.6 (City)	N/A	182	55.7 (City)	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-7 cm	N/A	N/A	N/A	56	N/A	N/A	207	89 (0-8 cm)	N/A	N/A	N/A	N/A
Dec-04	0-10 cm	N/A	N/A	N/A	26.4 (City)	N/A	N/A	147(City)	44.8 (City)	N/A	25.8 (City)	48.6(City)	N/A
May-05	0-10 cm	162	N/A	87	N/A	N/A	N/A	N/A	N/A	N/A	59	N/A	N/A
May-06	0-10 cm	15	N/A	9	N/A	16	N/A	N/A	N/A	N/A	11	N/A	N/A

Note: Bold = SQO exceedance

Table 4-8. Zinc Concentrations (mg/kg)

Early Warning (0 - 2 cm unless otherwise noted)

Date	RC-01	RC-02	RC-03	RC-04	RC-05	RC-06	RC-07	RC-08	RC-09	RC-10	RC-11	RC-12	RC-13	RC-14	RC-14B
Apr-04	74.3	71	115	70	70	56	40.6	33	53.3	43.7	82.8	43.9	99.3	167	N/A
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	99.6 (City) / 86.3 (UTL)	N/A	N/A	N/A	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	205 (City) / 280 (UTL)	N/A	N/A	N/A	N/A
Dec-04	71.9	164 (0-8 cm)	90 (0-12 cm)	128 (0-9 cm)	117 (0-11 cm)	153 (0-5 cm)	238 (0-4 cm)	180 (0-5 cm)	126 (0-6 cm)	182 (0-3 cm)	N/A	241 (0-3 cm)	71.2	135	N/A
May-05	289	261	123	254	187	216	141	215	211	203	231	217	118	203	117
May-06	287	254	166	108	189	121	169	150	158	52	56.9	59.9	208	219	194

Waterway Cap (0 - 10 cm unless otherwise noted)

Date	WC-01	WC-02	WC-03	WC-04	WC-05	WC-06	WC-07	WC-08	WC-09	WC-10	WC-11	WC-12	WC-13	WC-14
Apr-04	41	58	63	52.2	48	38.8	30.7	31.8	37.4	34.5	60.5	35.9	38.5	34.4
Aug-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	90.3 (City)	44.8 (City)	N/A	N/A
Sep-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	239 (City)	N/A	N/A	N/A
Nov-04	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	135 (UTL) / 168 B (City)	89.7 B (City)	N/A	N/A
Dec-04	68.5	107 B (City)	93 B (City)	95	138	N/A	93	N/A	81	66	N/A	111	N/A	N/A
May-05	N/A	127	N/A	113	111	N/A	62.2	N/A	N/A	54.9 B (City)	257	N/A	N/A	N/A
May-06	269	252	99	133	63	80.7	112	134	130	44	44.2	39.4	116	160

Core Samples

Date	Depth Below Mudline	WC-01B	Depth Below Mudline	WC-04	Depth Below Mudline	WC-05	Depth Below Mudline	WC-06	Depth Below Mudline	WC-10	Depth Below Mudline	WC-12
Apr-04	N/A	N/A	0-1 ft	35.3	0-1.3 ft	28.9	0-1 ft	39.4	0-1 ft	33.7	0-1.7 ft	34.3
Apr-04	N/A	N/A	1-2 ft	38	N/A	N/A	1-2 ft	40	1-2 ft	35.6	N/A	N/A
Apr-04	N/A	N/A	2-3 ft	36.9	N/A	N/A	N/A	N/A	2-3.3 ft	19.9	N/A	N/A
May-06	2-3 ft	29.5	1.5-3 ft	40.8	1-2.5 ft	34.7	2-3 ft	31.5	1-3 ft	33.7	1-2 ft	38.1

Slope Cap

Date	Depth Below Mudline	SC-01	SC-02	SC-03	SC-04
Apr-04	0-10 cm	33	31.1	36.3	35.7
May-06	0-10 cm	36.6	87.3	169	119

Supplemental Locations

Date	Depth	S-15	S-16	S-17	S-18	S-19	S-20	S-21	S-22	S-23	S-24	S-29	S-30
Aug-04	0-2 cm	79.6 (City)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-2 cm	363 (UTL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-2 cm	N/A	N/A	173	N/A	N/A	111	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-3 cm	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	145	175	N/A	N/A
Aug-04	0-10 cm	79.6 (UTL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sep-04	0-10 cm	360 (City)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nov-04	0-10 cm	179 (UTL) / 232 B (City)	279	64.3 B (City)	N/A	220	83.9 B (City)	N/A	N/A	N/A	N/A	N/A	N/A
Dec-04	0-7 cm	N/A	N/A	N/A	122	N/A	N/A	257	133 (0-8 cm)	N/A	N/A	N/A	N/A
Dec-04	0-10 cm	N/A	N/A	N/A	54.6 B (City)	N/A	N/A	159 B (City)	71.6 B (City)	N/A	48.6 B (City)	N/A	N/A
May-05	0-10 cm	200	N/A	134	N/A	N/A	N/A	N/A	N/A	N/A	105	71.7 B (City)	N/A
May-06	0-10 cm	58.8	N/A	43.4	N/A	50	N/A	N/A	N/A	N/A	40.3	N/A	N/A

Note: Bold = SQO exceedance

Table 4-9. Bioassay Reference Site Evaluation

Location	Percent Fines	TOC (%)	BEHP Concentration
CI-1	47.8	0.8	
CI-2	27.5	0.69	
WC-02	57.3	6.37	7700
WC-04	36.1	3.2	4600
WC-05	50.8	5.16	3600
WC-06	26.1	5.02	1600

Table 4-10. Interpretation of *Rhepoxynius abronius* (Amphipod) Test Data (Test No. 747-1) by Sediment Management Standards (SMS) Criteria

Sample Description	Percent Mortality	Significantly Higher than Reference Sediment at a = 0.05?	Percent Higher (absolute) than Reference Sediment	Failure of Sediment Quality Standards [1/] (No Adverse)	Failure of CSL or MCL? [2/] (Minor Adverse)
Control (NAS #0532G)	5.0 ± 3.5				
Y2-CI-01 (NAS #0531G)	9.0 ± 8.9				
Y2-CI-02 (NAS #0532G)	6.0 ± 6.5				
Y2-WC02-S (NAS #0520G) [3/]	42.0 ± 18.9	Yes	33.0	Yes	Yes
Y2-WC04-S (NAS #0522G) [3/]	12.0 ± 10.4	No	3.0	No	No
Y2-WC04-S (NAS #0522G) [4/]	12.0 ± 10.4	No	6.0	No	No
Y2-WC05-S (NAS #0523G) [3/]	13.0 ± 5.7	No	4.0	No	No
Y2-WC06_S (NAS #0524G) [3/]	12.0 ± 7.6	No	6.0	No	No

[1] SQS failure if the test sediment mean amphipod mortality (M_R) is significantly higher (I – failed t-test at P≤0.05) than the reference sediment mean amphipod mortality (M_R) and the absolute difference is >25 percent.
[2] CSL, or MCL failure (one test criterion) if the test sediment mean amphipod mortality (M_R) is significantly higher (I – failed t-test at P≤0.05) than the references sediment mean amphipod mortality (M_R) and the absolute difference is >30 percent.
[3] Statistical comparison was made to Y2-CI-01.
[4] Statistical comparison was made to Y2-CI-02.

Table 4-11. Interpretation of *Mytilus galloprovincialis* (larval) Sediment Bioassay Data (Test No. 747-3) by Sediment Management Standards (SMS) Criteria

Sample Description	Number of Normal Larvae	Significantly Less than Reference Sediment at a = 0.10?	Percent of the Reference Sediment Value	Failure of Sediment Quality Standards [1/] (No Adverse)	Failure of CSL or MCL? [2/] (Minor Adverse)
Seawater control	216 ± 14				
Y2-CI-01 (NAS #0531G)	121 ± 16				
Y2-CI-02 (NAS #0532G)	154 ± 10				
Y2-WC02-S (NAS #0520G) [3/]	59 ± 15	Yes	48.8	Yes	Yes
Y2-WC04-S (NAS #0522G) [3/]	86 ±17	Yes	71.1	Yes	No
Y2-WC04-S (NAS #0522G) [4/]	86 ± 17	Yes	55.8	Yes	Yes
Y2-WC05-S (NAS #0523G) [3/]	116 ± 34	No	95.9	No	No
Y2-WC06_S (NAS #0524G) [3/]	128 ± 26	Yes	83.1	Yes	Yes

[1] SQS failure if the mean number of normal survivors in the test sediment (N_T) is significantly less (I-failed t-test at P≤0.10) than the mean number of normal survivors in the reference sediment (N_T) is <85 percent of N_R.
[2] CSL, or MCL failure (one test criterion) if the mean number of normal survivors in the test sediment (N_T) is significantly less (I-failed t-test at P≤0.10) than the mean number of normal survivors in the reference sediment (N_R) and N_T is <70 percent of N_R..
[3] Statistical comparison was made to Y2-CI-01.
[4] Statistical comparison was made to Y2-CI-02.

Table 4-12. Interpretation of *Neanthes* (juvenile polychaete) Juvenile Infaunal Growth Test Data (Test No. 747-2) by Sediment Management Standards (SMS) Criteria

Sample Description	Individual Growth Rate (mg/day)	Significantly Less than Reference Sediment at a = 0.05?	Percent of the Reference Sediment Value	Failure of Sediment Quality Standards [1/] (No Adverse)	Failure of CSL or MCL? [2/] (Minor Adverse)
Control (NAS $0551G)	1.01 ± 0.06				
Y2-CI-01 (NAS #0531G)	0.97 ± 0.19				
Y2-CI-02 (NAS #0532G)	0.90 ± 0.07				
Y2-WC02-S (NAS #0520G) [3/]	0.89 ± 0.22	No	91.8	No	No
Y2-WC04-S (NAS #0522G) [3/]	0.97 ± 0.16	No	100	No	No
Y2-WC04-S (NAS #0522G) [4/]	0.97 ± 0.16	No	108	No	No
Y2-WC05-S (NAS #0523G) [3/]	0.87 ± 0.08	No	89.7	No	No
Y2-WC06_S (NAS #0524G) [3/]	0.95 ± 0.16	No	106	No	No

[1] SQS failure if the test sediment mean polychaete biomass (B_T) is significantly less (I-failed t-test at P≤0.05) than the reference sediment mean polychaete biomass (B_T) and B_T is <70 percent of B_R.
[2] CSL, or MCL failure (one test criterion) if the test sediment mean polychaete biomass (B_T) is significantly less (I-failed t-test at P≤0.05) than the reference sediment mean polychaete biomass (B_R) and B_T is <50 percent of B_R..
[3] Statistical comparison was made to Y2-CI-01.
[4] Statistical comparison was made to Y2-CI-02.

Table 4-13. Biological Criteria to be used for Thea Foss Waterway Remedial Design/Remedial Action

Bioassay	Negative Control Performance Standard	Reference Sediment Performance Standard	Sediment Quality Standards Interpretation Endpoints (Thea Foss RD/RA Performance Criteria (No Adverse)	Minimum Cleanup Level Interpretation Endpoints (Minor Adverse)
Amphipod (M expressed as %)	M_c < 10%	M_R <25%	M_T >25% Absolute and M_T vs M_R SD (p=.05)	M_T – M_R >30% and M_T vs M_R SD (p=.05)
Larval (N expressed as actual counts)	N_C I^3 0.70	N_R N_C^{3} 0.65 (per QA/QC guidance)	N_T/N_C ÷N_R/N_C <0.85 and N_T/N_C vs N_R/N_C SD (p=.05)	N_T/N_C ÷ N_R/N_C <0.70 and N_T/N_C vs N_R/N_C SD (p=.10)
Juvenile polychaete growth (MIG in mg/ind/d dry)	M_C < 10% and MIG 3 0.72 mg/ind/d (dry) (or case by case)	MIG_R MIG_C 3 0.80	MIG_T/MIG_R < 0.70 and MIG_T vs MIG_R SD (p=.08)	MIG_T/MIG_R < 0.50 and MIG_T vs MIG_R SD (p=.05)
Microtox	Case by Case	Case by Case (PSDDA, BLDR £ 20%)	ML_T ÷ ML_R < 0.85 and ML_T vs ML_R SD (p=.05)	No Microtox MCUL criteria are established. SQS level hit is valid for 2 hit rule

M = mortality; N = normals; I = initial count; MIG = mean individual growth rate; BLD = blank-corrected light decrease; SD = statistically different, NOCN = no other conditions necessary
Subscripts: R = reference sediment; C = negative control; T = test sediment

Table 4-14. Chemical and Biological Summary Results

SQO Exceedance Summary

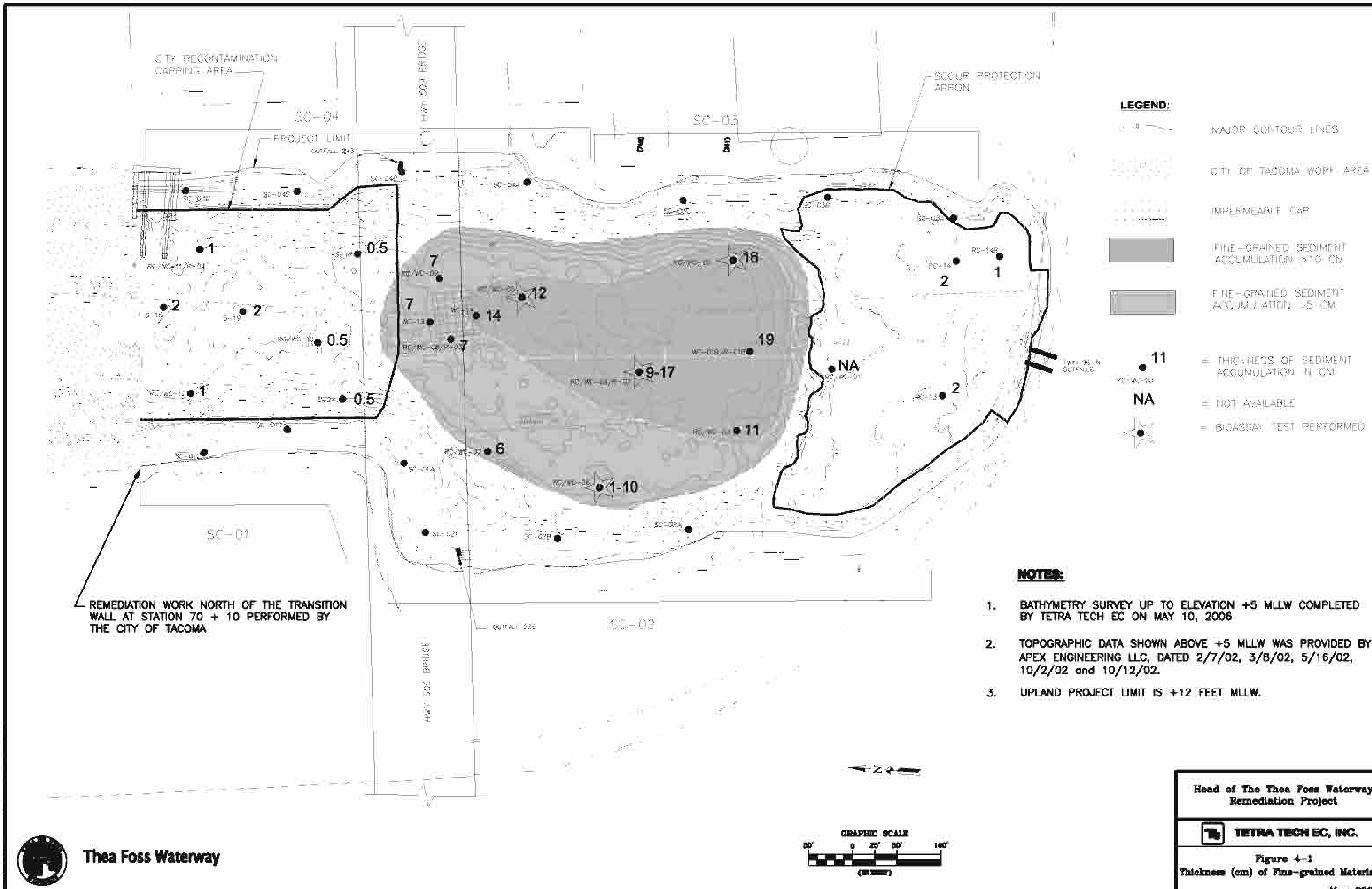
WC (0-10 cm) samples exceeding SQO's

Contaminant	SQO	Units	WC-01	WC-02	WC-03	WC-04	WC-04	WC-05	WC-06	WC-07	WC-08	WC-09	WC-13	WC-14
benzo (a) pyrene	1600	ug/Kg		1600										
EF				1.0										
Benzofluoranthenes	3600	ug/Kg		4000										
EF				1.1										
bis (2-ethylhexyl) phthalate	1300	ug/Kg	4300	7700	2300	4600	4600	3600	1600	1800	3400	4700	2000	3700
EF			3.3	5.9	1.8	3.5	3.5	2.8	1.2	1.4	2.6	3.6	1.5	2.8
Fluoranthene	2500	ug/Kg		4200				2700						
EF				1.7				1.1						
Phenanthrene	1500	ug/Kg						1500						
EF								1.0						
Phenol	420	ug/Kg	650											
EF			1.5											
HPAH	17000	ug/Kg		17000										
EF				1.0										

Bioassay Results Summary

	WC-02	WC-04	WC-04	WC-05	WC-06
Reference Station	CI-01	CI-01	CI-02	CI-01	CI-02
Amphipod	>CSL	<SQS	<SQS	<SQS	<SQS
Larval	>CSL	>SQS	>CSL	<SQS	>SQS
Juvenile Polychaete	<SQS	<SQS	<SQS	<SQS	<SQS
Station Designation	Adverse	Minor Adverse	Adverse	No Adverse Effect	Minor Adverse

Note:
EF = Exceedance Factor
(cyan) = Bioassays conducted
(green) = No Adverse Effect (<SQS)
(yellow) = Minor Adverse (>SQS and <CSL)
(orange) = Adverse (>CSL)

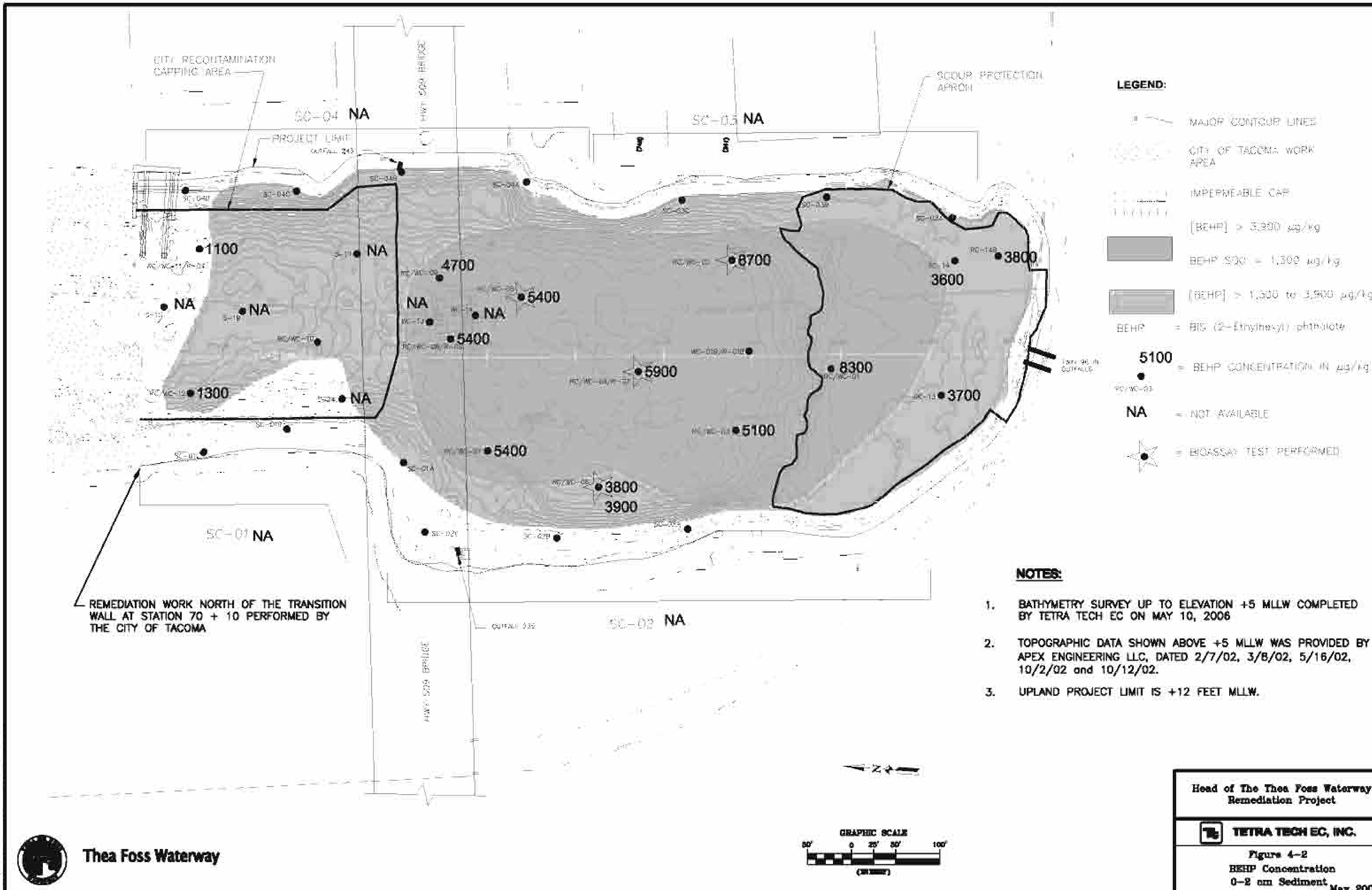


Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-1
Thickness (cm) of Fine-grained Material
May 2006

P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-1 (REV).DWG
PLOT/UPDATE: NOV 1 2006 15:03:10



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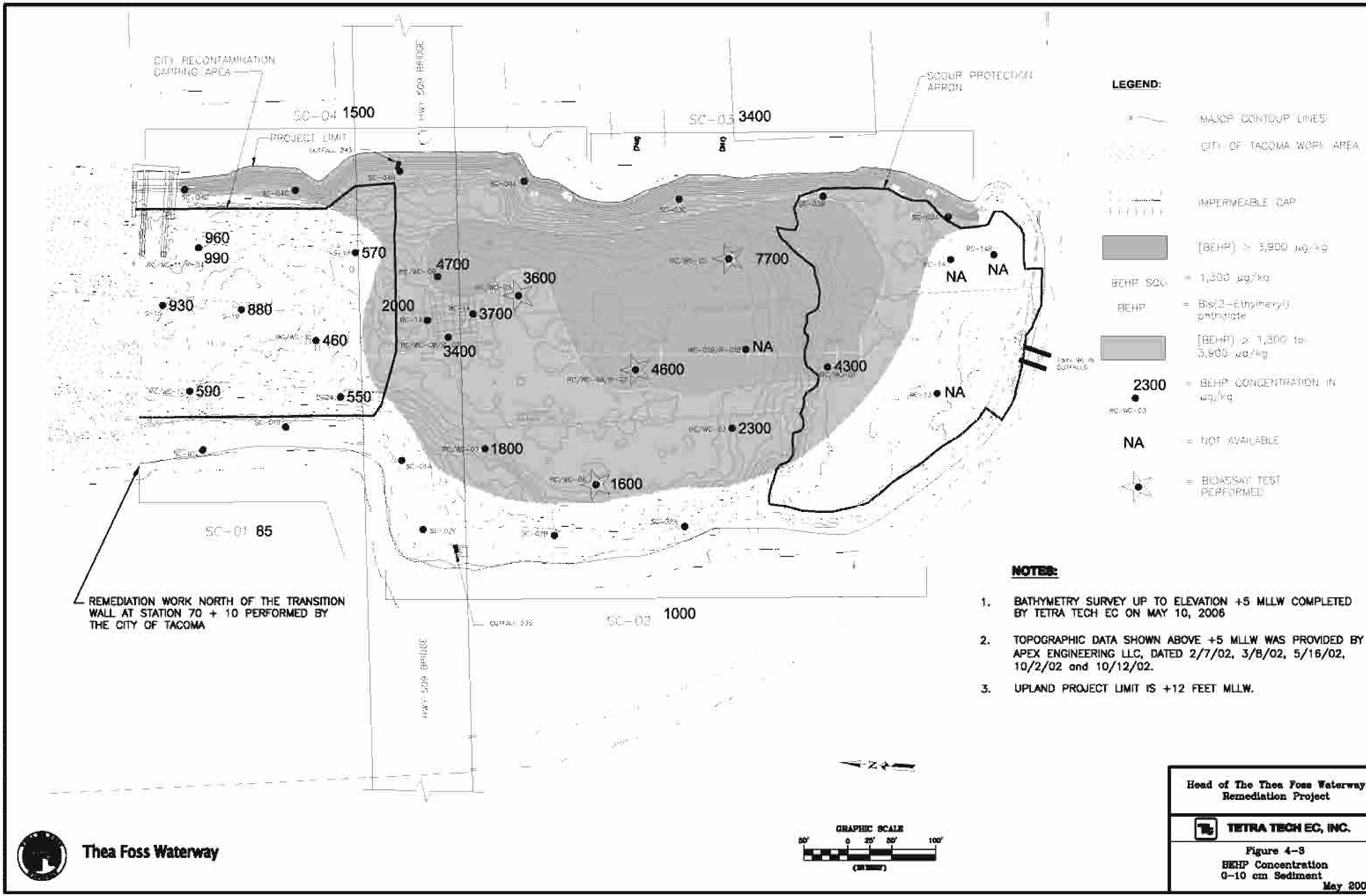
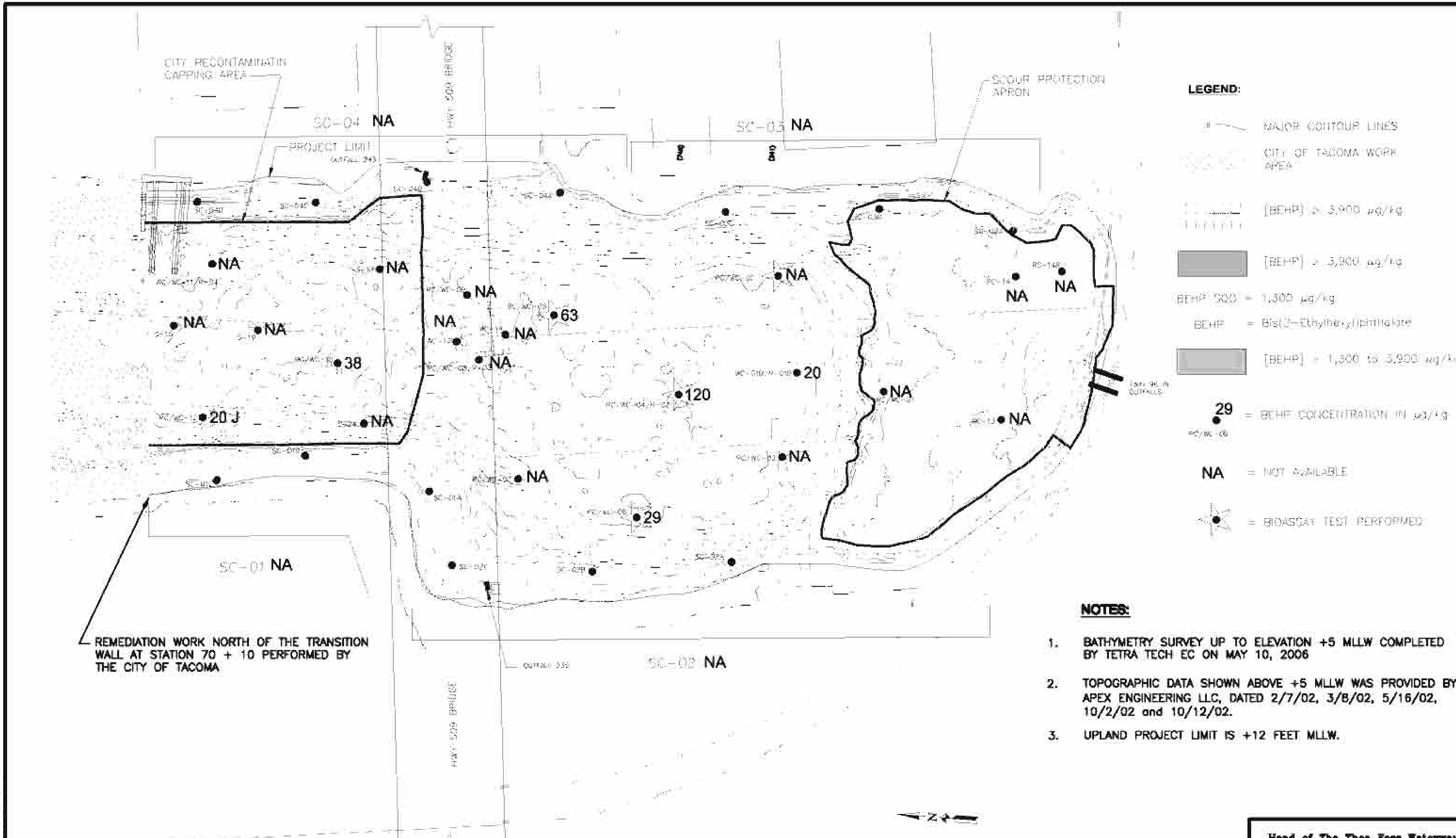


P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-3(REV).DWG
PLOT/UPDATE: NOV 1 2006 15:13:37



NOTES:

1. BATHYMETRY SURVEY UP TO ELEVATION +5 MLLW COMPLETED BY TETRA TECH EC ON MAY 10, 2006
2. TOPOGRAPHIC DATA SHOWN ABOVE +5 MLLW WAS PROVIDED BY APEX ENGINEERING LLC, DATED 2/7/02, 3/8/02, 5/16/02, 10/2/02 and 10/12/02.
3. UPLAND PROJECT LIMIT IS +12 FEET MLLW.

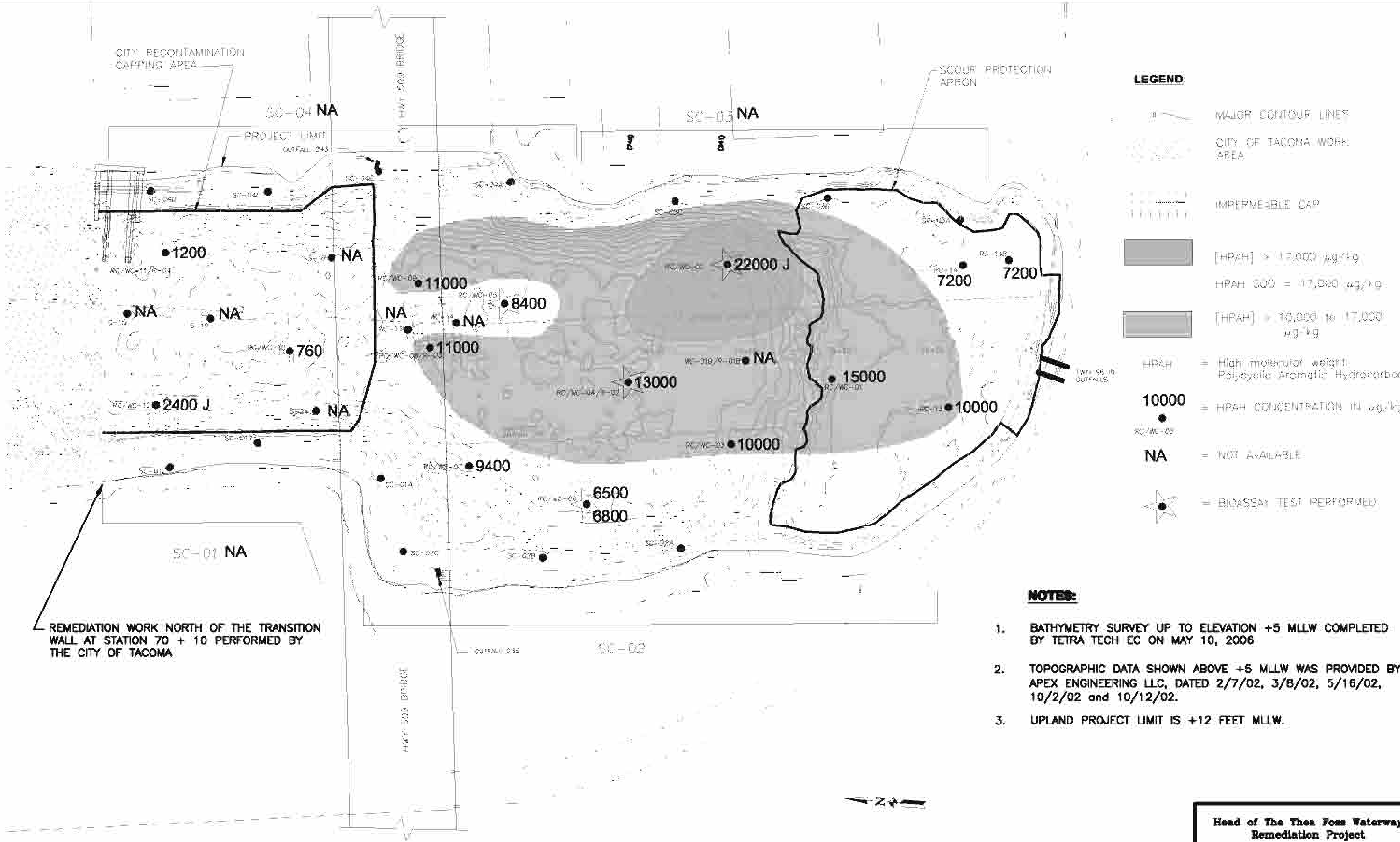
Thea Foss Waterway

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-4
BEHP Concentration
Bottom of Core
May 2006

P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-4(REV).DWG
PLOT/UPDATE: NOV 1 2006 15:17:16



NOTES:

1. BATHYMETRY SURVEY UP TO ELEVATION +5 MLLW COMPLETED BY TETRA TECH EC ON MAY 10, 2006
2. TOPOGRAPHIC DATA SHOWN ABOVE +5 MLLW WAS PROVIDED BY APEX ENGINEERING LLC, DATED 2/7/02, 3/8/02, 5/16/02, 10/2/02 and 10/12/02.
3. UPLAND PROJECT LIMIT IS +12 FEET MLLW.

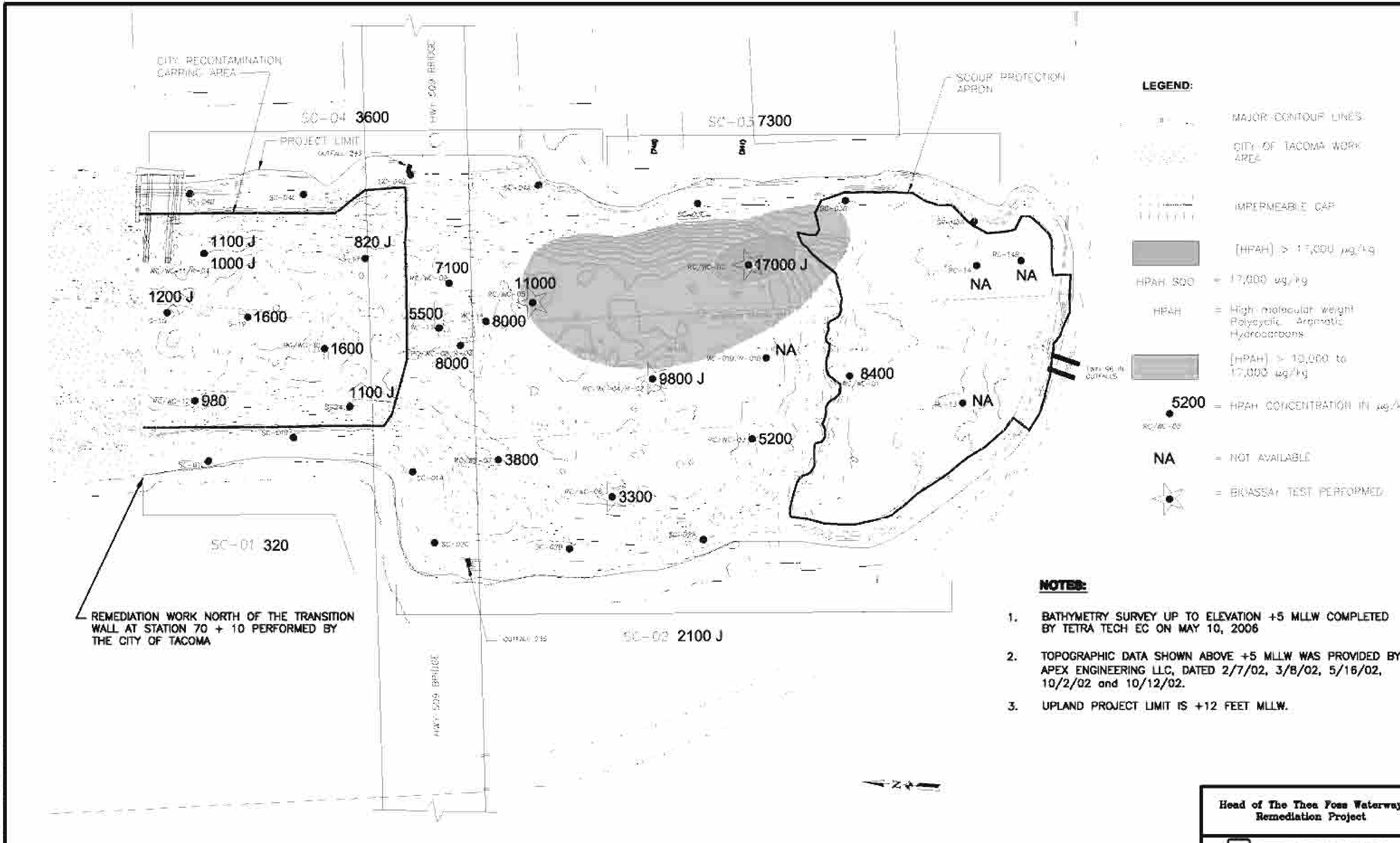
Thea Foss Waterway

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-5
HPAH Concentration
0-2 cm Sediment
May 2006

P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-5(REV).DWG
PLOT/UPDATE: NOV 1 2006 08:52:38



NOTES:

1. BATHYMETRY SURVEY UP TO ELEVATION +5 MLLW COMPLETED BY TETRA TECH EC ON MAY 10, 2006
2. TOPOGRAPHIC DATA SHOWN ABOVE +5 MLLW WAS PROVIDED BY APEX ENGINEERING LLC, DATED 2/7/02, 3/8/02, 5/16/02, 10/2/02 and 10/12/02.
3. UPLAND PROJECT LIMIT IS +12 FEET MLLW.

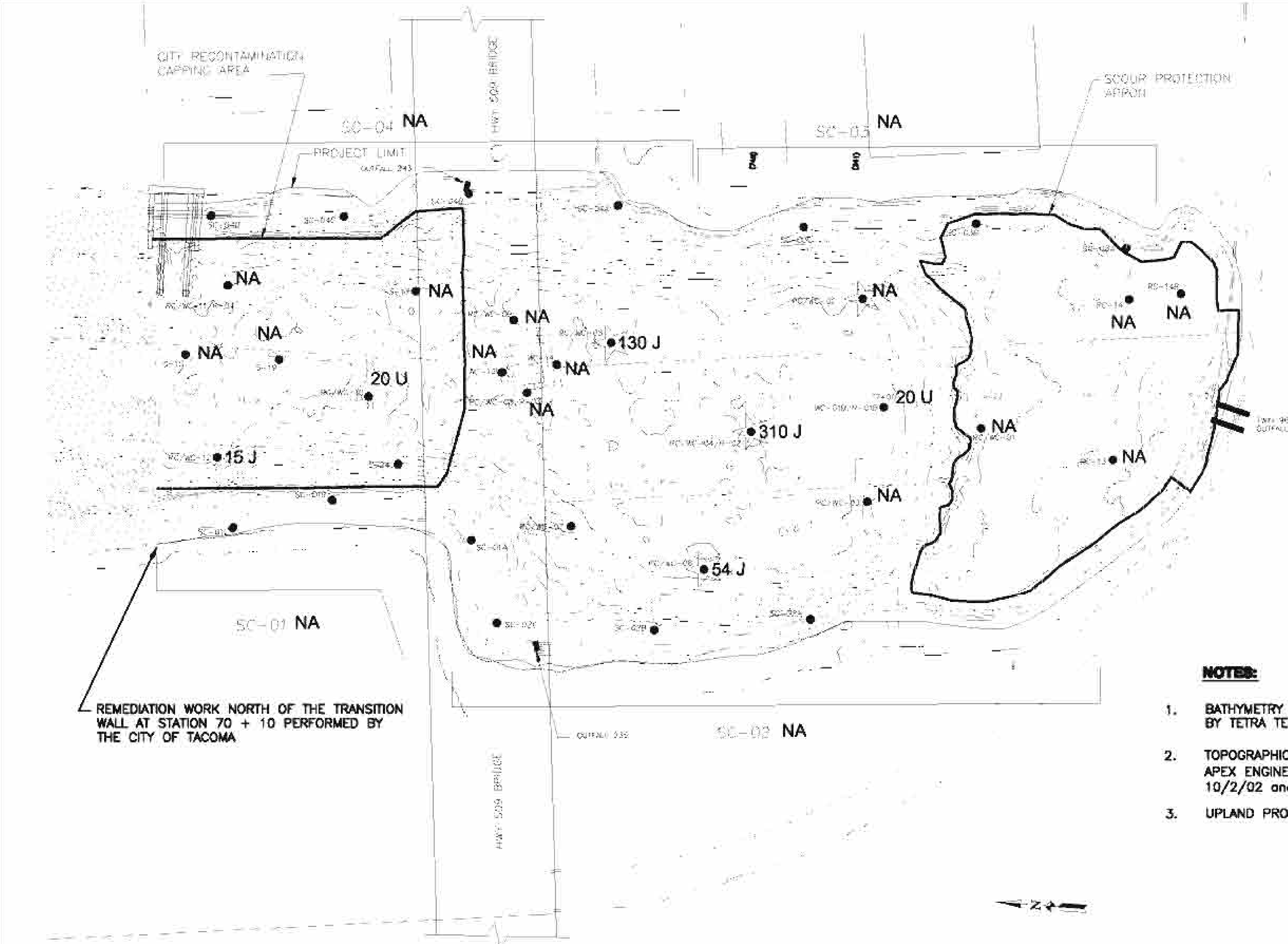
Thea Foss Waterway

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-6
HPAH Concentration
0-10 cm Sediment
May 2006

P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-6(REV).DWG
PLOT/UPDATE: NOV 1 2006 15:22:16



LEGEND:

- MAJOR CONTOUR LINES
- CITY OF TACOMA WORK AREA
- IMPERMEABLE CAP
- [HPAH] > 17,000 µg/kg
- HPAH SQO = 17,000 µg/kg
- [HPAH] > 10,000 to 17,000 µg/kg
- HPAH = High molecular weight Polycyclic Aromatic Hydrocarbons
- 54 J = HPAH CONCENTRATION IN µg/kg
- NA = NOT AVAILABLE
- = BIOASSAY TEST PERFORMED

NOTES:

1. BATHYMETRY SURVEY UP TO ELEVATION +5 MLLW COMPLETED BY TETRA TECH EC ON MAY 10, 2006
2. TOPOGRAPHIC DATA SHOWN ABOVE +5 MLLW WAS PROVIDED BY APEX ENGINEERING LLC, DATED 2/7/02, 3/8/02, 5/16/02, 10/2/02 and 10/12/02.
3. UPLAND PROJECT LIMIT IS +12 FEET MLLW.

GRAPHIC SCALE

Thea Foss Waterway

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-7
HPAH Concentration
Bottom of Core
May 2006

P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-7(REV).DWG
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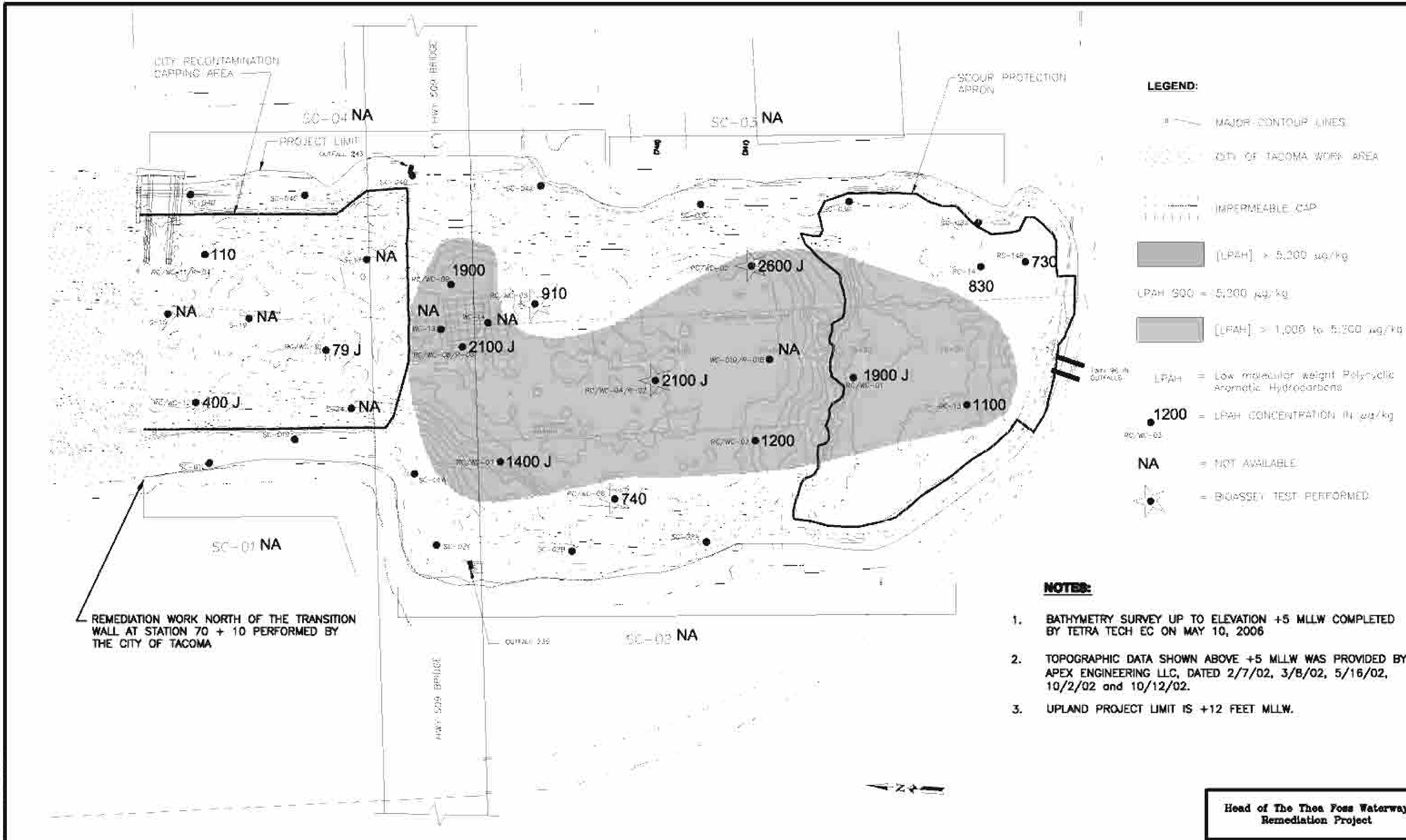


NOTES:

1. BATHYMETRY SURVEY UP TO ELEVATION +5 MLLW COMPLETED BY TETRA TECH EC ON MAY 10, 2006
2. TOPOGRAPHIC DATA SHOWN ABOVE +5 MLLW WAS PROVIDED BY APEX ENGINEERING LLC, DATED 2/7/02, 3/8/02, 5/16/02, 10/2/02 and 10/12/02.
3. UPLAND PROJECT LIMIT IS +12 FEET MLLW.

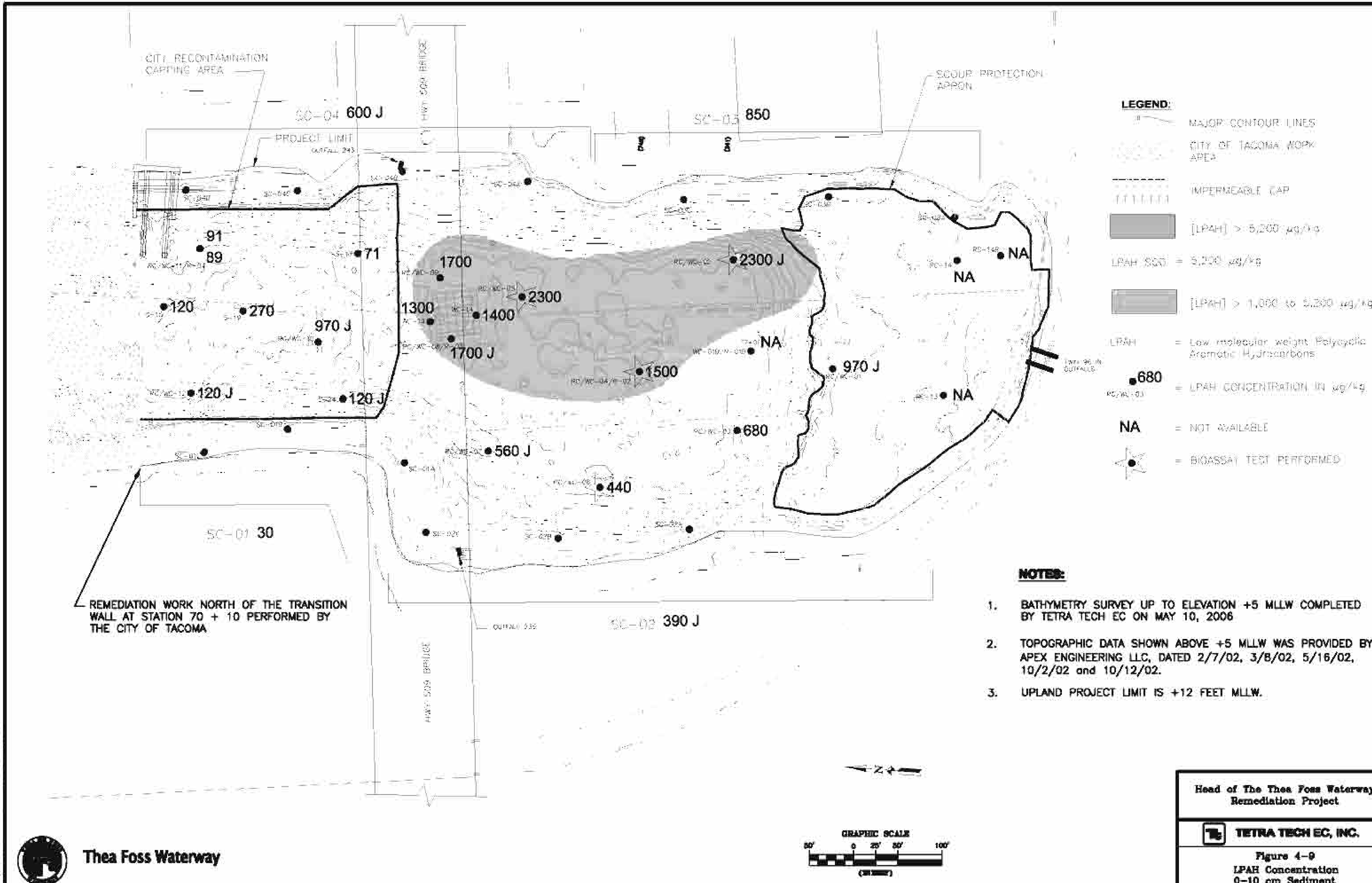
Thea Foss Waterway

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-8
LPAH Concentration
0-2 cm Sediment
May 2006

P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-8(REV).DWG
PLOT/UPDATE: NOV 1 2006 15:28:51



Thea Foss Waterway

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-9
LPAH Concentration
0-10 cm Sediment
May 2006

P:\2567_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSS FIGURE 4-9(REV).DWG
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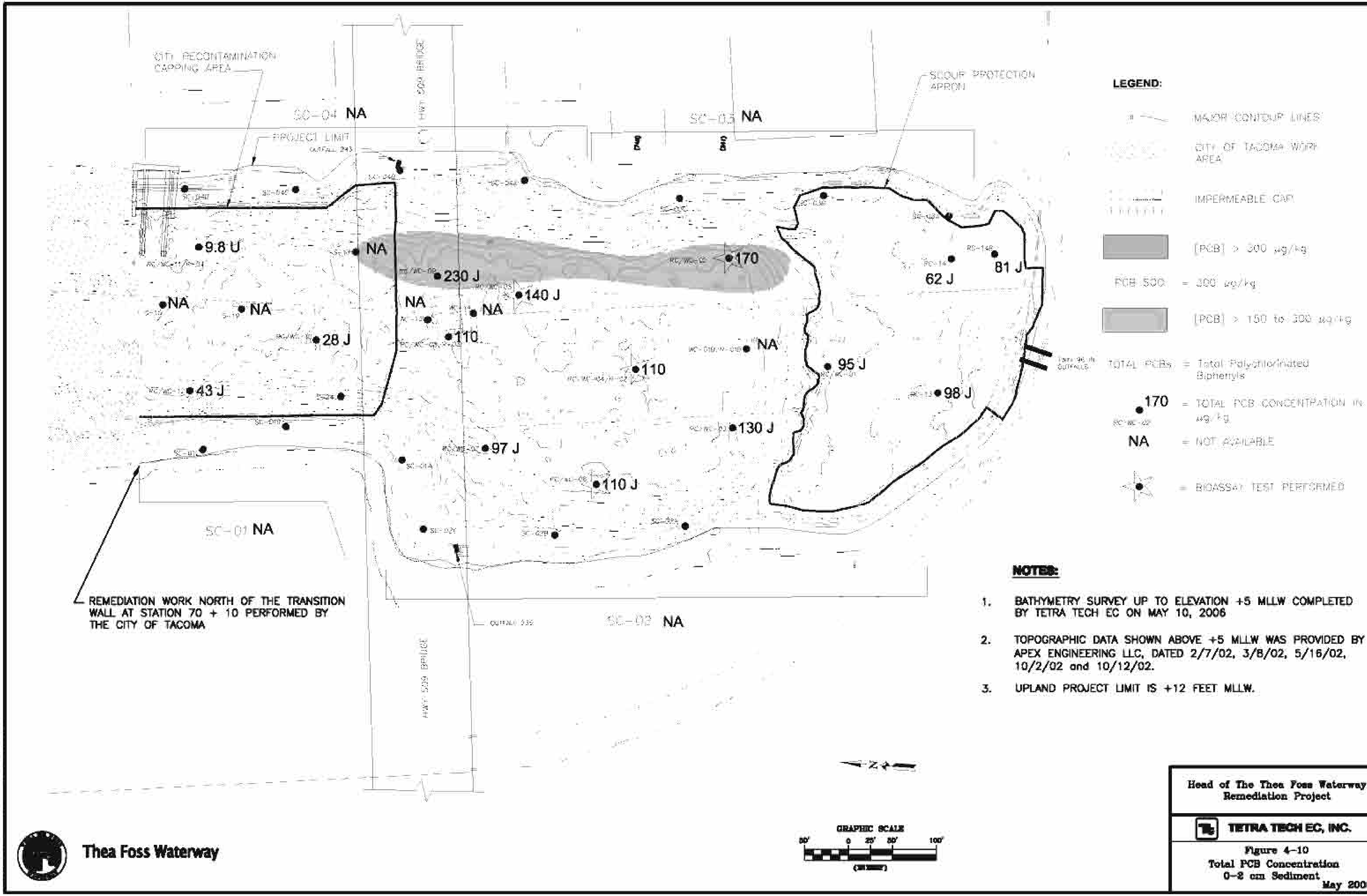


NOTES:

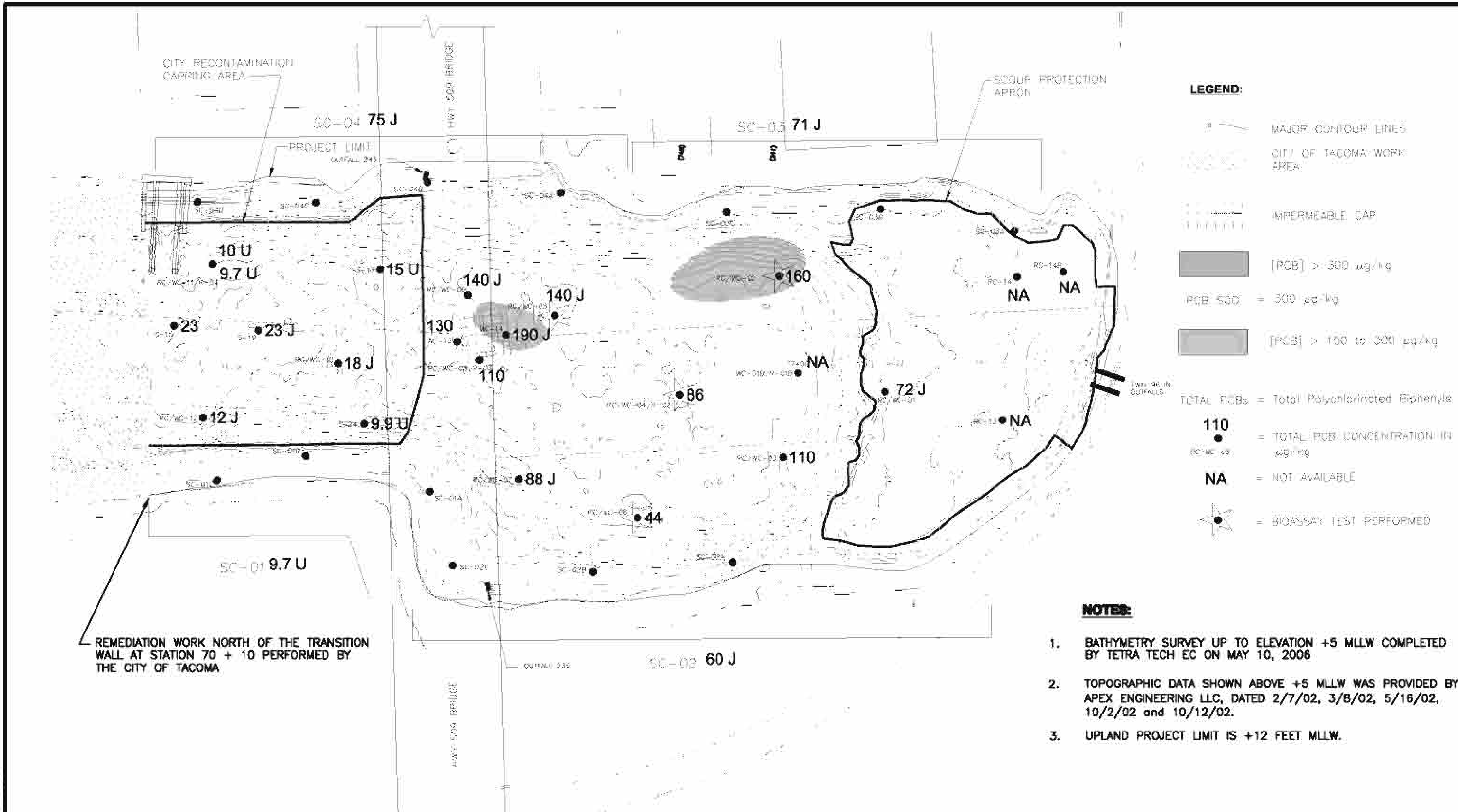
1. BATHYMETRY SURVEY UP TO ELEVATION +5 MLLW COMPLETED BY TETRA TECH EC ON MAY 10, 2006
2. TOPOGRAPHIC DATA SHOWN ABOVE +5 MLLW WAS PROVIDED BY APEX ENGINEERING LLC, DATED 2/7/02, 3/8/02, 5/16/02, 10/2/02 and 10/12/02.
3. UPLAND PROJECT LIMIT IS +12 FEET MLLW.

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-10
Total PCB Concentration
0-2 cm Sediment
May 2006

P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-10(REV).DWG
PLOT/UPDATE: NOV 1 2006 15:36:18



NOTES:

1. BATHYMETRY SURVEY UP TO ELEVATION +5 MLLW COMPLETED BY TETRA TECH EC ON MAY 10, 2006
2. TOPOGRAPHIC DATA SHOWN ABOVE +5 MLLW WAS PROVIDED BY APEX ENGINEERING LLC, DATED 2/7/02, 3/8/02, 5/16/02, 10/2/02 and 10/12/02.
3. UPLAND PROJECT LIMIT IS +12 FEET MLLW.

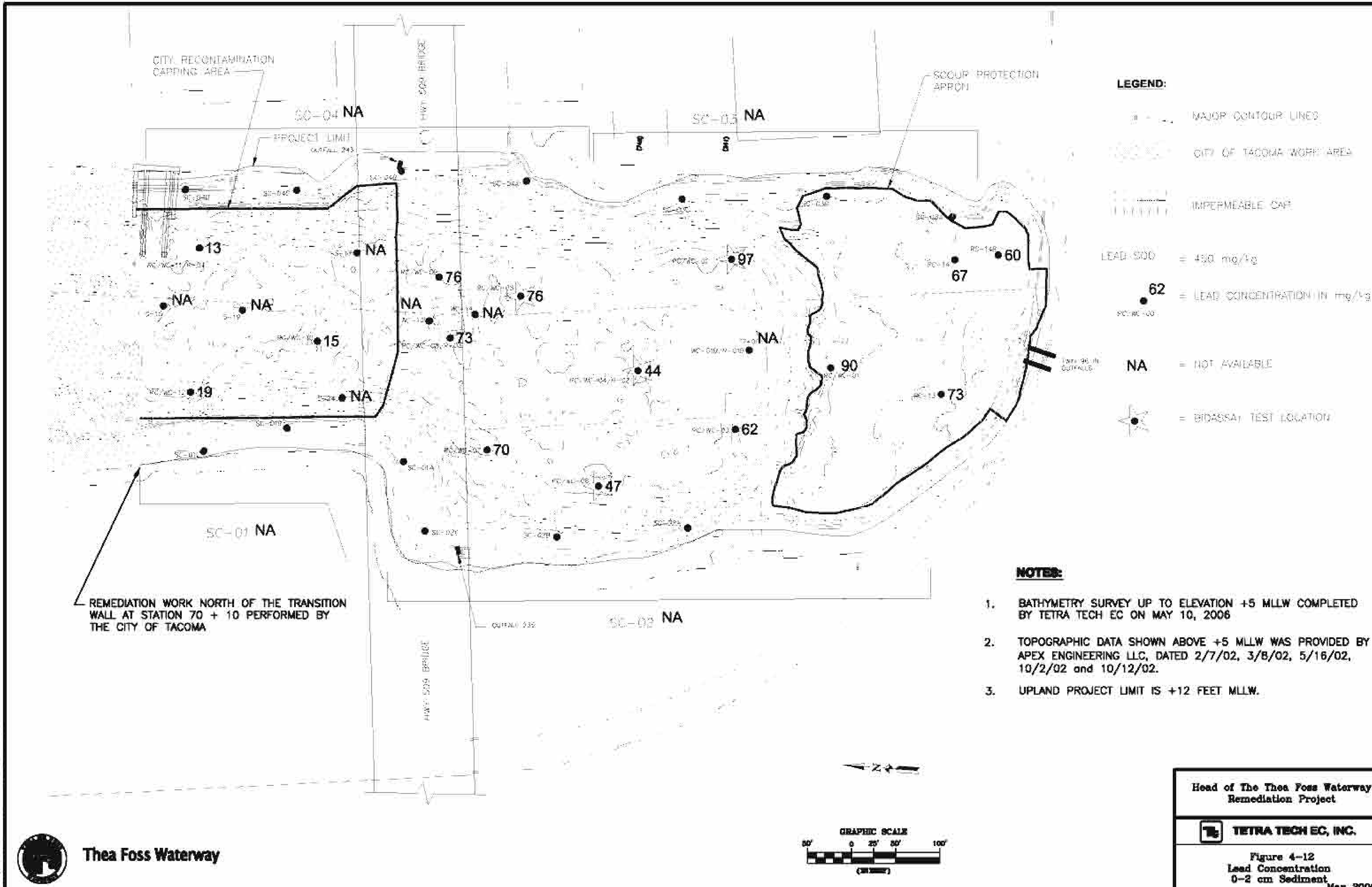
Thea Foss Waterway

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-11
Total PCB Concentration 0-10 cm Sediment
May 2006

P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-11(REV).DWG
PLOT/UPDATE: NOV 1 2006 15:37:23



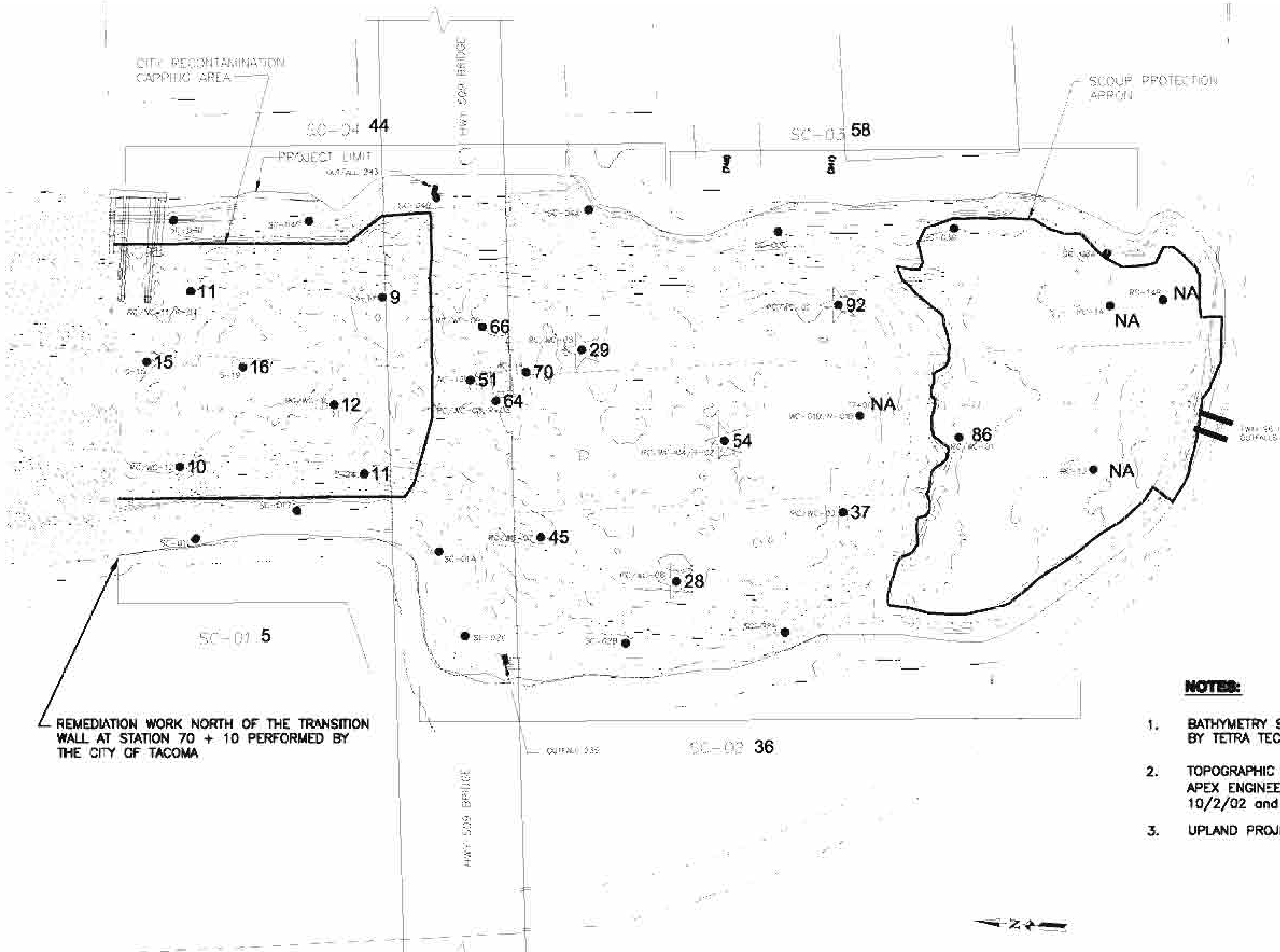
NOTES:

1. BATHYMETRY SURVEY UP TO ELEVATION +5 MLLW COMPLETED BY TETRA TECH EC ON MAY 10, 2006
2. TOPOGRAPHIC DATA SHOWN ABOVE +5 MLLW WAS PROVIDED BY APEX ENGINEERING LLC, DATED 2/7/02, 3/8/02, 5/16/02, 10/2/02 and 10/12/02.
3. UPLAND PROJECT LIMIT IS +12 FEET MLLW.

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-12
Lead Concentration
0-2 cm Sediment
May 2006



LEGEND:

MAJOR CONTOUR LINES

CITY OF TACOMA WORK AREA

IMPERMEABLE CAP

LEAD SQO = 450 mg/kg

37 = LEAD CONCENTRATION IN mg/kg

NA = NOT AVAILABLE

= BIOASSAY TEST PERFORMED

NOTES:

1. BATHYMETRY SURVEY UP TO ELEVATION +5 MLLW COMPLETED BY TETRA TECH EC ON MAY 10, 2006
2. TOPOGRAPHIC DATA SHOWN ABOVE +5 MLLW WAS PROVIDED BY APEX ENGINEERING LLC, DATED 2/7/02, 3/8/02, 5/16/02, 10/2/02 and 10/12/02.
3. UPLAND PROJECT LIMIT IS +12 FEET MLLW.

GRAPHIC SCALE
50' 0 25' 50' 100'
(IN FEET)

Thea Foss Waterway

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-13
Lead Concentration
0-10 cm Sediment
May 2006

P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-13(REV).DWG
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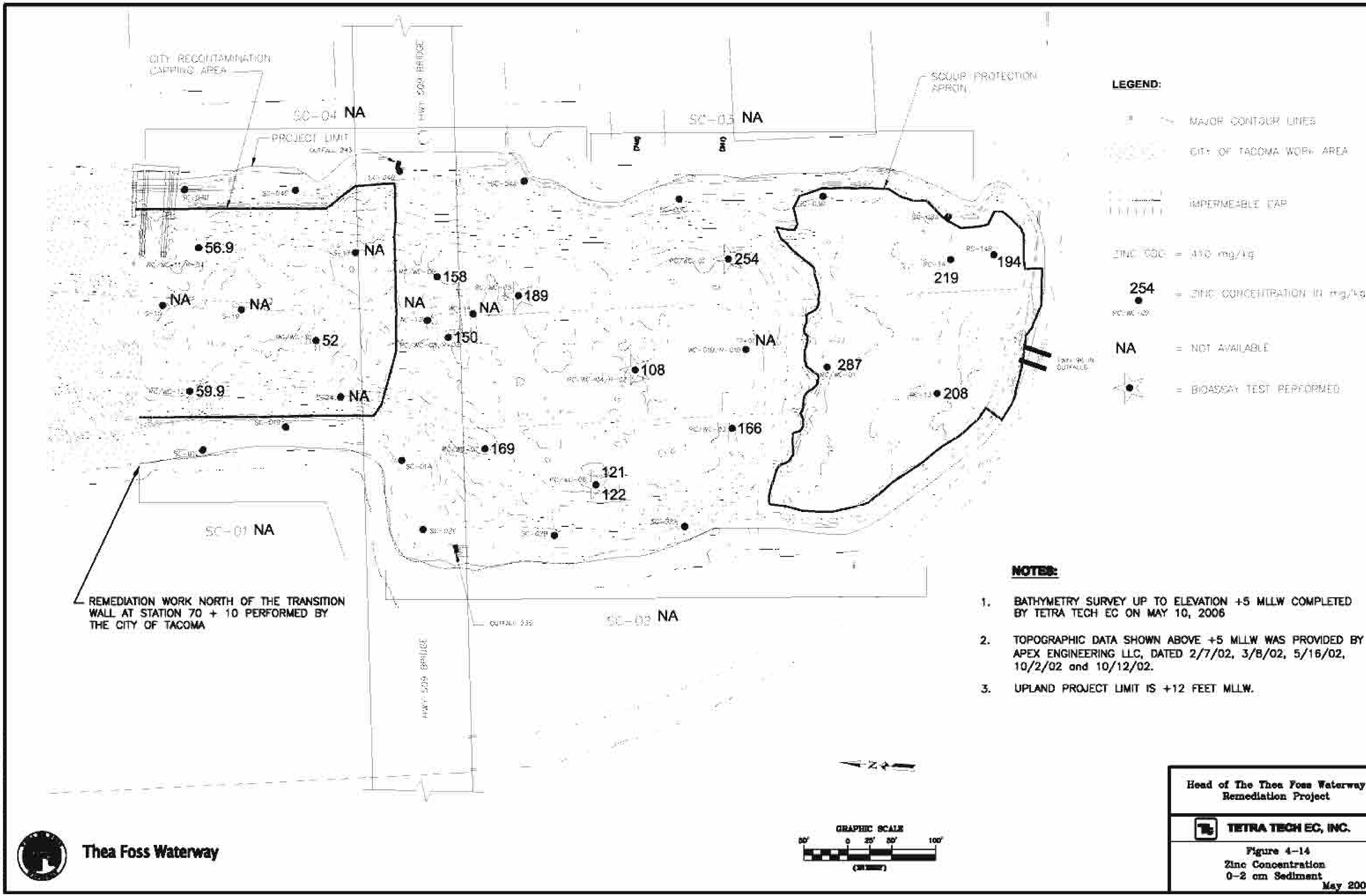
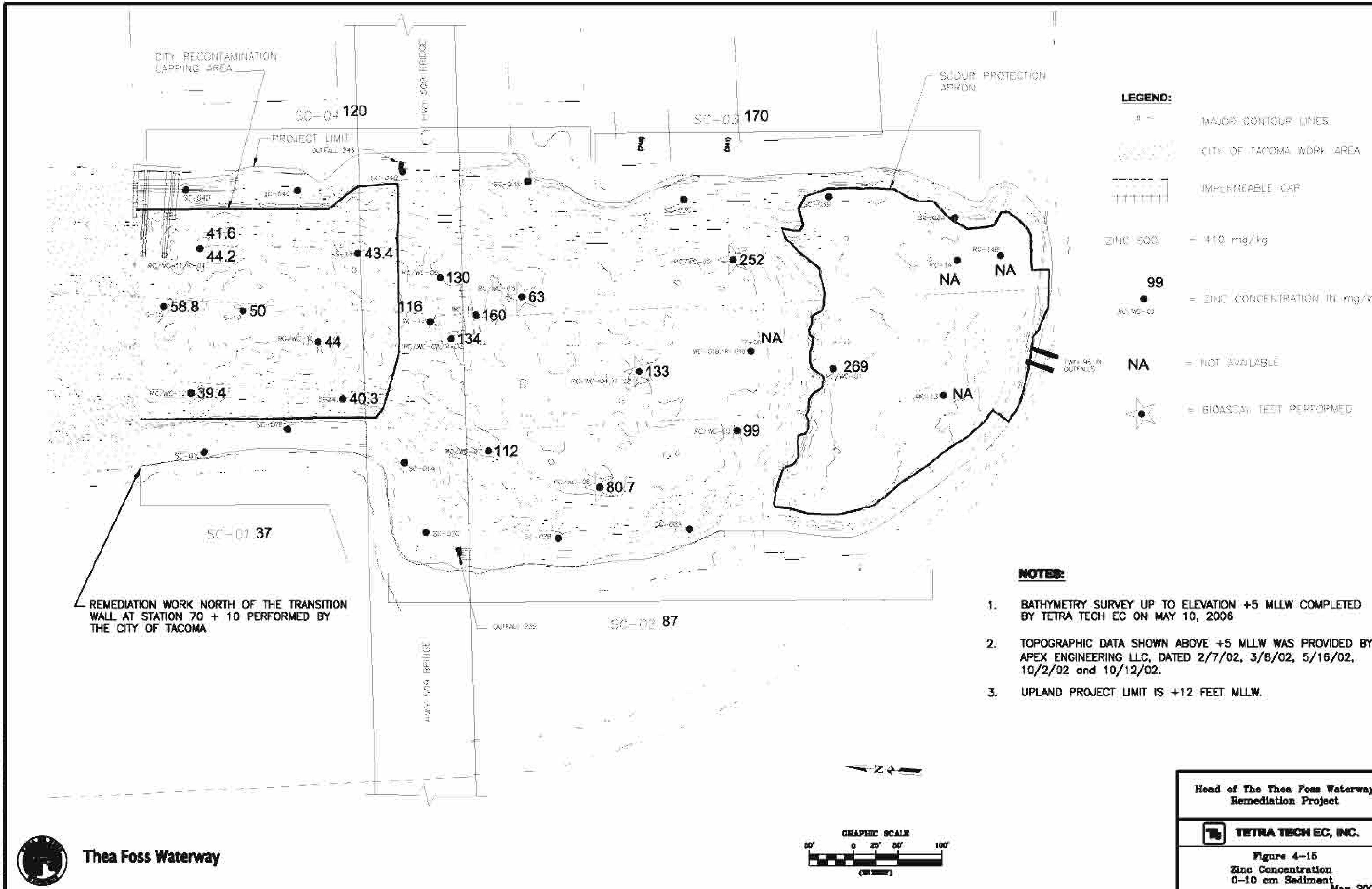


P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-14(REV).DWG
PLOT/UPDATE: NOV 1 2006 15:47:21



NOTES:

1. BATHYMETRY SURVEY UP TO ELEVATION +5 MLLW COMPLETED BY TETRA TECH EC ON MAY 10, 2006
2. TOPOGRAPHIC DATA SHOWN ABOVE +5 MLLW WAS PROVIDED BY APEX ENGINEERING LLC, DATED 2/7/02, 3/8/02, 5/16/02, 10/2/02 and 10/12/02.
3. UPLAND PROJECT LIMIT IS +12 FEET MLLW.

Head of The Thea Foss Waterway Remediation Project

TETRA TECH EC, INC.

Figure 4-15
Zinc Concentration
0-10 cm Sediment
May 2006

P:\2562_THEA FOSS\THEA FOSS\OMMP\YEAR 2\CAD\FOSS FIGURES REV.10-16-06\FOSSFIGURE 4-15(REV).DWG
PLOT/UPDATE: NOV 1 2006 15:48:23

5. RECOLONIZATION

During implementation of the remedy, dredging and capping eliminated non-mobile benthos over approximately 8.8 acres of the Utilities' Work Area. The bottom sediment created by the cap fill is expected to rapidly recolonize with infauna and epifauna (EPA 2000). In accordance with the ROD, the objective of the recolonization monitoring is to assess the success of the remediation at restoring a healthy benthic community in the waterway.

As part of the Utilities' OMMP, the primary means to evaluate habitat recolonization is through the use of SPI. The secondary method involves the collection and analysis of benthic infauna samples. Recolonization monitoring complements the Cap Integrity and Sediment Quality Monitoring discussed in Sections 2 and 5.

5.1 SPI

Recolonization is primarily assessed by SPI. As part of the post-construction monitoring required as part of the OMMP Year 2 Monitoring event, Germano & Associates, Inc. (G&A) performed an SPI survey at 16 stations on May 11, 2006.

5.1.1 Methods

The SPI survey uses a specialized camera that photographs the actual sediment profile up to a depth of approximately 20 cm. The photographs allow direct observation of benthic organisms found at the survey sites, as well as the physical conditions within the biologically active sediment zone (upper 10 cm). Color variation within the sediment provides insight on the probable oxidative state of the sediments (aerobic or anaerobic) while the observation of the marine macroinvertebrates facilitates evaluation of the successional stage of the benthic community. The photographs also provide data on the accumulation rate of new sediment and allow a qualitative evaluation of the overall benthic conditions in the Utilities' Work Area.

5.1.1.1 Monitoring Frequency and Locations

SPI was conducted in Year 2 according to the routine monitoring schedule identified in the OMMP. Sediment photographs are scheduled to be taken in Years 4, 7, and 10 corresponding to the years when physical cap integrity, compliance, top-down monitoring, and bottom-up monitoring will be completed.

SPI sampling locations are shown on Figure 2-1. Photographs were obtained at the 14 OMMP compliance locations (WC samples 1 through 14). Due to one location on the scour protection apron (WC-01) that did not allow for penetration of the camera, the SPI location was moved to station 78+00 and called WC-01B. An additional supplemental location, S-19, was also photographed, for a total of 16 SPI locations.

5.1.1.2 Field Activities

An SPI camera was used in the survey. The camera is designed to obtain *in situ* profile images of the top 20 cm of sediment. SPI photographs are included in Appendix F on CD.

5.1.1.3 Data Analysis

The SPI images were analyzed with the full-color analysis system. In general, three replicate SPI images were obtained and analyzed at each sampling location. Analysis of three replicate images per sample location allows for characterization of any variability in benthic habitat conditions that may exist at relatively small spatial scales (i.e., on the order of a few meters between individual camera drops).

Long term objectives involving this method include comparing measurements obtained from sediment profile images to evaluate benthic habitat conditions, map disturbance gradients, characterize sediment types, evaluate benthic habitat quality, and assess benthic recolonization.

SPI parameters estimated and mapped from the SPI images as part of the judgment-based assessment include:

- sediment type determination
- benthic habitat classification
- prism penetration depth
- surface boundary roughness
- infaunal successional stages
- apparent redox potential discontinuity (RPD) depth
- organism-sediment index (OSI)

Details of the assessment are included in the full SPI Survey Report in Appendix F.

5.1.1.4 Response Actions

The images collected were of sufficient quality to analyze for all the above parameters. Therefore, confirmation of the SPI survey with analysis of the archived benthic abundance samples was not required.

5.1.2 Results

The primary objective of the SPI technology survey was to document recolonization of benthic infauna as part of the post-cap environmental monitoring in the Thea Foss Waterway. While recolonization has definitely taken place, there were several notable findings from this initial SPI monitoring survey:

There has been a substantial deposition of new sediment in the area surveyed since the capping operations were completed. While the total thickness of this new deposit was deeper than the camera prism penetration at a few stations, the presence of the coarser-grained cap material was most visible in the profile images at the four northernmost stations surveyed (WC-10, WC-11, WC-12 and S-19). These four stations are within the City recontamination capping area completed in December 2005. Accumulation of fine-grained sediments throughout the survey area indicates that the main source of this recent sedimentary input is the large outfalls at the southern end of the site. The recent deposition (as measured to the buried former sediment-water interface) seen in the profile images (Appendix F, Figure 4) most likely represents a rapid input during the last wet period, but the lack of previous SPI time-series data does not allow us to conclude definitively whether the depositional interval measured represents a seasonal or annual input. Nearby shoreside or bank construction activities may have also contributed to the surface depositional layer on the capped area.

Station WC-01 was the only station where new sediment has not accumulated, and the slope armor/scour protection rock placed just north of the outfalls still serves as the seafloor surface. This station was located on the scour protection apron that was initially covered with “habitat mix” during construction, but the camera prism did not penetrate into the rocks. However, in the portion of the Thea Foss Waterway Head where the fine-grained material is accumulating, the post-cap sediment is organically enriched relative to surrounding sediments and also shows evidence of high sediment oxygen demand. As a result, the biological community has been severely compromised in those locations with surface sediments dominated by organically enriched, fine-grained material with high sediment oxygen demand (Stations WC-01B and WC-02). As long as these outfalls continue to discharge the volume and quality of material that they have since the completion of the capping operations, they will serve as a continuous source of disturbance to benthic recovery in the entire area surveyed. Compromised dissolved oxygen conditions in the benthic boundary layer and organic enrichment in the sediments were detected as far north as Stations WC-07 and WC-08.

Extensive burrow formations were not seen, and only one image showed evidence of infaunal reworking in the top 5 cm of the cap material at the four northernmost stations located within the City recontamination capping area.

It appears that sediment quality in the southern end of the area surveyed is definitely compromised by the nature of material being discharged by the twin outfalls at the southern end of the waterway. While the cap appears to be an effective isolation barrier from upward migration of contaminants, the more recent deposition of organically enriched, fine-grained material has limited the utility of the area as suitable habitat for mature benthic communities and also eliminated the original benefit of placing the “habitat mix” as an attractive surface for fish foraging.

5.2 BENTHOS

Five replicates were collected at four stations (R-01 through R-04) for benthic abundance. These samples were screened in the field on a 1-mm mesh screen, fixed in a 10 percent formalin solution, and archived for potential future analysis.

6. RECONTAMINATION EVALUATION AND INTERPRETATION

Available data indicate that the top of the Utilities' cap has been recontaminated to levels above the Commencement Bay-Nearshore/Tideflats SQOs. BEHP exceeds the SQOs by the greatest degree and over the widest area. Several individual PAHs, total HPAHs, and phenol also exceed their respective SQOs at one or more locations. The greatest exceedance of the SQOs occurs at location WC-02.

A temporary dredging recontamination source was identified in late 2004 (DOF 2005). The area impacted by the dredging recontamination was capped in December 2005 and the Utilities' OMMP was revised to account for the presence of this recontamination. However, available data also indicates the presence of an on-going source of recontamination.

To assess the likely source of on-going recontamination, the Utilities completed an evaluation of a variety of data including waterway surface sediment and core sample quality, and stormwater sediment quality collected by in-line sediment traps installed in outfalls that discharge to the head of the waterway. The results of this evaluation are presented in Appendix J (DOF 2006). This study concludes that the ongoing cap surface recontamination sources are stormwater outfalls that discharge to the head of the waterway based on the following lines of evidence:

- Four outfalls discharge to the head of the waterway including outfalls 237A, 237B, 235, and 243. Outfalls 237A and 237B are collectively termed the "Twin 96" outfalls. The four outfalls drain an area of approximately 7.6 square miles. Approximately 95 percent of the drainage area discharges through the "Twin 96" outfalls located at the very south end of the waterway.
- The outfalls discharge contaminated particulates that eventually settle to the waterway bottom. Bottom observations made in April 2004, December 2004, May 2005, and May 2006 indicate that up to 16 cm of fine-grained sediment has accumulated on the Utilities' cap surface since the cap was finished in February 2004. Fine-grained sediment accumulation trends are illustrated on Figure 6-1.
- Analysis of stormwater particulates collected by in-line sediment traps indicates that the particulates contain contaminants typical of stormwater, including BEHP and total HPAHs. These are the primary chemicals that are present in Thea Foss surface sediment at concentrations greater than the SQOs. Furthermore, the high contaminant concentrations are present in the fine-grained sediment that overlies

coarser-grained cap material based on analysis of surface sediment and core samples. The concentration relationships are illustrated on Figure 6-2 using data collected at location RC/WC-04. As shown on the figure, concentrations of BEHP, total HPAHs, total LPAHs, lead, zinc, and PCBs are substantially higher in the 0 to 2 cm and 0 to 10 cm samples as compared to the underlying core sample (0.7 to 1.5 feet). For example, total HPAH concentrations are approximately 4,700 percent higher in the 0 to 2 cm sample as compared to the underlying core sample (0.7 to 1.5 feet depth interval). Similar concentration differences are present for BEHP and total LPAHs.

Total HPAHs and BEHP concentrations in fine-grained sediment are highly correlated (R>0.90) and show a similar relationship to the stormwater particulates being discharged from the larger outfalls at the head of the waterway.

Figure 6-1. Thickness of Fine Grained Sediment in Utilities' Work Area

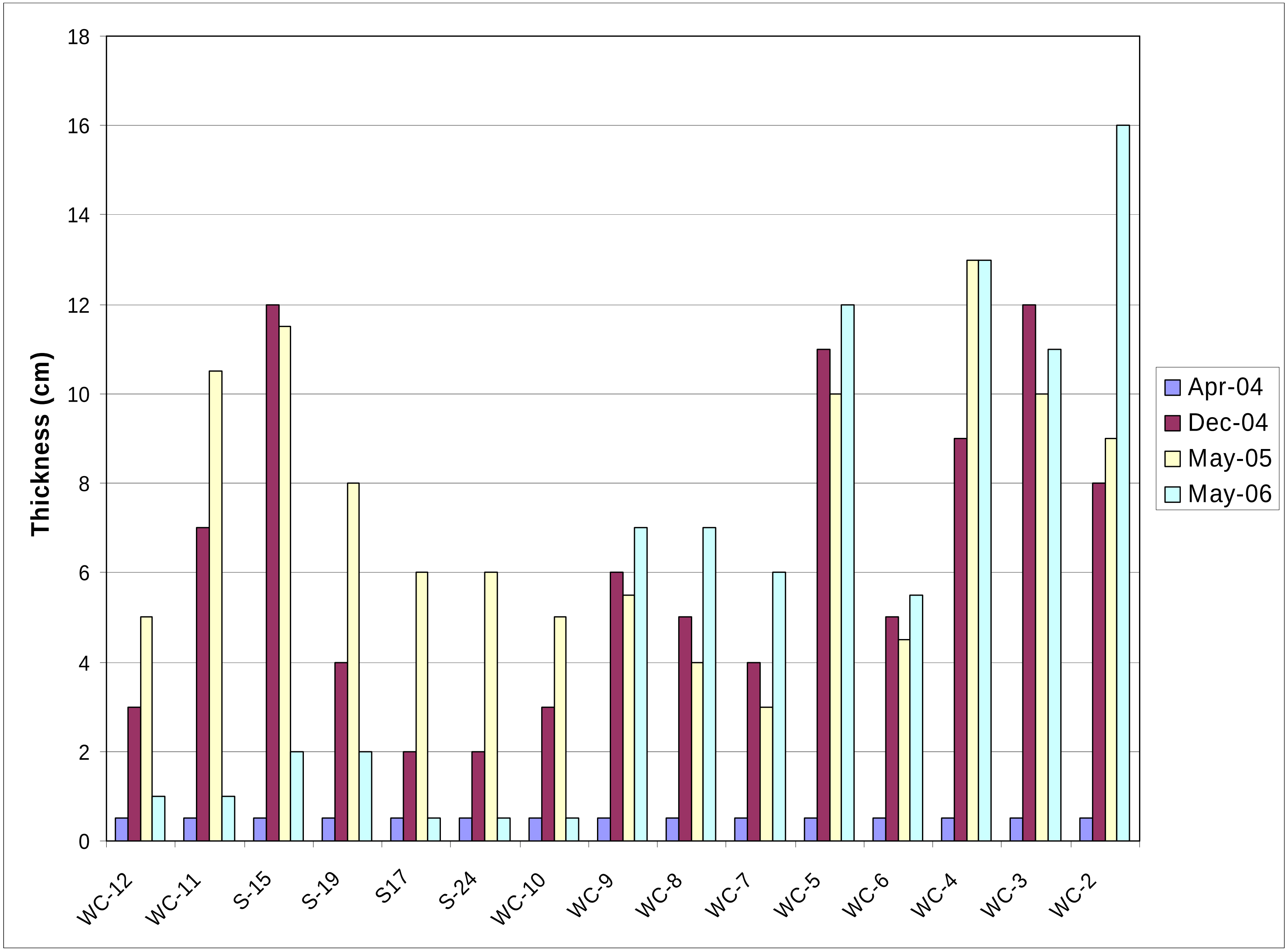
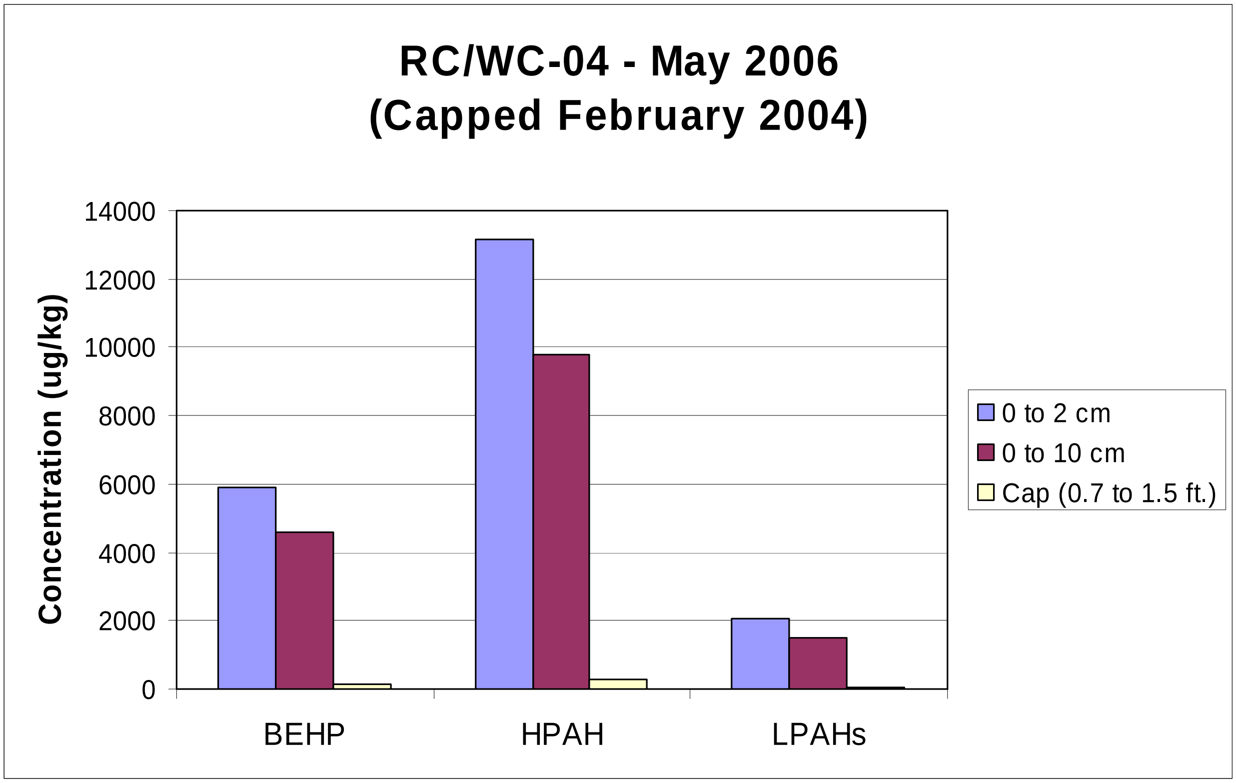
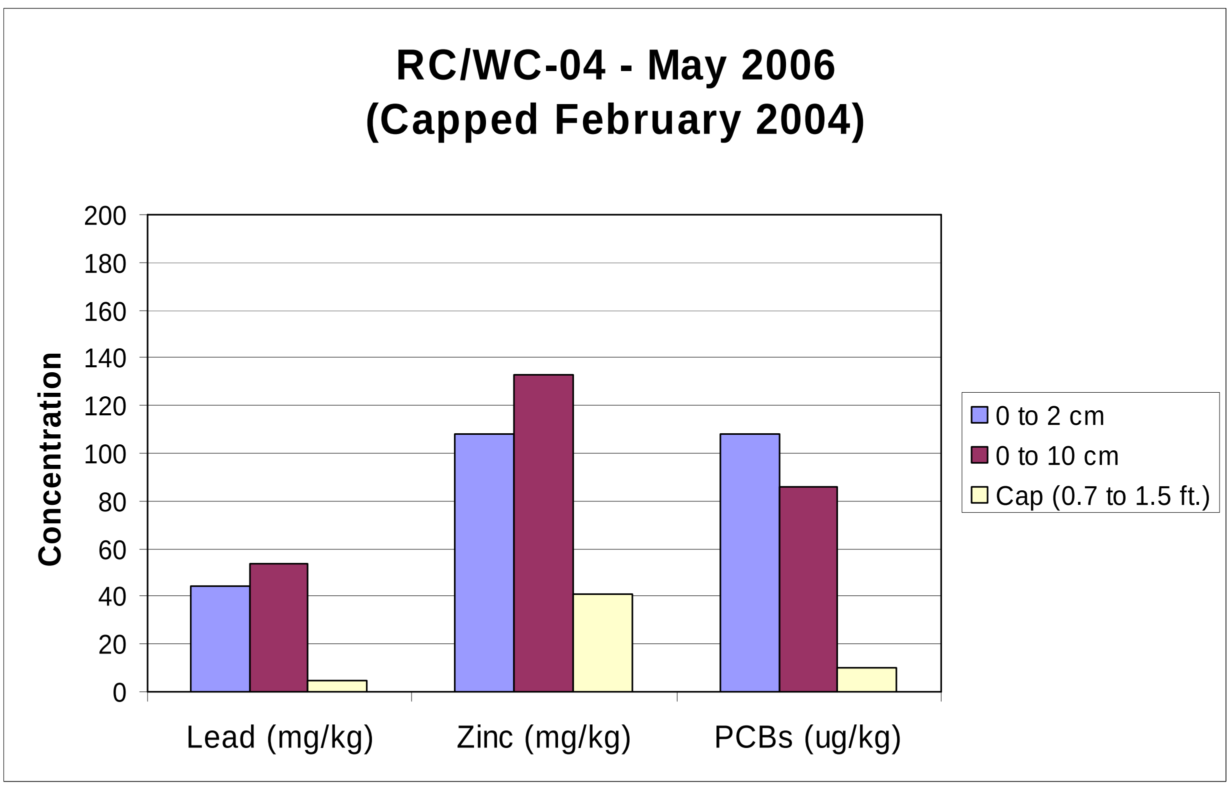


Figure 6-2. Comparison of Surface and Core Samples Sediment Quality





7. SUMMARY

Remediation of the Utilities' Work Area was completed with final placement of capping material in February 2004. Potential sediment recontamination sources investigated near the Head of Thea Foss Waterway between February 2004 and May 2006 include stormwater and dredging top-down sources, and upward migration of sediment contained by the Utilities' cap (bottom-up source). OMMP sampling was completed in April 2004 (Year 0 – baseline), May 2005 (Year 1), and May 2006 (Year 2) that consisted of collecting early warning top-down recontamination samples (0 to 2 cm), compliance samples (0 to 10 cm), and core samples (to assess the potential for bottom-up recontamination).

In September 2004 it was discovered that City dredging, completed after the Utilities' cap was installed, had caused contaminated sediment to be suspended in the water column and to migrate and settle on a portion of the Utilities' cap. The primary area of dredging recontamination was located generally north of the SR 509 Bridge. The dredging recontamination was differentiated from the stormwater contamination by the relative enrichment in HPAHs as compared to BEHP. The dredging recontamination area was capped by the City in December 2005 and modifications to the Utilities' OMMP were made to provide data to assess the effectiveness of the cap.

Year 2 sampling results for both recontamination (0 to 2 cm) and compliance (0 to 10 cm) samples showed exceedances of SQOs in the surface sediment samples. Biological testing of a subset of the compliance stations confirmed that biological effects were observed in the bioassay test organisms.

Year 2 core samples obtained and analyzed near the bottom of the Utilities' cap showed that the cap is containing the underlying contaminated sediments. The core data indicate that bottom-up migration of contamination is not occurring and the cap is functioning as intended. Any contamination on top of the cap is associated with a top-down source.

Contamination of the Utilities' Work Area (top of cap) began soon after the cap was installed. Fine-grained sediment began to accumulate and concentrations of BEHP, PAHs, and other contaminants began to increase. The source of this contamination appears to be stormwater discharges based on the following lines of evidence:

- Accumulation of fine-grained sediment on top of the Utilities' cap contains contaminants typical of stormwater discharges. Seven to 19 cm (about 7.5 inches) of very fine-grained sediment have accumulated on top of portions of the Utilities' cap since the cap was installed in late 2003 and early 2004. This fine-grained sediment is distinctly different from the underlying coarser-grained capping materials and contains the contaminants that exceed Thea Foss Waterway SQOs . Constituents detected in the fine-grained sediment on top of the cap are typical of the suite of chemicals that are normally found in stormwater and have been detected in stormwater sediment collected from the pipes prior to discharge to the Thea Foss Waterway. These contaminants include PAHs, phthalates, metals, pesticides, and PCBs. Not all of these contaminants exceed their respective SQOs, but their detection indicates a top-down stormwater contaminant source.

- BEHP exceeds its SQO by the greatest amount. Total HPAH concentrations have also increased in surface sediment. Total HPAHs and BEHP are highly correlated. This means that as the concentration of one contaminant increases, the concentration of the other contaminant also increases. The high correlation indicates a similar source of contamination. The May 2006 early-warning sediment sample total HPAH and BEHP correlation and trend analysis indicate that by May 2006, surface sediment is being primarily impacted by stormwater discharges.
- Bioassay testing was completed on selected samples because chemical concentrations of BEHP, and to a much lesser extent total HPAHs, exceeded their respective SQOs. These tests are used to more directly evaluate the toxicity of contaminated sediments to creatures that live in sediment by exposing sand fleas, mussel larvae, and juvenile worms to contamination. Four locations representative of a range of contamination levels were selected for testing with input and oversight by EPA. The samples were composed mostly of fine-grained sediment that had accumulated on the cap.
- Bioassay testing indicated that the sediment contamination had an impact on the mussel larvae in three of the four sampling locations, and on the sand fleas in one of the four sampling locations. Testing did not indicate impact on the juvenile worms.
- Results of the biological testing indicated that the test organisms were most adversely impacted where the chemical concentrations were highest (BEHP detected at a concentration that was six times its SQO).

Results of the biological testing are consistent with the evaluation of cap recolonization using the SPI camera. The SPI results indicate that in the portion of the Thea Foss Waterway Head where the fine-grained material is accumulating, the post-cap sediment is organically enriched relative to surrounding sediments and also shows evidence of high sediment oxygen demand. Low dissolved oxygen conditions in the benthic boundary layer and organic enrichment in the sediments were detected as far north as Stations WC-07 and WC-08. As a result, the biological community has been compromised at several sampling stations (Stations WC-01B and WC-02). As long as the stormwater outfalls continue to discharge the volume and quality of material that they have since the completion of the capping operations, they will serve as a continuous source of disturbance to benthic recovery in the entire area surveyed.

The Utilities have provided the chemical and biological testing results to the City of Tacoma and the EPA, and have engaged in discussions with the City and the EPA about the sampling results and next steps for further investigation and evaluation. The City is in the process of developing a formal submission to EPA that will outline the steps that they plan to take to further evaluate this top-down source of recontamination.

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APPENDIX A

POST CITY REMEDIAL ACTION

APPENDIX A.1

TETRA TECH EC OVERSIGHT TECH MEMORANDUM- CITY CAPPING ACTIVITIES

(Attachments and Photographs Located on Enclosed CD)

Memorandum

Date: March 24, 2006

To: Jackie Wetzsteon, PERCo

From: Walter Bowles and Gary Braun

RE: Utilities Project Area Telebelt Capping Observation and Sediment Cap Sampling Summary

Capping Observations

This memorandum summarizes the observations made during the City of Tacoma Telebelt capping operation on the Thea Foss Waterway between Stations 70+10 and 73+00 and the confirmation sampling of the sediment cap.

Capping operations lasted from approximately December 3 to December 12. Capping operations were conducted by Manson Construction Company and Brundage-Bone Concrete Pumping. Capping operations were observed on the 3rd, the 5th, the 6th, and the 8th. During this time there were no visits to the site by USACE or USEPA personnel recorded. On the 8th, Jackie Wetzsteon was informed of the progress of the operations and she said that she was satisfied that enough direct observation had been done and that daily trips to the site to monitor progress would no longer be required.

During capping operations, an observation log was maintained. In addition to the observation log, 74 digital pictures and 2 digital movies were recorded.

Sediment placement began between the piers of the Foss Landing boat lift. The sediment was composed of clean sand. One of the digital movies (PC030010.MOV) shows the Telebelt placing cap material in this location and the process whereby it placed a uniform thickness of material. Cap material was placed according to a system of 50 foot cells. The dimension of the cap area was approximately 5 cells in an east-west direction and 6 cells in a north-south direction. Two partial cells were located at the southeast corner of capping area. The rows of cells nearest shore were completed first followed by the outer 3 rows of cells. Figure 1 shows the map that was used to guide sediment placement.

The volume of cap material placed in a cell was used as a proxy for cap thickness. The amount of material needed to raise the bottom the required amount was calculated and this amount plus approximately five extra cubic yards of material was placed in each cell. Pre-placement tests of sand placement with the Telebelt showed that sand at the unconfined edges of a placement area tended to slough off resulting in the desired thickness not being attained in these areas. To remedy this, material in addition to these calculated volumes was placed along the northern and southern boundaries of the cap area. The eastern and western edges of the capping area were bounded by the channel slopes and additional material was not added to these areas. Periodic checks with leadline and underwater video camera showed the cap to be of the correct thickness where it was measured and to be smooth and uniform. It was originally calculated that 1,830 cubic yards of cap material would be required. However, 1,975 cubic yards were actually used. Capping material was fed to the Telebelt through a hopper by a front end loader. Material volumes were tracked by recording the number of loader buckets of a known volume that were placed in a cell.

Initially, the areas where cap material was placed were tracked and recorded electronically using WinOps software. Due to a loss of GPS signals under the bridge at the southern end of the cap area WinOps could not be used and a series of floats and lines on the water surface and docks marked the boundaries of the cap material placement cells. Typically, the Telebelt operator made a series of six passes over an area and then either extended or retracted the boom 2 feet, depending on where in a cell material placement started, until the cell had been completely covered. Where greater thicknesses of material were called for, more passes were made before extending or retracting the boom. The Telebelt operator had very fine control over the movement of the boom and from the viewpoint on shore it appeared visually that there were no gaps in the material coverage.

In areas next to and below the finger docks and boat lift at Foss Landing an attachment that could direct the material ejected by the Telebelt was used to ensure cap material was placed where it was intended. This attachment consisted of a large rubber hose that could be manually directed to place cap material directly below the end of the Telebelt boom. There are several photographs which show a Manson crew member directing sediment placement manually. To place cap material below the wider portions of the Foss Landing docks, the angle, direction, and belt speed of the Telebelt boom were adjusted. In this case, the trajectory of the cap material carried it below the docks.

In summary, the capping operation went smoothly. The Telebelt was particularly well suited to deliver discrete volumes of sediment in a controlled manner. It appeared that every reasonable effort was made to ensure that the desired thicknesses were obtained throughout the entire capping area. Observations made with a leadline and underwater camera during the operation seemed to confirm this.

Confirmation Sampling

Cap placement was completed on December 12, 2005 and surface samples of the cap were collected on December 14, 2005.

Surface samples were collected by Parametrix. Dave Humes of Tetra Tech EC accompanied the sampling crew to observe and collect splits from the samples. Sampling went smoothly without complications. Eleven samples were collected with a Van Veen grab sampler. Seventy six digital photographs of samples and the sampling process were taken. Samples were collected at stations S-15, S-16, S-17, S-19, S-20, S-24, WC-8, WC-9, WC-10, WC-11, and WC-12, shown in Figure 2. Sample splits collected by Tetra Tech EC were submitted to ARI for archiving. To our knowledge, Parametrix samples were submitted to ARI Laboratory and analyzed according to agreement, however Tetra Tech EC was not provided with copies of chain of custody forms for these samples.

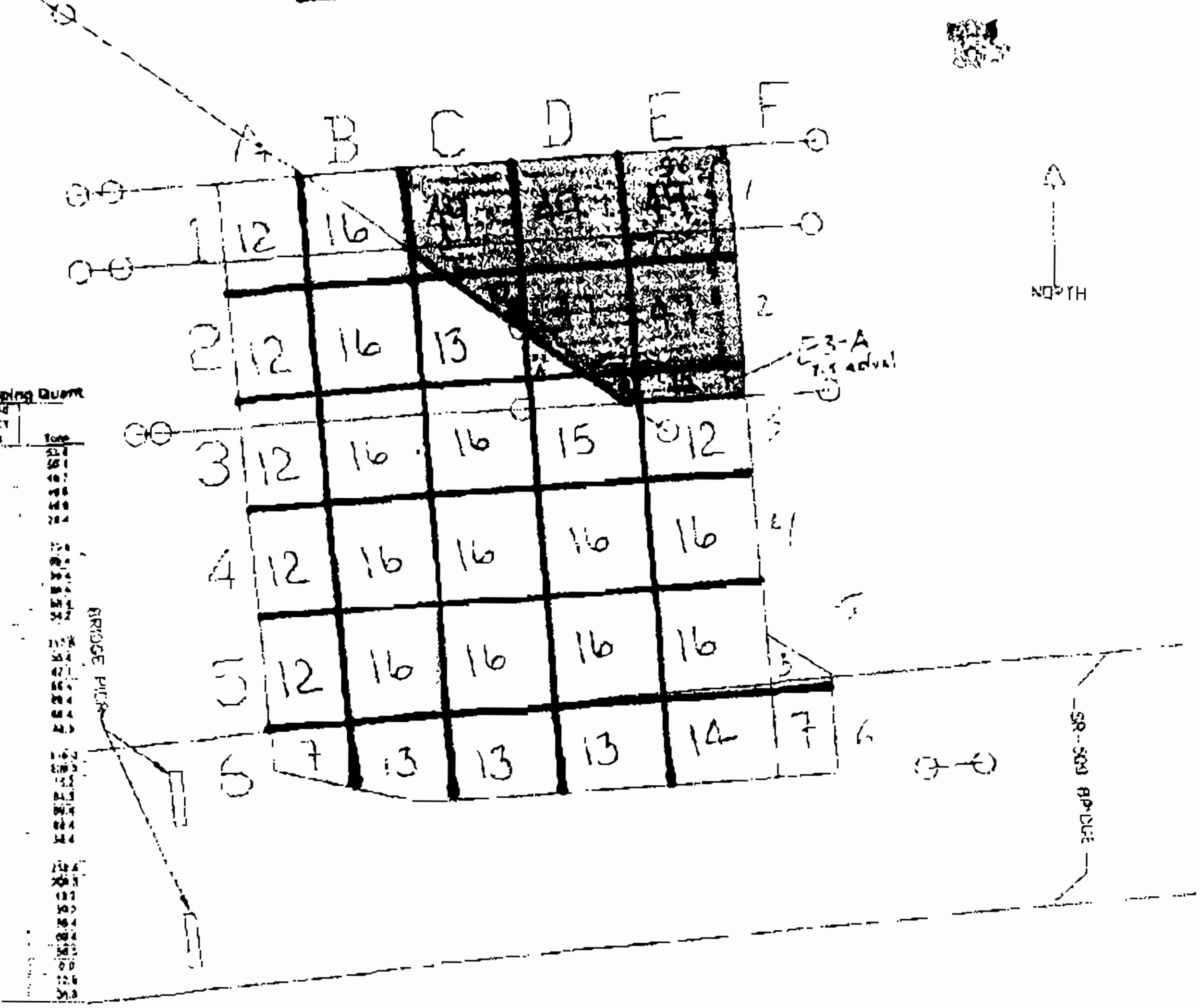
In most cases, the grab samples were composed entirely of the sand cap material covered with a thin layer of silt. This silt layer was homogenized with the sand. Within the capping area, only the sample from S-16 had a layer of sand less than the required six inches. In this case the sand layer was four inches thick. In the sample collected at WC-8 there was a 1 cm thick layer of brown silt over a 6 cm thick layer of gray silt overlying fine sand; at WC-9 there was a 0.5 cm thick layer of light brown silt over a 4 cm thick layer of dark olive silt overlying gray sand. These samples were taken adjacent to the Corrective Action area in these two cases, the sand overlain by the silt layers was not the sand placed during the capping operation.

The daily capping observation reports with photo logs, the sample collection forms, the sampling logbook pages, and the Tetra Tech split sample chain of custody forms are included as Attachments 1 through 4, respectively, to this memorandum. In addition, a CD of the photos and the movies is also included.

FIGURE 1

SEDIMENT PLACEMENT GRID MAP

FINAL USE THIS GRAPH

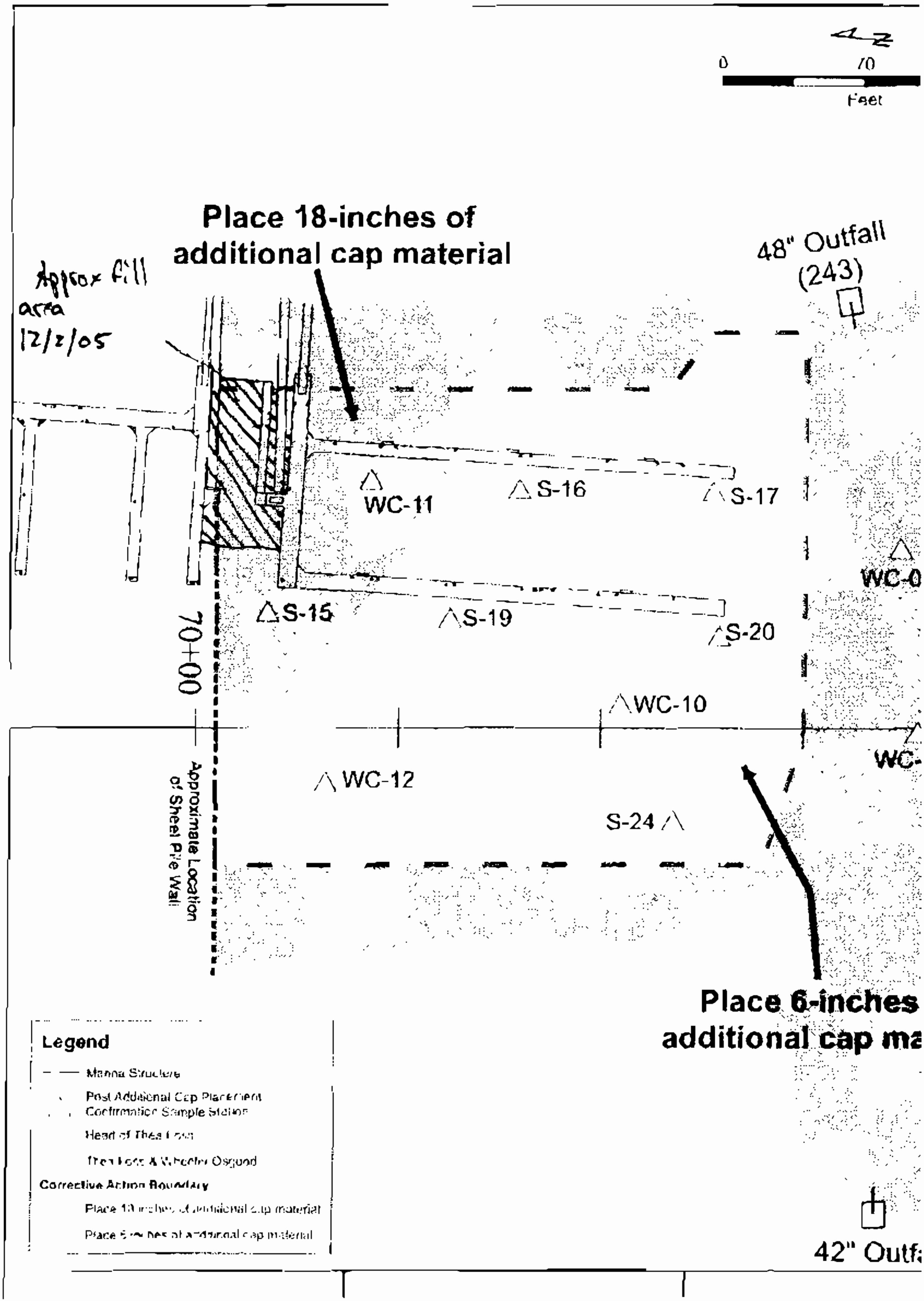


Utilities Area Capping Quant

Grid	Area	Depth in FT	Volume CY	Add Vol. For Edge Condition CY	Calculated [illegible] Bottoms	Tons
A-1	[illegible]	[illegible]	33.9	7.0	12	52.[illegible]
A-2	[illegible]	0.5	33.4		13	[illegible]
A-3	[illegible]	0.5	35.[illegible]		12	40.[illegible]
A-4	1711.1	0.5	32.7		[illegible]	[illegible]
A-5	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
A-6	[illegible]	[illegible]	[illegible]	[illegible]	7	28.4
B-1	[illegible]	0.5	45.6	[illegible]	18	[illegible]
B-2	2500	0.5	46.3		18	[illegible]
B-3	2500.1	0.5	46.3		16	[illegible]
B-4	2500.1	0.5	46.3		16	[illegible]
B-5	2500.1	0.5	[illegible]		16	[illegible]
B-6	[illegible]	0.5	[illegible]	2.0	12	34.2
C-1	1963	1.5	136.1	[illegible]	46	[illegible]
C-2A	[illegible]	0.5	[illegible]		13	[illegible]
C-2B	[illegible]	[illegible]	[illegible]	2.0	15	47.[illegible]
C-3	2500.1	0.5	[illegible]		16	[illegible]
C-4	2500.1	0.5	[illegible]		16	[illegible]
C-5	2500	0.5	[illegible]		16	[illegible]
C-6	[illegible]	0.5	[illegible]	2.0	13	[illegible]
D-1	[illegible]	1.5	[illegible]	[illegible]	[illegible]	[illegible]
D-2	2500	1.5	[illegible]		47	[illegible]
D-2A	181.0	1.5	[illegible]		4	15.2
D-2B	[illegible]	0.5	42.5		15	[illegible]
D-4	2500.1	0.5	[illegible]		16	[illegible]
D-5	2500.1	0.5	[illegible]		16	[illegible]
D-6	[illegible]	[illegible]	[illegible]	2.0	[illegible]	34.4
E-1	[illegible]	1.5	[illegible]	[illegible]	[illegible]	[illegible]
E-2	2510	1.5	[illegible]		47	[illegible]
E-2A	[illegible]	[illegible]	[illegible]		12	[illegible]
E-2B	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
E-4	2500.1	0.5	[illegible]		16	[illegible]
E-5	2500.1	0.5	[illegible]		15	[illegible]
E-6	[illegible]	0.5	[illegible]	[illegible]	[illegible]	[illegible]
						0.0
F-5	[illegible]	0.4	[illegible]		5	[illegible]
F-6	[illegible]	[illegible]	[illegible]	7.0	[illegible]	[illegible]
Total [illegible] Quantity						2744.[illegible]

FIGURE 2

SURFACE SAMPLE LOCATION MAP


N
0
70
Feet
Place 18-inches of
additional cap material
48" Outfall
(243)
Approx fill
area
12/2/05
WC-11
S-16
S-17
WC-0
S-15
S-19
S-20
70+00
WC-10
WC-
WC-12
Approximate Location
of Sheet Pile Wall
S-24
Place 6-inches
additional cap ma
Legend
Post Additional Cap Placement
Confirmation Sample Station
Corrective Action Boundary
42" Outf

ATTACHMENTS 1 THROUGH 4 ARE LOCATED ON THE ENCLOSED CD

APPENDIX A.2

FOSS LANDING BATHYMETRY SMOOTHING

TETRA TECH EC, INC.

Memorandum

Date: June 1, 2006

To: Jackie Wetzsteon, PERCo

From: Walter Bowles and Gary Braun

RE: Utilities Project Area Foss Landing Marina Boat Lift Bathymetry Smoothing Summary

Capping Observations

This memorandum summarizes the observations made during the City of Tacoma bathymetry smoothing operation at the Foss Landing Marina beneath the boat lift on May 26, 2006. The field observation log is included as Attachment A. Other observers present during the smoothing operation included Mary Henley, John O'Loughlin, Terry and Bill Conley from the City of Tacoma, Kym Takasaki from the USACE, Iain Wingard from Floyd Snider, and the two-man crew from Manson Construction. A diver from Shanes Diving Service was also present. Kym Takasaki provided oversight on the depth measurements during smoothing.

At 0940 the Manson truck arrived and the crew began to rig up the smoothing apparatus to the Foss Landing boat lift cradle. The smoothing blade consisted of an 8-inch I-beam approximately 10 feet long that was attached at an angle to the bottom of the lift cradle as shown in Figure 1.

Sediment smoothing started at approximately 1015. Smoothing was planned to be conducted around low tide which was predicted to be -2.7 ft MLLW at 1110 am. A tape measure was laid out on the southern concrete lift pier next to where the cradle would be traversing. This tape measure can be seen beneath the lift operator's foot in Figure 2. Figure 3 gives an idea of the tide level during smoothing. The front of the cradle was aligned with a given mark on the tape measure and the cradle was moved out and down (toward the channel) at the direction of the crew on the lower dock. The cradle was then raised, moved back to a position one foot shoreward of its previous starting point and the process was repeated. In this way, most excess sediment was moved deeper into the channel to the extent limited by the movement of the cradle. Several passes were also made to move sediment upward toward the shore.

At several times, the operation was paused to complete leadline measurements to gauge smoothing progress and to allow the diver to inspect the work. The diver reported that the slope toward the channel appeared fairly uniform and that there was not a mound of sediment building up at the west end of the cradle's movement limit. He also reported that the shoreward slope appeared smooth as well.

Smoothing was completed at approximately 1114. At this time the measurement at the west end of the lift was -8.5 feet, and Bill Conley and John O'Loughlin estimated that approximately 2 feet of sediment from the middle part of the hump beneath the boat lift had been removed. Prior to the diver exiting the water he reported that a 6-inch hump had built up at the western limit of the smoothed area. He was able to smooth this area by hand.

Figure 1 Assembling the Smoothing Rake

Figure 2 Sediment Smoothing

Figure 3 Low Tide During Smoothing Operation

ATTACHMENT A

OBSERVATION AND PHOTO LOG

Tetra Tech FW, Inc.

Daily Report

Report Taken By:
Reviewed By:

Project: Thea Foss Remediation – City of Tacoma Date 11/ /04 Daily Report No.:

Weather:
Weather:

Temperature Low: High Seas

Personnel on Site:

TtFW & DOF
- [ ] Matt Dalton
- [ ] Gary Braun
- [ ] Bob Feldpausch
- [ ] Walter Bowles

Others:

Floyd Snyder/KPFF
- [ ] Iain Winpard
- [ ] Scott Henderson
- [ ] Jeff Wilson

Others:

Manson
- [ ] Michael Lloyd
- [ ] Eric McMan
- [ ] Tommy (DB Foremen)

Crew [ ]
Others:

Equipment on Site:

Manson
- [ ] Derrick Barge – DB Andrew
- [ ] Bucket Type/Size
- [ ] Dump Barge(s) _55_______________
- [ ] Dump Barge(s) ________________
- [ ] Tug – The Workhouse
- [ ] Tug – The Wollochet

Other.

PHOTO LOG

Time (24 HR)	Photo ID	Direction of shot	Photo Description

Tetra Tech FW, Inc.

LOG

LOG

APPENDIX B

SITE OBSERVATIONS

(Site Photographs Located on Enclosed CD)

TETRA TECH EC, INC.

Memorandum

Date: June 22, 2006

To: Jacqueline Thiell Wetzsteon, PacifiCorp

From: Pamela Sargent and Gary Braun

RE: Site Observations
June 14, 2006
Head of the Thea Foss Waterway Project

This technical memorandum presents a summary of the observed site conditions within the Head of the Thea Foss Waterway, Tacoma, Washington (Figure 1). The observations were made by Pamela Sargent, Principal Environmental Engineer, and Gary Braun, Thea Foss Project Manager for Tetra Tech EC, Inc. (TtEC). They visited the site between approximately 12 noon and 2:45 pm PDT on June 14, 2004. During this period, a low tide of -2.93 feet Mean Lower Low Water (MLLW) was predicted for 1:36 pm PDT (Figure 2). This visit was made with representatives of the City of Tacoma, the Utilities, and Citizens for a Healthy Bay (CHB).

The purpose of this site visit was to observe the:

- General condition of the scour protection apron placed at the head of the waterway,
- General condition of the waterway slopes exposed at low tides,
- Former SR-509 seep area for evidence of sheens,

and to document the observed site conditions during the lowest daytime tides of the year as part of the Year 2 Operation, Maintenance and Monitoring activities for the Head of the Thea Foss Waterway Project.

Field Observations – June 14, 2006

Condition of the Scour Protection Apron Placed at the Head of the Waterway:

The condition of the scour protection apron at the south end of the waterway are shown in Figures 3 to 6. Water was flowing out of outfalls 237a and 237b during the site visit (Figure 7). The discharge from these outfalls was spreading out over the apron and flowing northward towards the turning basin. As previously noted in the Year 0 and Year 1 low tide site observations, a small, shallow channel is present in the apron near the southeast corner of the waterway (Figure 3). The configuration and shallow depth of this channel appear unchanged from previous observations and the overall integrity of the cap has not been adversely impacted by the presence of this localized feature. No corrective action is proposed at this time. However, this feature should continue to be monitored during future low tide events for changes. Some miscellaneous debris (clothing, a traffic cone, and an old bicycle) were present on the scour apron in front of outfalls 237a and 237b at the very head of the waterway.

General Condition of the Waterway Slopes Exposed at Low Tide:

Photographs of the east and west bank slopes exposed during low tide are shown in Figures 8 to 13. No slope erosion or sloughing was observed. As previously noted in the Year 0 and Year 1 site observation memoranda, the coarser slope cap materials are covered with algae and barnacles. A layer of olive and gray silt is present over capping material on the lower portions of the east and west bank slopes.

Observations in the Vicinity of the Former SR-509 Seep Area:

Gas bubbles were observed during our site visit but no sheens were observed in the former SR-509 seep area (Figures 14 to 16).

General Observations:

The weather was overcast with intermittent showers and light winds during this field visit. Gas bubbles were observed throughout the head of the waterway but no sheens were observed in this area. Algae and barnacles are present on coarser slope cap and scour protection materials. The scour protection adjacent to outfalls 243 (at Station 73+40 on the east side of the waterway under the SR-509 bridge) and 235 (at Station 73+20 on the west side of the waterway under the SR-509 bridge) shows no signs of erosion or displacement (Figures 17 to 20). Water was flowing out of both these outfalls during the site visit.

Figures

FIGURES

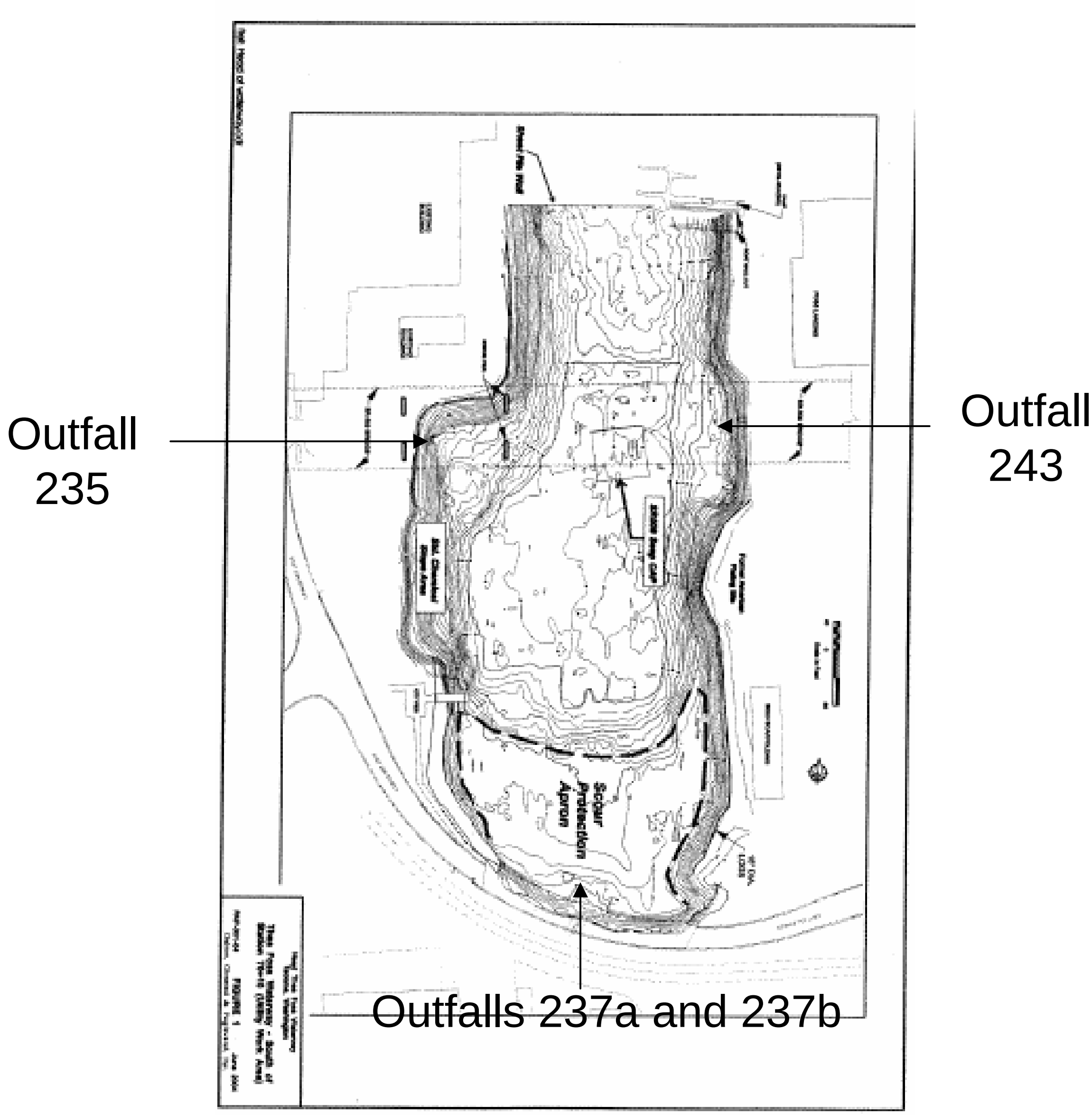


Figure 1 – Head of the Thea Foss Waterway
Utilities' Work Area

TETRA TECH EC, INC.

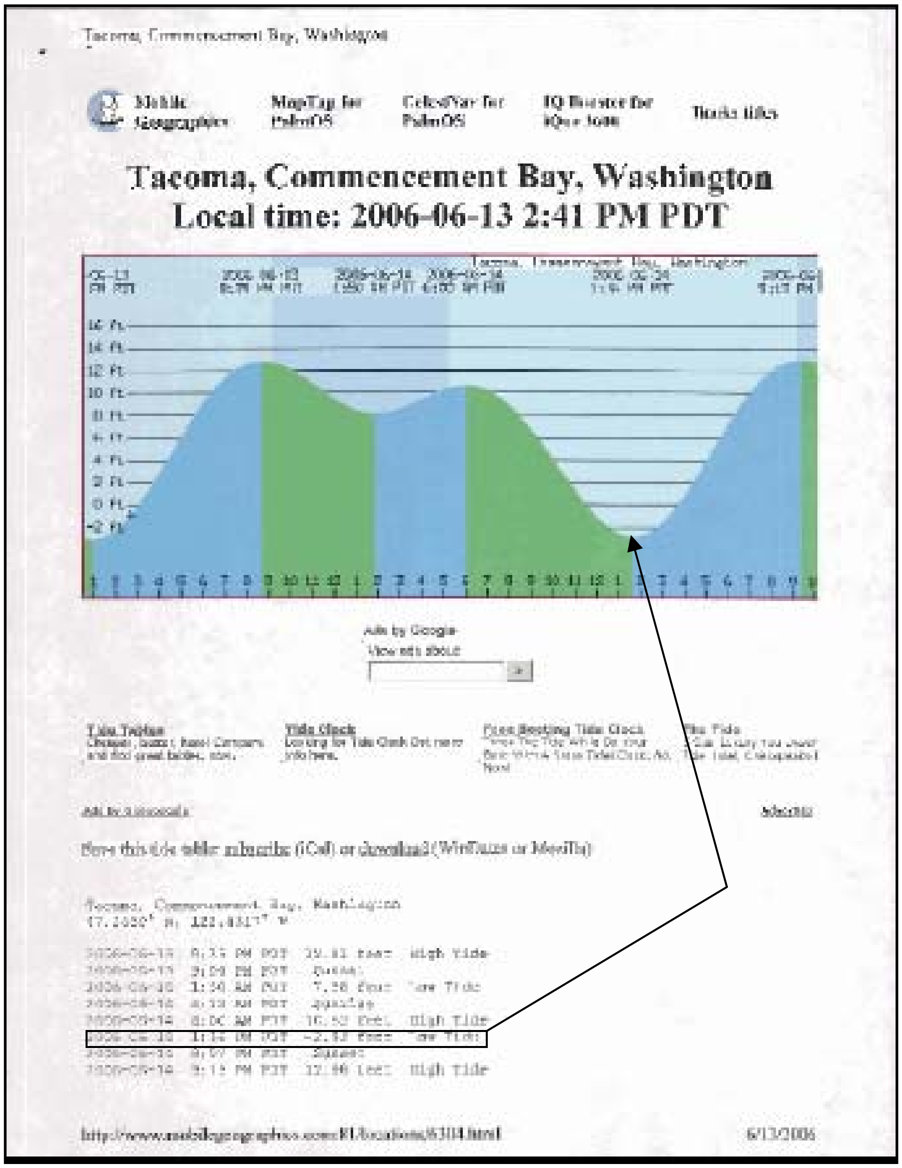


Figure 2 – Commencement Bay Tides
June 14, 2006

Figure 3 – Scour Protection Apron
Looking South Along East Bank

Figure 4 – Scour Protection Apron
Looking South Along the West Bank

TETRA TECH EC, INC.

Figure 5 – Scour Protection Apron
Close-up Looking South from SR-509 Bridge

Figure 6 – Scour Protection Apron
Looking South from the SR-509 Bridge

TETRA TECH EC, INC.

Figure 7 –
Close-up of Outfalls 237a and 237b
Looking South

TETRA TECH EC, INC.

Figure 8 – East Bank Looking South

Figure 9 – East Bank Looking North

TETRA TECH EC, INC.

Figure 10 – East Bank from SR-509 Bridge

Figure 11 – West Bank Looking North

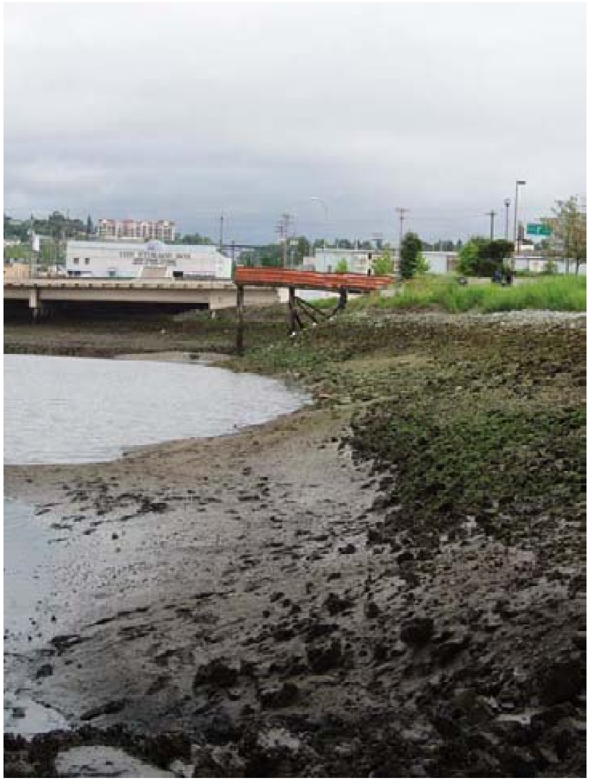


Figure 12 –
West Bank
Looking South
from Under
SR-509 Bridge

Figure 13 – West Bank
Looking South from SR-509 Bridge Deck

Figure 14 – Former SR-509 Seep Area
Looking West from East Bank

Figure 15 – Floats over Former SR-509 Seep Area

Figure 16 – Southeast Corner of Former SR-509 Seep Area

TETRA TECH EC, INC.

Figure 17 – Outfall 243
Looking East from West Bank Under SR-509 Bridge

Figure 18 – Outfall 235
Looking West from Under SR-509 Bridge

TETRA TECH EC, INC.

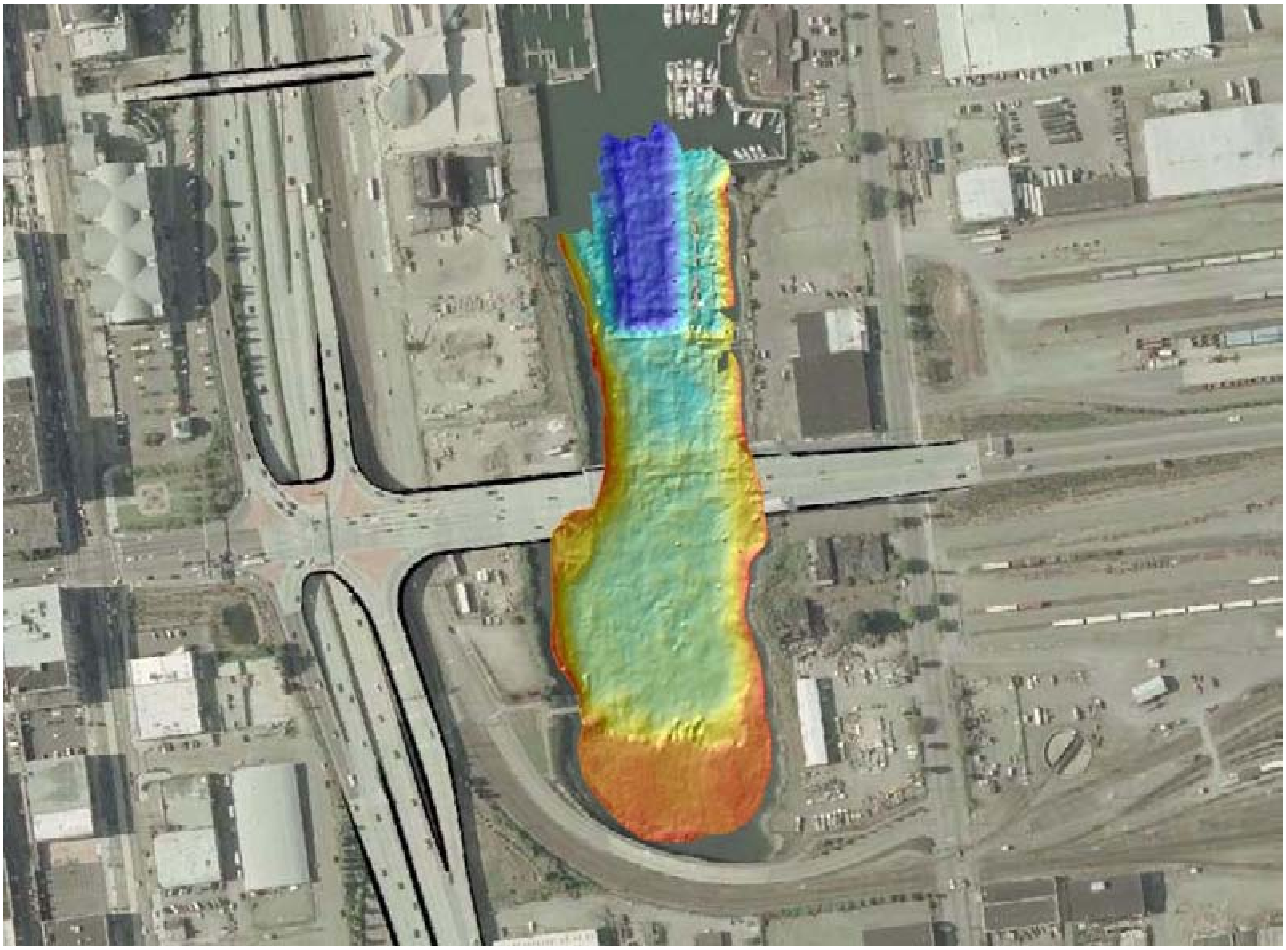
Figure 19 – Outfall 235 and Scour Protection

Figure 20 – Close-up of Outfall 235

APPENDIX C

BATHYMETRY REPORT

Puget Sound Energy / PacifiCorp
Head of the Thea Foss Bathymetry Survey



May 2006

Prepared by:
TetraTech EC, Inc.
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Bothell, WA 98011
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1 Overview

The following document describes a survey which was conducted for Puget Sound Energy and PacifiCorp Environmental Remediation Company, by TetraTech EC, Inc, on May 10, 2006, under contract M1108. The primary survey equipment was a multibeam sonar system. This system was used to provide a high resolution, full bottom coverage, bathymetry map. Table 1 lists the personnel and their roles in the survey.

Table 1 – Survey team

Company	Personnel
TetraTech EC, Inc.	Robert Feldpausch - Hydrographer Burton Bridge - Hydrographer
Sound Vessels, Inc.	Lou Schwartz – Vessel Captain

2 System Setup

The survey systems were installed on the R/V *Brendan D II*, a 32 foot research vessel owned by Sound Vessels, Inc., of Port Townsend, WA. A picture of the vessel is shown in Figure 1. The equipment used for the survey is shown in Table 2. Data sheets for the main survey systems are included in Attachment B.

Table 2 - Survey Equipment

Sensor Type	Manufacturer/Model
Multibeam Sonar	RESON SeaBat 8101
Motion Sensor	Applanix WaveMaster
Heading	Applanix WaveMaster
Position	Applanix WaveMaster
Sound Speed Profiler	SeaBird SBE-19
Tide Corrections	Leica 1230 RTK GPS

Data collection and navigation software for the bathymetry survey was Hypack®/Hysweep®. Software settings for bathymetry data acquisition include the serial I/O configuration and sensor offsets in Hypack, and Hypack Navigation device offsets in the Hysweep hardware configuration.

Figure 1 - R/V Brendan D

2.1 Interconnections

Figure 2 shows the data flow and communications setup for the devices which make up the survey system. Table 3 lists the settings for each of the data communication links.

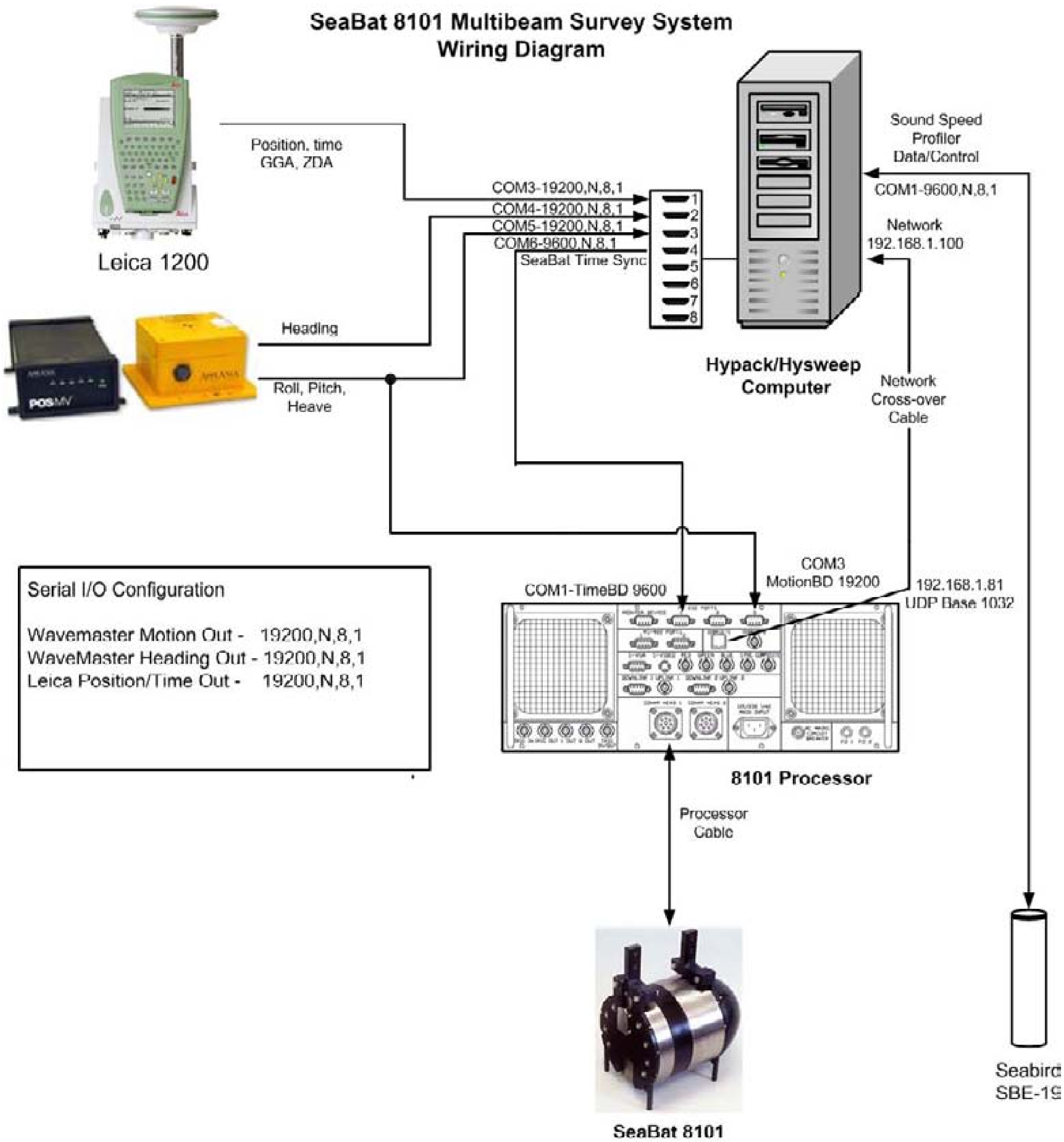


Figure 2 – 8101 Multibeam Survey System

Table 3 - Communications Settings

Device	Communications link	Settings
8101 SeaBat	Network imagery data out	Local IP 192.168.1.81 Remote IP 192.168.1.100 UDP base port 1032
8101 SeaBat	UTC time sync in	COM 1 – 9600, N, 8, 1
Applanix WaveMaster	TSS1 roll, pitch, heave out	19200, N, 8, 2, 50 Hz update
Applanix WaveMaster	NMEA HDT heading	19200, N, 8, 1, 5 Hz update
Applanix WaveMaster	NMEA GGA position	19200, N, 8, 1, 5 Hz update
Applanix WaveMaster	NMEA ZDA time	19200, N, 8, 1, 1 Hz update
Leica RTK	NMEA GGA RTK height	19200, N, 8, 1, 10 Hz update

2.2 Device Offsets

Device offsets are precisely defined for the multibeam sonar, attitude sensor and GPS antenna, so that the Hypack/HySweep acquisition software can accurately convert the input sonar and support sensor data into XYZ soundings on the earth.

2.2.1 Hypack/Hysweep Offsets

The following offsets, in feet, were used for the Hysweep sensors:

Table 4 - Sensor Offsets (feet)

Sensor	Across	Along	Vertical
SeaBat 8101	1.84	0.00	2.95
Motion Sensor (Applanix WaveMaster)	0.00	0.00	-4.50
Hypack Navigation (Applanix WaveMaster)	0.00	0.00	-4.50
RTK Height (Leica RTK antenna)	1.84	0.00	-11.78

2.3 Sonar Mount

The sonar head was mounted to the vessel using a side mount pole. The mount is rigidly attached to the side of the vessel, with the Leica GPS antenna mounted on an extension pole, directly above the sonar.

2.4 Geodesy Settings

The geodesy settings shown in Table 5 were used for the project.

Table 5 - Survey Geodesy Settings

Parameter	Setting	
Grids	State Plane NAD-83	
Zone	WA-4602 Washington South	
Distance Unit	US Survey Feet	
Depth Unit	US Survey Feet	
Geoid	NGVD 29	
Vertical Datum	MLLW - Epoch 1960-1978	
Base Station Position	Benchmark: Position: Benchmark Height: Antenna Height:	IS27-119 1160648.604 E 701382.869N 42.165 (re. MLLW) 4.4652 ft (1.361 m)
Vertical Control	Benchmark: Type: Location: Elevation:	City of Tacoma 1823/3547 Brass Monument Puyallup Ave. & East C St. 36.441 ft (m) MLLW

The elevations output by the Leica RTK were referenced to MLLW. Epoch 1960 - 1978.

2.5 GPS Reference Station

The local Coast Guard DGPS differential signal was used with the Applanix WaveMaster for X and Y positions (i.e. northing and easting). This device was used in preference to the RTK GPS due to its built-in inertial platform that allows it to maintain usable position tracking during brief periods of loss of GPS satellite signals. This was required to enable the survey to include areas under the SR-509 Bridge, which blocked the signals to most or all the GPS satellite constellation while the vessel pasted under the bridge.

A GPS RTK base station was set up at the benchmark on Puyallup Ave., as shown in Figure 3. This system provided vertical positioning which was used to correct sounding data to MLLW, Epoch 1960 – 1978 (i.e. the RTK GPS was used as a tide gauge).

Figure 3 - RTK GPS Base Station

3 Patch Test Results

A standard patch test was carried out within the survey area to determine the calibration offsets between the multibeam echosounder and the motion reference unit. The offsets shown in Table 6 were calculated from the patch test which was conducted on 10 May 2006. These offsets were applied in the data processing software to correct residual misalignments in the mechanical installation of the sensors, and to compensate for any latency in the positioning system.

Table 6 - Patch Test Results

Parameter	Value
Roll	1.10
Pitch	0.9
Yaw	-1.0
Latency	0.0 sec

4 Bathymetry Results

The results from the multibeam bathymetry survey are shown in Figure 4 and in Attachment A. Attachment C contains the survey collection logs.

4.1 Historical Bathymetry Data (February 2004)

At the completion of remedial action activities in the Head of the Thea Foss Waterway in February 2004 a bathymetry survey was conducted. This survey was conducted by Dalton, Olmsted, & Fuglevand, Inc. (DOF) with a single beam echosounder (SBE). This system consisted of a Knudsen 320M echosounder with an 8 degree, 200 kHz transducer and a Trimble differential GPS. Vertical positioning was provided using a combination of an onsite staff and electronic tide gauges. Positioning below the 509 bridge was provided with a Leica total station.

4.2 Single Beam/Multibeam Comparisons

There are several factors which make it difficult to compare single beam and multibeam sonar bathymetry survey results. These factors include the following:

- Coverage – While multibeam sonars provide 100% coverage of the seafloor, single beam soundings are sparse. Single beam sonar data is sparse because it is collected along transect lines, rather than as swath, requiring interpolation of depths between the lines. Except in areas were bathymetry is very flat, the practical difficulties in following precisely the same transect line during multiple single beam surveys makes it problematic to reproduce single beam results. As a result of this different surfaces and calculated change (i.e. sediment scour and/or deposition) are likely to occur between single beam surveys as well as between single beam and multibeam surveys.
- Beam Geometry – Typically, multibeam sonars have much narrower beams than single beam sonars and show much greater detail. Also, single beam sonars are typically designed to return the value of the first return that exceeds a threshold, rather than the average depth within the beam, which is the case for most multibeam systems. On slopes, or over varying topography, single beam systems tend to be shallow biased, with the biasing effect increasing with the beamwidth of the sounder.

- Sonar Frequency - Transducer frequencies vary between single beam sonar systems, as well as between single and multibeam sonar systems. In the case of the February 2004 single beam survey and the May 2006 multibeam surveys the transducer frequencies were very similar, 200 kHz and 255 kHz respectively. The bottom return from these slightly different frequencies is negligible.
- Horizontal Positioning – Both surveys were conducted with DGPS which typically provides positional accuracies of +/- 3-ft or better.
- Vertical Positioning – The February 2004 survey utilized a combination of an onsite staff and electronic tide gauges, while the May 2006 survey used a RTK GPS. The variation in vertical positioning methods may have resulted in differences of reported depths at any given position on the order of approximately 0.1 ft or less.
- Processing artifacts – The interpolation of single beam data, to fill in the gaps between soundings, may also result in an inaccurate representation of the seafloor. Features, such as mounds or depressions that occur between single beam tracklines, will not be represented accurately in the interpolated surface.

4.3 Survey Results

Figure 5 shows a plot, color coded for changes in elevations of the bottom, for the southern section of the Thea Foss Waterway. Figure 6 shows the cross section profile results for the cross section lines shown in Figure 5.

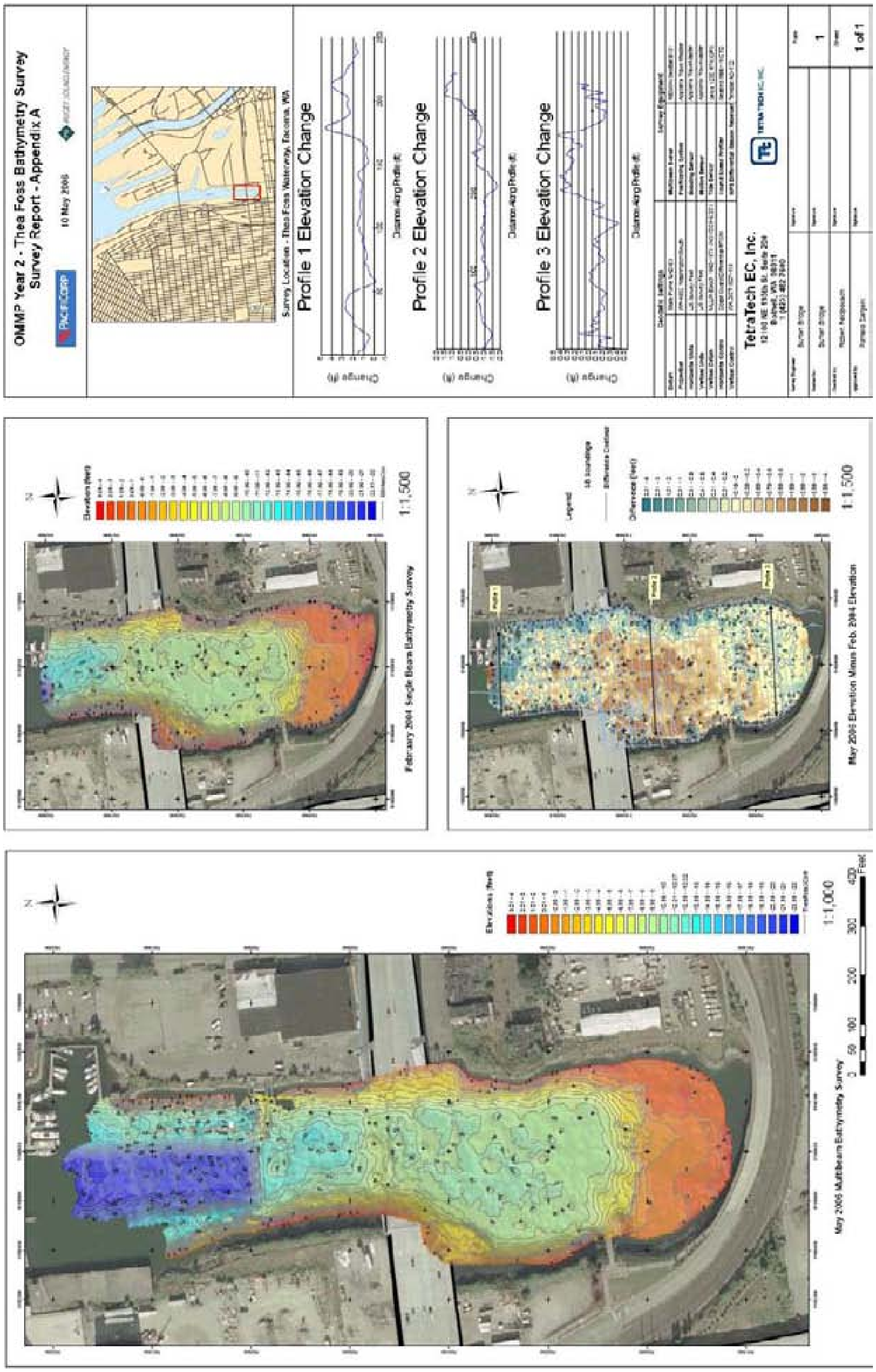


Figure 4 - Thea Foss Bathymetry – May 2006

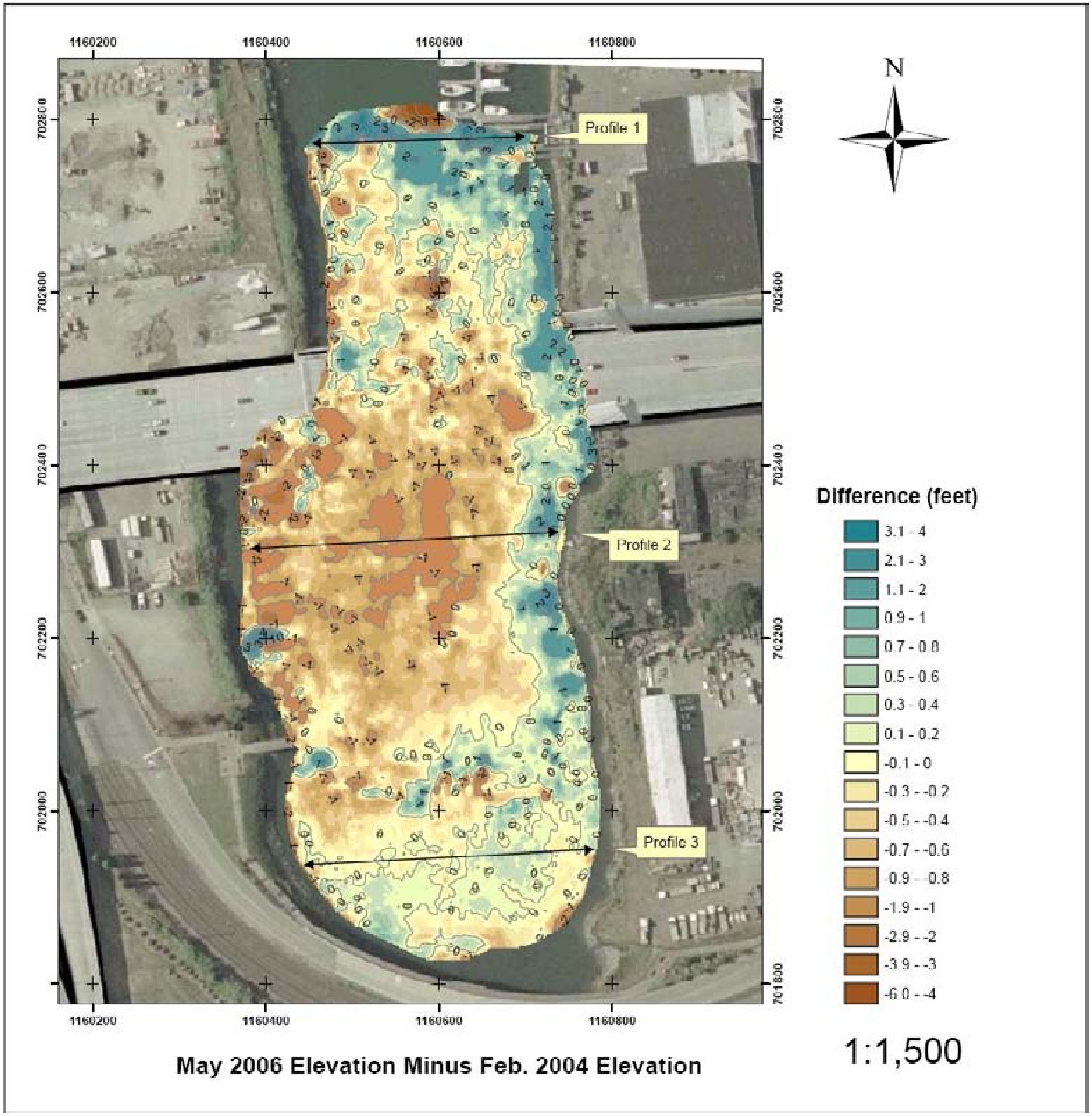


Figure 5 - Elevation Change Plot

Profile 1 shows an increase in elevation where capping materials were placed in December 2005, after the single beam survey was conducted. Profile 2 is through an area that had capping material placed a short time prior to the single beam survey in February 2004. The reduction in elevations in this area is most likely due to consolidation of the deposited sand and gravel capping material and/or the underlying sediment over the last 1.5 years and is consistent with the consolidation calculations made during design. Profile 3 is in an area where capping material and slope armor material (e.g. rock) were placed to the design grades. Consolidation calculations during design in this area predicted < 3 in of consolidation. This is consistent with the bathymetry results. The minimal differences along the western half of the profile are probably due to the differences in the equipment and procedures between the surveys (refer to Section 4.2). The increase in elevation just east of center in Profile 3may be a result of sediment deposit from the outfall at the south end of the waterway.

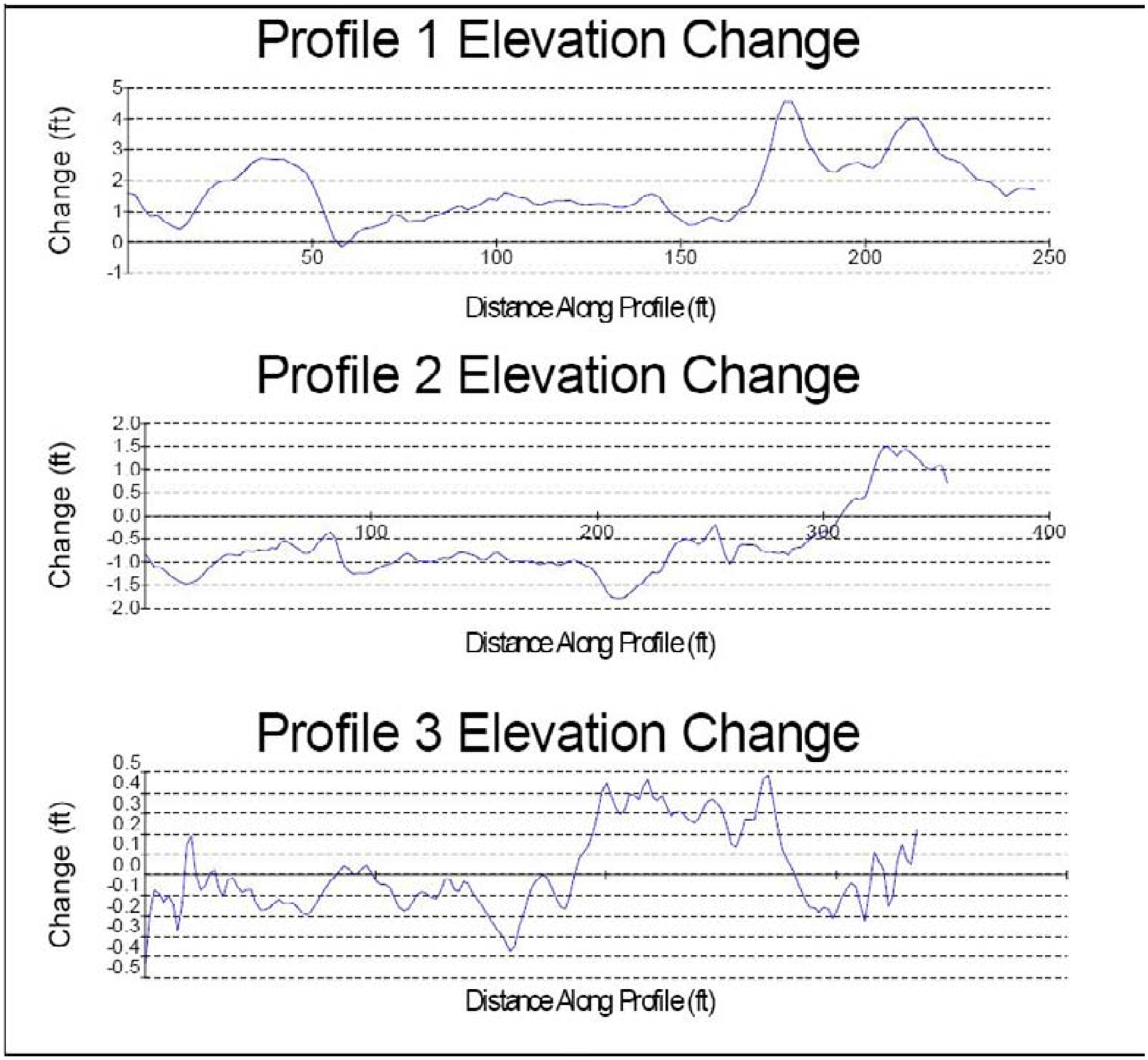
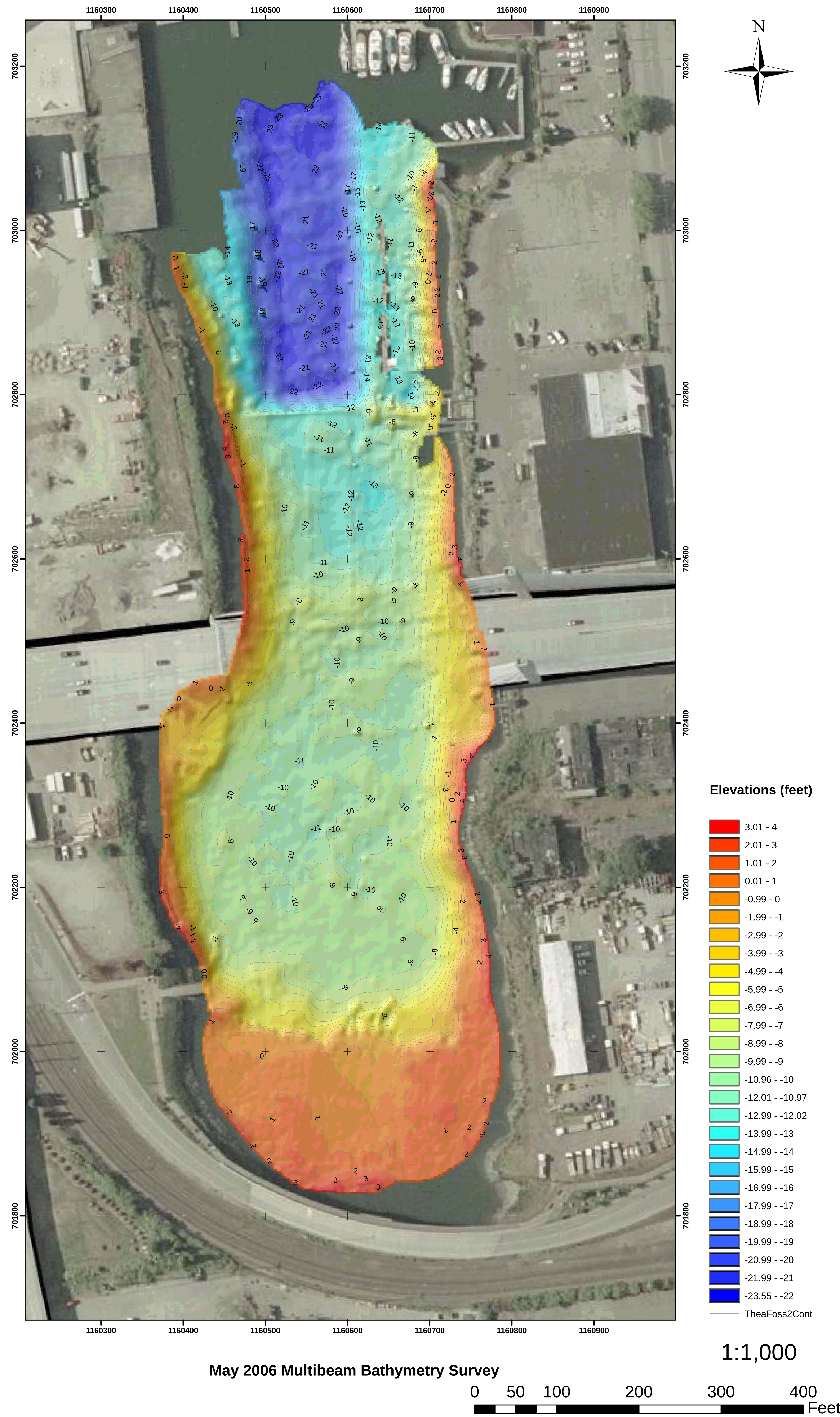


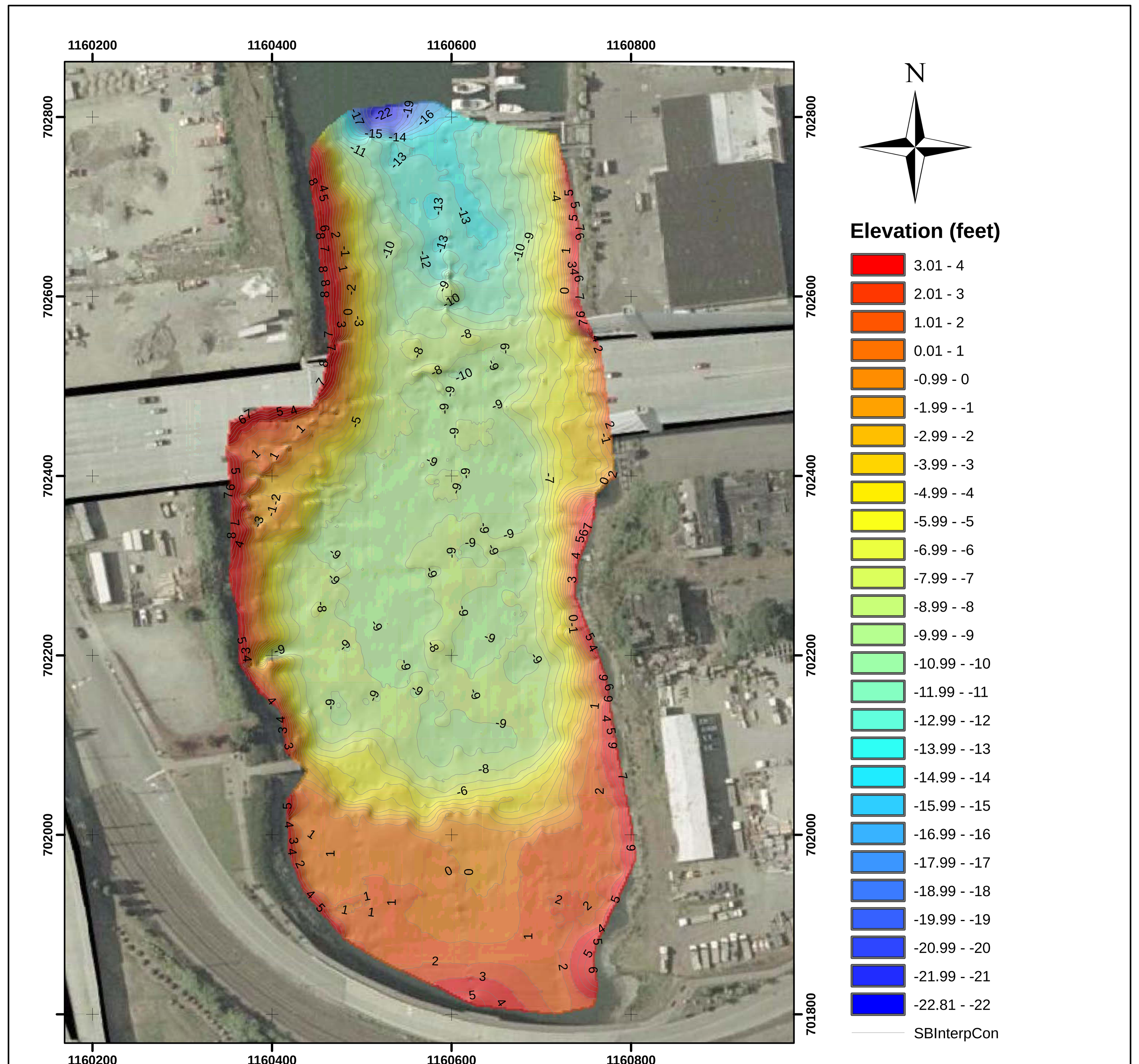
Figure 6 - Elevation Difference Profiles

OMMP Year 2 - Thea Foss Bathymetry Survey
Survey Report - Appendix A

PACIFICORP | 10 May 2006 | PUGET SOUND ENERGY

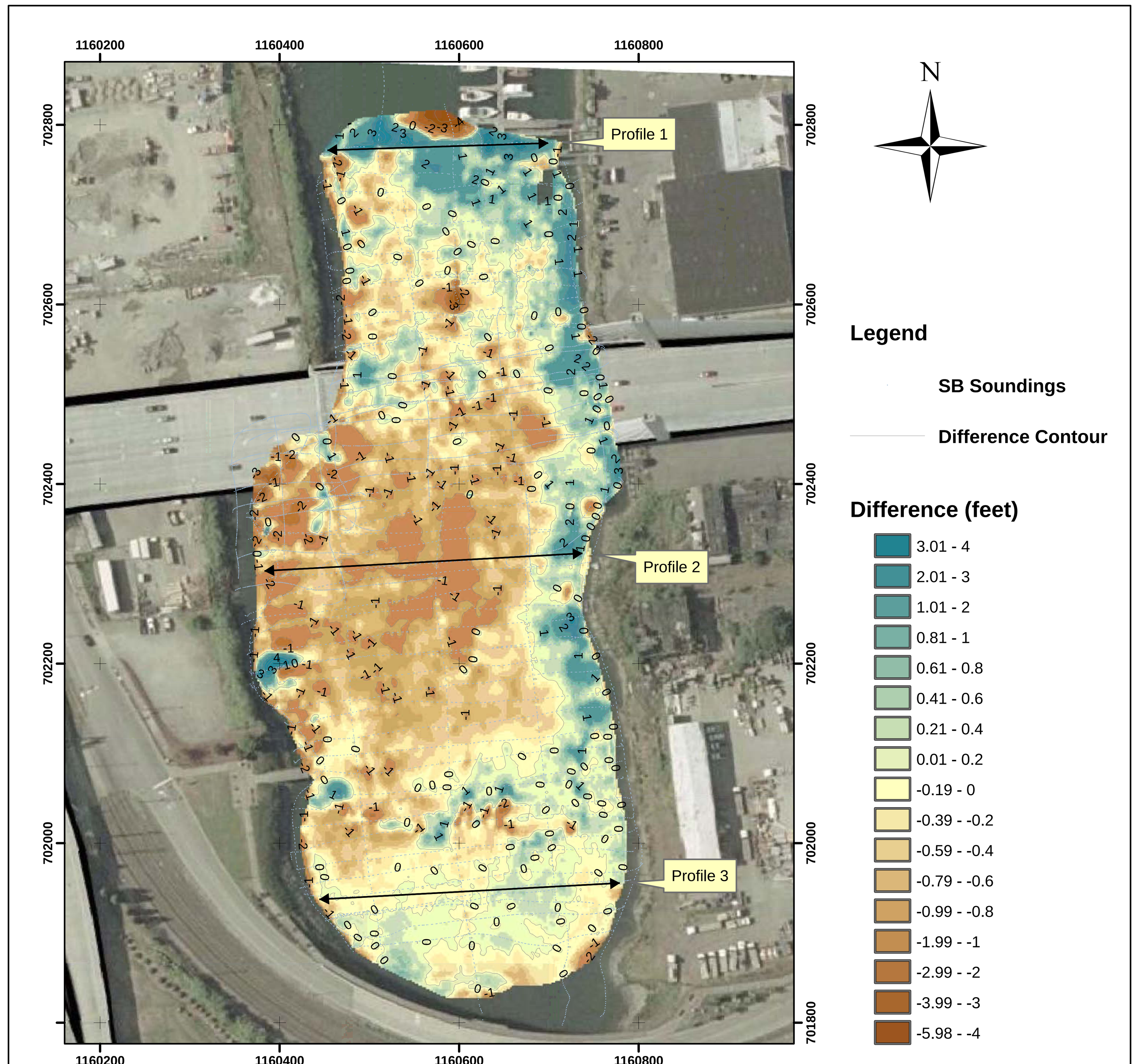


May 2006 Multibeam Bathymetry Survey



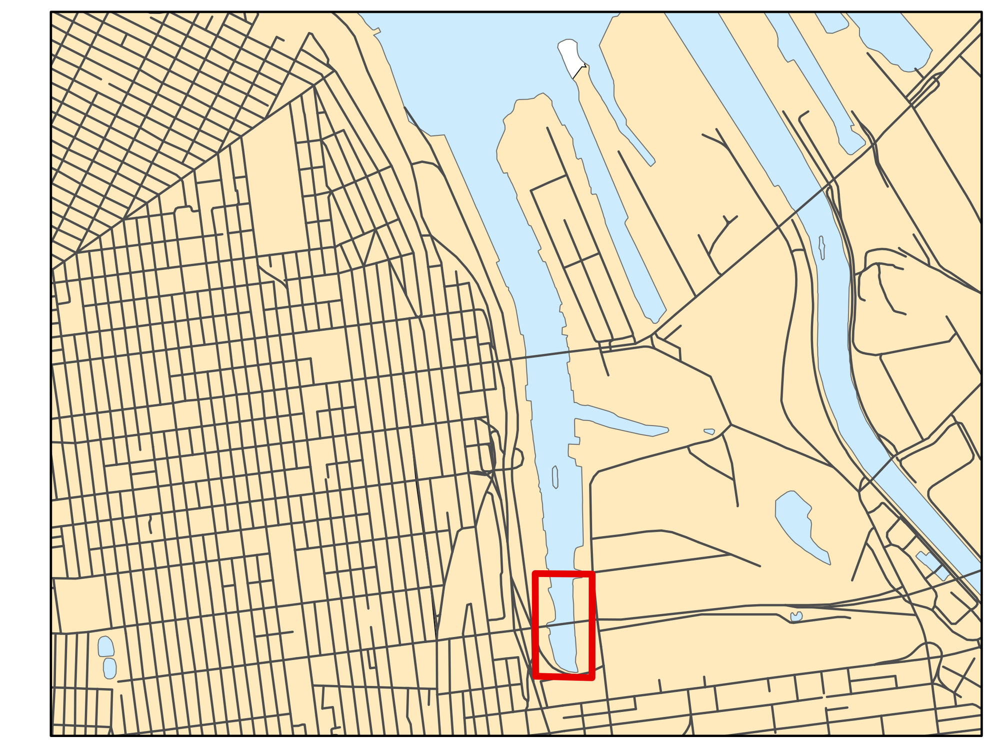
February 2004 Single Beam Bathymetry Survey

1:1,500

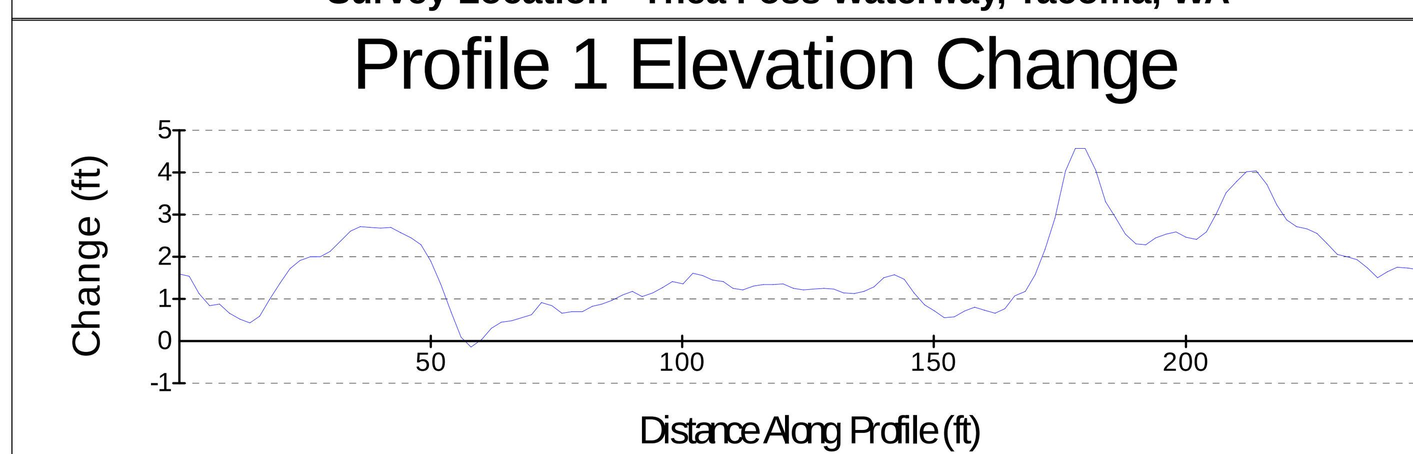


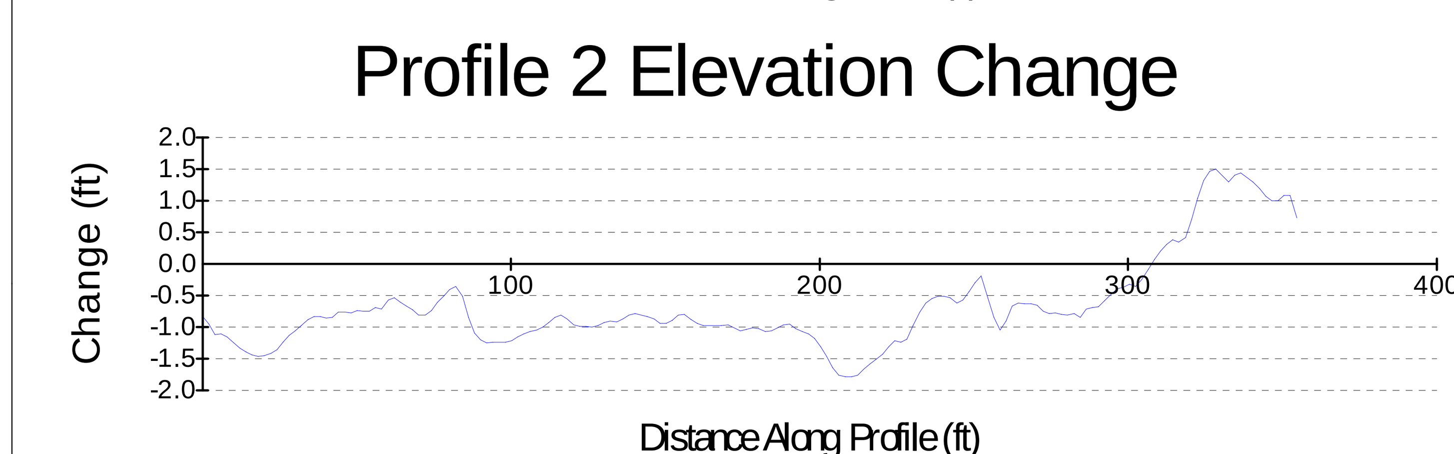
May 2006 Elevation Minus Feb. 2004 Elevation

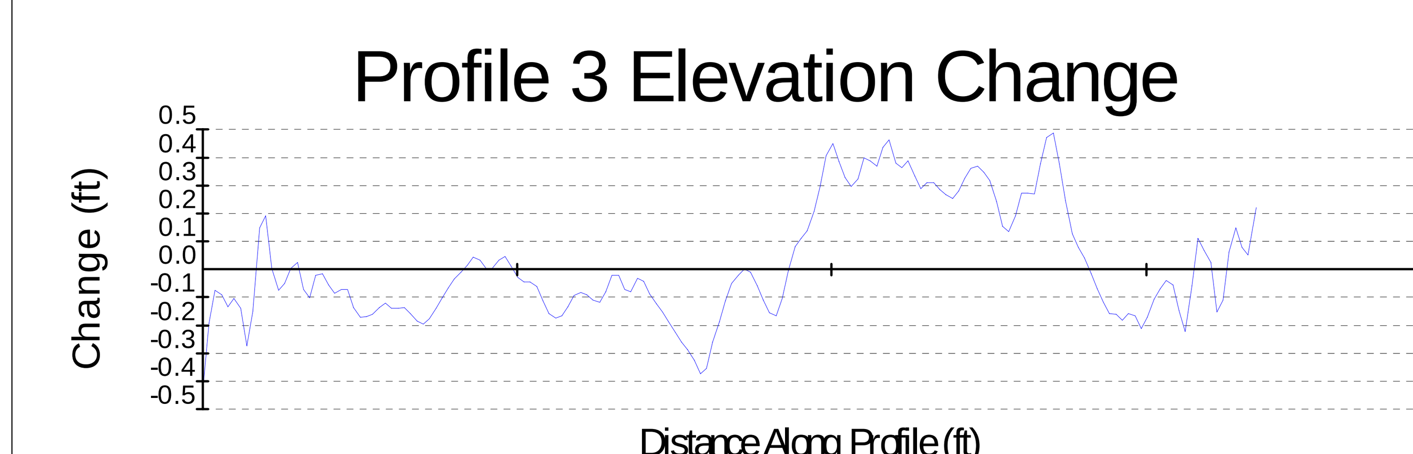
1:1,500



Survey Location - Thea Foss Waterway, Tacoma, WA







Geodetic Settings		Survey Equipment	
Datum	State Plane NAD-83	Multibeam Sonar	RESON SeaBat 8101
Projection	WA-4602 Washington South	Positioning System	Applanix Wave Master
Horizontal Units	US Survey Feet	Heading Sensor	Applanix WaveMaster
Vertical Units	US Survey Feet	Motion Sensor	Applanix WaveMaster
Vertical Datum	MLLW Epoch 1960-1978 (NGVD29-6.33')	Tide Sensor	Leica 1230 RTK GPS
Horizontal Control	Coast Guard Differential RTCM	Sound Speed Profiler	Seabird SBE-19 CTD
Vertical Control	WA DOT IS27-119	GPS Differential Beacon Receiver	Trimble AG-132

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TETRA TECH EC, INC.

Survey Engineer: Burton Bridge	Signature	Plate: 1
Drafted by: Burton Bridge	Signature	
Checked by: Robert Feldpausch	Signature	Sheet: 1 of 1
Approved by: Pamela Sargent	Signature	

P:\projects_2006\Thea Foss\maps\Thea Foss Ver1.mxd

Attachment B. Equipment Data Sheets

The following are copies of the equipment data sheets provided by the manufacturers of some of the systems used in the survey.

RESON

SeaBat 8101

Multibeam Echosounder

SeaBat 8101

- Phase and amplitude bottom detection
- Circular array: all beams 1.5°
- 150° swath coverage (upgradeable to 210°)
- 240kHz frequency
- Up to 600m swath width (with Option 040)
- Meets IHO & USACE Class 1 standards

The SeaBat 8101 Multibeam Echosounder measures discrete depths, enabling complex underwater features to be mapped with precision. Dense coverage is achieved utilizing up to 4,000 soundings per second for a swath up to 600 meters in width, even as the survey vessel travels at speeds in excess of 12 knots.

With high accuracy and a measurement rate of up to 40 profiles per second, the SeaBat 8101 enables surveys to be completed faster and in greater detail than previously realized.

The SeaBat 8101 transducer is available for operating depths of 120, 300, 1500, and 3,000 meters. Small and lightweight, it can be mounted on underwater vehicles (ROV or towed) and transported to locations where accurate measurements are required.

www.reson.com

SeaBat 8101
Multibeam Echosounder

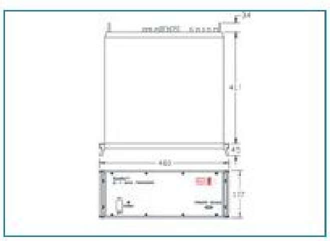
SYSTEM PERFORMANCE		
Operating Frequency:	240kHz	
Swath Coverage:	150°	(upgradeable to 210°)
Max Range:	300m 450m max range available with ER option	
Number of Beams:	101, beamspacing 1.5°	
Along-Track Beamwidth:	1.5° (all beams)	
Across-Track Beamwidth:	1.5° (all beams)	
Max. Update Rate:	40	
Operational Speed:	Up to 18 knots	

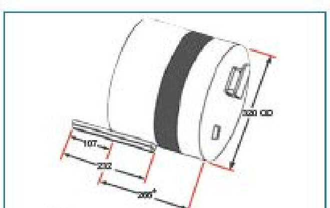
PROCESSOR SPECIFICATIONS		
Power Required:	100/240VAC, 47/63Hz, 100W maximum	
Data Uplink:	High-speed digital coax with fiber-optic option	
Computer Interface:	10MB Ethernet and RS232C	
Data Downlink:	Serial, 19.2k baud	
Display Video Out:	SVGA: 800 x 600;	
	Refresh Rate:	~72Hz
Graphics Colors:	Sonar Image:	256 Colors
	Other Graphics:	8-bit RGB
Input Device:	3-Button Trackball	
Dimensions (HWD):	177 x 483 x 417mm	
Mounting:	19in. rack mountable	
Temperature:	Operating: 0° to +40°C	Storage: -30° to +55°C
Weight:	20kg (44 lbs.)	

DISPLAY SPECIFICATIONS	
Screen Size:	14" diagonal
Display:	SVGA High-Resolution, Color Monitor
Power Consumption:	80W
Weight:	11.2kg (24.6lbs.)

SONARHEAD SPECIFICATIONS		
Power Requirements:	24VDC, 2 amps max. (Power available from Processor.)	
Operating Depth:	120m (300,1500, and 3000m available)	
Dimensions:	266 x 320mm (W / D) excluding projector	
Temperature:	Operating:	-5° to +40°C
	Storage	-30° to +55°C
Weight (aluminum):	Dry: 26.8kg (59lbs.)	Wet: 4.8kg (10.6lbs.)
Weight (titanium):	Dry: 40kg (88lbs.)	Wet: 18kg (39.6lbs.)

OPTIONS	
Sidescan ugrade	Mounting plate assembly
Fairings	Spares kit
Titanium housing	210° swath
Extended-Range (ER) projector	Coax to fiber optic interface unit
Increase sonar head depth rating	





*Option 049: 274mm

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E-mail: reson@reson.co.za

www.reson.com

Version: 8007 051103 / US

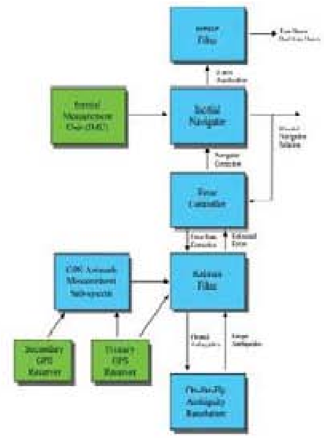
POS MV™ WaveMaster

Providing Survey Launch Marine Industry with robust, reliable, and repeatable position and orientation solutions in all dynamics

Accurate Position and Orientation Solution
POS MV WaveMaster designed for survey launch vessels, maintains positioning accuracy under the most demanding conditions. With its high data update rate, the system delivers a full six degree-of-freedom position and orientation solution to provide the following:

- Position (latitude, longitude and elevation)
- Velocity (north, east and vertical)
- Attitude (roll, pitch and true heading)
- Heave (real-time, delayed)
- Acceleration Vectors
- Angular Rate Vectors

The new POS MV WaveMaster generates a tightly-integrated solution for smaller vessels, which means the system's Inertial Navigator will provide continuous positioning information while surveying in areas where GPS reception is compromised by multipath effect and signal loss. Raw GPS data from as few as one satellite can now be processed directly within the WaveMaster.



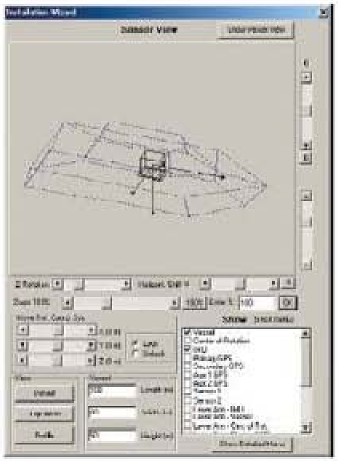
Tightly Coupled POS MV WaveMaster

Tightly-coupled integration offers the following advantages:

Advantage – Strengthens the system's ability to provide continuous, accurate data in areas with intermittent GPS reception
Advantage – Reduces position drift
Advantage – Enables almost instantaneous RTK re-acquisition (with internal RTK option)

WaveMaster Features and Benefits:

- Uses the latest GPS receiver technology from Trimble:
  - Maxwell™ chip technology
  - Everest™ multipath elimination technology
  - 10Hz raw observables for post processing
  - Outstanding positioning performance and low elevation satellite tracking accuracy
- TrueHeave – Applanix's ground breaking delayed time heave processor
  - Removes processing artifacts but not real motion
  - No tuning required for varying sea conditions
  - Provides online quality measurement
- Faster CPU (700Mhz)
  - Low system loading allows for enhanced capabilities in the future
  - Runs at less than 10% of its total capacity to allow for upgrades and additional features
- TCP/IP protocol for raw data logging
  - Reliable logging of all raw data with microsecond-accurate time stamping
  - POSPac ready (for post-mission analysis)
- Firmware migration path
  - Access to new releases with new features as they become available
- New small, compact form-factor
- New Graphical User Interface
  - Makes installation and setup intuitive
  - Reduces operator error



POS MV WaveMaster Graphical User Interface

SYSTEM COMPONENTS

POS Computer System (PCS)
A rugged, compact computer system contains the core POS processor and IMU interface electronics, plus two GPS receivers. The PCS provides all motion variables and timing data at high rate and/or provides motion compensation and georeferenceing data to all multibeam systems.

POS Inertial Measurement Unit
The system's primary sensor is a Ring Laser Gyro (RLG) manufactured by one of the world's experts in inertial technology. This high performance, low drift rate gyro ensures that the attitude data remains robust as the dynamics increase.

Primary and Secondary GPS Antennas
Dual frequency antennas for use with GAMS and/or RTK.

APPLANIX
A TRIMBLE COMPANY

POS MV™ WaveMaster

POS MV WAVEMASTER MAIN SPECIFICATIONS (with Differential Corrections)

Roll, Pitch accuracy:	0.03° (1 sigma with GPS or DGPS) 0.02° (1 sigma with RTK)
Heave Accuracy:	5 cm or 5% (whichever is greater) for periods of 20 seconds or less
Heading Accuracy:	0.06° (1 sigma) with 1 m antenna baseline, 0.03 (1 sigma) with 2 m baseline, 0.015 (1 sigma) with 4 m baseline
Position Accuracy:	0.5 - 2 m (1 sigma) depending on quality of differential corrections; 0.02 - 0.10 m (RTK) with input from auxiliary RTK or optional internal RTK receiver
Velocity Accuracy:	0.05 m/s horizontal

POS MV WAVEMASTER DURING GPS OUTAGES

Roll, Pitch accuracy:	0.04° (1 sigma)
Heave accuracy:	5 cm or 5% (whichever is greater) for wave periods of 18s or less
Heading accuracy:	Drift less than 2° per hour
Position accuracy degradation:	3 m (1 sigma) for 30 s outages; <10 m (1 sigma) for 60 s outages

PHYSICAL CHARACTERISTICS

Size

IMU	160mm x 160mm x 102mm
PCS	281mm x 165mm x 90mm
GPS Antenna (2)	187mm x 53mm

Weight

IMU	3.6kg
PCS	3.0kg
GPS Antenna	<0.5kg

Power

IMU	Power provided by PCS
PCS	24vdc, 50 W (peak)
GPS Antenna	Power provided by PCS

ENVIRONMENTAL

Temperature Range (Operating)

IMU	-40 °C to +60 °C
PCS	-20 °C to +60 °C
GPS Antenna	-40 °C to +70 °C

Temperature Range (Storage)

IMU	-40 °C to +60 °C
PCS	-20 °C to +60 °C
GPS Antenna	-40 °C to +70 °C

Humidity

IMU	10-80% RH, Ingress Protection of 65
PCS	5-90% RH, non-condensing
GPS Antenna	0-100% RH

Ethernet (100 base-T)

Parameters	Time tag, status, position, attitude, heave, velocity, track and speed, dynamics, performance metrics, raw IMU data, raw GPS data
Display Port	Low rate (1 Hz) UDP protocol output
Control Port	TCP/IP input for system commands
Data Port 1	Real-time (up to 200 Hz) UDP protocol output
Data Port 2	Buffered TCP/IP protocol output for data logging to external device

Serial RS232 I/O

5 COM Ports	User assignable to: NMEA output, Binary output, Auxiliary GPS input (2), Base GPS correction input (2)

NMEA ASCII Output

Parameters	NMEA Standard ASCII messages: Position ($INGGA, $INGGK), Heading ($INHDT), Track and Speed ($INVTG), Statistics ($INGST), Attitude ($PASHR, $PRDID), Time and Date ($INZDA, $UTC).
Rate	Up to 50 Hz (user selectable)

High Rate Attitude Output

Parameters	User selectable binary messages: attitude, heading, speed
Rate	Up to 100 Hz (user selectable)

Auxiliary GPS Inputs

Parameter	NMEA Standard ASCII messages: $GPGGA, $GPGST, $GPGSA, $GPGSV. Uses Aux input with best quality.
Rate	1 Hz

Base GPS Correction Inputs

Parameter	RTCM 1, 9, 18, 19, CMR and CMR+ input formats accepted. Combined with raw GPS observables in tightly coupled navigation solution.
Rate	1 Hz

Digital I/O

1PPS Output	1 pulse-per-second Time Sync output, normally high, active low pulse
Event Input (2)	Time mark of external events. TTL pulses > 1 msec width, rising or falling edge, max rate 200 Hz.

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APPLANIX
A TRIMBLE COMPANY

Leica GPS1200
Technical specifications and system features

GPS1200 receivers	GX1230 GG/ATX1230 GG	GX1230/ATX1230	GX1220	GX1210
GNSS technology	SmartTrack+	SmartTrack	SmartTrack	SmartTrack
Type	Dual frequency	Dual frequency	Dual frequency	Single frequency
Channels	14 L1 + 14 L2 GPS 2 SBAS 12 L1 + 12 L2 GLONASS 72 Channels	12 L1 + 12 L2 GPS 2 SBAS	12 L1 + 12 L2 GPS 2 SBAS (with DGPS option)	12 L1 2 SBAS (with DGPS option)
RTK	SmartCheck+	SmartCheck	No	No
Status indicators	3 LED indicators: for power, tracking, memory			

GPS1200 receivers	GX1230 GG/GX1230/GX1220	GX1210	ATX1230 GG/ATX1230
Ports	1 power port, 3 serial ports, 1 controller port, 1 antenna port		1 power/controller port, Bluetooth® port
Supply voltage,	Nominal 12 VDC		Nominal 12 VDC
Consumption	4.6 W receiver + controller + antenna		1.8 W
Event input and PPS	Optional:	Optional:	
	1 PPS output port	1 PPS output port	
	2 event input ports	2 event input ports	
Standard antenna	SmartTrack+ AX1202 GG	SmartTrack AX1201	SmartTrack+ ATX1230 GG
Built-in groundplane	Built-in groundplane	Built-in groundplane	Built-in groundplane

The following apply to all receivers except where stated.

Power supply	Two Li-Ion 3.8 Ah/7.2 V plug into receiver. One Li-Ion 1.9 Ah/7.2 V plugs into ATX1230 and RX1250.
Plug-in Li-Ion batteries Same for GPS and TPS	Power receiver + controller + SmartTrack antenna for about 15 hours (for data logging).
	Power receiver + controller + SmartTrack antenna + low power radio modem or phone for about 10 hours (for RTK/DGPS). Power SmartAntenna + RX1250 controller for about 5 hours (for RTK/DGPS)
External power	External power input 10.5 V to 28 V.
Weights	Receiver 1.20 kg. Controller 0.48 kg (RX1210) and 0.75 kg (RX1250). SmartTrack antenna 0.44 kg. SmartAntenna 1.12 kg. Plug-in Li-Ion battery 0.09 kg (1.9 Ah) and 0.19 kg (1.9 Ah).
	Carbon fiber pole with SmartTrack antenna and RX1210 controller: 1.80 kg.
	All on pole: carbon fiber pole with SmartAntenna. RX1250 controller and plug-in batteries. 2.84 kg.

Temperature ISO9022 MIL-STD-810F	Operation:	Receiver	−40°C to +65°C
		Antennas	−40°C to +70°C
		Controllers	−30°C to +65°C
	Storage:	Receiver	−40°C to +80°C
		Antennas	−55°C to +85°C
		Controllers	−40°C to +80°C
Humidity ISO9022, MIL-STD-810F	Receiver, antennas and controllers Up to 100% humidity.		
Protection against water, dust and sand IP67, MIL-STD-810F	Receiver, antennas and controllers: Waterpoof to 1 m temporary submersion. Dust tight		
Shock/drop onto hard surface	Receiver withstands 1 m drop onto hard surface. Antennas: withstand 1.5 m drop onto hard surface.		
Topple over on pole	Receiver, antennas and controllers: withstand fall if pole topples over.		
Vibrations ISO9022 MIL-STD-810F	Receiver, antennas and controllers: withstand vibrations on large construction machines. No loss of lock.		

Attachment C. Survey Log Sheets

TetraTech EC								
Date:	5/10/2006		Survey Area:	Thea Foss		Page 1 / Pages:		
Survey Name:	Thea Foss		Surveyors:	Bridge, Feldpausch		TimeZone:	GMT	
Survey Vessel:	R/V Brendan D		Client:	Tetra Tech EC				

Offset Information

	X	Y	Z	Latency	Roll	Pitch	Yaw
Sounder	1.84	0.00	2.95	0.00	1.10	0.90	-1.00
RTK GPS	1.84	0.00	-11.78	0.00			
Motion Sensor	0.00	0.00	-4.50				
WaveMaster Nav	0.00	0.00	-4.50				

SVP File: 051006 1904 Thea F
Tide File: RTK GPS

Total Pole 14.73
minus Dry Pole 11.78
Draft (Z) 2.95

Date of Patch Test 5/10/2006

Start	Stop	Line (.raw)	Dir.	Speed	COMMENTS
2250	2306	001_2250	355	2	back down inside of dock
0007	0016	001_0007	177	2	PosMV/RTCM position, Leica tide
0016	0035	001_0016	176	2	
0036	0045	001_0036	350	2	
0046	0059	001_0046	174	3	
0100	0123	001_0100	85	2	
0123	0125	001_0123	344	2	
0126	0131	001_0126	203	2.5	
0132	0150	001_0132	135	2	
0152	0154	001_0152	33	2.7	
019	20	001_0202	2	2.3	
0204	22	001_0204	320	2	
0222	0229	001_0222	256	1	in boat launch area - backing in
0232	0236	001_0232	76	1	in boat launch area - bow in

Survey Manager: ____________ Client Representative: ____________
Signature: ____________ Signature: ____________

APPENDIX D

FIELD NOTES

APPENDIX D.1

SAMPLE LOG FORMS

(Located on Enclosed CD)

APPENDIX D.2

SAMPLE PHOTOS

(Located on Enclosed CD)

Appendix D.2 Field Photos

File Name	Subject	Date
Picture 001	Camera with WC-14 behind	5/11/2006
Picture 002	Twin 96ers & head of waterway	5/11/2006
Picture 003	Camera with WC-01 behind	5/11/2006
Picture 004	Y2-R01B-BE	5/12/2006
Picture 005	Y2-R01B-BD	5/12/2006
Picture 006	Y2-R01B-BC	5/12/2006
Picture 007	Y2-R01B-BA	5/12/2006
Picture 008	YR-R01B-BA repeat	5/12/2006
Picture 009	Y2-R01B-BD	5/12/2006
Picture 010	Y2-R01B-BB	5/12/2006
Picture 011	Y2-R01B-BC	5/12/2006
Picture 012	Worm at Y2-R01B-BC	5/12/2006
Picture 013	Y2-R01B-BE	5/12/2006
Picture 014	Worm at Y2-R01B-BE	5/12/2006
Picture 015	Worm at Y2-R01B-BE	5/12/2006
Picture 016	Snail at Y2-R01B-BA	5/12/2006
Picture 017	Y2-R02-BA	5/12/2006
Picture 018	Y2-RC04-SB	5/12/2006
Picture 019	Y2-R02-BB	5/12/2006
Picture 020	Y2-R04-BA	5/12/2006
Picture 021	Y2-RC-11	5/12/2006
Picture 022	Y2-R04-BB	5/12/2006
Picture 023	Y2-WC11-S	5/12/2006
Picture 024	Y2-WC11-S	5/12/2006
Picture 025	Y2-R04-BE	5/12/2006
Picture 026	Y2-RC08-SA	5/12/2006
Picture 027	Y2-WC08-SA	5/12/2006
Picture 028	Y2-WC08-SB	5/12/2006
Picture 029	Y2-RC02-SA	5/12/2006
Picture 030	Y2-RC02-SA	5/12/2006
Picture 031	Y2-WC02-S	5/12/2006
Picture 032	Y2-WC02-SB	5/12/2006
Picture 033	Y2-S17-S	5/12/2006
Picture 034	YS-WC03-S	5/15/2006
Picture 035	Y2-WC03-S	5/15/2006
Picture 036	Y2-WC03-SB	5/15/2006
Picture 037	Y2-RCO3-S	5/15/2006
Picture 038	Y2-RC03-S	5/15/2006
Picture 039	Y2-RC03-S Lobster	5/15/2006
Picture 040	Y2-WC06-S	5/15/2006
Picture 041	Y2-WC06-SB	5/15/2006
Picture 042	Y2-WC06-SB Spoonful of uneven stratification	5/15/2006
Picture 043	Y2-RC06-SB	5/15/2006
Picture 044	Y2-RC06-S Biota- Crab and Clam	5/15/2006
Picture 045	Y2-RC06-SB	5/15/2006
Picture 046	Y2-RC06-SB- Clam	5/15/2006
Picture 047	Y2-WC05-S- Crab in recovery	5/15/2006
Picture 048	Y2-WC05-S	5/15/2006
Picture 049	Y2-WC05-SC	5/15/2006
Picture 050	Y2-RC05-S	5/15/2006
Picture 051	Y2-WC09-S	5/15/2006
Picture 052	Y2-WC09-SB	5/15/2006
Picture 053	Y2-RC09-S	5/15/2006
Picture 054	Y2-WC13-S	5/15/2006

Appendix D.2 Field Photos

File Name	Subject	Date
Picture 055	Y2-WC13-SC	5/15/2006
Picture 056	Y2-WC14-S	5/15/2006
Picture 057	Y2-WC14-SB	5/15/2006
Picture 058	Y2-S15-S	5/15/2006
Picture 059	Y2-S19-S	5/15/2006
Picture 060	Y2-WC07-S	5/16/2006
Picture 061	Y2-WC07-SB	5/16/2006
Picture 062	Y2-RC07-S	5/16/2006
Picture 063	Y2-WC10-S	5/16/2006
Picture 064	Y2-RC10-S	5/16/2006
Picture 065	Y2-RC10-SB	5/16/2006
Picture 066	Crab found in RC10	5/16/2006
Picture 067	Crab found in RC10	5/16/2006
Picture 068	Y2-WC12-S	5/16/2006
Picture 069	Y2-RC12-S	5/16/2006
Picture 070	Y2-SC04-S	5/16/2006
Picture 071	Y2-SC03-S	5/16/2006
Picture 072	Y2-RC14-S	5/16/2006
Picture 073	Y2-WC01-S	5/16/2006
Picture 074	Y2-RC01-S	5/16/2006
Picture 075	Collection of Y2-RC14B-S	5/16/2006
Picture 076	Y2-RC14B-S Bowl	5/16/2006
Picture 077	Y2-RC13-S	5/16/2006
Picture 078	Y2-SC01-S	5/16/2006
Picture 079	Y2-SC02-S	5/16/2006
Picture 080	Vibrocore system	5/17/2006
Picture 081	Core tubes	5/17/2006
Picture 082	Walt and Lou with Vibrocore	5/17/2006
Picture 083	Walt and Lou with Vibrocore	5/17/2006
Picture 084	Vibrocore with float package	5/17/2006
Picture 085	Y2-WC01B-C1 intact	5/17/2006
Picture 086	Y2-WC01B-C2 intact	5/17/2006
Picture 087	Y2-WC01B-C3 intact	5/17/2006
Picture 088	Y2-WC01B-C1 open	5/17/2006
Picture 089	Y2-WC10B-C2 open	5/17/2006
Picture 090	Y2-WC01B-C3 open	5/17/2006
Picture 091	Y2-WC01B Below cap	5/17/2006
Picture 092	Y2-WC06-C1	5/17/2006
Picture 093	Y2-WC06-C2	5/17/2006
Picture 094	Y2-WC06-C3	5/17/2006
Picture 095	Foss Landing Marina	5/17/2006
Picture 096	Tacoma 509 Bridge	5/17/2006
Picture 097	Recovered Cores	5/17/2006
Picture 098	Recovered Cores on Ice	5/17/2006
Picture 099	Recovered Cores on Ice	5/17/2006
Picture 100	Y2-WC04-C3	5/18/2006
Picture 101	Y2-WC04-C3	5/18/2006
Picture 102	Y2-WC05	5/18/2006
Picture 103	Y2-WC05	5/18/2006
Picture 104	Y2-WC12-C3	5/18/2006
Picture 105	Y2-WC10-C3	5/18/2006
Picture 106	Y2-WC10-C2	5/18/2006
Picture 107	Y2-WC10-C1	5/18/2006
Picture 108	Y2-WC10-C1 and whole core	5/18/2006

APPENDIX E

SAMPLE LOCATIONS AND DESCRIPTONS

Table E-1. Sample Locations and Descriptions

Sample	Easting[1/]	Northing[1/]	Time	Date	Depths	Depths of Fines	Sample Type	Sample Description
Y2-R02-BA	1160568	702214	10:14:28	5/12/2006	0- 10 cm	N/A	Benthos	Grayish black SILT. Sheen present. Strong H2S odor. Organic debris. Snail.
Y2-R02-BB	1160571	702228	10:16:07	5/12/2006	0- 10 cm	N/A	Benthos	Black SILT. Slight sheen present. H2S odor. Organic debris, twigs, leaves.
Y2-R02-BC	1160569	702231	10:18:27	5/12/2006	0- 10 cm	N/A	Benthos	Brownish black SILT. Slight sheen. H2S odor. Paper or plastic, organic debris. Worm tube.
Y2-R02-BD	1160573	702216	10:20:13	5/12/2006	0- 10 cm	N/A	Benthos	1.5-2 cm RPD layer of brownish black SILT. Slight sheen. H2S odor. Worm tube. Organic debris, ear phone cover. 5 snails.
Y2-R02-BE	1160586	702217	10:22:33	5/12/2006	0- 10 cm	N/A	Benthos	Black SILT with some sand. Slight sheen present. H2S odor. Organic debris, twigs, leaves.
Y2-R03-BA	1160586	702435	11:50	5/12/2006	0- 10 cm	N/A	Benthos	Black SILT over coarse SAND. Little organic debris, twigs. Worm tubes, worms.
Y2-R03-BB	1160586	702435	11:53	5/12/2006	0- 10 cm	N/A	Benthos	Black SILT over coarse-grained SAND. Slight shell hash. Worm tubes and worms.
Y2-R03-BC	1160586	702435	11:56	5/12/2006	0- 10 cm	N/A	Benthos	Black SILT over coarse-grained SAND. Shell hash, organic debris, twigs. Worm tubes, worms.
Y2-R03-BD	1160586	702435	11:59	5/12/2006	0- 10 cm	N/A	Benthos	Black SILT with 2 rocks. Sheen present. Lots of fine organic debris, leaf, twigs, shell hash. 3 polychaetes.
Y2-R03-BE	1160586	702435	12:02	5/12/2006	0- 10 cm	N/A	Benthos	Black fine SILT with large gravel SAND. Sheen present. Shell hash, organic debris, twigs, leaves. 2 clams.
Y2-R04-BA	1160666	702726	12:56:57	5/12/2006	0- 10 cm	N/A	Benthos	Coarse-grained gravely SAND. Worm tube. .
Y2-R04-BB	1160666	702726	12:59	5/12/2006	0- 10 cm	N/A	Benthos	SILT over gravely SAND. Shell hash. Worm tube, snails.
Y2-R04-BC	1160666	702726	13:00	5/12/2006	0- 10 cm	N/A	Benthos	Coarse SAND mixed with fine gravel. Worm tubes, snails.
Y2-R04-BD	1160666	702726	13:01	5/12/2006	0- 10 cm	N/A	Benthos	SILT over coarse SAND. Worm.
Y2-R04-BE	1160666	702726	13:08	5/12/2006	0- 10 cm	N/A	Benthos	Fine- to coarse-grained SAND. Shell hash. Worms.

Table E-1. Sample Locations and Descriptions (continued)

Sample	Easting[1/]	Northing[1/]	Time	Date	Depths	Depths of Fines	Sample Type	Sample Description
Y2-R01B-BE	1160599	702096	9:09:21	5/12/2006	0- 10 cm	N/A	Benthos	Black SILT. Organic debris. Worm.
Y2-R01B-BD	1160607	702092	9:11:54	5/12/2006	0- 10 cm	N/A	Benthos	Black SILT. H2S odor. Organic debris, leaves, twigs. Worms.
Y2-R01B-BC	1160607	702096	9:14:49	5/12/2006	0- 10 cm	N/A	Benthos	Black SILT. H2S odor. Organic debris, leaves, twigs. Worm- polychaete .
Y2-R01B-BB	1160613	702093	9:16:00	5/12/2006	0- 10 cm	N/A	Benthos	Black SILT. H2S odor. Organic debris, leaves, twigs, piece of CD/glass. 1.5-inch worms.
Y2-R01B-BA	1160613	702093	9:18:00	5/12/2006	0- 10 cm	N/A	Benthos	Black SILT. Organic debris, leaves, twigs.
Y2-WC01-SA	1160586	702003	13:15	5/16/2006	0-10 cm	N/A	Cap Compliance	0.5 cm RPD layer over dark mulchy sandy SILT with some gravel. Mild H2S odor. Leaves, twigs, mulchy and woody debris. Amphipods, worms, muscles.
Y2-WC02-SA	1160705	702132	15:32:30	5/12/2006	0-10 cm	15.5 cm	Cap Compliance	Black SILT. H2S odor. Organic debris, leaves, cassette film. Dead crab.
Y2-WC02-SB	1160695	702131	15:46:49	5/12/2006	0-10 cm	15.5 cm	Cap Compliance	Black SILT. Definite H2S odor. Broken piece of shell, organic debris, leaves, plastic lid. Gelatinous egg mass.
Y2-WC03-SA	1160511	702109	8:36:16	5/15/2006	0-10 cm	10-12 cm	Cap Compliance	Top 1 mm olive RPD layer olive SILT, dark gray olive SILT to ~11 cm then SAND below. Organic debris, twigs, hair.
Y2-WC03-SB	1160504	702109	8:49:42	5/15/2006	0-10 cm	9.5 cm	Cap Compliance	Top 1 mm RPD layer SILT. 9.5 cm dark olive SILT over SAND. Twig, woodchip.
Y2-WC04-SB	1160573	702217	11:13:26	5/12/2006	0-10 cm	9 cm	Cap Compliance	0.5 cm olive sandy SILT over 9 cm dark olive sandy SILT over layer of SAND. Sheen present. H2S odor. Organic debris.
Y2-WC04-SD	1160560	702212	11:31:28	5/12/2006	0-10 cm	10 cm	Cap Compliance	Olive SILT over 10 cm grayish black SILT over SAND. Sheen present. Slight H2S odor. Organic debris, leaves, twigs, worm tubes. 4 snails (1-inch), Ghost shrimp (3-inch body).

Table E-1. Sample Locations and Descriptions (continued)

Sample	Easting[1/]	Northing[1/]	Time	Date	Depths	Depths of Fines	Sample Type	Sample Description
Y2-WC05-SB	1160644	702357	10:49:12	5/15/2006	0-10 cm	13 cm	Cap Compliance	1 mm light brown RPD layer SILT over ~13 cm dark olive gray SILT over SAND. Moderate H2S odor. Twig debris, shell fragments.
Y2-WC05-SC	1160636	702361	11:00:35	5/15/2006	0-10 cm	12 cm	Cap Compliance	1 mm olive RPD SILT over ~12 cm dark gray SILT over SAND. Twig, leaf, shell fragments, electrical cable. Kelp, worm.
Y2-WC06-SA	1160438	702255	9:36:34	5/15/2006	0-10 cm	NA	Cap Compliance	1 mm light reddish brown RPD layer SILT over dark olive gray silty SAND- no defined sand layer. Kelp, snails, worms.
Y2-WC06-SB	1160435	702253	9:48:30	5/15/2006	0-10 cm	NA	Cap Compliance	1 mm light reddish brown RPD layer SILT over 8 cm dark olive gray SILT over silty SAND, not stratified, silt pockets at varied depths. Twig debris. Kelp.
Y2-WC07-SA	1160458	702381	7:51:31	5/16/2006	0-10 cm	6.5 cm	Cap Compliance	1 mm light olive RPD layer SILT over 6.5 cm soft dark olive gray silty SAND with SILT pockets. Strong H2S odor. Twig debris. Kelp.
Y2-WC07-SB	1160457	702381	8:02:10	5/16/2006	0-10 cm	4.5 cm	Cap Compliance	1 mm light olive RPD layer SILT over 4.5 cm dark olive gray silty SAND over SAND. Strong H2S odor. Twigs, leaves, shells, gravel chunk with barnacles, worm tubes.
Y2-WC08-SA	1160586	702435	14:23:00	5/12/2006	0-10 cm	7 cm	Cap Compliance	1-2 cm olive RPD SILT over blackish gray SILT to 7 cm fine SAND. Slight H2S odor. Shell hash on surface, twigs, sticks. Worms.
Y2-WC08-SB	1160586	702435	14:36:00	5/12/2006	0-10 cm	7-8 cm	Cap Compliance	Olive Silt over 7-8 cm blackish gray SILT over SAND. Leaf.
Y2-WC09-SA	1160653	702452	12:10:00	5/15/2006	0-10 cm	8 cm	Cap Compliance	1 mm light olive RPD layer SILT over 8 cm dark olive gray SILT over gray SAND. Leaf debris. Blenny.
Y2-WC09-SB	1160653	702452	12:20:00	5/15/2006	0-10 cm	6.5 cm	Cap Compliance	1 mm light olive RPD layer SILT over 6.5 cm dark olive gray SILT over gray SAND. Feather, twigs. Green kelp, shell.

Table E-1. Sample Locations and Descriptions (continued)

Sample	Easting[1/]	Northing[1/]	Time	Date	Depths	Depths of Fines	Sample Type	Sample Description
Y2-WC10-SA	1160566	702583	8:45:17	5/16/2006	0-10 cm	0.6 cm	Cap Compliance	1 mm light olive RPD layer SILT over 0.6 cm SILT over gray coarse SAND. Twig debris. Worm, worm tube, cockle, snails.
Y2-WC11-SA	1160667	702727	13:35:27	5/12/2006	0-10 cm	1 cm	Cap Compliance	1 cm SILT over coarse SAND with gravel mix. Worm tubes and snails.
Y2-WC12-SA	1160503	702727	9:33:00	5/16/2006	0-10 cm	0.5 cm	Cap Compliance	1 mm light olive RPD layer SILT over 0.5 cm olive SILT over coarse SAND. Worm tubes, clam.
Y2-S15-SA	1160598	702761	14:25:01	5/15/2006	0-10 cm	2 cm	Cap Compliance	1 mm RPD layer over 2 cm soft dark olive gray SILT over gray coarse SAND. Leaves, wood debris. Muscles.
Y2-S17-SA	1160670	702560	16:22:54	5/12/2006	0-10 cm	0.5 cm	Cap Compliance	0.5 cm SILT over coarse SAND.
Y2-S19-SA	1160598	702675	15:29:48	5/15/2006	0-10 cm	2 cm	Cap Compliance	2 cm olive SILT over gray coarse SAND (cap material).
Y2-S24-SB	1160508	702559	16:02:26	5/12/2006	0-10 cm	0.5 cm	Cap Compliance	0.5 cm SILT over coarse SAND.
Y2-WC13-SA	1160603	702460	12:50:00	5/15/2006	0-10 cm	8 cm	Cap Compliance	1 mm light olive brown RPD layer SILT over 8 cm soft dark olive gray silty SAND over SAND.
Y2-WC13-SC	1160603	702460	13:04:00	5/15/2006	0-10 cm	6 cm	Cap Compliance	Light RPD layer SILT over 6 cm dark olive gray silty SAND. Moderate H2S odor. Leaf debris. Crab (3-4") caught in Van Veen.
Y2-WC14-SA	1160627	702367	13:43:48	5/15/2006	0-10 cm	15 cm	Cap Compliance	1 mm light olive RPD layer SILT over dark olive gray silty SAND with SILT pockets, discontinuous SAND at 15 cm. Slight sheen in homogenized pot. Branch, shell fragments, twigs, bark.
Y2-WC14-SB	1160622	702365	13:56:32	5/15/2006	0-10 cm	13 cm	Cap Compliance	2 mm olive RPD layer SILT over dark gray olive SILT over SAND at ~ 13 cm. Slight sheen in homogenized pot. Leaves, twigs, shell fragment debris. Worms and brown kelp.

Table E-1. Sample Locations and Descriptions (continued)

Sample	Easting[1/]	Northing[1/]	Time	Date	Depths	Depths of Fines	Sample Type	Sample Description
Y2-RC01-SA	1160586	702003	13:25	5/16/2006	0- 2 cm	N/A	Early-warning	Dark mulchy silty SAND with some gravel. Mild H2S odor. Organic, leaves, twigs, wood debris. Isopods, amphipods, worms, sand fleas, mussels.
Y2-RC02-SA	1160696	702125	15:18:26	5/12/2006	0- 2 cm	17 cm	Early-warning	Black SILT. Slight H2O odor. Organic, leaves debris, plastic straw. Snail.
Y2-RC03-SA	1160520	702118	9:00:19	5/15/2006	0- 2 cm	11 cm	Early-warning	1 mm light brown RPD layer SILT over 11 cm dark olive SILT over SAND. Twig debris. Worms.
Y2-RC04-SB	1160569	702231	10:30:01	5/12/2006	0- 2 cm	17 cm	Early-warning	0.5 cm olive SILT over black SILT. Kelp on surface.
Y2-RC04-SC	1160568	702220	10:44:58	5/12/2006	0- 2 cm	17 cm	Early-warning	Black SILT with sand. Slight sheen. H2S odor.
Y2-RC05-SA	1160644	702357	11:10:50	5/15/2006	0- 2 cm	12 cm	Early-warning	1 mm light olive RPD layer SILT over ~ 12 cm dark gray SILT over SAND. Snails and kelp. Debris – twigs and cigarette butt.
Y2-RC06-SA	1160441	702258	10:03:09	5/15/2006	0- 2 cm	0.1 cm	Early-warning	1 mm brown RPD layer SILT over 2 cm dark olive gray silty SAND over gray SAND. Slight undefined odor. Clam, barnacles, crab.
Y2-RC06-SB	1160435	702248	10:17:09	5/15/2006	0- 2 cm	10 cm	Early-warning	1 mm light olive RPD layer over 10 cm dark olive gray sandy SILT over gray SAND. Clam.
Y2-RC07-SB	1160457	702385	8:16:31	5/16/2006	0- 2 cm	7 cm	Early-warning	1 mm light olive RPD layer over ~ 7 cm soft olive gray SILT over silty SAND below. Slight H2S odor. Twig debris. Worm.
Y2-RC08-SA	1160586	702435	14:06:00	5/12/2006	0- 2 cm	7 cm	Early-warning	1 mm olive RPD layer over 7 cm black SILT over SAND. Small twig debris.
Y2-RC09-SA	1160653	702452	12:29:00	5/15/2006	0- 2 cm	8 cm	Early-warning	1 mm light olive RPD layer over 8 cm dark olive gray SILT over SAND. Roots.
Y2-RC10-SA	1160571	702580	9:04:38	5/16/2006	0- 2 cm	0.3 cm	Early-warning	1 mm light olive RPD layer over 0.3 cm of soft SILT over coarse gray SAND. Kelp, clam shell, worm.

Table E-1. Sample Locations and Descriptions (continued)

Sample	Easting[1/]	Northing[1/]	Time	Date	Depths	Depths of Fines	Sample Type	Sample Description
Y2-RC10-SB	1160574	702586	9:15:04	5/16/2006	0- 2 cm	0.3 cm	Early-warning	1 mm of light olive brown RPD layer over 0.3 cm of SILT over coarse gray SAND. Crab.
Y2-RC11-SA	1160667	702723	13:12:57	5/12/2006	0- 2 cm	1 cm	Early-warning	1 cm of SILT over SAND
Y2-RC11-SB	1160667	702723	13:23:00	5/12/2006	0- 2 cm	N/A	Early-warning	No description
Y2-RC12-SA	1160503	702724	9:44:35	5/16/2006	0- 2 cm	1 cm	Early-warning	1 mm light olive RPD layer over 1 cm soft olive gray SILT over coarse SAND. Kelp, worm tubes, worm.
Y2-RC13-S	1160566	701876	14:05:00	5/16/2006	0- 2 cm	N/A	Early-warning	0-2 cm light gray brown sandy SILT with gravel. Twigs. Mussels.
Y2-RC14-S	1160719	701873	13:20	5/16/2006	0- 2 cm	N/A	Early-warning	1 mm light olive RPD layer over ~ 2 cm dark olive gray SILT over gray SAND with gravel. Slight H2S odor. Shells, mussels.
Y2-RC14B-S	1160728	701824	14:00	5/16/2006	0- 2 cm	N/A	Early-warning	1 mm brown olive RPD layer over 1 cm dark gray olive silty SAND with fibrous material over gray SAND with some orange iron-oxidized spots. Kelp, mussels, and barnacles.
Y2-CI-01E	1104063	737735	13:41:17	5/18/2006	0- 10 cm	15 cm	Reference	1 mm RPD olive SILT, 1 cm dark gray SILT over silty sand. Twig. Worm. 60% fines.
Y2-CI-02B	1104083	737773	14:38:25	5/18/2006	0- 10 cm	12.5 cm	Reference	Slight dark gray SILT over olive gray medium grain silty SAND. Brittle stars, worms, worm tubes. 40% fines.
Y2-SC01-SA	1160442	702476	15:20	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	Brown medium SAND with some gravel. Mussels, shells.
Y2-SC01-SB	1160470	702611	15:25	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	Gray coarse SAND (cap material). Kelp.
Y2-SC01-SC	1160436	702702	15:26	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	Gray coarse SAND (cap material) with some gravel.
Y2-SC02-SA	1160393	702150	15:07	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	Gray coarse SAND. Cockle.
Y2-SC02-SB	1160371	702297	15:11	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	Gray silty gravely SAND with some red oxidation on gravel. Kelp.

Table E-1. Sample Locations and Descriptions (continued)

Sample	Easting[1]	Northing[1]	Time	Date	Depths	Depths of Fines	Sample Type	Sample Description
Y2-SC02-SC	1160366	702446	15:16	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	Dark olive gray silty SAND over coarse gray SAND with gravel. Leaves and twigs. Barnacles, mussels, little crab.
Y2-SC03-SA	1160743	702221	12:53	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	1mm RPD layer. 2cm light brown silty SAND over gray silty SAND with gravel. Kelp with barnacles.
Y2-SC03-SB	1160753	702115	12:59	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	1 mm light olive RPD layer SILT over 2 cm dark olive gray SILT over gray SAND. Shell hash. Mussels, kelp, barnacles.
Y2-SC03-SC	1160760	701902	13:05	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	1 mm light olive RPD layer silty SAND over 2 cm dark gray silty SAND over orange-reddish-brown gravelly SAND. Organic debris, leaves, twigs, shells. Kelp.
Y2-SC04-SA	1160749	702363	12:05	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	1 mm light olive RPD layer SILT over gray SAND with gravel habitat mix. Kelp.
Y2-SC04-SB	1160722	702674	12:09	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	1 mm light olive RPD layer SILT over gray coarse SAND with silt. Kelp.
Y2-SC04-SC	1160739	702621	12:15	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	2 cm light olive sandy SILT over 2 cm dark olive gray sandy SILT over gray SAND with gravel. Mussel shells, barnacles, shell hash.
Y2-SC04-SD	1160743	702375	15:45	5/16/2006	0- 10 cm	N/A	Slope Compliance Composite	Gravel on top with 1 mm RPD layer over 10 cm dark olive gray SILT over gray SAND. Slight H2S odor. Root debris, leaves, barnacles, shell hash. Worms.
Y2-WC04-C1	1160566	702209	19:07:28	5/17/2006	0- 1.5 ft	N/A	Subsurface core	0-0.7 ft wet black SILT. Sheen noted. Mussel shell.
Y2-WC04-C3	1160566	702209	19:07:28	5/17/2006	1.5- 3 ft	N/A	Subsurface core	0.7- 1 ft gray medium SAND. 1-1.5 ft coarse gray SAND (cap material). (Combined with C2 increment for sufficient sampling material.)

Table E-1. Sample Locations and Descriptions (continued)

Sample	Easting[1]	Northing[1]	Time	Date	Depths	Depths of Fines	Sample Type	Sample Description
Y2-WC05-C1	1160655	702352	19:17:12	5/17/2006	0- 1 ft	N/A	Subsurface core	0-0.3 ft dark olive SILT. Mussel shell.
Y2-WC05-C3	1160655	702352	19:17:12	5/17/2006	1- 2.5 ft	N/A	Subsurface core	0.3-0.8: ft gray medium SAND. 0.8-1.5 ft: gray medium to coarse SAND (cap material). (Combined C2 increment for sufficient sampling material.)
Y2-WC06-C1	1160432	702255	9:58:38	5/17/2006	0- 1 ft	N/A	Subsurface core	0-0.6 ft: Top 2 cm soft wet dark olive gray SILT over wet gray coarse SAND. Cobble, twig debris. Shell fragments.
Y2-WC06-C2	1160432	702255	9:58:38	5/17/2006	1- 2 ft	N/A	Subsurface core	0.6-1.2 ft moist firm gray fine- to medium-grained SAND with brown SILT lens at 0.9 ft and 1.2 ft.
Y2-WC06-C3	1160432	702255	9:58:38	5/17/2006	2- 3 ft	N/A	Subsurface core	1.2-1.8 ft moist firm gray fine- to medium-grained SAND with brown SILT lens at 1.4 ft.
Y2-WC10-C1	1160527	702637	20:20:14	5/17/2006	0- 1 ft	N/A	Subsurface core	0-1 ft: Top 2 cm olive brown SILT over coarse gray SAND (cap material).
Y2-WC10-C3	1160527	702637	20:20:14	5/17/2006	1- 2.5 ft	N/A	Subsurface core	1-2.5 ft coarse gray SAND (cap material). (Combined C2 increment for sufficient sampling material.)
Y2-WC12-C1	1160509	702717	20:04:14	5/17/2006	0- 1 ft	N/A	Subsurface core	0-0.5 ft: Top 0.5 cm olive brown layer of SILT over gray coarse SAND (cap material). Kelp on surface.
Y2-WC12-C3	1160509	702717	20:04:14	5/17/2006	1- 2 ft	N/A	Subsurface core	0.5-1.1 ft gray coarse SAND (cap material). (Combined with C2 increment for sufficient sampling material.)
Y2-WC01B-C1	1160613	702093	8:31:19	5/17/2006	0- 1 ft	N/A	Subsurface core	0-0.7 ft soft wet dark olive gray SILT. No strong odor. Twig. 0.7-0.725 ft Moist gray coarse SAND (cap material).
Y2-WC01B-C2	1160613	702093	8:31:19	5/17/2006	1- 2 ft	N/A	Subsurface core	0.725-1.5 ft moist gray coarse SAND (cap material)
Y2-WC01B-C3	1160613	702093	8:31:19	5/17/2006	2- 3 ft	N/A	Subsurface core	1.5- 2.2 ft moist gray coarse SAND (cap material)

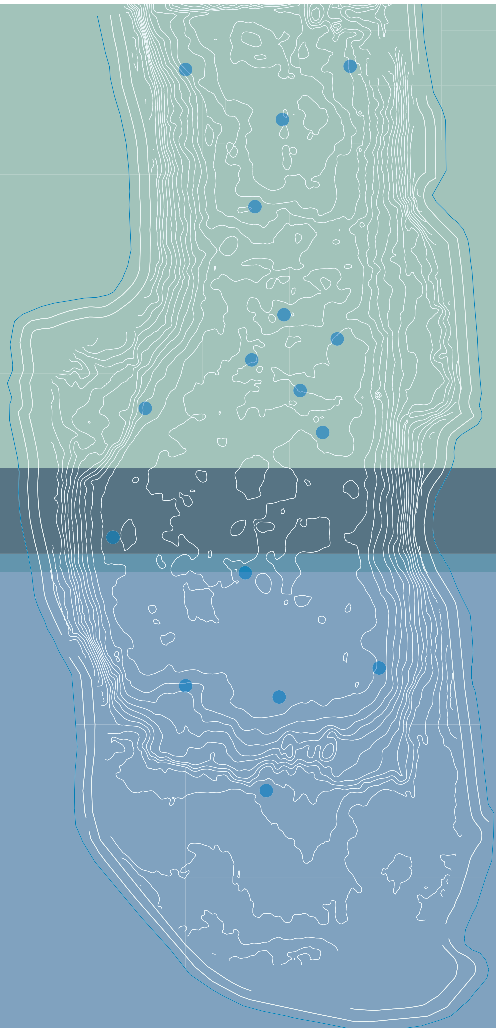
Notes:
[1] Datum: WA State Plane Zone South, NAD 83, US survey feet.

APPENDIX F

SEDIMENT PROFILE IMAGING REPORT

(SPI Photographs Located on Enclosed CD)

July, 2006



Thea Foss OMMP Year 2 Monitoring:

Sediment Profile Imaging Survey

Prepared for:

Tetra Tech EC, Inc.
12100 NE 195th Street
Suite 200
Bothell, WA 98011
Contract Number 059487

Prepared by:

Germano & Associates, Inc.
12100 SE 46th Place
Bellevue, WA 98006

Sediment Profile Imaging Report

THEA FOSS OMMP YEAR 2 MONITORING: SEDIMENT PROFILE IMAGING SURVEY

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July, 2006

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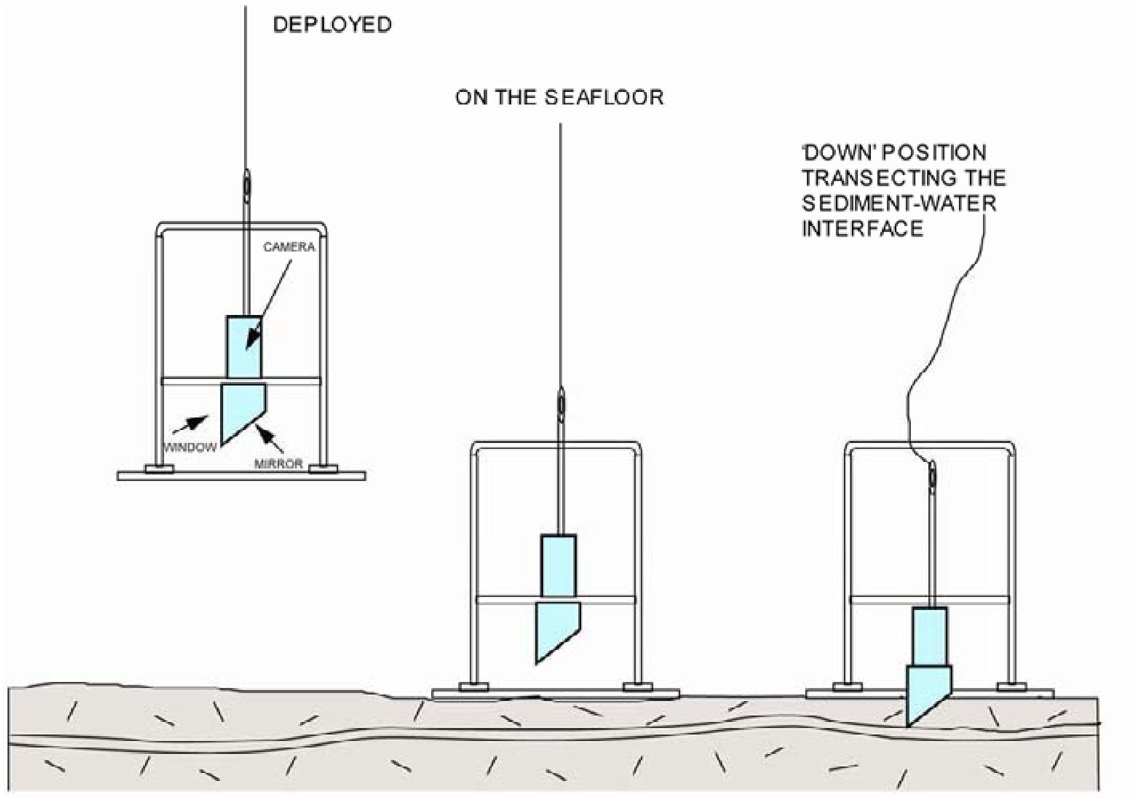
1.0
INTRODUCTION

As part of the post-construction monitoring required as part of the OMMP Year 2 Monitoring event at the Head of the Thea Foss Waterway, Germano & Associates, Inc. (G&A) performed a Sediment Profile Imaging (SPI) survey at a series of pre-determined stations on May 11, 2006. The purpose of the SPI survey was to document recolonization of benthic infauna on the constructed cap; a series of benthic grabs were also taken at the same stations by Tetra Tech EC and archived for possible future analyses.

2.0
MATERIALS AND METHODS

On May 11, 2006, scientists from G&A collected sediment profile images at a total of 16 stations under the direction of Tetra Tech EC, Inc. aboard the *R/V Brendan D II*. An Ocean Imaging Systems Model 3731 sediment profile camera was used for this survey; a total of 54 sediment profile images were collected at 16 stations (Figure 1) during the course of the field operations.

SPI was developed almost two decades ago as a rapid reconnaissance tool for characterizing physical, chemical, and biological seafloor processes and has been used in numerous seafloor surveys throughout the United States, Pacific Rim, and Europe (Rhoads and Germano 1982, 1986, 1990; Revelas et al. 1987; Valente et al. 1992). The sediment profile camera works like an inverted periscope. A Nikon D100 6-megapixel SLR camera with a 1-gigabyte compact flash card is mounted horizontally inside a watertight housing on top of a wedge-shaped prism. The prism has a Plexiglas® faceplate at the front with a mirror placed at a 45° angle at the back. The camera lens looks down at the mirror, which is reflecting the image from the faceplate. The prism has an internal strobe mounted inside at the back of the wedge to provide illumination for the image; this chamber is filled with distilled water, so the camera always has an optically clear path. This wedge assembly is mounted on a moveable carriage within a stainless steel frame. The frame is lowered to the seafloor on a winch wire, and the tension on the wire keeps the prism in its "up" position. When the frame comes to rest on the seafloor, the winch wire goes slack (see illustration below) and the camera prism descends into the sediment at a slow, controlled rate by the dampening action of a hydraulic piston so as not to disturb the sediment-water interface. On the way down, it trips a trigger that activates a time-delay circuit of variable length (operator-selected) to allow the camera to penetrate the seafloor before any image is taken. The knife-sharp edge of the prism transects the sediment, and the prism penetrates the bottom. The strobe is discharged after an appropriate time delay to obtain a cross-sectional image of the upper 20 cm of the sediment column. The resulting images give the viewer the same perspective as looking through the side of an aquarium half-filled with sediment. After the first image is obtained at the first location, the camera is then raised up about 2 to 3 meters off the bottom to allow the strobe to recharge; a wiper blade mounted on the frame removes any mud adhering to the faceplate. The strobe recharges within 5 seconds, and the camera is ready to be lowered again for a replicate image. Surveys can be accomplished rapidly by "pogo-sticking" the camera across an area of seafloor while recording positional fixes on the surface vessel.



***The central cradle** of the camera is held in the "up" position by tension on the winch wire as it is being lowered to the seafloor (left); once the frame base hits the bottom (center), the prism is then free to penetrate the bottom (right) and take the photograph.*

Two types of adjustments to the SPI system are typically made in the field: physical adjustments to the chassis stop collars or adding/subtracting lead weights to the chassis to control penetration in harder or softer sediments, and electronic software adjustments to the Nikon D100 to control camera settings. Camera settings (f-stop, shutter speed, ISO equivalents, digital file format, color balance, etc.) are selectable through a water-tight USB port on the camera housing and Nikon Capture® software. At the beginning of the survey, the time on the sediment profile camera's internal data logger was synchronized with the internal clock on the computerized navigation system to local time. Details of the camera settings for each digital image are available in the associated parameters file embedded in the electronic image file. Three replicate images were taken at each station; each SPI replicate is identified by the time recorded on the digital file and on disk along with vessel position. Multiple images were taken at each location, and each image was assigned a unique time stamp in the digital file attributes by the data logger and cross-checked with the time stamp in the navigational system's computer data file. The field crew kept redundant written sample logs. Images were downloaded periodically (sometimes after each station) to verify successful sample acquisition or to assess what type of sediment/depositional layer was present at a particular station. Digital image files were re-named with the appropriate station name immediately after downloading on deck as a further quality assurance step.

Test exposures of the Kodak® Color Separation Guide (Publication No. Q-13) were made on deck at the beginning of the survey to verify that all internal electronic systems were working to design specifications and to provide a color standard against which final images could be checked for proper color balance. A spare camera and charged battery were carried in the field at all times to insure uninterrupted sample acquisition. After deployment of the camera at each station, the frame counter was checked to make sure that the requisite number of replicates had been taken. In addition, a prism penetration depth indicator on the camera frame was checked to verify that the optical prism had actually penetrated the bottom to a sufficient depth. If images were missed (frame counter indicator or verification from digital download) or the penetration depth was insufficient (penetration indicator), chassis stops were adjusted and/or weights were added or removed, and additional replicate images were taken. Changes in prism weight amounts, the presence or absence of mud doors, and chassis stop positions were recorded for each replicate image. Images were inspected in the field to determine whether any stations needed re-sampling with different stop collar or weight settings.

Following completion of field operations, the digital images were analyzed from this survey using Sigma Scan® software (Aspire Software International). Calibration information was determined by measuring 1-cm gradations from the Kodak® Color Separation Guide. This calibration information was applied to all SPI images analyzed. Linear and area measurements were recorded as number of pixels and converted to scientific units using the calibration information.

Measured parameters were recorded on a Microsoft® Excel© spreadsheet. G&A's senior scientist (Dr. J. Germano) subsequently checked all these data as an independent quality assurance/quality control review of the measurements before final interpretation was performed.

2.1 MEASURING, INTERPRETING, AND MAPPING SPI PARAMETERS

2.1.1 Sediment Type

The sediment grain-size major mode and range were visually estimated from the color images by overlaying a grain-size comparator that was at the same scale. This comparator was prepared by photographing a series of Udden-Wentworth size classes (equal to or less than coarse silt up to granule and larger sizes) with the SPI camera. Seven grain-size classes were on this comparator: >4 ϕ (silt-clay), 4 - 3 ϕ (very fine sand), 3-2 ϕ (fine sand), 2 - 1 ϕ (medium sand), 1-0 ϕ (coarse sand), 0 - (-)1 ϕ (very coarse sand), < -1 ϕ (granule and larger). The lower limit of optical resolution of the photographic system was about 62 microns, allowing recognition of grain sizes equal to or greater than coarse silt ($\geq 4\ \phi$). The accuracy of this method has been documented by comparing SPI estimates with grain-size statistics determined from laboratory sieve analyses.

The comparison of the SPI images with Udden-Wentworth sediment standards photographed through the SPI optical system was also used to map near-surface stratigraphy such as sand-over-mud and mud-over-sand. When mapped on a local scale, this stratigraphy can provide information on relative transport magnitude and frequency.

2.1.2 Prism Penetration Depth

The SPI prism penetration depth was measured from the bottom of the image to the sediment-water interface. The area of the entire cross-sectional sedimentary portion of the image was digitized, and this number was divided by the calibrated linear width of the image to determine the average penetration depth. Linear maximum and minimum depths of penetration were also measured. All three measurements (maximum, minimum, and average penetration depths) were recorded in the data file.

Prism penetration is a noteworthy parameter; if the number of weights used in the camera is held constant throughout a survey, the camera functions as a static-load penetrometer. Comparative penetration values from sites of similar grain size give an indication of the relative water content of the sediment. Highly bioturbated sediments and rapidly accumulating sediments tend to have the highest water contents and greatest prism penetration depths.

The depth of penetration also reflects the bearing capacity and shear strength of the sediments. Overconsolidated or relic sediments and shell-bearing sands resist camera penetration. Highly bioturbated, sulfitic, or methanogenic muds are the least consolidated, and deep penetration is typical. Seasonal changes in camera prism penetration have been observed at the same station in other studies and are related to the control of sediment geotechnical properties by bioturbation (Rhoads and Boyer 1982). The effect of water temperature on bioturbation rates appears to be important in controlling both biogenic surface relief and prism penetration depth (Rhoads and Germano 1982).

2.1.3 Small-Scale Surface Boundary Roughness

Surface boundary roughness was determined by measuring the vertical distance between the highest and lowest points of the sediment-water interface. The surface boundary roughness (sediment surface relief) measured over the width of sediment profile images typically ranges from 0.02 to 3.8 cm, and may be related to either physical structures (ripples, rip-up structures, mud clasts) or biogenic features (burrow openings, fecal mounds, foraging depressions). Biogenic roughness typically changes seasonally and is related to the interaction of bottom turbulence and bioturbational activities.

The camera must be level in order to take accurate boundary roughness measurements. In sandy sediments, boundary roughness can be a measure of sand wave height. On silt-clay bottoms, boundary roughness values often reflect biogenic features such as fecal mounds or surface burrows. The size and scale of boundary roughness values can have dramatic effects on both sediment erodibility and localized oxygen penetration into the bottom (Huettel et al., 1996).

2.1.4 Thickness of Depositional Layers

Because of the camera's unique design, SPI can be used to detect the thickness of depositional and dredged material layers. SPI is effective in measuring layers ranging in thickness from 1 mm to 20 cm (the height of the SPI optical window). During image analysis, the thickness of the newly deposited sedimentary layers can be determined by measuring the distance between the pre- and post-disposal sediment-water interface. Recently deposited material is usually evident because of its unique optical reflectance and/or color relative to the underlying material representing the pre-disposal surface. Also, in most cases, the point of contact between the two layers is clearly visible as a textural change in sediment composition, facilitating measurement of the thickness of the newly deposited layer.

2.1.5 Mud Clasts

When fine-grained, cohesive sediments are disturbed, either by physical bottom scour or faunal activity, e.g., decapod foraging, intact clumps of sediment are often scattered about the seafloor. These mud clasts can be seen at the sediment-water interface in SPI images. During analysis, the number of clasts was counted, the diameter of a typical clast was measured, and their oxidation state was assessed. The abundance, distribution, oxidation state, and angularity of mud clasts can be used to make inferences about the recent pattern of seafloor disturbance in an area.

Depending on their place of origin and the depth of disturbance of the sediment column, mud clasts can be reduced or oxidized. In SPI images, the oxidation state is apparent from the reflectance; see Section 2.1.6. Also, once at the sediment-water interface, these mud clasts are subject to bottom-water oxygen concentrations and currents. Evidence from laboratory microcosm observations of reduced sediments placed within an aerobic environment indicates that oxidation of reduced surface layers by diffusion alone is quite rapid, occurring within 6 to 12 hours (Germano 1983). Consequently, the detection of reduced mud clasts in an obviously aerobic setting suggests a recent origin. The size and shape of the mud clasts are also revealing; some clasts seen in the profile images are artifacts caused by the camera deployment (mud clots falling off the back of the prism or the wiper blade). Naturally-occurring mud clasts may be moved and broken by bottom currents and animals (macro- or meiofauna; Germano 1983). Over time, these naturally-occurring, large angular clasts become small and rounded.

2.1.6 Apparent Redox Potential Discontinuity Depth

Aerobic near-surface marine sediments typically have higher reflectance relative to underlying hypoxic or anoxic sediments. Surface sands washed free of mud also have higher optical reflectance than underlying muddy sands. These differences in optical reflectance are readily apparent in SPI images; the oxidized surface sediment contains particles coated with ferric hydroxide (an olive or tan color when associated with particles), while reduced and muddy sediments below this oxygenated layer are darker, generally gray to black. The boundary between the colored ferric hydroxide surface sediment and underlying gray to black sediment is called the apparent redox potential discontinuity (RPD).

The depth of the apparent RPD in the sediment column is an important time-integrator of dissolved oxygen conditions within sediment porewaters. In the absence of bioturbating organisms, this high reflectance layer (in muds) will typically reach a thickness of 2 mm below the sediment-water interface (Rhoads 1974). This depth is related to the supply rate of molecular oxygen by diffusion into the bottom and the consumption of that oxygen by the sediment and associated microflora. In sediments that have very high sediment oxygen demand (SOD), the sediment may lack a high reflectance layer even when the overlying water column is aerobic.

In the presence of bioturbating macrofauna, the thickness of the high reflectance layer may be several centimeters. The relationship between the thickness of this high reflectance layer and the presence or absence of free molecular oxygen in the associated porewaters must be considered with caution. The actual RPD is the boundary or horizon that separates the positive Eh region of the sediment column from the underlying negative Eh region. The exact location of this Eh = 0 boundary can be determined accurately only with microelectrodes; hence, the relationship between the change in optical reflectance, as imaged with the SPI camera, and the actual RPD can be determined only by making the appropriate *in situ* Eh measurements. For this reason, the optical reflectance boundary, as imaged, was described in this study as the "apparent" RPD and it was mapped as a mean value. In general, the depth of the actual Eh = 0 horizon will be either equal to or slightly shallower than the depth of the optical reflectance boundary. This is because bioturbating organisms can mix ferric hydroxide-coated particles downward into the bottom below the Eh = 0 horizon. As a result, the apparent mean RPD depth can be used as an estimate of the depth of porewater exchange, usually through porewater irrigation (bioturbation). Biogenic particle mixing depths can be estimated by measuring the maximum and minimum depths of imaged feeding voids in the sediment column. This parameter represents the particle mixing depths of head-down feeders, mainly polychaetes.

The rate of depression of the apparent RPD within the sediment is relatively slow in organic-rich muds, on the order of 200 to 300 micrometers per day; therefore this parameter has a long time constant (Germano and Rhoads 1984). The rebound in the apparent RPD is also slow (Germano 1983). Measurable changes in the apparent RPD depth using the SPI optical technique can be detected over periods of 1 or 2 months. This parameter is used effectively to document changes (or gradients) that develop over a seasonal or yearly cycle related to water temperature effects on bioturbation rates, seasonal hypoxia, SOD, and infaunal recruitment. Time-series RPD measurements following a disturbance can be a critical diagnostic element in monitoring the degree of recolonization in an area by the ambient benthos (Rhoads and Germano 1986).

The apparent mean RPD depth also can be affected by local erosion. The peaks of disposal mounds commonly are scoured by divergent flow over the mound. This scouring can wash away fines and shell or gravel lag deposits, and can result in very thin surface oxidized layer. During storm periods, erosion may completely remove any evidence of the apparent RPD (Fredette et al. 1988).

Another important characteristic of the apparent RPD is the contrast in reflectance at this boundary. This contrast is related to the interactions among the degree of organic loading, the bioturbation activity in the sediment, and the concentrations of bottom-water dissolved oxygen in an area. High inputs of labile organic material increase SOD and, subsequently, sulfate reduction rates and the associated abundance of sulfide end products. This results in more highly reduced, lower-reflectance sediments at depth and higher RPD contrasts. In a region of generally low RPD contrasts, images with high RPD contrasts indicate localized sites of relatively large inputs of organic-rich material such as phytoplankton, other naturally-occurring organic detritus, dredged material, or sewage sludge.

Because the determination of the apparent RPD requires discrimination of optical contrast between oxidized and reduced particles, it is difficult, if not impossible, to determine the depth of the apparent RPD in well-sorted sands of any size that have little to no silt or organic matter in them. When using SPI technology on sand bottoms, little information other than grain-size, prism penetration depth, and boundary roughness values can be measured; while oxygen has no doubt penetrated the sand beneath the sediment-water interface just due to physical forcing factors acting on surface roughness elements (Ziebis et al., 1996; Huettel et al., 1998), estimates of the mean apparent RPD depths in these types of sediments are indeterminate with conventional white light photography.

2.1.7 Sedimentary Methane

If organic loading is extremely high, porewater sulfate is depleted and methanogenesis occurs. The process of methanogenesis is indicated by the appearance of methane bubbles in the sediment column, and the number and total area covered by all methane pockets is measured. These gas-filled voids are readily discernable in SPI images because of their irregular, generally circular aspect and glassy texture (due to the reflection of the strobe off the gas bubble).

2.1.8 Infaunal Successional Stage

The mapping of infaunal successional stages is readily accomplished with SPI technology. These stages are recognized in SPI images by the presence of dense assemblages of near-surface polychaetes and/or the presence of subsurface feeding voids; both may be present in the same image. Mapping of successional stages is based on the theory that organism-sediment interactions in fine-grained sediments follow a predictable sequence after a major seafloor perturbation. This theory states that primary succession results in "the predictable appearance of macrobenthic invertebrates belonging to specific functional types following a benthic disturbance. These invertebrates interact with sediment in specific ways. Because functional types are the biological units of interest..., our definition does not demand a sequential appearance of particular invertebrate species or genera" (Rhoads and Boyer 1982). This theory is presented in Pearson and Rosenberg (1978) and further developed in Rhoads and Germano (1982) and Rhoads and Boyer (1982).

This continuum of change in animal communities after a disturbance (primary succession) has been divided subjectively into three stages: Stage I is the initial community of tiny, densely populated polychaete assemblages; Stage II is the start of the transition to head-down deposit feeders; and Stage III is the mature, equilibrium community of deep-dwelling, head-down deposit feeders.

After an area of bottom is disturbed by natural or anthropogenic events, the first invertebrate assemblage (Stage I) appears within days after the disturbance. Stage I consists of assemblages of tiny tube-dwelling marine polychaetes that reach population densities of 10^4 to 10^6 individuals per m^2. These animals feed at or near the sediment-water interface and physically stabilize or bind the sediment surface by producing a mucous "glue" that they use to build their tubes. Sometimes deposited dredged material layers contain Stage I tubes still attached to mud clasts from their location of origin; these transported individuals are considered as part of the *in situ* fauna in our assignment of successional stages.

If there are no repeated disturbances to the newly colonized area, then these initial tube-dwelling suspension or surface-deposit feeding taxa are followed by burrowing, head-down deposit-feeders that rework the sediment deeper and deeper over time and mix oxygen from the overlying water into the sediment. The animals in these later-appearing communities (Stage II or III) are larger, have lower overall population densities (10 to 100 individuals per m^2), and can rework the sediments to depths of 3 to 20 cm or more. These animals "loosen" the sedimentary fabric, increase the water content in the sediment, thereby lowering the sediment shear strength, and actively recycle nutrients because of the high exchange rate with the overlying waters resulting from their burrowing and feeding activities.

While the successional dynamics of invertebrate communities in fine-grained sediments have been well-documented, the successional dynamics of invertebrate communities in sand and coarser sediments are not well-known. Subsequently, the insights grained from sediment profile imaging technology regarding biological community structure and dynamics in sandy and coarse-grained bottoms are fairly limited.

2.1.9 Biological Mixing Depth

During the past two decades, there has been a considerable emphasis on studying the effects of bioturbation on sediment geotechnical properties as well as sediment diagenesis (Ekman et al., 1981; Nowell et al., 1981; Rhoads and Boyer, 1982; Grant et al., 1982; Boudreau, 1986; 1994; 1998). However, an increasing focus of research is centering on the rates of contaminant flux in sediments (Reible and Thibodeaux, 1999; François et al., 2002; Gilbert et al., 2003), and the two parameters that affect the time rate of contaminant flux the greatest are erosion and bioturbation (Reible and Thibodeaux, 1999). The depth to which sediments are bioturbated, or the biological mixing depth, can be an important parameter for studying either nutrient or contaminant flux in sediments. While the apparent RPD is one potential measure of biological mixing depth, it is quite common in profile images to see evidence of biological activity (burrows, voids, or actual animals) well below the mean apparent RPD. Both the minimum and maximum linear distance from the sediment surface to both the shallowest and deepest feature of biological activity are measured along with a notation of the type of biogenic structure measured. From these, either the minimum, maximum, or average biological mixing depth can be mapped across a surveyed area of interest.

2.1.10 Organism-Sediment Index

The Organism-Sediment Index (OSI) is a summary mapping statistic that is calculated on the basis of four independently measured SPI parameters: apparent mean RPD depth, presence of methane gas, low/no dissolved oxygen at the sediment-water interface, and infaunal successional stage. Table 1 shows how these parameters are summed to derive the OSI.

The highest possible OSI is +11, which reflects a mature benthic community in relatively undisturbed conditions (generally a good yardstick for high benthic habitat quality). These conditions are characterized by deeply oxidized sediment with a low inventory of anaerobic metabolites and low SOD, and by the presence of a climax (Stage III) benthic community. The lowest possible OSI is -10, which indicates that the sediment has a high inventory of anaerobic metabolites, has a high oxygen demand, and is azoic. In our mapping experience over the past 15 years, we have found that OSI values of 6 or less indicate that the benthic habitat has experienced physical disturbance, organic enrichment, or excessive bioavailable contamination in the recent past.

2.1.11 Benthic Habitat Classification

A habitat classification strategy for the profile images from the Thea Foss Waterway was developed to identify the principal benthic habitats encountered. This strategy focused on sediment characteristics that reflected the kinetic regime of the waterway and likely correlate with the diversity and biomass of benthic infauna.

Four habitat classes and five habitat subclasses were recognized in this particular area (Table 2). The four classes were hard bottom, sandy silt bottoms, silty sand bottoms, and bottoms with no discernable infauna and/or bacterial mats ("oligozoic"). These classes were not designed to be mutually exclusive; some stations fit into more than one class (oligozoic bottoms could also have been classified as a subclass of sandy-silt bottoms). Areas with organic-rich sediments and high oxygen demand along with the presence of bacterial colonies (*Beggiatoa* spp.) indicated a potential resource management concern, so they were given priority over the silty and sandy classes.

Table 1. Calculation of the SPI Organism-Sediment Index

Parameter	Index Value
A. Mean RPD Depth (choose one)	
0.00 cm	0
> 0-0.75 cm	1
0.76-1.50 cm	2
1.51-2.25 cm	3
2.26-3.00 cm	4
3.01-3.75 cm	5
> 3.75 cm	6
B. Successional Stage (choose one)	
Azoic	-4
Stage I	1
Stage I → II	2
Stage II	3
Stage II → III	4
Stage III	5
Stage I on III	5
Stage II on III	5
C. Chemical Parameters (choose one or both if appropriate)	
Methane Present	-2
No/Low Dissolved Oxygen[a]	-4

Organism-sediment Index = Total of above subset indices (A+B+C)

Range: -10 to +11

[a] This is not based on a Winkler or polarigraphic electrode measurement, but on the imaged evidence of reduced, low reflectance (i.e., high-oxygen-demand) sediment at the sediment-water interface.

Table 2. Classification Scheme for Benthic Habitats in Thea Foss Waterway

Class and Subclass	Description
Hard Bottom	Cobble or mussel beds that prevent adequate camera prism penetration
Sandy Silt Bottom	Light gray to black silt/clay with a high percentage of very fine sand present
Over gravel barrier	Silty depositional layer with admixed very fine sand over tan coarse sandy gravel; fine-grained layer is less than 10 cm thick
With Infauna	Sandy silt with obvious tubicolous or burrowing infauna (polychaete or bivalve)
Silty Sand Bottom	Very fine sandy bottom with high percentage of silt present
Over gravel barrier	Very silty, very fine sand depositional layer over tan coarse sandy gravel; fine-grained layer is less than 10 cm thick
With Infauna	Silty very fine sand with obvious tubicolous or burrowing infauna (polychaete or bivalve)
Organic-rich	Silty, black, very fine to medium sand with high amount of organics present
Oligozoic Bottom	Organic-rich fine-grained sediment with high sediment-oxygen demand, little or no apparent infauna, and sulfur-reducing bacterial colonies present

2.2 USING SPI DATA TO ASSESS BENTHIC QUALITY & HABITAT CONDITIONS

While various measurements of water quality such as dissolved oxygen, contaminants, or nutrients are often used to assess regional ecological quality, interpretation is difficult because of the transient nature of water-column phenomena. Measurement of a particular value of any water-column variable represents an instantaneous "snapshot" that can change within minutes after the measurement is taken. By the time an adverse signal in the water column such as a low dissolved oxygen concentration is persistent, the system may have degraded to the point where resource managers can do little but map the spatial extent of the phenomenon while gaining a minimal understanding of factors contributing to the overall degradation.

The seafloor, on the other hand, is a long-term time integrator of sediment and overlying water quality; values for any variable measured are the result of physical, chemical, and biological interactions on time scales much longer than those present in a rapidly moving fluid. The seafloor is thus an excellent indicator of environmental quality, both in terms of historical impacts and of future trends for any particular variable.

Physical measurements made with the SPI system from profile images provide background information about gradients in physical disturbance (caused by dredging, disposal, oil platform cuttings and drilling muds discharge, trawling, or storm resuspension and transport) in the form of maps of sediment grain size, boundary roughness, sediment textural fabrics, and structures. The concentration of organic matter and the SOD can be inferred from the optical reflectance of the sediment column and the apparent RPD depth. Organic matter is an important indicator of the relative value of the sediment as a carbon source for both bacteria and infaunal deposit feeders. SOD is an important measure of ecological quality; oxygen can be depleted quickly in sediment by the accumulation of organic matter and by bacterial respiration, both of which place an oxygen demand on the porewater and compete with animals for a potentially limited oxygen resource (Kennish 1986).

The apparent RPD depth is useful in assessing the quality of a habitat for epifauna and infauna from both physical and biological points of view. The apparent RPD depth in profile images has been shown to be directly correlated to the quality of the benthic habitat in polyhaline and mesohaline estuarine zones (Rhoads and Germano 1986; Revelas et al. 1987; Valente et al. 1992). Controlling for differences in sediment type and physical disturbance factors, apparent RPD depths < 1 cm can indicate chronic benthic environmental stress or recent catastrophic disturbance.

The distribution of successional stages in the context of the mapped disturbance gradients is one of the most sensitive indicators of the ecological quality of the seafloor (Rhoads and Germano 1986). The presence of Stage III equilibrium taxa (mapped from subsurface feeding voids as observed in profile images) can be a good indication of high benthic habitat stability and relative quality. A Stage III assemblage indicates that the sediment surrounding these organisms has not been disturbed severely in the recent past and that the inventory of bioavailable contaminants is relatively small. These inferences are based on past work, primarily in temperate latitudes, showing that Stage III species are relatively intolerant to sediment disturbance, organic enrichment, and sediment contamination. Stage III species expend metabolic energy on sediment bioturbation (both particle advection and porewater irrigation) to control sediment properties, including porewater profiles of sulfate, nitrate, and RPD depth in the sedimentary matrix near their burrows or tubes (Aller and Stupakoff 1996; Rice and Rhoads 1989). This bioturbation results in an enhanced rate of decomposition of polymerized organic matter by stimulating microbial decomposition (“microbial gardening”). Stage III benthic assemblages are very stable and are also called climax or equilibrium seres.

The metabolic energy expended in bioturbation is rewarded by creating a sedimentary environment where refractory organic matter is converted to usable food. Stage III bioturbation has been likened to processes such as stirring and aeration used in tertiary sewage treatment plants to accelerate organic decomposition. These processes can be interpreted as a form of human bioturbation. Physical disturbance, contaminant loading, and/or over-enrichment result in habitat destruction and in local extinction of the climax seres. Loss of Stage III species results in the loss of sediment stirring and aeration and may be followed by a buildup of organic matter (sediment eutrophication). Because Stage III species tend to have relatively conservative rates of recruitment, intrinsic population increase, and ontogenetic growth, they may not reappear for several years once they are excluded from an area.

The presence of Stage I seres (in the absence of Stage III seres) can indicate that the bottom is an advanced state of organic enrichment, has received high contaminant loading, or experienced a substantial physical disturbance. Unlike Stage III communities, Stage I seres have a relatively high tolerance for organic enrichment and contaminants. These opportunistic species have high rates of recruitment, high ontogenetic growth rates, and live and feed near the sediment-water interface, typically in high densities. Stage I seres often co-occur with Stage III seres in marginally enriched areas. In this case, Stage I seres feed on labile organic detritus settling onto the sediment surface, while the subsurface Stage III seres tend to specialize on the more refractory buried organic reservoir of detritus.

Stage I and III seres have dramatically different effects on the geotechnical properties of the sediment (Rhoads and Boyer 1982). With their high population densities and their feeding efforts concentrated at or near the sediment-water interface, Stage I communities tend to bind fine-grained sediments physically, making them less susceptible to resuspension and transport. Just as a thick cover of grass will prevent erosion on a terrestrial hillside, so too will these dense assemblages of tiny polychaetes serve to stabilize the sediment surface. Conversely, Stage III taxa increase the water content of the sediment and lower its shear strength through their deep burrowing and pumping activities, rendering the bottom more susceptible to erosion and resuspension. In shallow areas of fine-grained sediments that are susceptible to storm-induced or wave orbital energy, it is quite possible for Stage III taxa to be carried along in the water column in suspension with fluid muds. When redeposition occurs, these Stage III taxa can become quickly re-established in an otherwise physically disturbed surface sedimentary fabric.

SPI has been shown to be a powerful reconnaissance tool that can efficiently map gradients in sediment type, biological communities, or disturbances from physical forces or organic enrichment. The conclusions reached at the end of this report are about dynamic processes that have been deduced from imaged structures; as such, they should be considered hypotheses available for further testing/confirmation. By employing Occam's Razor, we feel reasonably assured that the most parsimonious explanation is usually the one borne out by subsequent data confirmation.

3.0
RESULTS

A complete set of all the summary data measured from each image is presented in Appendix A; a CD with digital files of the sediment profile images in Joint Photographic Experts Group high resolution format (*.jpg) has been provided under separate cover to the client.

Parameters such as boundary roughness and mud clast data (number, size) provide supplemental information pertaining to the physical regime and bottom sediment transport activity at a site. Even though mud clasts are definitive characteristics whose presence can indicate physical disturbance of some form, the mud clasts noted in the images from this survey were artifacts due to sampling (mud clumps clinging to the frame base) and not indicative of physical disturbance or sediment transport activities. Therefore, mud clast data were not used as individual parameters for interpretation.

3.1 GRAIN SIZE

The surface sediments throughout the entire area surveyed were primarily fine-grained sandy silts or silty sands (Figure 2). Most of the profile images showed evidence of recent depositional layering, either in the form of distinct strata separating dissimilar grain sizes e.g., mud over gravel, or surface layers of similar grain-size formed by rapid deposition of sediment on the former sediment-water interface (burial of oxidized surface layers; Figure 3). The average thickness of this surface depositional layer ranged from 4.5 – 14.6 cm (Figure 4).

3.2 SURFACE BOUNDARY ROUGHNESS

Surface boundary roughness ranged from 0.5 to 9.9 cm (Appendix A), with the larger values (above 2 cm) either caused by natural physical processes or disturbance of the sediment-water interface by sampling (Figure 5). The overall station-averaged surface boundary roughness value for the surveyed area was 1.3 cm.

3.3 PRISM PENETRATION DEPTH

With camera stop collar and weight settings uniform throughout the entire survey except for two stations where softer sediments were encountered (WC-02 and WC-04; see Appendix A), the variation in prism penetration was a good indicator of relative sediment shear strength (Figure 6). The average prism penetration depth in the study area ranged from 0 cm (hard bottom at Station WC-01 covered with rock and mussels; Figure 7) to 19.1 cm, with an overall site average of 11.2 cm.

3.4 APPARENT REDOX POTENTIAL DISCONTINUITY DEPTH

The distribution of mean apparent RPD (aRPD) depths is shown in Figure 8; station-averaged aRPD values ranged from 0 cm (anoxic muds found at Station WC-02; Figure 9) to 1.5 cm. The overall station-averaged mean aRPD depth for the site was 0.9 cm. Low oxygen conditions were found at three locations (Figure 10) as indicated by the presence of sulfur-reducing bacterial colonies (*Beggiatoa* spp.). These white, filamentous bacterial colonies (Figure 11) only appear at the sediment surface when dissolved oxygen concentrations in the benthic boundary layer drop below 1 mg/L (Rosenberg and Diaz, 1993).

3.5 INFAUNAL SUCCESSIONAL STAGE

The mapped distribution of infaunal successional stages is shown in Figure 12. While lower order successional seres dominated three of the stations (WC-02, WC-07, and WC-09), the majority of the images from the other locations showed evidence of mature benthic assemblages (Stage 3 infauna) present (Figure 13).

3.6 ORGANISM-SEDIMENT INDEX

The spatial distribution of median OSI values throughout the study area can be seen in Figure 14. An OSI of +6 or less typically indicates that a benthic habitat has experienced physical disturbances, eutrophication, or excessive bioavailable contamination in the recent past. Of the 15 stations where the OSI could be calculated, only seven stations had median values just above the +6 threshold (Figure 14), and the remaining eight stations all showed signs of disturbance, with two stations (WC-01 and WC-02) scoring values in the negative range.

3.7 BENTHIC HABITAT CLASSIFICATION

The spatial distribution of mapped benthic habitats in the Thea Foss Waterway can be seen in Figure 15. The two stations with the negative OSI values (WC-01 and WC-02) were classified as Oligozoic (Table 2); only one other station (WC-07) showed evidence of excessive organic enrichment (Figure 16). The four stations at the northern end of the site were notably distinct because of the subsurface layer of "habitat mix" (coarse gravel used for capping) that will serve as a barrier to infaunal bioturbation (Figure 17).

4.0 DISCUSSION

The primary objective of the SPI technology survey was to document recolonization of benthic infauna as part of the post-cap environmental monitoring in the Thea Foss Waterway. While recolonization has definitely taken place (Figure 12), there were several notable findings from this initial SPI monitoring survey:

1. There has been a substantial deposition of new sediment in the area surveyed since the capping operations were completed. While the total thickness of this new deposit was deeper than the camera prism penetration at a few stations, the presence of the coarser-grained "habitat mix" was most visible in the profile images at the four northern-most stations surveyed; these four stations are within the city recontamination capping area (this cap was completed in December, 2005). Accumulation of fine-grained sediments throughout the survey area indicates that the main source of this recent sedimentary input is the large outfalls at the southern end of the site. The recent deposition (as measured to the buried former sediment-water interface) seen in the profile images (Appendix A, Figure 4) most likely represents a rapid input during the last wet period, but the lack of previous SPI time-series data does not allow us to conclude definitively whether the depositional interval measured represents a seasonal or annual input. Nearby shoreside or bank construction activities may have also contributed to the surface depositional layer on the capped area.

2. Station WC-01 was the only station where new sediment has not accumulated, and the slope armor/scour protection rock placed just north of the outfall still serves at the seafloor surface. This station was located at the toe of the riprap slope. However, in portion of the Thea Foss Waterway head where the fine-grained material is accumulating, the post-cap sediment is organically enriched relative to surrounding sediments and also shows evidence of high sediment oxygen demand. As a result, the biological community has been severely compromised in those locations with surface sediments dominated by organically enriched, fine-grained material with high sediment oxygen demand (Stations WC-01B and WC-02; Figures 11 and 14). As long as these outfalls continue to discharge the volume and quality of material that they have since the completion of the capping operations, they will serve as a continuous source of disturbance to benthic recovery in the entire area surveyed. Compromised dissolved oxygen conditions in the benthic boundary layer and organic enrichment in the sediments were detected as far north as Stations WC-07 and WC-08.

3. The four northernmost stations are located within the city recontamination capping area, completed in December 2005. Therefore, extensive burrow

formations were not seen, and only one image showed evidence of infaunal re-working in the top 5 cm of the coarse cap material.

The key to success in any sediment remediation project is not only adequate removal and conformance to original engineering design, but effective source control. While SPI technology can only make inferences about relative concentration of sediment contaminants (contaminant concentration is usually well-correlated with organic enrichment gradients in fine-grained sediments), we would predict that sediment quality in the southern end of the area surveyed is definitely compromised by the nature of material being discharged by the twin outfalls at the southern end of the waterway. While the cap appears to be an effective isolation barrier from upward migration of contaminants as well as downward migration of benthic infauna, the more recent deposition of organically-enriched, fine-grained material has limited the utility of the area as suitable habitat for mature benthic communities and also eliminated the original benefit of placing the "habitat mix" as an attractive surface for fish foraging.

5.0
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FIGURES

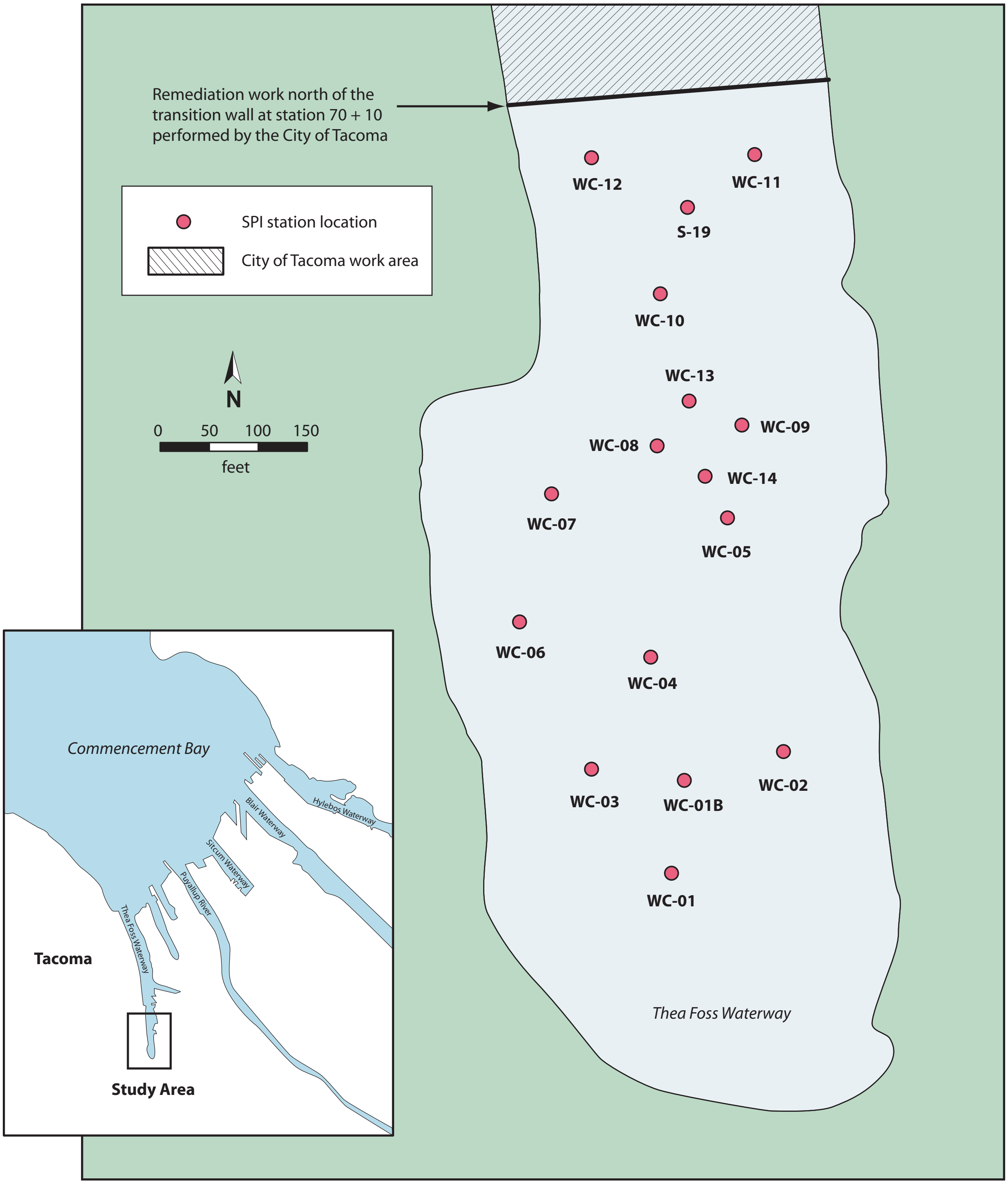


Figure 1: Location of SPI stations sampled in the Thea Foss Waterway in May, 2006.

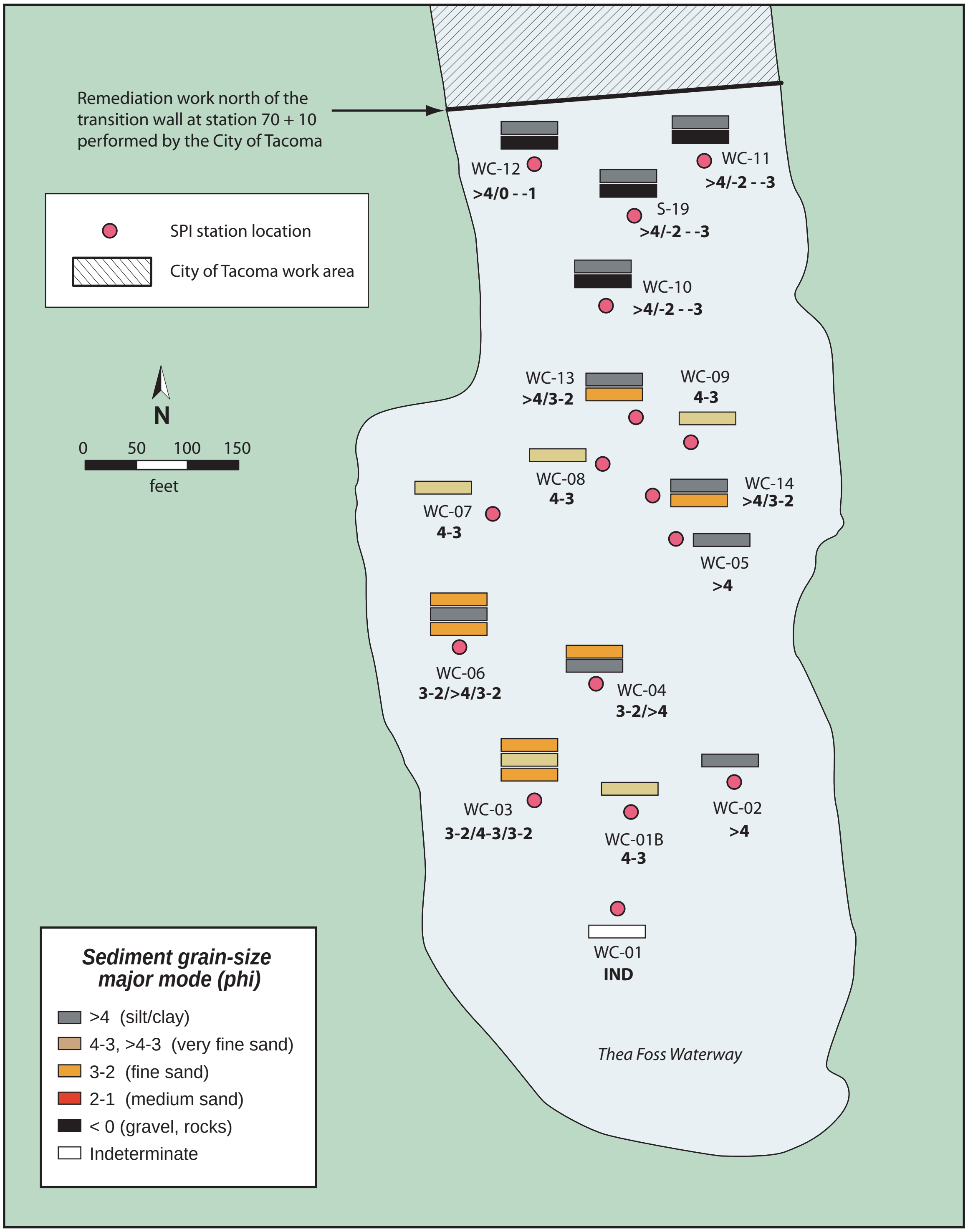
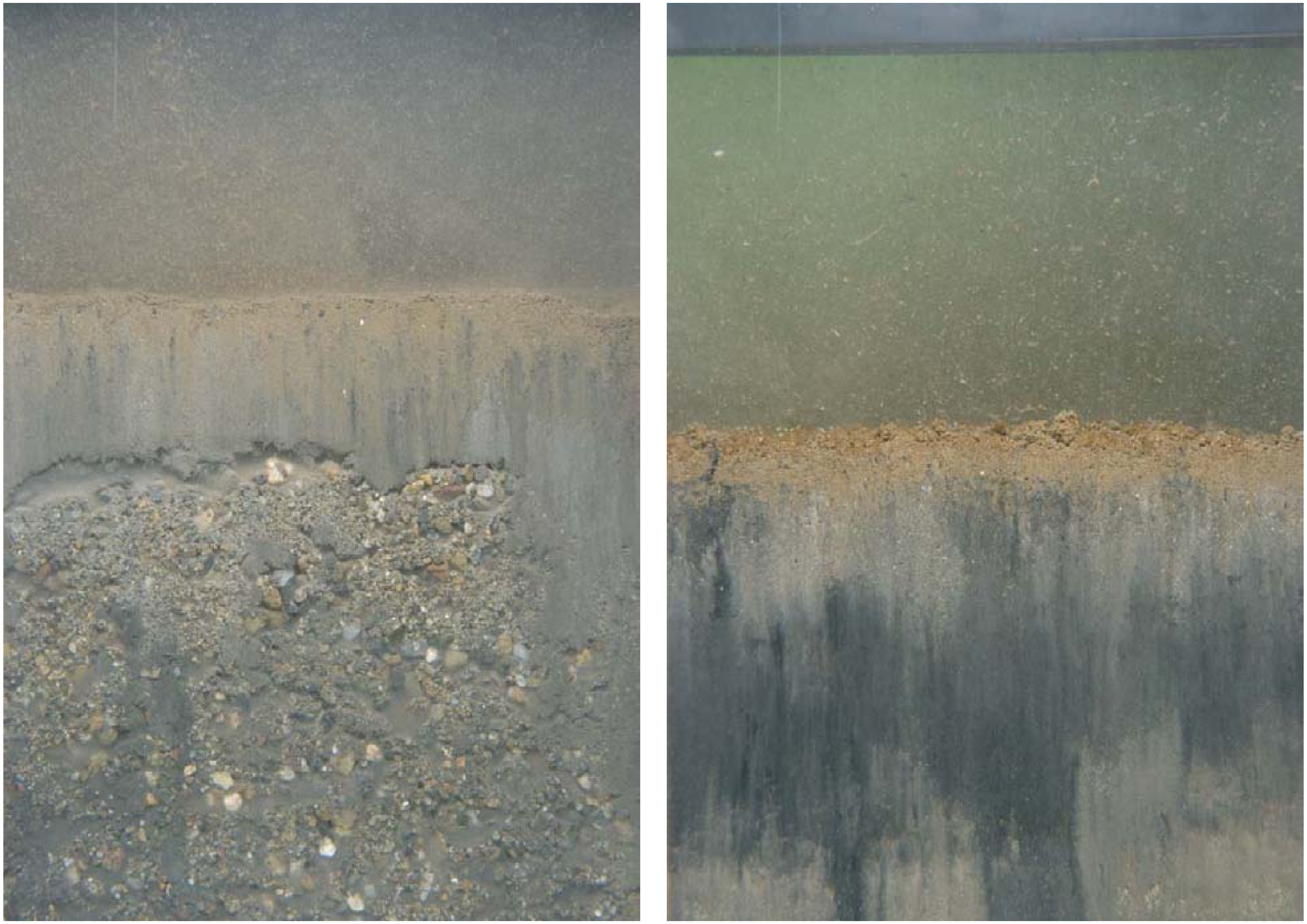


Figure 2: Distribution of surface sediment facies at the surveyed stations.



S19 **WC-06**

Figure 3: These profile images from Station S19 (left) and WC-06 (right) show different textural characteristics for depositional strata. The left image shows a distinct grain-size difference in the surface layer, while the right image shows a surface layer with similar grain-size deposited on top what used to be the sediment surface (buried oxidized horizon). SCALE: Width of image = 14.3 cm.

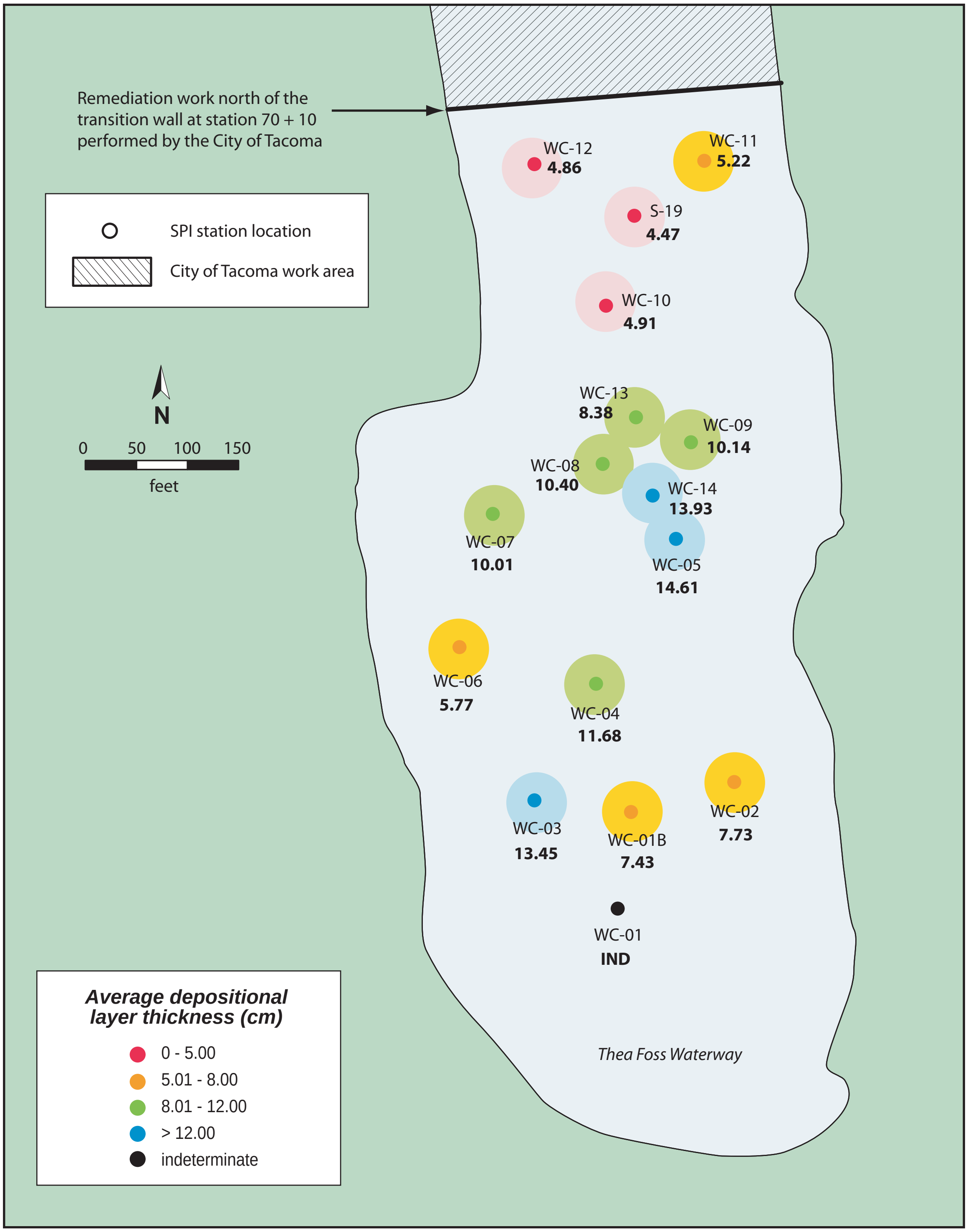


Figure 4: Average surface depositional layer thickness (cm) at SPI stations in the Thea Foss Waterway.

Figure 5: The large surface boundary roughness value (9.9 cm) measured in this image from Station WC-14 is caused by a sampling artifact; this replicate image was taken in the same location as the previous image, showing the "divot" carved out of the bottom by the camera prism in the previous deployment. SCALE: Width of image = 14.3 cm.

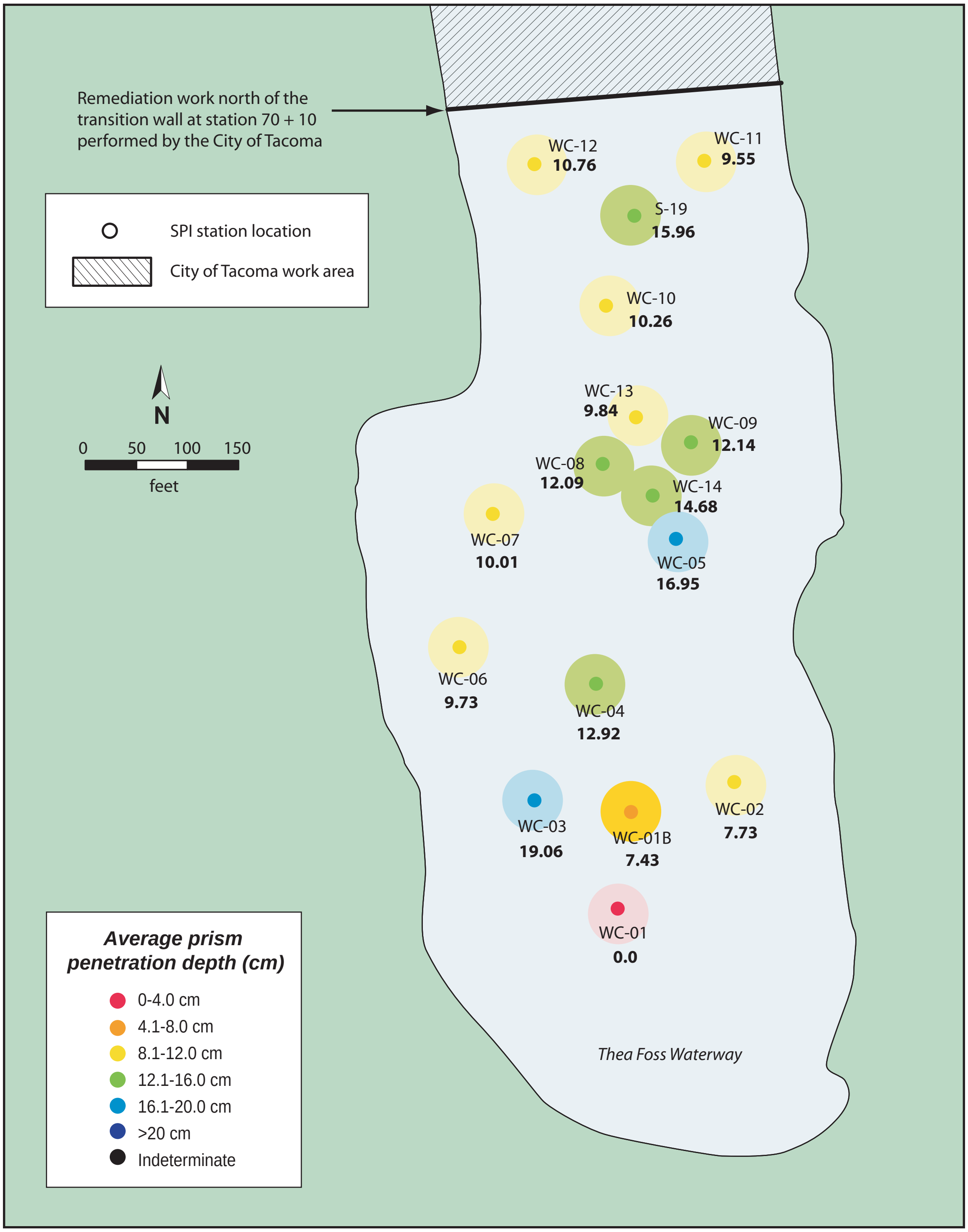


Figure 6: Spatial distribution of average camera prism penetration depth (cm) in the Thea Foss Waterway.

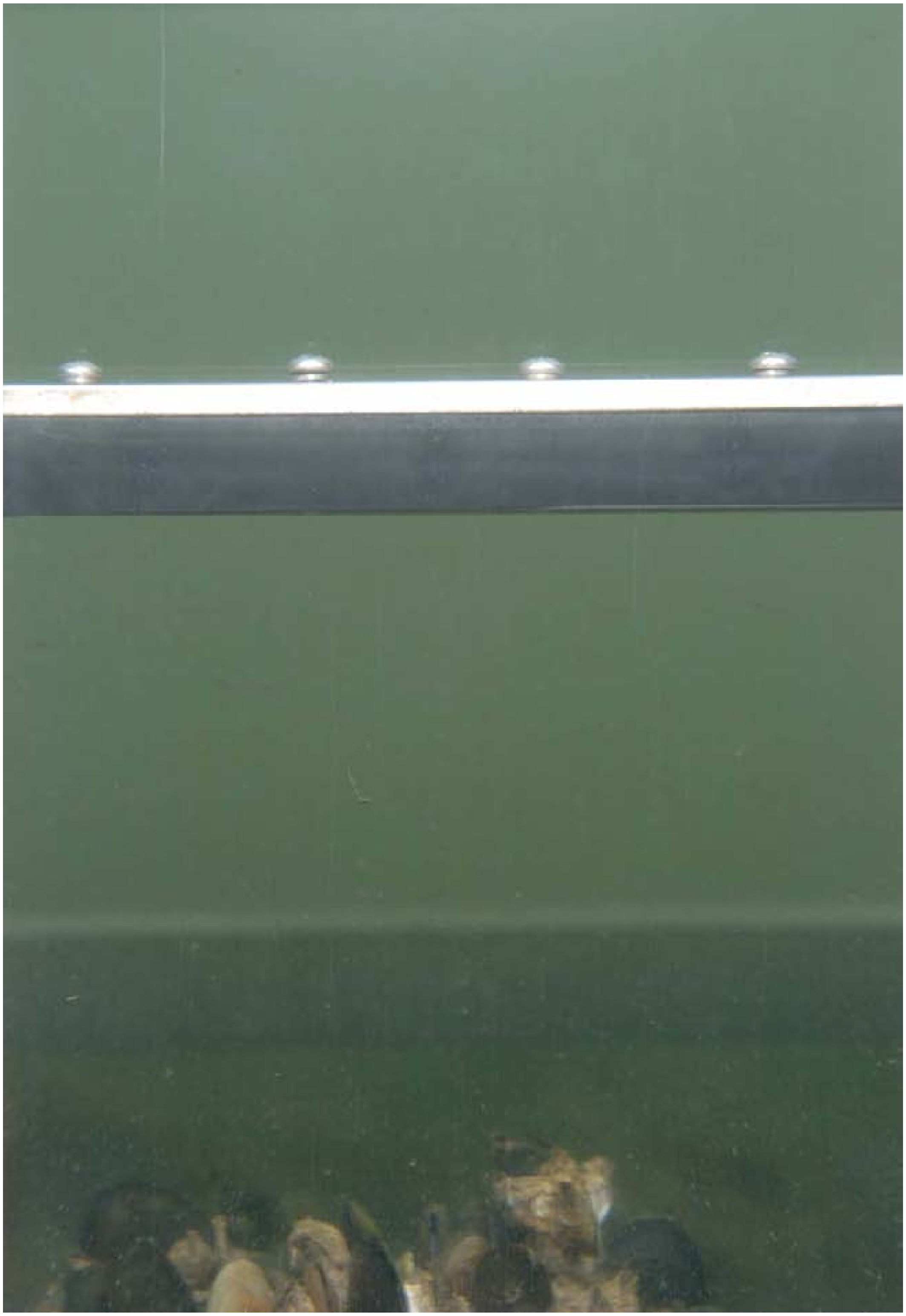


Figure 7: The mussel bed shown in this profile image from Station WC-01 prevented camera prism penetration as well as measurement of any other SPI parameters at this particular location. SCALE: Width of image = 14.3 cm.

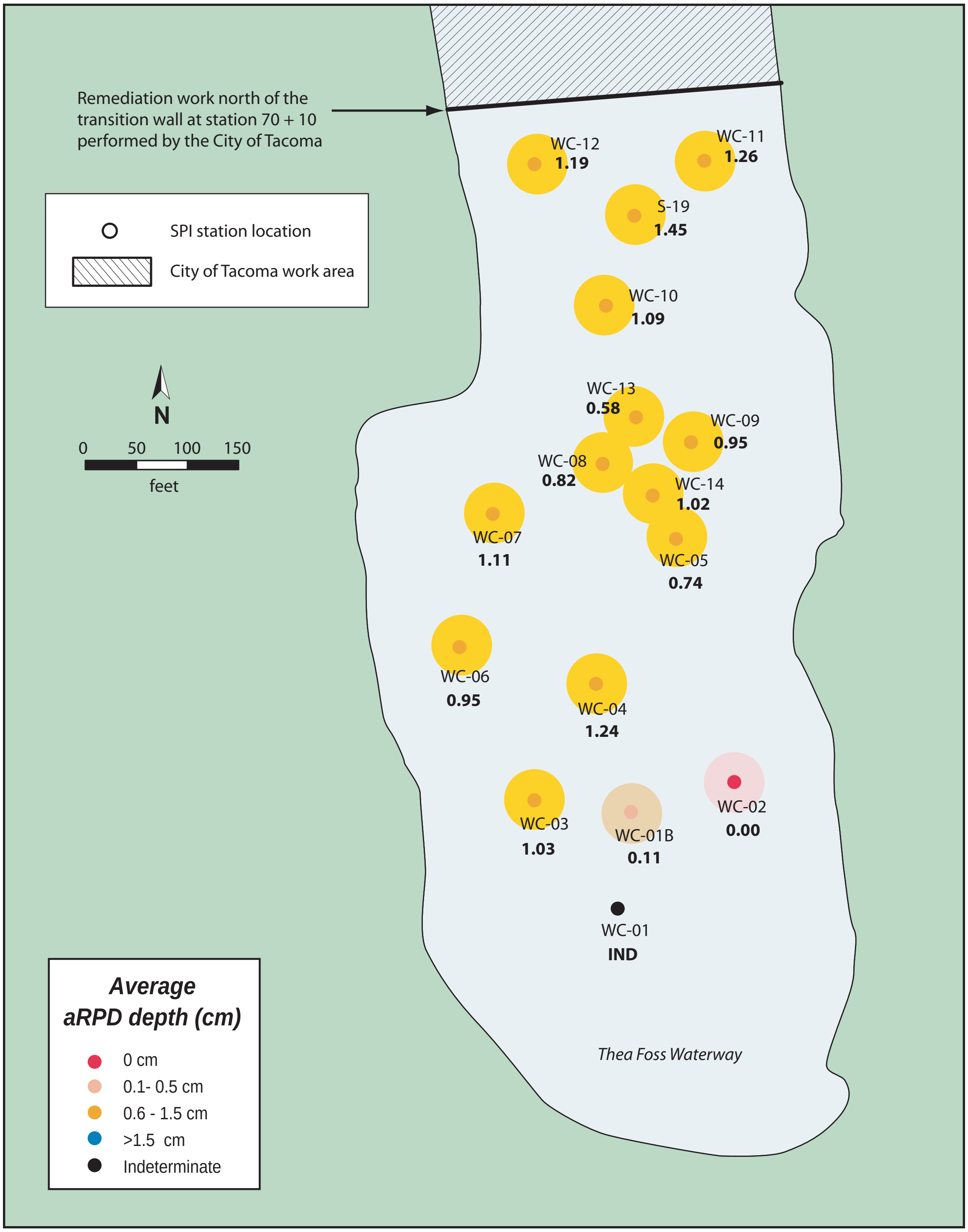
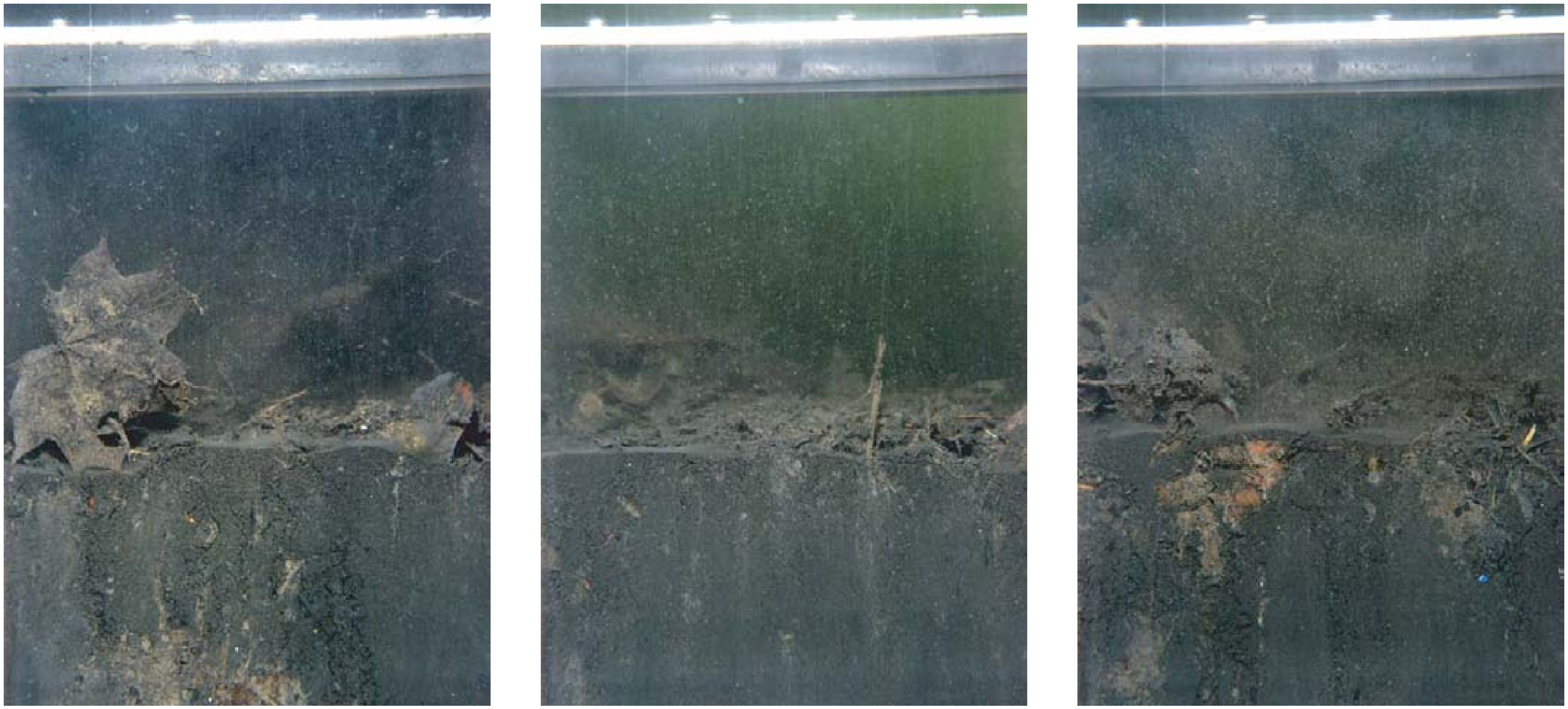


Figure 8: Spatial distribution of average apparent RPD depth (cm) in the Thea Foss Waterway.



WC-02D **WC-02E** **WC-02F**

Figure 9: These profile images from Station WC-02 show anoxic mud throughout the entire vertical sediment profile, indicative of high sediment oxygen demand. SCALE: Width of image = 14.3 cm.

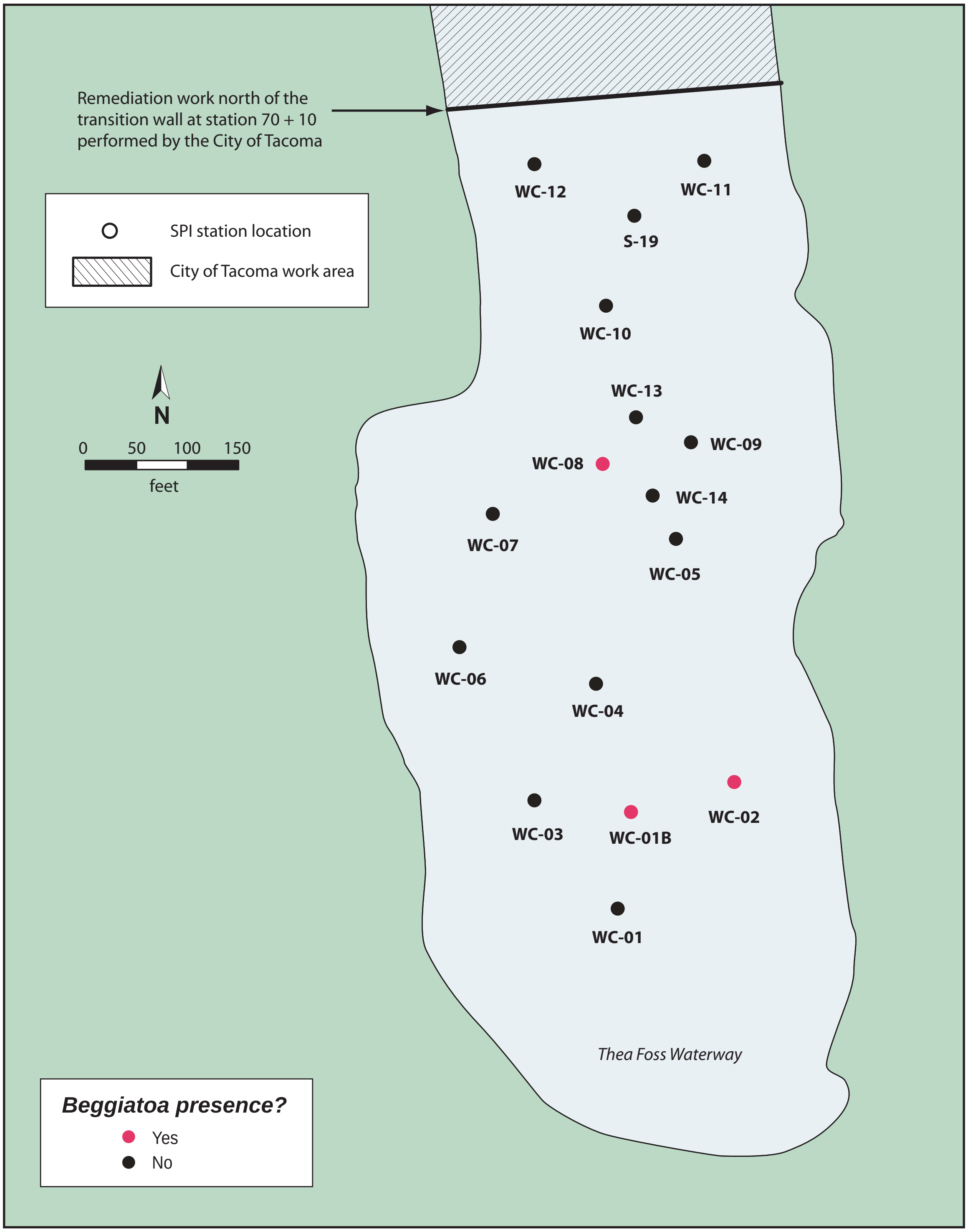


Figure 10: Locations where *Beggiatoa* colonies were found in surface sediments in the Thea Foss Waterway, indicative of low dissolved oxygen concentrations in the benthic boundary layer.

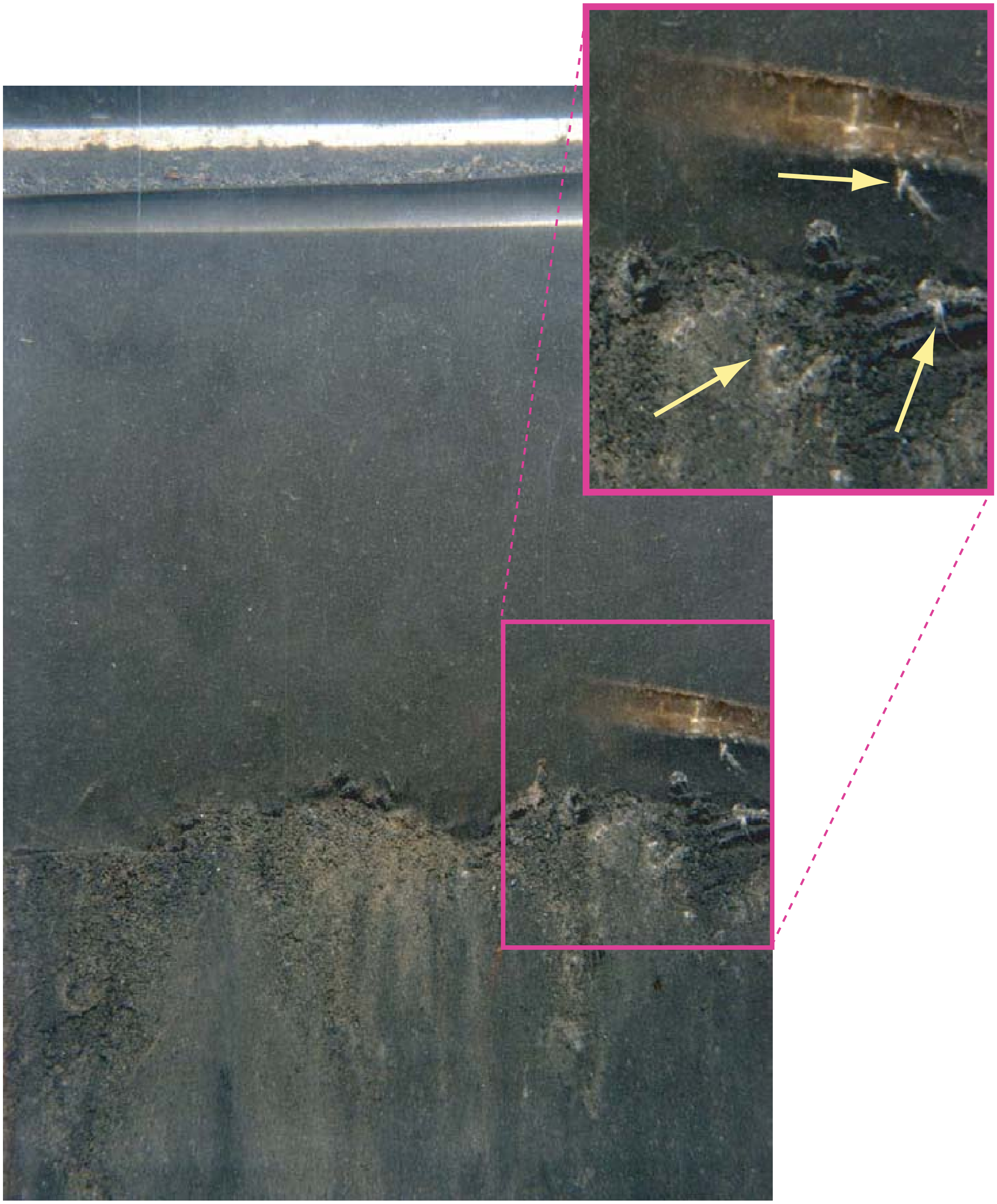


Figure 11: The white patches with string-like wisps at the sediment surface in this profile image from Station WC-01B are colonies of the sulfur-reducing bacteria *Beggiatoa*.

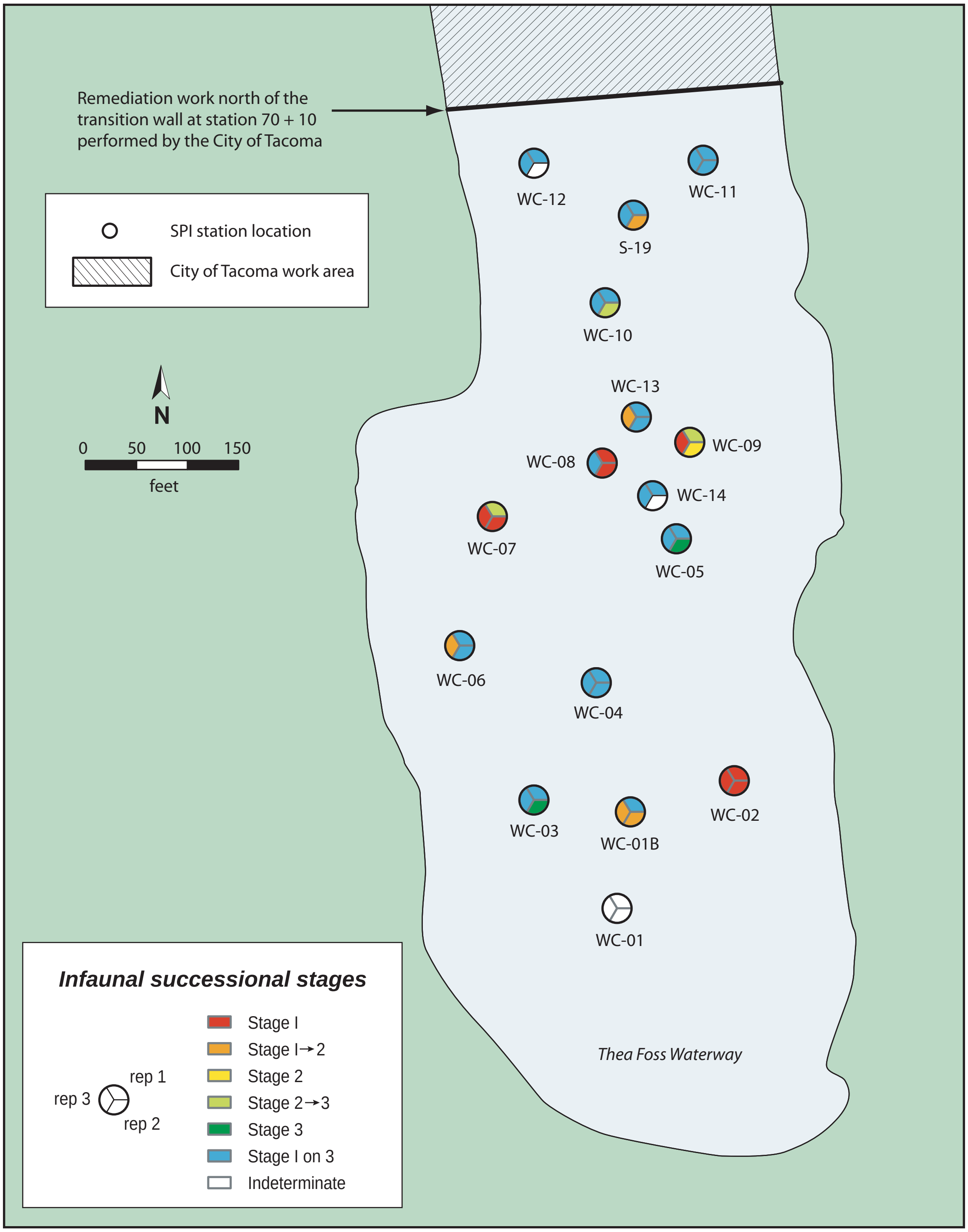
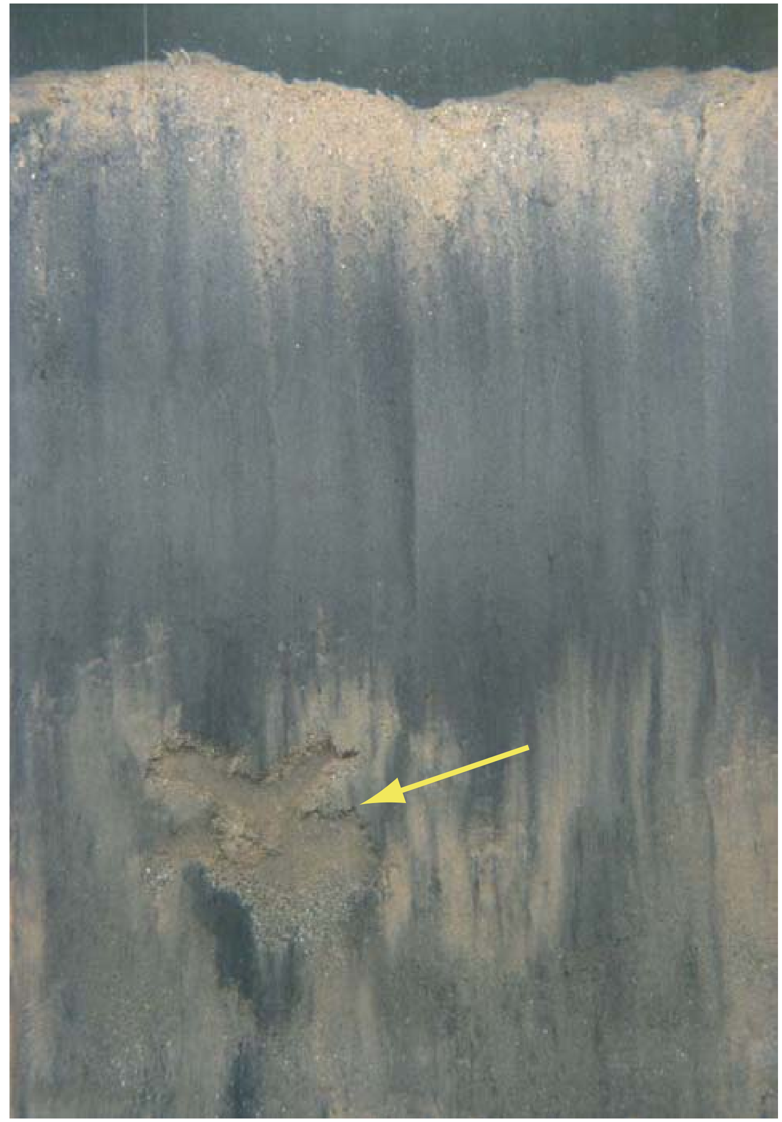


Figure 12: Distribution of infaunal successional stages for all sediment profile images collected at the Thea Foss Waterway.

WC-03



WC-04

Figure 13: These profile images from Station WC-03 (left) and WC-04 (right) show evidence (arrows) of deposit-feeding infauna (burrows and sub-surface feeding voids). SCALE: Width of image = 14.3 cm.

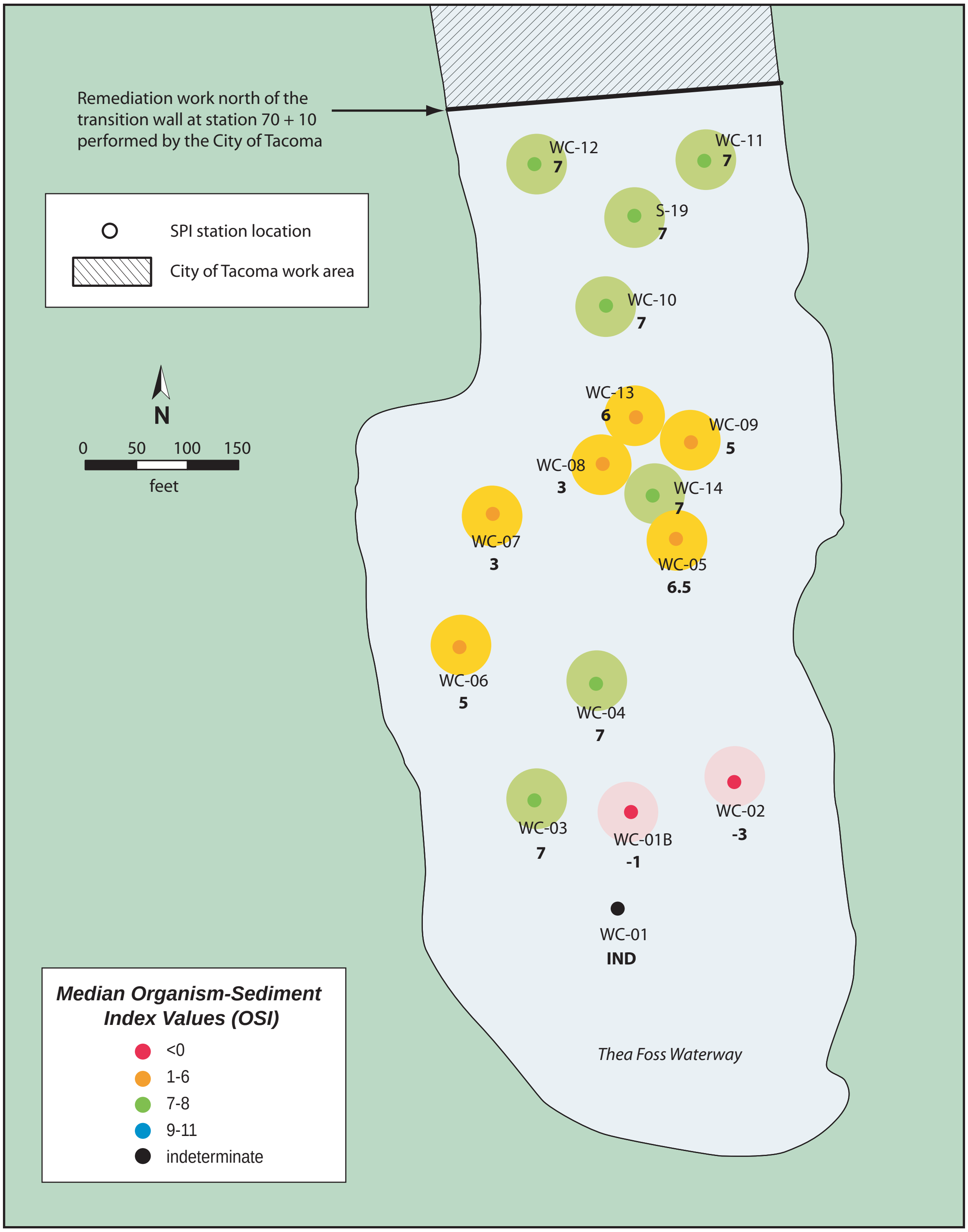


Figure 14: Distribution of median OSI values in the Thea Foss Waterway.

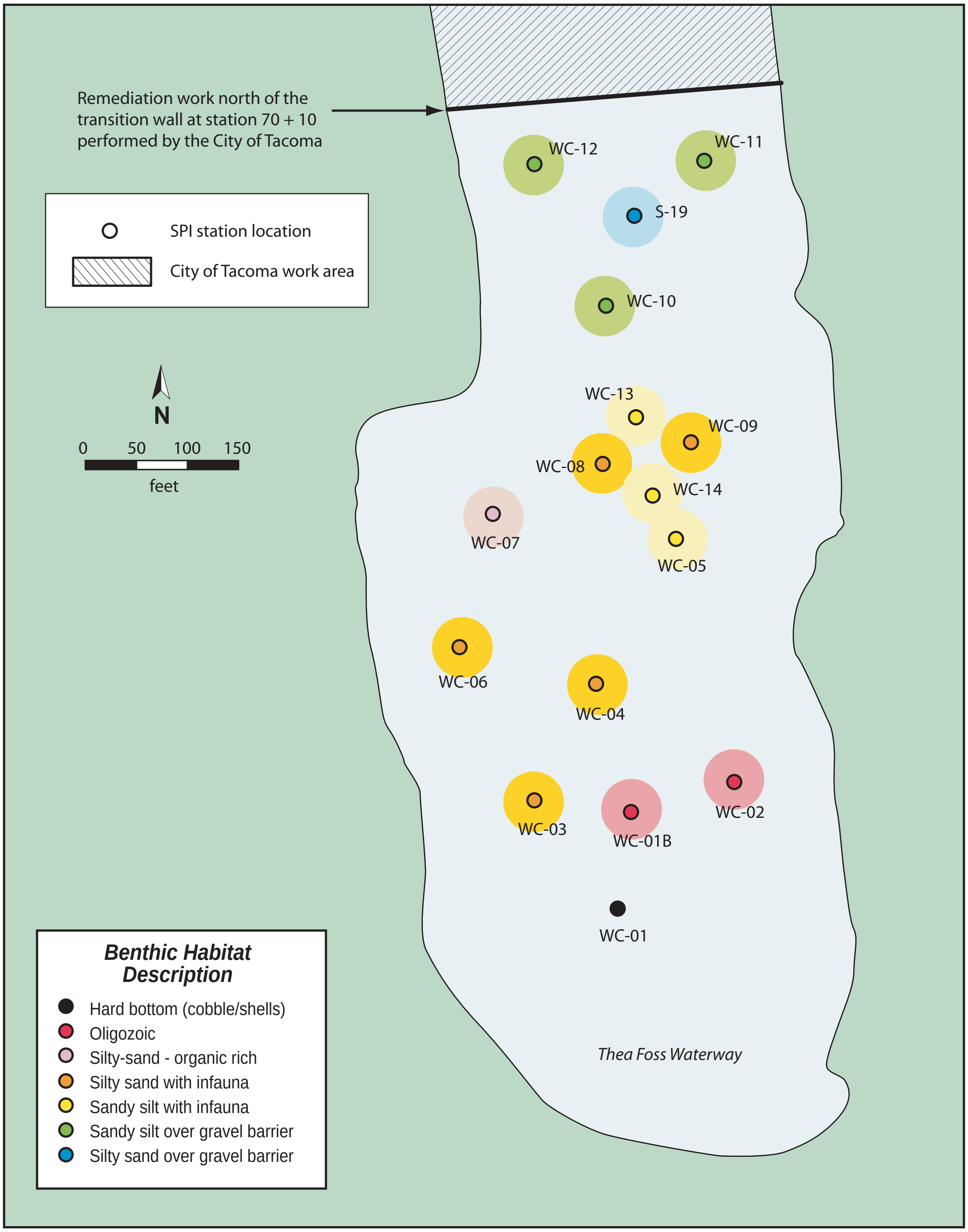


Figure 15: Spatial distribution of benthic habitat based on SPI classification in the Thea Foss Waterway.

WC-07A

WC-07B

Figure 16: The relatively thin oxidized surface layers and dark subsurface sediments seen in these two profile images from Station WC-07 are indicative of either excessive organic enrichment or high sulfide inventories. SCALE: Width of image = 14.3 cm.

WC-10

S-19

WC-12

WC-11

Figure 17: These profile images from the four northernmost stations have the common distinguishing feature of the Thea Foss capping material visible in the bottom half of the image. SCALE: Width of image = 14.3 cm.

APPENDIX A

Sediment Profile Image Analysis Results

Station	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per Carriage	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	-
Y2-S19-I A	5/11/2006	14:25:57	13.25	5	14.31	>4/-2 - -3	-3	>4	>4 to -3	250.36	17.50	17.03	17.87	0.84	Physical	17.20	1.20	0	-	
Y2-S19-I B	5/11/2006	14:26:47	13.25	5	14.31	>4/-2 - -3	-3	>4	>4 to -3	201.40	14.07	13.67	14.25	0.59	Physical	15.74	1.10	0	-	
Y2-S19-I C	5/11/2006	14:27:59	13.25	5	14.31	>4/-2 - -3	-3	>4	>4 to -3	233.51	16.32	14.48	17.70	3.22	Physical	29.39	2.05	0	-	
Y2-WC01-I A	5/11/2006	16:43:31	13.25	5	14.31	Ind	Ind	Ind	Ind	0.00	0.00	0.00	0.00	0.00	Ind	Ind	Indeterminate	Ind	Ind	
Y2-WC01-I B	5/11/2006	16:44:22	13.25	5	14.31	Ind	Ind	Ind	Ind	0.00	0.00	0.00	0.00	0.00	Ind	Ind	Indeterminate	Ind	Ind	
Y2-WC01-I C	5/11/2006	16:46:48	13.25	5	14.31	Ind	Ind	Ind	Ind	0.00	0.00	0.00	0.00	0.00	Ind	Ind	Indeterminate	Ind	Ind	
Y2-WC01B-I A	5/11/2006	17:32:05	13.25	5	14.31	4-3	1	>4	>4 to 1	118.58	8.29	7.78	9.27	1.48	Physical	0.00	0.00	0	-	
Y2-WC01B-I B	5/11/2006	17:32:56	13.25	5	14.31	4-3	1	>4	>4 to 1	97.55	6.82	5.99	8.01	2.02	Physical	0.50	0.04	0	-	
Y2-WC01B-I C	5/11/2006	17:33:52	13.25	5	14.31	4-3	1	>4	>4 to 1	102.69	7.18	6.38	7.67	1.29	Physical	4.24	0.30	0	-	
Y2-WC02-I A	5/11/2006	16:34:36	13.25	5	14.31	>4/3-2	1	>4	>4 to 1	-	21.53	21.53	21.53	0.00	Ind	Ind	Indeterminate	Ind	Ind	
Y2-WC02-I B	5/11/2006	16:35:30	13.25	5	14.31	>4/3-2	1	>4	>4 to 1	-	21.53	21.53	21.53	0.00	Ind	Ind	Indeterminate	Ind	Ind	
Y2-WC02-I C	5/11/2006	16:36:35	13.25	5	14.31	>4	1	>4	>4 to 1	-	21.53	21.53	21.53	0.00	Ind	Ind	Indeterminate	Ind	Ind	
Y2-WC02-I D	5/11/2006	17:23:52	12.5	0	14.31	>4	1	>4	>4 to 1	106.78	7.46	6.97	7.78	0.81	Physical	0.00	0.00	0	-	
Y2-WC02-I E	5/11/2006	17:24:48	12.5	0	14.31	>4	1	>4	>4 to 1	107.17	7.49	6.89	7.78	0.90	Physical	0.00	0.00	0	-	
Y2-WC02-I F	5/11/2006	17:25:51	12.5	0	14.31	>4	1	>4	>4 to 1	117.69	8.22	7.70	8.60	0.90	Physical	0.00	0.00	0	-	
Y2-WC03-I A	5/11/2006	16:26:34	13.25	5	14.31	4-3	1	>4	>4 to 1	295.47	20.65	19.85	20.78	0.92	Physical	15.55	1.09	0	-	
Y2-WC03-I B	5/11/2006	16:27:20	13.25	5	14.31	3-2/4-3/3-2	0	>4	>4 to 0	-	21.53	21.53	21.53	0.00	Ind	Ind	Indeterminate	0	-	
Y2-WC03-I C	5/11/2006	16:30:11	13.25	5	14.31	3-2/4-3/3-2	0	>4	>4 to 0	214.55	14.99	14.45	15.40	0.95	Biological	13.89	0.97	0	-	
Y2-WC04-I A	5/11/2006	16:15:20	13.25	5	14.31	4-3/3'2	0	>4	>4 to 0	277.70	19.41	18.90	19.88	0.98	Biological	14.79	1.03	0	-	
Y2-WC04-I D	5/11/2006	17:12:30	12.5	0	14.31	>4	1	>4	>4 to 1	142.67	9.97	9.16	10.95	1.79	Biological	17.80	1.24	0	-	
Y2-WC04-I E	5/11/2006	17:13:29	12.5	0	14.31	3-2/>4	1	>4	>4 to 1	134.39	9.39	8.54	10.02	1.48	Biological	20.74	1.45	0	-	
Y2-WC05-I A	5/11/2006	15:43:51	13.25	5	14.31	3-2/>4	1	>4	>4 to 1	268.99	18.80	18.40	18.90	0.50	Biological	11.99	0.84	0	-	

Station	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per Carriage	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	-
Y2-WC05-I B	5/11/2006	15:49:21	13.25	5	14.31	>4	1	>4	>4 to 1	-	21.53	21.53	21.53	0.00	Ind	Ind	Indeterminate	Ind	Ind	
Y2-WC05-I C	5/11/2006	15:51:15	13.25	5	14.31	>4	1	>4	>4 to 1	150.53	10.52	7.17	11.87	4.70	Physical	-	0.64	0	-	
Y2-WC06-I A	5/11/2006	16:04:57	13.25	5	14.31	3-2/>4	1	>4	>4 to 1	159.55	11.15	10.78	11.40	0.62	Biological	14.40	1.01	5	Ox	
Y2-WC06-I B	5/11/2006	16:06:10	13.25	5	14.31	3-2	1	>4	>4 to 1	117.20	8.19	7.62	8.79	1.18	Physical	15.02	1.05	0	-	
Y2-WC06-I C	5/11/2006	16:07:07	13.25	5	14.31	3-2/>4/3-2	1	>4	>4 to 1	140.98	9.85	9.52	10.25	0.73	Physical	11.36	0.79	0	-	
Y2-WC07-I A	5/11/2006	15:56:47	13.25	5	14.31	4-3	1	>4	>4 to 1	144.76	10.12	9.46	10.92	1.46	Physical	22.64	1.58	0	-	
Y2-WC07-I B	5/11/2006	15:57:50	13.25	5	14.31	4-3	1	>4	>4 to 1	135.77	9.49	8.96	10.36	1.40	Physical	11.79	0.82	0	-	
Y2-WC07-I C	5/11/2006	16:00:05	13.25	5	14.31	4-3	-3	>4	>4 to -3	149.25	10.43	9.77	11.37	1.60	Physical	13.35	0.93	1	Ox	
Y2-WC08-I A	5/11/2006	15:07:22	13.25	5	14.31	4-3	1	>4	>4 to 1	165.32	11.55	10.98	12.38	1.40	Physical	13.88	0.97	0	-	
Y2-WC08-I B	5/11/2006	15:08:11	13.25	5	14.31	4-3	1	>4	>4 to 1	159.42	11.14	10.86	11.65	0.78	Biological	12.43	0.87	0	-	
Y2-WC08-I C	5/11/2006	15:09:50	13.25	5	14.31	4-3	1	>4	>4 to 1	194.33	13.58	13.25	14.00	0.76	Biological	9.09	0.64	0	-	
Y2-WC09-I A	5/11/2006	15:13:29	13.25	5	14.31	4-3	1	>4	>4 to 1	178.84	12.50	11.99	12.85	0.87	Physical	12.78	0.89	0	-	
Y2-WC09-I B	5/11/2006	15:14:16	13.25	5	14.31	4-3	1	>4	>4 to 1	164.10	11.47	10.02	12.01	1.99	Biological	12.65	0.88	0	-	
Y2-WC09-I C	5/11/2006	15:15:13	13.25	5	14.31	4-3	1	>4	>4 to 1	178.37	12.46	11.84	12.97	1.12	Physical	15.23	1.06	0	-	
Y2-WC10-I A	5/11/2006	14:35:26	13.25	5	14.31	>4/-2 - -3	-3	>4	>4 to -3	137.55	9.61	8.99	10.14	1.15	Physical	13.95	0.97	0	-	
Y2-WC10-I B	5/11/2006	14:36:26	13.25	5	14.31	>4/-2 - -3	-3	>4	>4 to -3	152.75	10.67	10.30	11.17	0.87	Physical	14.48	1.01	0	-	
Y2-WC10-I C	5/11/2006	14:37:09	13.25	5	14.31	>4/-2 - -3	-3	>4	>4 to -3	150.03	10.48	10.30	11.17	0.87	Physical	18.54	1.30	0	-	
Y2-WC11-I A	5/11/2006	14:46:49	13.25	5	14.31	>4/-2 - -3	-3	>4	>4 to -3	128.98	9.01	8.82	9.52	0.70	Biological	16.30	1.14	0	-	
Y2-WC11-I B	5/11/2006	14:47:39	13.25	5	14.31	>4/-2 - -3	-3	>4	>4 to -3	144.97	10.13	9.69	10.47	0.78	Biological	22.48	1.57	0	-	
Y2-WC11-I C	5/11/2006	14:48:48	13.25	5	14.31	>4/-2 - -3	-3	>4	>4 to -3	136.04	9.51	9.02	9.91	0.90	Biological	15.19	1.06	0	-	
Y2-WC12-I A	5/11/2006	14:09:22	13.25	5	14.31	>4/0 - -1	-3	>4	>4 to -3	160.52	11.22	10.28	11.85	1.57	Biological	18.06	1.26	0	-	
Y2-WC12-I B	5/11/2006	11:14:10	13.25	5	14.31	>4/0 - -1	-3	>4	>4 to -3	149.46	10.44	9.80	10.84	1.04	Biological	Ind	Indeterminate	0	-	
Y2-WC12-I C	5/11/2006	14:11:21	13.25	5	14.31	>4/-2 - -3	-3	>4	>4 to -3	151.83	10.61	10.14	11.15	1.01	Biological	15.97	1.12	0	-	
Y2-WC13-I A	5/11/2006	14:59:31	13.25	5	14.31	>4	1	>4	>4 to 1	137.38	9.60	9.04	9.94	0.90	Biological	11.47	0.80	0	-	

Station	DATE	TIME	Stop Collar Setting (in)	# of Lead Weights per Carriage	Calibration Constant	Grain Size Major Mode (phi)	Grain Size Maximum (phi)	Grain Size Minimum (phi)	GrnSize RANGE	Penetration Area (sq.cm)	Penetration Mean (cm)	Penetration Minimum (cm)	Penetration Maximum (cm)	Boundary Roughness (cm)	Boundary Roughness Type	RPD Area (sq.cm)	Mean RPD (cm)	Mud Clast Number	Mud Clast State	-
Y2-WC13-I B	5/11/2006	15:00:14	13.25	5	14.31	>4/3-2	1	>4	>4 to 1	142.30	9.94	9.44	10.33	0.90	Physical	8.57	0.60	0	-	
Y2-WC13-I C	5/11/2006	15:01:04	13.25	5	14.31	>4/3-2	1	>4	>4 to 1	142.58	9.96	9.52	10.36	0.84	Physical	4.69	0.33	0	-	
Y2-WC14-I A	5/11/2006	15:20:14	13.25	5	14.31	>4/3-2	1	>4	>4 to 1	241.07	16.85	16.19	17.59	1.40	Physical	11.63	0.81	1	Ox	
Y2-WC14-I B	5/11/2006	15:20:55	13.25	5	14.31	Ind	-1	>4	>4 to -1	120.65	8.43	5.66	15.60	9.94	Disturbed	Ind	Indeterminate	Ind	Ind	
Y2-WC14-I C	5/11/2006	15:21:48	13.25	5	14.31	>4/3-2	1	>4	>4 to 1	268.68	18.78	18.37	19.35	0.98	Physical	17.69	1.24	3	Ox and Red	

Station	METHANE	TOTAL Cap AREA	TOTAL Cap MEAN		TOTAL Cap MIN		TOTAL Cap MAX		Low DO?	Beggiatoa present?	Mean Recent Deposition (cm)	COMMENT
Y2-S19-I A	None	188.36	>	13.16	>	12.29	>	12.85	No	No	4.33	Very silty very fine sand over coarse sandy gravel (habitat mix). Upper layer appears to be recent, post-cap deposition and some fine grained cap sand. Some prop-wash evidence at SWI. Several shallow burrows and deep oxidized burrow in lower right within cap. 4 to 4.5 cm of admixed recent, post-cap deposition.
Y2-S19-I B	None	141.02	>	9.85	>	8.12	>	10.36	No	No	4.22	Slightly sandy, medium gray silt over coarse sandy gravel (habitat mix), Habitat mix is cap material and extends deeper than penetration. 2.1 5.1 cm of recent silty deposition with some admixed/reworked cap material in this deposit. Contact between cap and port-cap deposition distinct. Unclear whether there is void in upper contact or whether it is a tear from penetration. Several polychaete/worm head extending down from roof of this space.
Y2-S19-I C	None	163.91	>	11.45	>	8.57	>	13.44	No	No	4.86	Very silty, very fine sand that is recent deposition over habitat mix/cap that is coarse sandy gravel. 2.8 to 5.1 of recent deposition that has a fair amount of labile organics. Several shallow burrows and polychaete in the habitat mix. Possible voids in upper portion of the sediment column. Ulva fragments at SWI. Three are similar.
Y2-WC01-I A	None	Ind	Ind	Indeterminate	Ind	Ind	Ind	Ind	No	No	Indeterminate	No sediment visible. Abundant material visible in the sediment column including organic detritus such as leaves, twig/sticks.
Y2-WC01-I B	None	Ind	Ind	Indeterminate	Ind	Ind	Ind	Ind	No	No	Indeterminate	No sediment visible in cross-section. Background is armored cobble with barnacle encrustations.
Y2-WC01-I C	None	Ind	Ind	Indeterminate	Ind	Ind	Ind	Ind	No	No	Indeterminate	No sediment visible in cross-section. Mussels and barnacles visible in bottom of frame.
Y2-WC01B-I A	None	0.00		0.00		-		-	Yes	Yes	8.29	Very dark gray slightly silty fine sand. Beggiatoa present and there is an irregular dusting of oxidized particles but DO condition appear marginal at the SWI. Void complex in lower left. Tubes in right background. Worm in lower center. Does not appear to be cap material (no habitat mix) nor is there any layering in sand
Y2-WC01B-I B	None	0.00		0.00		-		-	Yes	Yes	6.82	Very dark gray slightly silty fine sand with leaf and twig litter at SWI. Low DO and Beggiatoa. Patch of oxidized sediment at right at highest elevation of sediment column but no continuous RPD. Organism in mid-center. Does not appear to be cap material based no habitat mix. Similar to A.
Y2-WC01B-I C	None	0.00		0.00		-		-	Yes	Yes	7.18	Very dark gray slightly silty fine sand with leaf and twig litter at SWI. Beggiatoa. Patch of oxidized sediment at center but no continuous RPD. Organism in mid-center. Does not appear to be cap material based no habitat mix. Similar to A and B.
Y2-WC02-I A	None	100.24	>	7.01	>	6.44	>	7.31	Yes	Yes	14.53	Dark gray to black very sandy silt over tan silty medium sand. Distinct contact between two sediment units. Bottom unit interpreted to cap and upper unit recent deposition. Overpenetrated but analyzed to show strata, with evidence of low DO & Beggiatoa strands at top of image. Void in lower center. Odd substance in lower right that appear dark brown and smears.
Y2-WC02-I B	None	41.27		2.88		1.79		4.48	Indetermin	Indetermin	18.65	Dark gray to black very sandy silt over tan silty medium sand. Distinct contact between two sediment units. Bottom unit interpreted to cap and upper unit recent deposition. Overpenetrated but analyzed to show strata. Two voids in lower center. 16-19 cm of recent, organic deposition.
Y2-WC02-I C	None	Ind		Indeterminate		Ind		Ind	Yes	Yes	Indeterminate	Dark gray to black very sandy silt. Overpenetrated. Beggiatoa in upper center and large void/burrow complex at bottom of frame. Polychaete in bottom right. Unclear whether there is cap material but the organic nature of sediment column argues for recent deposition.
Y2-WC02-I D	None	0.00		0.00		-		-	Yes	Yes	7.46	Dark gray to black very sandy silt with leaf litter at SWI. Beggiatoa. Leaf dragdown in center. A thin dusting of oxidized sediment on some part of SWI and litter, RPD is at best discontinuous and not a result of bioturbation. Organic.
Y2-WC02-I E	None	0.00		0.00		-		-	Yes	Yes	7.49	Dark gray to black sandy silt with leaf litter at SWI. Beggiatoa. A thin dusting of oxidized sediment on some part of SWI and litter, RPD is at best discontinuous and not a result of bioturbation. Organic. Thought to be recent deposition versus cap material.
Y2-WC02-I F	None	0.00		0.00		-		-	Yes	Yes	8.22	Dark gray to black sandy silt with leaf litter at SWI. Beggiatoa. A thin dusting of oxidized sediment on some part of SWI and litter, RPD is at best discontinuous and not a result of bioturbation. Organic. Thought to be recent deposition versus cap material. Lots of leaf dragdown.
Y2-WC03-I A	None	62.12	>	4.34	>	1.82	>	5.71	No	No	16.31	Dark gray to black silty fine to medium sand over tan silty fine to medium sand. Bottom tan unit nominally called cap material but may be old native without knowing depositional history. Recent deposition in to 15 cm with two layers present. Recent deposition is organic in nature. Burrow in lower center.
Y2-WC03-I B	None	90.88	>	6.35	>	2.88	>	8.54	No	No	15.18	Sorted medium sand over dark gray to black silty fine sand over tan silty fine to medium sand. Prominent voids and burrow. Upper dark colored strata is recent deposition. Lower tan unit nominally designated cap material.
Y2-WC03-I C	None	87.73	>	6.13	>	4.42	>	8.37	No	No	8.86	Sorted medium sand over very dark gray to black silty fine sand over tan very silty fine to medium sand. Lower unit called cap. Upper unit is recent deposition some sorting at SWI presumably due to prop wash. Nice burrow in center of frame and active void in lower left. Three reps are similar.
Y2-WC04-I A	None	110.52	>	7.72	>	6.58	>	8.71	No	No	11.68	Dark gray to black silty very fine sand over tan fine to medium sand with abundant silt. Upper layer is clearly recent deposition. Lower strata is nominally designated cap and is relict RPD. Large active oxidized void in lower left center. Two layers in recent deposition, may be annual signature. Several mud/sand tubes at SWI.
Y2-WC04-I D	None	Ind		Indeterminate		Ind		Ind	No	No	Indeterminate	Dark gray to black silt to very silty very fine sand. Two active voids at right. Reduced sediment being brought to SWI by fauna. Entire sediment column in picture is recent deposition. This rep has half the penetration of rep A and the oxidized strata encountered in rep A is not seen in this pic due to penetration. It should be noted that the oxidized basal strata seen in rep A was also present in reps B and C which were not analyzed due to overpenetration.
Y2-WC04-I E	None	Ind		Indeterminate		Ind		Ind	No	No	Indeterminate	Dark gray to black very silty very fine sand. Large burrow in left background with reduced sediment being conveyored to the SWI. Entire sediment column in picture is recent deposition. This rep has half the penetration of rep A and the oxidized strata encountered in rep A is not seen in this pic due to penetration. It should be noted that the oxidized basal strata seen in rep A was also present in reps B and C which were not analyzed due to overpenetration.
Y2-WC05-I A	None	38.63	>	2.70	>	1.26	>	4.40	No	No	16.10	Dark gray to black very fine sand silt/clay over tan sandy silt. Lower tan strata is nominally designated as cap and upper black, organic strata is recent deposition. Active void with oxidized sediment in lower right. Nice burrows with reduced sediment conveyored to SWI in upper right. SWI enriched in sand. Contact between strata is indistinct.

Station	METHANE	TOTAL Cap AREA		TOTAL Cap MEAN		TOTAL Cap MIN		TOTAL Cap MAX	Low DO?	Beggiatoa present?	Mean Recent Deposition (cm)	COMMENT
Y2-WC05-I B	None	61.87	>	4.32	>	2.07	>	5.60	No	No	17.21	Overpenetrated. Dark gray to black very fine sandy silt/clay with tan silt/clay at bottom of frame. Upper strata is recent deposition and has two prominent voids in center and lower left. Bottom tan strata nominally called cap. Odd brown smear in lower right of tan strata.
Y2-WC05-I C	None	0.00		0.00		-		-	No	No	10.52	Dragdown scar at left. RPD linear measurements. Dark gray to black very fine sandy silt/clay. Voids at right. Shallower penetration than previous two reps and no tan strata at bottom of frame.
Y2-WC06-I A	METHANE	26.19	>	1.83	>	1.29	>	2.58	No	No	9.32	Dark gray very sandy silt with some sorted medium sand at SWI over tan silty sand. Bottom tan unit interpreted to be cap. Void in upper left. Stunning amount of small methane bubble at SWI and a couple of methane vesicles in upper left SWI. Very cool pic.
Y2-WC06-I B	METHANE	117.20	>	8.19	>	7.62	>	8.79	No	No	0.00	Tan to light gray silty medium sand. Appears to all cap with some post-cap deposition admixed in. Burrow at lower left. A few beads of sedimentary gas at left SWI.
Y2-WC06-I C	None	26.44	>	1.85	>	1.26	>	2.30	No	No	8.00	Medium to dark gray sandy silt/clay with sorted SWI over tan silty sand. Lower tan strata is interpreted to be cap material and above strata is dominated by recent deposition although some cap material is admixed. Shallow burrow at right. Three reps are generally similar but there is less post-cap deposition in rep B.
Y2-WC07-I A	METHANE	0.00		0.00		0.00		0.00	No	No	10.12	Dark gray to black very organic silty fine sand. Two small sedimentary gas bubble in upper mid-left. Small void in lower center. Organic particles throughout sediment column which appear to be bits of vascular plant material. Biogenic aggregated material at SWI. If cap material present it deeper than penetration of the cap material has been obscured by post-cap deposition.
Y2-WC07-I B	None	0.00		0.00		0.00		0.00	No	No	9.49	Dark gray to black silty fine to medium sand. Recent deposition or recent deposition of organically enriched material has obscured cap deposit. Abundant organic particles in sediment column. Similar to rep A.
Y2-WC07-I C	None	0.00		0.00		0.00		0.00	No	No	10.43	Dark gray to black silty fine to medium sand. Recent deposition or recent deposition of organically enriched material has obscured cap deposit. Abundant organic particles in sediment column. Similar to reps A and B.
Y2-WC08-I A	None	26.66	>	1.86	>	1.49	>	3.00	No	No	9.69	Medium to dark gray silty fine sand over tan fine sand. Mostly recent, organic deposition with shallow dwelling organisms. Particulate organics in sediment column. The tan sediment at bottom of frame interpreted to be cap material.
Y2-WC08-I B	None	24.28	>	1.70	>	1.18	>	2.18	No	Yes	9.44	Medium gray to black silty fine sand over tan/gray sand. Top 8.5 cm of sediment organic rich recent deposition. Possible incipient beggiatoa in left center SWI adjacent to black patch of mud and if present due to local influence of high SOD. Oxidized burrow in lower left. Particulate organics in sediment column.
Y2-WC08-I C	None	21.62	>	1.51	>	1.01	>	2.24	No	No	12.07	Medium gray to black silty fine sand over tan/gray sand. Top 11.7 cm of sediment organic rich recent deposition. Particulate organics in sediment column. Void in left center and bottom of frame. Not very extensive bioturbation. Tan material at bottom of frame interpreted to be cap surface. Tube at left. Three reps are similar.
Y2-WC09-I A	None	33.16	>	2.32	>	1.51	>	4.65	No	No	10.18	Medium gray to black silty fine sand over tan/gray sand. Top 9+ cm of sediment organic rich recent deposition. Particulate organics in sediment column. Polychaete in lower left of frame . Not very extensive bioturbation. Tan material at bottom of frame interpreted to be cap surface. Burrow in mid-left.
Y2-WC09-I B	None	24.99	>	1.75	>	1.37	>	2.91	No	No	9.72	Medium gray to black silty fine sand over tan/gray sand. Top 8.9cm of sediment organic rich recent deposition. Particulate organics in sediment column. Polychaete in lower left of frame but no trace of deposit feeding. Not very extensive bioturbation. Tan material at bottom of frame interpreted to be cap surface. Burrow at right SWI and oxidized burrow traces in lower right.
Y2-WC09-I C	None	27.64	>	1.93	>	1.18	>	2.77	No	No	10.53	Medium gray to black silty fine sand over tan/gray sand. Top 9.8 cm of sediment organic rich recent deposition. Particulate organics in sediment column. Not very extensive bioturbation. Tan material at bottom of frame interpreted to be cap surface. Whitish material under RPD in reps B and C unclear whether its beggiatoa. All three reps are similar and similar to C08.
Y2-WC10-I A	None	64.88	>	4.53	>	3.14	>	4.84	No	No	5.08	Light gray sandy silt/clay over tan coarse sandy gravel. Recent deposition over habitat mix cap. Small void in left center. Several shallow burrows. Biogenic aggregate/algae at SWI.
Y2-WC10-I B	None	84.36	>	5.90	>	5.71	>	6.02	No	No	4.78	Light gray sandy silt/clay over tan coarse sandy gravel. Recent deposition (4.2 cm) over habitat mix cap. Several shallow burrows. Similar to rep A.
Y2-WC10-I C	None	80.14	>	5.60	>	4.90	>	6.16	No	No	4.88	Light gray sandy silt/clay over tan coarse sandy gravel. Recent deposition (4.3 cm) over habitat mix cap. Several shallow burrows and small void in far left. Tube at left. SWI periodically resuspended. Similar to reps A and B.
Y2-WC11-I A	None	52.20	>	3.65	>	2.35	>	4.54	No	No	5.37	Light gray slightly sandy silt/clay over tan coarse sandy gravel. Recent deposition (4.3 cm) over habitat mix cap. Several shallow burrows. Similar to Rep A.
Y2-WC11-I B	None	79.89	>	5.58	>	4.98	>	6.02	No	No	4.55	Light gray slightly sandy silt/clay over tan coarse sandy gravel. Recent deposition (4.3 cm) over habitat mix cap. Several shallow burrows. Similar to Rep A. Deep RPD with lots of complexed FeO-OH.
Y2-WC11-I C	None	53.60	>	3.75	>	2.04	>	3.89	No	No	5.76	Light gray slightly sandy silt/clay over tan coarse sandy gravel. Recent deposition (6.2 cm) over habitat mix cap. Several shallow burrows and active feeding v lower left - animal mining pocket of reduced sediment. Similar to Reps A and B. Deep RPD with lots of complexed FeO-OH.
Y2-WC12-I A	None	91.75	>	6.41	>	5.29	>	5.94	No	No	4.81	Light gray fine sandy silt/clay over gravelly very coarse sand. Finer grained habitat mix cap at bottom of frame and recent deposition above. Large burrow with oxidized halo in center and several other medium to deep burrows with oxidized sediment at right. Abundant algae at SWI. Similar to Stations 10 and 11 but cap material slightly finer.
Y2-WC12-I B	None	88.25	>	6.17	>	4.96	>	6.92	No	No	4.28	Light gray fine sandy silt/clay over gravelly very coarse sand. Finer grained habitat mix cap at bottom of frame and recent deposition above. Abundant algae at SWI and dragdown into sediment column - obscuring voids/RPD.
Y2-WC12-I C	None	73.02	>	5.10	>	3.89	>	5.63	No	No	5.51	Light gray slightly sandy silt/clay over tan coarse sandy gravel. Recent deposition (4.7 cm) over habitat mix cap. Several shallow burrows and oxidized void in lower left.
Y2-WC13-I A	None	20.98	>	1.47	>	0.00	>	2.69	No	No	8.13	Medium to dark gray very sandy silt over tan silt. Tan silt at bottom of frame nominally interpreted to be cap material, recent deposition above. Polychaete lower right. Particulate organics in upper sediment column.

Station	METHANE	TOTAL Cap AREA	TOTAL Cap MEAN		TOTAL Cap MIN		TOTAL Cap MAX		Low DO?	Beggiatoa present?	Mean Recent Deposition (cm)	COMMENT
Y2-WC13-I B	None	20.07	>	1.40	>	0.42	>	1.85	No	No	8.54	Medium to dark gray very sandy silt over tan silty fine to medium sand. Tan silty sand at bottom of frame nominally interpreted to be cap material, recent depo above. Polychaete lower right. A few tubes at left. Particulate organics in upper sediment column. Similar to Rep A.
Y2-WC13-I C	None	21.26	>	1.49	>	0.84	>	4.71	No	No	8.48	Medium to dark gray very sandy silt over tan silty fine to medium sand. Tan silty sand at bottom of frame nominally interpreted to be cap material, recent depo above. A few tubes at left. Particulate organics in upper sediment column. Several small fine polychaetes just above recent/cap boundary. Similar to Reps A and B.
Y2-WC14-I A	None	68.29	>	4.77	>	3.47	>	5.85	No	No	12.07	Medium gray to black very fine sandy silt over tan silty fine to medium sand. Medium to coarse sand at SWI indicating some physical disturbance. Tan sediment cap, overlying gray to black mud is recent deposition. Large MC at SWI Particulate organics in sediment column. Transected edge of burrow running from mid right to bottom slightly left of center.
Y2-WC14-I B	None	Ind		Indeterminate		Ind		Ind	No	No	Indeterminate	Disturbed from sampling.
Y2-WC14-I C	None	42.77	>	2.99	>	0.81	>	5.01	No	No	15.79	Medium gray to black very fine sandy silt over tan silty fine to medium sand. Tan sediment cap, overlying gray to black mud is recent deposition. Particulate organics in sediment column. Void in upper center and at left, one against edge of animal (echinoderm?). Oxidized burrows in center. A few tubes at SWI.

Station	Benthic Habitat Classification	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Bioturba-tion Depth (cm)	Successional Stage	OSI
Y2-S19-I A	Silty sand over gravel barrier	0	-	-	-	15.60	Stage 1 on 3	7
Y2-S19-I B	Silty sand over gravel barrier	0	-	-	-	4.09	Stage 1 -> 2	4
Y2-S19-I C	Silty sand over gravel barrier	0	-	-	-	12.21	Stage 1 on 3	8
Y2-WC01-I A	Hard bottom (cobble/shells)	Ind	Ind	Ind	-	Ind	Indeterminate	Indeterminate
Y2-WC01-I B	Hard bottom (cobble/shells)	Ind	Ind	Ind	-	Ind	Indeterminate	Indeterminate
Y2-WC01-I C	Hard bottom (cobble/shells)	Ind	Ind	Ind	-	Ind	Indeterminate	Indeterminate
Y2-WC01B-I A	Oligozoic	1	5.32	8.09	6.71	8.74	Stage 1 on 3	1
Y2-WC01B-I B	Oligozoic	0	-	-	-	4.62	Stage 1 -> 2	-1
Y2-WC01B-I C	Oligozoic	0	-	-	-	2.74	Stage 1 -> 2	-1
Y2-WC02-I A	Oligozoic	1	12.27	15.63	13.95	15.63	Stage 3	Indeterminate
Y2-WC02-I B	Oligozoic	2	13.86	16.35	15.11	16.35	Indeterminate	Indeterminate
Y2-WC02-I C	Oligozoic	2	15.07	21.53	18.30	21.53	Stage 3	Indeterminate
Y2-WC02-I D	Oligozoic	0	-	-	-	3.06	Stage 1	-3
Y2-WC02-I E	Oligozoic	0	-	-	-	5.57	Stage 1	-3
Y2-WC02-I F	Oligozoic	0	-	-	-	4.93	Stage 1	-3
Y2-WC03-I A	Silty sand with infauna	0	-	-	-	18.23	Stage 1 on 3	7
Y2-WC03-I B	Silty sand with infauna	2	4.70	11.40	8.05	21.09	Stage 3	Indeterminate
Y2-WC03-I C	Silty sand with infauna	2	8.12	14.87	11.50	14.87	Stage 1 on 3	7
Y2-WC04-I A	Silty sand with infauna	1	12.07	15.91	13.99	15.91	Stage 1 on 3	7
Y2-WC04-I D	Silty sand with infauna	2	1.40	6.61	4.01	6.61	Stage 1 on 3	7
Y2-WC04-I E	Silty sand with infauna	0	-	-	-	6.50	Stage 1 on 3	7
Y2-WC05-I A	Sandy silt with infauna	1	16.83	18.37	17.60	18.37	Stage 1 on 3	7

Station	Benthic Habitat Classification	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Bioturba-tion Depth (cm)	Successional Stage	OSI
Y2-WC05-I B	Sandy silt with infauna	2	7.39	12.49	9.94	19.63	Stage 3	Indeterminate
Y2-WC05-I C	Sandy silt with infauna	2	3.64	6.24	4.94	6.24	Stage 1 on 3	6
Y2-WC06-I A	Silty sand with infauna	1	3.89	4.28	4.09	9.97	Stage 1 on 3	5
Y2-WC06-I B	Silty sand with infauna	0	-	-	-	8.46	Stage 1 on 3	5
Y2-WC06-I C	Silty sand with infauna	0	-	-	-	3.61	Stage 1 -> 2	4
Y2-WC07-I A	Silty-sand - organic rich	1	7.39	7.98	7.69	7.98	Stage 2 -> 3	5
Y2-WC07-I B	Silty-sand - organic rich	0	-	-	-	8.48	Stage 1	3
Y2-WC07-I C	Silty-sand - organic rich	0	-	-	-	9.13	Stage 1	3
Y2-WC08-I A	Silty sand with infauna	0	-	-	-	7.73	Stage 1	3
Y2-WC08-I B	Silty sand with infauna	0	-	-	-	8.21	Stage 1	3
Y2-WC08-I C	Silty sand with infauna	3	6.92	13.19	10.05	13.19	Stage 1 on 3	6
Y2-WC09-I A	Silty sand with infauna	0	-	-	-	10.70	Stage 2 -> 3	6
Y2-WC09-I B	Silty sand with infauna	0	-	-	-	8.32	Stage 2	5
Y2-WC09-I C	Silty sand with infauna	0	-	-	-	7.45	Stage 1	3
Y2-WC10-I A	Sandy silt over gravel barrier	1	4.79	5.13	4.96	7.23	Stage 1 on 3	7
Y2-WC10-I B	Sandy silt over gravel barrier	0	-	-	-	5.38	Stage 2 -> 3	6
Y2-WC10-I C	Sandy silt over gravel barrier	1	4.40	4.82	4.61	6.43	Stage 1 on 3	7
Y2-WC11-I A	Sandy silt over gravel barrier	0	-	-	-	6.05	Stage 1 on 3	7
Y2-WC11-I B	Sandy silt over gravel barrier	0	-	-	-	5.60	Stage 1 on 3	8
Y2-WC11-I C	Sandy silt over gravel barrier	1	7.06	8.49	7.77	8.49	Stage 1 on 3	7
Y2-WC12-I A	Sandy silt over gravel barrier	0	-	-	-	7.36	Stage 1 on 3	7
Y2-WC12-I B	Sandy silt over gravel barrier	Ind	-	-	-	Ind	Indeterminate	Indeterminate
Y2-WC12-I C	Sandy silt over gravel barrier	1	6.02	6.75	6.39	6.75	Stage 1 on 3	7
Y2-WC13-I A	Sandy silt with infauna	0	-	-	-	9.83	Stage 1 on 3	7

Station	Benthic Habitat Classification	Feeding Void #	Void Minimum Depth (cm)	Void Maximum Depth (cm)	Void Average Depth (cm)	Bioturba-tion Depth (cm)	Successional Stage	OSI
Y2-WC13-I B	Sandy silt with infauna	0	-	-	-	8.20	Stage 1 on 3	6
Y2-WC13-I C	Sandy silt with infauna	0	-	-	-	6.50	Stage 1 -> 2	3
Y2-WC14-I A	Sandy silt with infauna	0	-	-	-	17.59	Stage 1 on 3	7
Y2-WC14-I B	Sandy silt with infauna	Ind	Ind	Ind	-	Ind	Indeterminate	Indeterminate
Y2-WC14-I C	Sandy silt with infauna	2	6.25	10.31	8.28	10.47	Stage 1 on 3	7

APPENDIX G

DATA EVALUATION REPORTS

APPENDIX G.1

CHEMISTRY DATA QA/QC

D.M.D., Inc.
Environmental & Toxicological Services
13706 SW Caster Road, Vashon, WA 98070-7428 (206) 463-6223 fax: (206) 463-4013

MEMORANDUM

TO: Matt Dalton (DOF)

FROM: Raleigh Farlow

DATE: August 17, 2006

SUBJECT: QA1-type Review of Results of Analyses for Forty-seven Sediments and Three Field Rinsate Blanks Collected during May 2006 from the Head of Thea Foss Waterway (Year-Two Post-Construction Monitoring) *revised*

Forty-seven sediment samples and three field equipment rinsate samples were collected and submitted in five sample delivery groups to Analytical Resources Inc. (ARI) of Tukwila, Washington, for analyses of TOC (Plumb, 1981), TPH-Dx (NWTPHDx), metals (6010B, 7421, 7060A & 7471A), SVOCs (including PAH and phthalates)(8270D), DDT analogs (8081), PCBs (8082) and sediment grain size (PSEP). Results of analyses (all dry weight normalized for sediments, as required) are attached to this summary. Samples were relinquished by Tetra Tech EC under chain-of-custody procedure and "hand" delivered to ARI within the same day of collection. Samples were received intact at 2.2 - 14 °C, with ice present in all coolers. All analyses were completed within the technical holding time requirements identified in the project QAPP (*Quality Assurance Project Plan (QAPP), Utilities Work Area Remediation*, prepared by DOF, DMD & Tetra Tech-FW, July 24, 2003) and/or within the recommended maximum holding times recommended by the U.S. EPA. SVOC and pesticides analyses for samples Y2-SC01-S and Y2-SC02-S were performed on frozen archived samples at the request of the client on 7/28/06. Sample holding times/conditions are within specifications.

Most **reporting limits** are sufficiently low for comparison to the project/task SQO's. Many SVOC constituents reported nondetects (with "U" qualifier code) greater than the Commencement Bay SQOs; however, these cases are associated with samples exhibiting other target parameters with detected SQO exceedances. Dilutions and reruns were frequently required for SVOC extracts to bring QC measures within performance specifications. Most SVOC parameters show a lower reporting limit of 20 - 320 µg/kg, with the exception of benzoic acid and pentachlorophenol which were generally reported with quantitation limits at 10 and 5 times, respectively, the limits of other parameters within the same extract. All lower reporting limits for organics are based on the lowest calibration point used to establish instrument linearities. Detections of organic analytes at less than the lower verifiable calibration point are qualified as estimates with the "J" qualifier code.

Method blanks were analyzed with each parameter group, and all blanks showed nondetected analytes; with the exception of some relatively low levels of target analytes that could have an affect on sample results. These cases are identified in the attached results table with the "J_B"

qualifier code for di-n-butylphthalate. The "J_B" qualifier code was assigned to values that are within 2x the level found in method blanks. Other analytes (other than di-n-butylphthalate) detected in method blanks were sufficiently low to have no expected adverse effect on reported sample results.

Field equipment **rinsate blanks** showed minor contamination from copper (Cu), lead (Pb) and zinc (Zn). Levels were sufficiently low to have minimal to no adverse effect on sample results.

All laboratory control sample (**LCS**) and matrix spike (**MS/MSD**) recoveries were within the QAPP-specified ranges for all designated analytes, with the exception of low recoveries for antimony (Sb) in matrix spike analyses. Sb forms siliceous complexes in sediment digestates, which results in low recoveries (10-50%). Sb is reported as nondetected in all samples; however a "U_J" qualifier code is assigned to all Sb results to warn the user of potential low bias due to low recoveries. (LCS recoveries for Sb reported acceptable performance; due to no silicates present in the LCS.) No other analytes showed unacceptable recovery performance, and no other qualification of results were required.

All **surrogate compound recoveries** (for organic analytes) are within the project-specified acceptance ranges. All measures of recovery performance in sediments are within specification; no data qualification is necessary.

Internal standards (**IS**) performance was determined to be outside method specifications for selected groups of organic analytes. Affected extracts were diluted and reanalyzed to improve IS performance. Some IS performance continued to fall outside specified limits, which appears to be a result of matrix effects in especially contaminated samples. Non-compliant IS performance is identified for butylbenzylphthalate, di-n-octylphthalate and some PAH analytes; and associated noncompliant values are identified in the attached results table with the "J_{IS}" qualifier code. These values are identified as estimates due to reported high variability in IS areas.

Initial and **continuing calibration** performances were determined to be within method specifications for all analyses; with the exception of continuing calibration end-of-run checks for Aroclor 1260 in many samples from analytical group JJ54. Reanalyses were attempted, however continuing failures persisted and are subsequently identified with the "J_C" qualifier code as estimates due to noncompliant continuing calibration check performance.

Chlorinated pesticide (DDT and analogs) and PCB dual-column RPDs were within method specifications, with the exception of Aroclor 1248 concentrations in many samples for analytical group JJ31. Associated values are qualified as estimates with the "J_P" qualified code. The greater value for Aroclor 1248, associated with the primary (ZB5) column, was reported in order to minimize low reporting bias.

Examination of **TPH-Dx** profiles revealed the presence of principally lubricant-range hydrocarbons, and not diesel-range hydrocarbons. The values reported by the analyst/laboratory for diesel-range hydrocarbons are due to the chromatographic overlap associated with lubricant hydrocarbons. The lube-range profile exhibits an unresolved complex mixture (UCM) typical of contamination from urban runoff. Total hydrocarbons are most represented by the lube-range values, and are thus highlighted in bold in the attached results table.

All chromatograms were inspected to evaluate general chromatographic integrity. Peak shapes are reasonable and acceptable, and no abrupt baseline shifts are noted.

Sample results reported here are determined to be in general compliance with method and QAPP requirements. Some deviations from specified performance goals are associated with matrix effects from contaminated samples. Sample extracts/digestates were rerun/reanalyzed when QC performance goals were not initially met. Continuing deviations in subsequent analyses were identified and flagged; generally resulting in identifying associated values as estimates with the "J_x" qualifier code. Bias associated with estimated values is not expected to be consistent, however, with the exception of the low bias in lower quantitation limits for antimony and possibly high bias in di-n-butylphthalate results. In the case of antimony, low bias is typical for siliceous matrices using the digestion method specified (HNO_3, nitric acid). Antimony quantitation limits may be a factor of 2 - 10x greater than reported. Di-n-butylphthalate values may be biased high due to presence of some laboratory background contamination near the same levels as reported for project samples. All reported data (see attached) are considered usable for the intended purposes of the project.

Head of Thea Foss Waterway
Post-Construction Monitoring
May 2006

metals - mg/kg, dry
organics - µg/kg, dry

							TPH-Dx (mg/kg)		As	Sb	Cd
Field Sample I.D.	**Location**	Comments	Sample Date	Lab I.D.	% solids	% TOC	Diesel-range	Lube-range	7440-38-2	7440-36-0	7440-43-9
Y2-RC04-S	RC/WC-04/R-02	0-2 cm	5/12/2006	068227-JJ17A	46	7.4	680	**3000**	10 U	10 U_J	0.5 U
Y2-WC04-S	RC/WC-04/R-02	0-10 cm	5/12/2006	068228-JJ17B	55	3.2	470	**2100**	9 U	9 U_J	**0.6**
Y2-RC11-S	RC/WC-11/R-04	0-2 cm	5/12/2006	068229-JJ17C	85	4.3	140	**660**	6 U	6 U_J	0.2 U
Y2-WC11-S	RC/WC-11/R-04	0-10 cm	5/12/2006	068230-JJ17D	86	3.6	130	**580**	6 U	6 U_J	0.2 U
Y2-WC15-S	RC/WC-11/R-04	0-10 cm; dup.	5/12/2006	068231-JJ17E	86	2.9	140	**570**	6 U	6 U_J	0.2 U
Y2-RC08-S	RC/WC-08/R-03	0-2 cm	5/12/2006	068232-JJ17F	53	5.6	550	**2200**	**10**	10 U_J	**0.8**
Y2-WC08-S	RC/WC-08/R-03	0-10 cm	5/12/2006	068233-JJ17G	59	4.2	470	**1800**	9 U	9 U_J	**0.8**
Y2-RC02-S	RC/WC-02	0-2 cm	5/12/2006	068234-JJ17H	42	5.2	1000	**5300**	10 U	10 U_J	**1.0**
Y2-WC02-S	RC/WC-02	0-10 cm	5/12/2006	068235-JJ17I	47	6.4	840	**4000**	10 U	10 U_J	**1.2**
Y2-S24-S	S-24	0-10 cm	5/12/2006	068236-JJ17J	87	2.5	97	**410**	5 U	5 U_J	0.2 U
Y2-S17-S	S-17	0-10 cm	5/12/2006	068237-JJ17K	87	3.9	95	**400**	6 U	6 U_J	0.2 U
Y2-WC03-S	RC/WC-03	0-10 cm	5/15/2006	068308-JJ31A	54	5.3	340	**1400**	10 U	10 U_J	0.4 U
Y2-RC03-S	RC/WC-03	0-2 cm	5/15/2006	068309-JJ31B	48	5.0	530	**2300**	10 U	10 U_J	**0.6**
Y2-WC06-S	RC/WC-06	0-10 cm	5/15/2006	068310-JJ31C	66	5.0	190	**810**	8 U	8 U_J	0.3 U
Y2-RC06-S	RC/WC-06	0-2 cm	5/15/2006	068311-JJ31D	59	5.5	380	**1700**	8 U	8 U_J	**0.3**
Y2-RC15-S	RC/WC-06	0-2 cm; dup.	5/15/2006	068312-JJ31E	60	6.7	400	**1700**	9 U	9 U_J	0.3 U
Y2-WC05-S	RC/WC-05	0-10 cm	5/15/2006	068313-JJ31F	49	5.2	580	**2300**	10 U	10 U_J	0.4 U
Y2-RC05-S	RC/WC-05	0-2 cm	5/15/2006	068314-JJ31G	45	6.6	720	**3200**	10 U	10 U_J	**0.7**
Y2-WC09-S	RC/WC-09	0-10 cm	5/15/2006	068315-JJ31H	59	4.4	350	**1300**	9 U	9 U_J	**0.7**
Y2-RC09-S	RC/WC-09	0-2 cm	5/15/2006	068316-JJ31I	48	5.1	740	**2800**	10 U	10 U_J	**0.7**
Y2-WC13-S	WC-13	0-10 cm	5/15/2006	068317-JJ31J	62	3.9	330	**1500**	9 U	9 U_J	**0.5**
Y2-WC14-S	WC-14	0-10 cm	5/15/2006	068318-JJ31K	47	4.5	650	**3200**	10 U	10 U_J	**0.7**
Y2-S15-S	S-15	0-10 cm	5/15/2006	068319-JJ31L	83	3.8	130	**670**	6 U	6 U_J	0.2 U
Y2-S19-S	S-19	0-10 cm	5/15/2006	068320-JJ31M	84	1.3	120	**590**	6 U	6 U_J	0.2 U
Y2-RB-01	field QC	Rinsate Blank	5/15/2006	068321-JJ31N	0.0		0.25 U	0.5 U	0.05 U	0.05 U	0.002 U
Y2-SC04-S	SC-04d	0-10 cm	5/16/2006	068434-JJ54A	72	5.3	210	**1100**	7 U	7 U_J	0.3 U
Y2-SC03-S	SC-03c	0-10 cm	5/16/2006	068435-JJ54B	60	5.5	380	**2000**	8 U	8 U_J	**0.3**
Y2-RC01-S	RC/WC-01	0-2 cm	5/16/2006	068436-JJ54C	40	9.9	900	**4700**	10 U	10 U_J	**0.6**
Y2-WC01-S	RC/WC-01	0-10 cm	5/16/2006	068437-JJ54D	36	7.1	1100	**5100**	10 U	10 U_J	**0.6**
Y2-RC14-S	RC-14	0-2 cm	5/16/2006	068438-JJ54E	57	7.1	470	**2300**	**9**	8 U_J	**0.4**
Y2-RC14B-S	RC-14B	0-2 cm	5/16/2006	068439-JJ54F	59	6.3	360	**2400**	**10**	8 U_J	0.3 U
Y2-RC13-S	RC-13	0-2 cm	5/16/2006	068440-JJ54G	49	6.7	450	**2800**	10 U	10 U_J	0.4 U
Y2-WC07-S	RC/WC-07	0-10 cm	5/16/2006	068441-JJ54H	69	4.2	220	**1100**	8 U	8 U_J	**0.4**
Y2-WC10-S	RC/WC-10	0-10 cm	5/16/2006	068442-JJ54I	84	2.0	68	**290**	6 U	6 U_J	0.2 U
Y2-RC07-S	RC/WC-07	0-2 cm	5/16/2006	068443-JJ54J	53	6.0	600	**2700**	10 U	10 U_J	**0.6**

Head of Thea Foss Waterway
Post-Construction Monitoring
May 2006

metals - mg/kg, dry
organics - µg/kg, dry

Field Sample I.D.	Location	Comments	Sample Date	Lab I.D.	% solids	% TOC	TPH-Dx (mg/kg) Diesel-range	TPH-Dx (mg/kg) Lube-range	As 7440-38-2	Sb 7440-36-0	Cd 7440-43-9
Y2-RC10-S	RC/WC-10	0-2 cm	5/16/2006	068444-JJ54K	84	3.0	110	**510**	6 U	6 U_J	0.2 U
Y2-RC12-S	RC/WC-12	0-2 cm	5/16/2006	068445-JJ54L	76	3.7	160	**720**	6 U	6 U_J	0.3 U
Y2-WC12-S	RC/WC-12	0-10 cm	5/16/2006	068446-JJ54M	85	1.0	69	**310**	6 U	6 U_J	0.2 U
Y2-SC01-S	SC-01c	0-10 cm	5/16/2006	068447-JJ54N/JQ90A	94	0.46	14	**75**	5 U	5 U_J	0.2 U
Y2-SC02-S	SC-02c	0-10 cm	5/16/2006	068448-JJ54O/JQ90B	81	2.8	160	**770**	6 U	6 U_J	0.2 U
Y2-RB-02	field QC	Rinsate Blank	5/16/2006	068449-JJ54P	0.0		0.25 U	0.5 U	0.05 U	0.05 U	0.002 U
Y2-WC01B-C3	WC-01B/R-01B	1.5-2.2 ft	5/17/2006	068524-JJ68C	86	0.55			6 U	6 U_J	0.2 U
Y2-WC06-C3	RC/WC-06	1.2-1.8 ft	5/17/2006	068527-JJ68F	85	1.0			6 U	6 U_J	0.2 U
Y2-RB-03	field QC	Rinsate Blank	5/17/2006	068528-JJ68G	0.0				0.05 U	0.05 U	0.002 U
Y2-WC04-C3	RC/WC-04/R-02	0.7-1.5 ft	5/17/2006	068622-JJ84B	88	0.87			6 U	6 U_J	0.2 U
Y2-WC05-C3	RC/WC-05	0.3-1.5 ft	5/17/2006	068623-JJ84C	88	0.53			6 U	6 U_J	0.2 U
Y2-CI-01	CI-1	0-10 cm	5/18/2006	068625-JJ84E	64	0.80					
Y2-CI-02	CI-2	0-10 cm	5/18/2006	068626-JJ84F	74	0.69					
Y2-WC12-C3	RC/WC-12	0.4-1.1 ft	5/17/2006	068627-JJ84G	90	0.14			6 U	6 U_J	0.2 U
Y2-WC10-C3	RC/WC-10	1.0-2.5 ft	5/17/2006	068629-JJ84I	87	0.23			5 U	5 U_J	0.2 U

U = nondetected at the associated value
U_J = nondetected, with low recovery of matrix spike
J = associated value is considered an estimate; less than verifiable lower calibration point
J_B = estimate; value less than 2x method blank level
J_C = estimate; noncompliant continuing calibration response
J_{IS} = estimate; noncompliant internal standard area
J_P = estimate; dual-column quant. confirmation > 40% difference

D.M.D., Inc.

Head of Thea Foss Waterway
Post-Construction Monitoring
May 2006

metals - mg/kg, dry
organics - µg/kg, dry

Field Sample I.D.	Cu 7440-50-8	Pb 7439-92-1	Hg 7439-97-6	Ni 7440-02-0	Ag 7440-22-4	Zn 7440-66-6	% gravel > 2000 µm	% v. coarse sand 1000-2000 µm	% coarse sand 500-1000 µm	% med. sand 250-500 µm	% fine sand 125-250 µm	% v. fine sand 62-125 µm	% silt 3.9-62.5 µm	% clay < 3.9 µm	% fines < 62.5 µm
Y2-RC04-S	**46.7**	**44**	**0.2**	**19**	0.7 U	**108**	2.8	3.5	5.9	14	18	10	33	13	46
Y2-WC04-S	**61.2**	**54**	**0.18**	**23**	0.6 U	**133**	7.1	5.2	9.5	19	16	7.2	24	12	36
Y2-RC11-S	**25.3**	**13**	0.06 U	**18**	0.4 U	**56.9**	60	10	11	7.1	2.4	1.0	5.7	3.0	8.7
Y2-WC11-S	**17.9**	**11**	0.06 U	**16**	0.4 U	**44.2**	49	15	14	9.4	2.6	1.0	5.5	2.6	8.1
Y2-WC15-S	**20.5**	**11**	**0.05**	**20**	0.4 U	**41.6**	54	13	14	8.3	2.3	0.9	5.0	2.3	7.3
Y2-RC08-S	**73.6**	**73**	**0.22**	**30**	0.6 U	**150**	2.3	2.4	7.0	18	16	7.6	32	15	47
Y2-WC08-S	**72.0**	**64**	**0.19**	**24**	**0.6**	**134**	2.8	2.9	7.7	20	20	8.4	25	14	38
Y2-RC02-S	**88.4**	**97**	**0.2**	**31**	0.7 U	**254**	0.8	3.8	16	16	12	0	35	17	52
Y2-WC02-S	**90.8**	**92**	**0.22**	**32**	0.7 U	**252**	0.6	3.0	5.0	12	19	11	34	24	57
Y2-S24-S	**18.7**	**11**	**0.17**	**14**	0.3 U	**40.3**	68	11	7.3	5.8	3.0	0.9	2.7	1.5	4.2
Y2-S17-S	**19.9**	**9**	0.04 U	**14**	0.3 U	**43.4**	59	14	12	6.9	0.8	1.3	3.4	2.1	5.5
Y2-WC03-S	**55.7**	**37**	**0.13**	**21**	0.6 U	**99**	1.5	1.9	5.3	16	23	12	26	14	40
Y2-RC03-S	**73.6**	**62**	**0.16**	**28**	0.7 U	**166**	3.8	2.4	5.0	15	18	9.2	33	14	46
Y2-WC06-S	**52.2**	**28**	**0.08**	**20**	0.5 U	**80.7**	1.0	2.1	6.4	26	30	8.4	17	9.3	26
Y2-RC06-S	**56.8**	**47**	**0.11**	**24**	0.5 U	**121**	3.6	4.4	11	25	20	6.9	21	8.9	30
Y2-RC15-S	**57.7**	**47**	**0.12**	**24**	0.5 U	**122**	6.3	4.5	11	24	20	6.6	20	8.0	28
Y2-WC05-S	**31.6**	**29**	**0.2**	**11**	0.6 U	**63**	1.4	2.2	3.6	12	19	11	36	15	51
Y2-RC05-S	**83.5**	**76**	**0.19**	**32**	0.7 U	**189**	0.4	3.7	4.8	12	17	11	34	17	51
Y2-WC09-S	**70.6**	**66**	**0.18**	**25**	0.5 U	**130**	0.5	3.1	7.4	22	20	6.8	26	14	40
Y2-RC09-S	**73.5**	**76**	**0.28**	**26**	0.7 U	**158**	0.2	3.4	5.6	13	13	6.7	39	19	58
Y2-WC13-S	**61.3**	**51**	**0.20**	**23**	0.5 U	**116**	3.6	3.8	9.0	21	20	8.4	22	13	35
Y2-WC14-S	**78.3**	**70**	**0.2**	**28**	0.7 U	**160**	0.6	2.5	4.5	13	18	9.6	33	20	52
Y2-S15-S	**23.6**	**15**	0.05 U	**23**	0.4 U	**58.8**	53	11	11	11	4.7	1.3	5.7	3.6	9.3
Y2-S19-S	**22.0**	**16**	0.05 U	**18**	0.4 U	**50.0**	52	12	12	9.1	2.8	1.4	6.2	4.2	10
Y2-RB-01	**0.002**	**0.04**	0.0001 U	0.01 U	0.003 U	**0.016**									
Y2-SC04-S	**51.1**	**44**	**0..08**	**28**	0.4 U	**119**	61	6.0	8.4	7.1	4.5	2.2	6.1	4.4	11
Y2-SC03-S	**78.8**	**58**	**0.10**	**29**	0.5 U	**169**	46	4.9	8.5	8.6	6.5	4.3	14	7.3	21
Y2-RC01-S	**76.5**	**90**	**0.1**	**59**	0.8 U	**287**	22	10	10	11	9.9	9.6	15	12	27
Y2-WC01-S	**69.4**	**86**	**0.1**	**34**	0.8 U	**269**	21	9.1	808	11	8.9	7.1	20	15	35
Y2-RC14-S	**63.9**	**67**	**0.13**	**31**	0.5 U	**219**	32	7.5	12	9.9	8.0	7.7	15	8.2	23
Y2-RC14B-S	**67.2**	**60**	**0.11**	**33**	0.5 U	**194**	35	8.7	15	8.9	4.1	4.4	16	8.6	25
Y2-RC13-S	**62.3**	**73**	**0.12**	**34**	0.6 U	**208**	7.6	8.1	12	9.4	13	14	25	11	36
Y2-WC07-S	**59.0**	**45**	**0.11**	**26**	0.5 U	**112**	9.7	4.2	11	28	22	4.4	15	6.6	21
Y2-WC10-S	**20.6**	**12**	0.05 U	**18**	0.4 U	**44.0**	47	12	16	15	4.6	1.0	2.9	1.8	4.7
Y2-RC07-S	**69.9**	**70**	**0.15**	**26**	0.6 U	**169**	4.0	3.3	7.7	19	18	7.7	33	8.1	41

Head of Thea Foss Waterway
Post-Construction Monitoring
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metals - mg/kg, dry
organics - µg/kg, dry

Field Sample I.D.	Cu 7440-50-8	Pb 7439-92-1	Hg 7439-97-6	Ni 7440-02-0	Ag 7440-22-4	Zn 7440-66-6	% gravel > 2000 µm	% v. coarse sand 1000-2000 µm	% coarse sand 500-1000 µm	% med. sand 250-500 µm	% fine sand 125-250 µm	% v. fine sand 62-125 µm	% silt 3.9-62.5 µm	% clay < 3.9 µm	% fines < 62.5 µm
Y2-RC10-S	**24.3**	**15**	0.04 U	**20**	0.4 U	**52.0**	56	13	12	8.0	3.2	1.3	4.9	2.6	7.5
Y2-RC12-S	**24.7**	**19**	0.05 U	**19**	0.4 U	**59.9**	42	8.5	12	18	6.4	2.0	8.1	3.3	11
Y2-WC12-S	**16.9**	**10**	0.05 U	**18**	0.3 U	**39.4**	72	8.8	5.7	5.3	2.2	0.8	3.3	1.7	5.0
Y2-SC01-S	**24.1**	**5**	0.04 U	**19**	0.3 U	**36.6**	56	11	11	12	7.3	1.8	0.7	1.0	1.7
Y2-SC02-S	**44.6**	**36**	0.05 U	**21**	0.3 U	**87.3**	30	14	21	17	7.9	2.1	6.4	2.9	9.3
Y2-RB-02	0.002 U	0.02 U	0.0001 U	0.01 U	0.003 U	**0.014**									
Y2-WC01B-C3	**31.1**	**3**	0.05 U	**15**	0.3 U	**29.5**	28	16	18	21	12	1.5	1.7	0.9	2.6
Y2-WC06-C3	**33.6**	**3**	0.05 U	**17**	0.3 U	**31.5**	13	15	20	28	17	3.3	2.0	1.7	3.7
Y2-RB-03	**0.004**	0.02 U	0.0001 U	0.01 U	0.003 U	**0.017**									
Y2-WC04-C3	**43.8**	**5**	0.06 U	**21**	0.3 U	**40.8**	21	17	20	24	13	2.9			2.7
Y2-WC05-C3	**35.3**	**3**	0.05 U	**19**	0.3 U	**34.7**	21	14	18	25	17	2.8			2.6
Y2-CI-01							0.0	0.2	0.5	5.8	23	23	39	8.5	48
Y2-CI-02							0.1	0.2	1.5	13	37	21	22	5.2	28
Y2-WC12-C3	**44.3**	**3**	0.05 U	**25**	0.3 U	**38.1**	29	15	20	24	9.5	0.9			1.2
Y2-WC10-C3	**37.8**	**2**	0.05 U	**20**	0.3 U	**33.7**	26	14	19	26	13	1.3			0.8

U = nondetected at the associated value
U_J = nondetected, with low recovery of matrix spike
J = associated value is considered an estimate; less than verifiable lower calibration point
J_B = estimate; value less than 2x method blank level
J_C = estimate; noncompliant continuing calibration response
J_{IS} = estimate; noncompliant internal standard area
J_P = estimate; dual-column quant. confirmation > 40% difference

Head of Thea Foss Waterway
Post-Construction Monitoring
May 2006

metals - mg/kg, dry
organics - µg/kg, dry

Field Sample I.D.	Phenol 108-95-2	1,3-Dichloro-benzene 541-73-1	1,4-Dichloro-benzene 106-46-7	Benzyl alcohol 100-51-6	1,2-Dichloro-benzene 95-50-1	2-Methyl-phenol 95-48-7	4-Methyl-phenol 106-44-5	Hexachloro-ethane 67-72-1	2,4-Dimethyl-phenol 105-67-9	Benzoic acid 65-85-0	1,2,4-Trichloro-benzene 120-82-1	Naphthalene 91-20-3	Hexachloro-butadiene 87-68-3
Y2-RC04-S												320 U	
Y2-WC04-S	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	1000 U	100 U	**190**	3.5 U
Y2-RC11-S												48 U	
Y2-WC11-S	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	440 U	44 U	44 U	3.4 U
Y2-WC15-S	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	440 U	44 U	44 U	3.4 U
Y2-RC08-S												**330**	
Y2-WC08-S	94 U	94 U	94 U	94 U	94 U	94 U	94 U	94 U	94 U	940 U	94 U	**290**	3.5 U
Y2-RC02-S												**190**	
Y2-WC02-S	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	1200 U	120 U	**210**	3.5 U
Y2-S24-S	39 U	39 U	39 U	39 U	39 U	39 U	39 U	39 U	39 U	390 U	39 U	39 U	3.4 U
Y2-S17-S	40 U	40 U	40 U	40 U	40 U	40 U	40 U	40 U	40 U	400 U	40 U	40 U	3.4 U
Y2-WC03-S	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	730 U	73 U	**99**	3.5 U
Y2-RC03-S												**150**	
Y2-WC06-S	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	600 U	60 U	**62**	3.4 U
Y2-RC06-S												87 U	
Y2-RC15-S												86 U	
Y2-WC05-S	99 U	99 U	99 U	99 U	99 U	99 U	99 U	99 U	99 U	990 U	99 U	**200**	3.5 U
Y2-RC05-S												150 U	
Y2-WC09-S	90 U	90 U	90 U	90 U	90 U	90 U	90 U	90 U	90 U	900 U	90 U	**300**	3.5 U
Y2-RC09-S												**340**	
Y2-WC13-S	69 U	69 U	69 U	69 U	69 U	69 U	69 U	69 U	69 U	690 U	69 U	**210**	3.5 U
Y2-WC14-S	96 U	96 U	96 U	96 U	96 U	96 U	96 U	96 U	96 U	960 U	96 U	**240**	3.6 U
Y2-S15-S	51 U	51 U	51 U	51 U	51 U	51 U	51 U	51 U	51 U	510 U	51 U	51 U	3.5 U
Y2-S19-S	48 U	48 U	48 U	48 U	48 U	48 U	48 U	48 U	48 U	480 U	48 U	**54**	3.5 U
Y2-RB-01	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	0.05 U
Y2-SC04-S	79 U	79 U	79 U	79 U	79 U	79 U	**40 J**	79 U	79 U	790 U	79 U	**65 J**	3.5 U
Y2-SC03-S	88 U	88 U	88 U	88 U	88 U	88 U	88 U	88 U	88 U	880 U	88 U	88 U	3.5 U
Y2-RC01-S												160 U	
Y2-WC01-S	**650**	190 U	190 U	190 U	190 U	190 U	**650**	190 U	190 U	1900 U	190 U	190 U	3.5 U
Y2-RC14-S												110 U	
Y2-RC14B-S												94 U	
Y2-RC13-S												120 U	
Y2-WC07-S	83 U	83 U	83 U	83 U	83 U	83 U	83 U	83 U	83 U	830 U	83 U	**90**	3.5 U
Y2-WC10-S	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	**13 J**	3.5 U
Y2-RC07-S												**120 J**	

Head of Thea Foss Waterway
Post-Construction Monitoring
May 2006

metals - mg/kg, dry
organics - µg/kg, dry

Field Sample I.D.	Phenol 108-95-2	1,3-Dichloro-benzene 541-73-1	1,4-Dichloro-benzene 106-46-7	Benzyl alcohol 100-51-6	1,2-Dichloro-benzene 95-50-1	2-Methyl-phenol 95-48-7	4-Methyl-phenol 106-44-5	Hexachloro-ethane 67-72-1	2,4-Dimethyl-phenol 105-67-9	Benzoic acid 65-85-0	1,2,4-Trichloro-benzene 120-82-1	Naphthalene 91-20-3	Hexachloro-butadiene 87-68-3
Y2-RC10-S												26 U	
Y2-RC12-S												**39**	
Y2-WC12-S	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	**12 J**	3.4 U
Y2-SC01-S	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	20 U	1 U
Y2-SC02-S	21 U	21 U	21 U	21 U	21 U	21 U	21 U	21 U	21 U	**480**	21 U	**20 J**	1 U
Y2-RB-02	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	0.05 U
Y2-WC01B-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	20 U	1 U
Y2-WC06-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	20 U	1 U
Y2-RB-03	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 U	0.05 U
Y2-WC04-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	20 U	1 U
Y2-WC05-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	20 U	1 U
Y2-CI-01													
Y2-CI-02													
Y2-WC12-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	20 U	1 U
Y2-WC10-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	20 U	1 U

U = nondetected at the associated value
U_J = nondetected, with low recovery of matrix spike
J = associated value is considered an estimate; less than verifiable lower calibration point
J_B = estimate; value less than 2x method blank level
J_C = estimate; noncompliant continuing calibration response
J_{IS} = estimate; noncompliant internal standard area
J_P = estimate; dual-column quant. confirmation > 40% difference

Head of Thea Foss Waterway
Post-Construction Monitoring
May 2006

metals - mg/kg, dry
organics - µg/kg, dry

Field Sample I.D.	2-Methyl-naphthalene 91-57-6	Dimethyl-phthalate 131-11-3	Acenaph-thylene 208-96-8	Acenaphthene 83-32-9	Dibenzo-furan 132-64-9	Diethyl-phthalate 84-66-2	Fluorene 86-73-7	N-Nitroso-diphenylamine 86-30-6	Hexachloro-benzene 118-74-1	Pentachloro-phenol 87-86-5	Phenanthrene 85-01-8	Anthracene 120-12-7	Di-n-butyl-phthalate 84-74-2	Fluoranthene 206-44-0
Y2-RC04-S	320 U		320 U	**190 J**	320 U		**190 J**				**1400**	**270 J**		**2900**
Y2-WC04-S	100 U	100 U	100 U	**120**	100 U	100 U	**120**	100 U	3.5 U	520 U	**840**	**220**	**290**	**2400**
Y2-RC11-S	48 U		48 U	48 U	48 U		48 U				**110**	48 U		**290**
Y2-WC11-S	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	3.4 U	220 U	**91**	44 U	44 U	**240**
Y2-WC15-S	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	3.4 U	220 U	**89**	44 U	**63 J_B**	**240**
Y2-RC08-S	**120**		**84 J**	**170**	92 U		**130**				**950**	**310**		**2400**
Y2-WC08-S	**99**	94 U	**64 J**	**150**	94 U	94 U	**110**	94 U	3.5 U	470 U	**710**	**270**	94 U	**1600**
Y2-RC02-S	160 U		160 U	**140 J**	160 U		**150 J**				**1700**	**370**		**5300**
Y2-WC02-S	120 U	120 U	**60 J**	**130**	120 U	120 U	**110 J**	120 U	3.5 U	580 U	**1400**	**360**	**170 J_B**	**4200**
Y2-S24-S	39 U	39 U	39 U	39 U	39 U	39 U	39 U	39 U	3.4 U	200 U	**100**	**24 J**	39 U	**230**
Y2-S17-S	40 U	40 U	40 U	40 U	40 U	40 U	40 U	40 U	3.4 U	200 U	**71**	40 U	40 U	**170**
Y2-WC03-S	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	3.5 U	370 U	**440**	**140**	**200 J_B**	**1200**
Y2-RC03-S	120 U		120 U	120 U	120 U		120 U				**820**	**210**		**2400**
Y2-WC06-S	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	3.4 U	300 U	**290**	**85**	**210 J_B**	**760**
Y2-RC06-S	87 U		87 U	87 U	87 U		87 U				**610**	**130**		**1400**
Y2-RC15-S	86 U		86 U	86 U	86 U		86 U				**600**	**140**		**1300**
Y2-WC05-S	99 U	99 U	99 U	**140**	99 U	99 U	**130**	99 U	3.5 U	500 U	**1500**	**310**	**240 J_B**	**2700**
Y2-RC05-S	150 U		150 U	150 U	150 U		150 U				**690**	**220**		**1700**
Y2-WC09-S	**100**	90 U	90 U	**170**	90 U	90 U	**120**	90 U	**3.5**	450 U	**700**	**280**	**340 J_B**	**1200**
Y2-RC09-S	**120**		110 U	**180**	110 U		110 U				**940**	**330**		**2000**
Y2-WC13-S	69 U	69 U	69 U	**150**	69 U	69 U	**110**	69 U	3.5 U	350 U	**590**	**210**	**160 J_B**	**960**
Y2-WC14-S	96 U	96 U	96 U	**130**	96 U	96 U	**98**	96 U	3.6 U	480 U	**680**	**260**	**150 J_B**	**1600**
Y2-S15-S	51 U	51 U	51 U	51 U	51 U	51 U	51 U	51 U	3.5 U	260 U	**120**	51 U	**65 J_B**	**230**
Y2-S19-S	48 U	48 U	48 U	48 U	48 U	48 U	48 U	48 U	3.5 U	240 U	**160**	**59**	**62 J_B**	**350**
Y2-RB-01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.05 U	5 U	1 U	1 U	1 U	1 U
Y2-SC04-S	79 U	79 U	79 U	**53 J**	79 U	79 U	79 U	79 U	3.5 U	400 U	**380**	**100**	**50 J**	**750**
Y2-SC03-S	88 U	88 U	88 U	88 U	88 U	88 U	88 U	88 U	3.5 U	440 U	**700**	**150**	**110**	**1800**
Y2-RC01-S	160 U		160 U	160 U	160 U		**100 J**				**1600**	**230**		**3900**
Y2-WC01-S	190 U	190 U	190 U	190 U	190 U	190 U	190 U	190 U	3.5 U	960 U	**810**	**160 J**	**160 J**	**2100**
Y2-RC14-S	110 U		110 U	110 U	110 U		110 U				**710**	**120**		**1800**
Y2-RC14B-S	94 U		94 U	94 U	94 U		94 U				**620**	**110**		**1800**
Y2-RC13-S	120 U		120 U	120 U	120 U		120 U				**970**	**160**		**2600**
Y2-WC07-S	83 U	83 U	83 U	**54 J**	83 U	83 U	83 U	83 U	3.5 U	410 U	**310**	**110**	**45 J**	**880**
Y2-WC10-S	20 U	20 U	20 U	**78**	**64**	20 U	**120**	20 U	3.5 U	98 U	**680**	**80**	**18 J**	**580**
Y2-RC07-S	120 U		120 U	**110 J**	120 U		**100 J**				**800**	**220**		**2200**

Head of Thea Foss Waterway
Post-Construction Monitoring
May 2006

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Field Sample I.D.	2-Methyl-naphthalene 91-57-6	Dimethyl-phthalate 131-11-3	Acenaph-thylene 208-96-8	Acenaphthene 83-32-9	Dibenzo-furan 132-64-9	Diethyl-phthalate 84-66-2	Fluorene 86-73-7	N-Nitroso-diphenylamine 86-30-6	Hexachloro-benzene 118-74-1	Pentachloro-phenol 87-86-5	Phenanthrene 85-01-8	Anthracene 120-12-7	Di-n-butyl-phthalate 84-74-2	Fluoranthene 206-44-0
Y2-RC10-S	26 U		26 U	26 U	26 U		26 U				**65**	**14 J**		**160**
Y2-RC12-S	20 U		**12 J**	**30**	20 U		**24**				**230**	**61**		**580**
Y2-WC12-S	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	3.4 U	98 U	**90**	**19 J**	**23**	**230**
Y2-SC01-S	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	1 U	98 U	**30**	20 U	20 U	**63**
Y2-SC02-S	21 U	21 U	21 U	**17 J**	21 U	21 U	**22**	21 U	1 U	**73 J**	**250**	**77**	**38**	**580**
Y2-RB-02	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.05 U	5 U	1 U	1 U	1 U	1 U
Y2-WC01B-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	1 U	98 U	20 U	20 U	20 U	20 U
Y2-WC06-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	1 U	98 U	20 U	20 U	**10 J**	**21**
Y2-RB-03	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.05 U	5 U	1 U	1 U	1 U	1 U
Y2-WC04-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	1 U	98 U	**36**	20 U	**14 J**	**66**
Y2-WC05-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	1 U	100 U	**11 J**	20 U	**11 J**	**27**
Y2-CI-01														
Y2-CI-02														
Y2-WC12-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	1 U	99 U	20 U	20 U	20 U	20 U
Y2-WC10-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	1 U	97 U	20 U	20 U	20 U	20 U

U = nondetected at the associated value
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J = associated value is considered an estimate; less than verifiable lower calibration point
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J_{IS} = estimate; noncompliant internal standard area
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Head of Thea Foss Waterway
Post-Construction Monitoring
May 2006

metals - mg/kg, dry
organics - µg/kg, dry

Field Sample I.D.	Pyrene 129-00-0	Butylbenzyl-phthalate 85-68-7	Benzo(a)-anthracene 56-55-3	*bis* (2-Ethylhexyl)-phthalate 117-81-7	Chrysene 218-01-9	Di-n-octyl-phthalate 117-84-0	Benzo(b)-fluoranthene 205-99-2	Benzo(k)-fluoranthene 207-08-9	Benzo(a)-pyrene 50-32-8	Indeno(1,2,3-cd)pyrene 193-39-5	Dibenz(a,h)-anthracene 53-70-3	Benzo(ghi)-perylene 191-24-2
Y2-RC04-S	2600		960	5900	1500		1600	920	1100	670	320 U	910
Y2-WC04-S	1900	200	780	4600	1100	180	1400	640	860	300	63 J	350
Y2-RC11-S	200		82	1100	170		140	120	99	49	48 U	61
Y2-WC11-S	180	51	71	960	140	84	120	120	86	42 J	44 U	48
Y2-WC15-S	180	41 J	74	990	140	86	160	86	90	41 J	44 U	51
Y2-RC08-S	2000		930	5400	1300		1600	1000	1100	330	130	410
Y2-WC08-S	1700	170	700	3400	890	130	1000	790	850	230	94 U	280
Y2-RC02-S	3500		1600	8700	2700		2700	2300	2100	620	100 J	790
Y2-WC02-S	3100	380	1200	7700	2200	190	2200	1800	1600	480	81 J	620
Y2-S24-S	200	26 J	80	550	120	34 J	150	98	96	39 J	39 U	45
Y2-S17-S	150	28 J	59	570	100	45	120	74	76	30 J	40 U	38 J
Y2-WC03-S	920	130	400	2300	570	100	530	480	480	250	73 U	320
Y2-RC03-S	1700		790	5100	1200		1100	1000	970	410	120 U	520
Y2-WC06-S	580	110	270	1600	390	60 U	400	280	310	150	60 U	200
Y2-RC06-S	1300		540	3900	820		750	780	660	220	87 U	280
Y2-RC15-S	1300		510	3800	800		900	590	640	210	86 U	240
Y2-WC05-S	2400	160 J_{IS}	760	3600	1800	150 J_{IS}	1200	760	810	230	99 U	280
Y2-RC05-S	1600		690	5400	1100		820	1100	840	240	150 U	280
Y2-WC09-S	1600	210 J_{IS}	660	4700	800	120 J_{IS}	840	760	800	200	90 U	250
Y2-RC09-S	2100		950	4700	1300		1600	940	1200	270	110 U	320
Y2-WC13-S	1200	140 J_{IS}	510	2000	630	87 J_{IS}	570	670	610	140	69 U	180
Y2-WC14-S	1700	180 J_{IS}	690	3700	880	170 J_{IS}	1300	560	790	200	96 U	240
Y2-S15-S	250	51 U	98 J_{IS}	930	160 J_{IS}	76 J_{IS}	200	110	120	51 U	51 U	51 U
Y2-S19-S	290	48 U	140	880	200	66	240	140	170	48 U	48 U	53
Y2-RB-01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Y2-SC04-S	610	130	290	1500	450	62 J	490	250	340	170	79 U	220
Y2-SC03-S	1100	190	570	3400	940	140	900	700	670	260	88 U	340
Y2-RC01-S	2200		1100	8300	1800		1600	1700	1400	410	160 U	480
Y2-WC01-S	1400	180 J	670	4300	1100	420	1200	660	690	260	190 U	330
Y2-RC14-S	1100		590	3600	920		860	820	650	210	110 U	260
Y2-RC14B-S	1100		530	3800	920		1100	620	680	210	94 U	250
Y2-RC13-S	1600		820	3700	1300		1700	820	960	280	120 U	340
Y2-WC07-S	700	120	320	1800	450	53 J	500	320	370	110	83 U	130
Y2-WC10-S	300	26	120	460	160	30	110	130	88	29	20 U	36
Y2-RC07-S	1600		760	5400	1200		890	890	780	450	120 U	610

Head of Thea Foss Waterway
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Field Sample I.D.	Pyrene 129-00-0	Butylbenzyl-phthalate 85-68-7	Benzo(a)-anthracene 56-55-3	*bis* (2-Ethylhexyl)-phthalate 117-81-7	Chrysene 218-01-9	Di-n-octyl-phthalate 117-84-0	Benzo(b)-fluoranthene 205-99-2	Benzo(k)-fluoranthene 207-08-9	Benzo(a)-pyrene 50-32-8	Indeno(1,2,3-cd)pyrene 193-39-5	Dibenz(a,h)-anthracene 53-70-3	Benzo(ghi)-perylene 191-24-2
Y2-RC10-S	**130**		**62**	**420**	**94**		**97**	**56**	**59**	**45**	26 U	**61**
Y2-RC12-S	**360**		**190**	**1300**	**310**		**300**	**230**	**210**	**82**	**14 J**	**100**
Y2-WC12-S	**160**	**28**	**75**	**590**	**120**	**32**	**120**	**88**	**84**	**45**	20 U	**60**
Y2-SC01-S	**59**	20 U	**26**	**85**	**38**	20 U	**31**	**31**	**28**	**24**	20 U	**24**
Y2-SC02-S	**270**	**62**	**150**	**1000**	**260**	**57**	**200 J_{IS}**	**200 J_{IS}**	**180 J_{IS}**	**130 J_{IS}**	**36 J_{IS}**	**120 J_{IS}**
Y2-RB-02	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Y2-WC01B-C3	20 U	20 U	20 U	**20**	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Y2-WC06-C3	**23**	20 U	20 U	**29**	**10 J**	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Y2-RB-03	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Y2-WC04-C3	**68**	20 U	**25**	**120**	**34**	20 U	**38**	**19 J**	**26**	**16 J**	20 U	**22**
Y2-WC05-C3	**32**	20 U	**12 J**	**63**	**15 J**	20 U	**19 J**	20 U	**11 J**	20 U	20 U	**10 J**
Y2-CI-01												
Y2-CI-02												
Y2-WC12-C3	**15 J**	20 U	20 U	**20 J**	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Y2-WC10-C3	20 U	20 U	20 U	**38**	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U

U = nondetected at the associated value
U_J = nondetected, with low recovery of matrix spike
J = associated value is considered an estimate; less than verifiable lower calibration point
J_B = estimate; value less than 2x method blank level
J_C = estimate; noncompliant continuing calibration response
J_{IS} = estimate; noncompliant internal standard area
J_P = estimate; dual-column quant. confirmation > 40% difference

Head of Thea Foss Waterway
Post-Construction Monitoring
May 2006

metals - mg/kg, dry
organics - µg/kg, dry

Field Sample I.D.	4,4'-DDE 72-55-9	4,4'-DDD 72-54-8	4,4'-DDT 50-29-3	Aroclor 1016 12674-11-2	Aroclor 1242 53469-21-9	Aroclor 1248 12672-29-6	Aroclor 1254 11097-69-1	Aroclor 1260 11096-82-5	Aroclor 1221 11104-28-2	Aroclor 1232 11141-16-5
Y2-RC04-S				10 U	10 U	**20**	**46**	**42**	10 U	10 U
Y2-WC04-S	7 U	7 U	7 U	9.8 U	9.8 U	**17**	**36**	**33**	9.8 U	9.8 U
Y2-RC11-S				9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U
Y2-WC11-S	7 U	7 U	7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U
Y2-WC15-S	7 U	7 U	7 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Y2-RC08-S				9.8 U	9.8 U	**22**	**50**	**40**	9.8 U	9.8 U
Y2-WC08-S	7 U	7 U	7 U	9.8 U	9.8 U	**18**	**47**	**46**	9.8 U	9.8 U
Y2-RC02-S				9.8 U	9.8 U	**23**	**77**	**69**	9.8 U	9.8 U
Y2-WC02-S	7 U	7 U	12 U	9.8 U	9.8 U	**27**	**69**	**64**	9.8 U	9.8 U
Y2-S24-S	7 U	7 U	7 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U
Y2-S17-S	7 U	7 U	7 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	15 U	9.9 U
Y2-WC03-S	7 U	7 U	7 U	10 U	10 U	**24**	**47**	**36**	10 U	10 U
Y2-RC03-S				9.8 U	9.8 U	**32 J_P**	**58**	**44**	9.8 U	9.8 U
Y2-WC06-S	7 U	7 U	7 U	9.8 U	9.8 U	9.8 U	**25**	**19**	9.8 U	9.8 U
Y2-RC06-S				9.8 U	9.8 U	**26 J_P**	**49**	**38**	9.8 U	9.8 U
Y2-RC15-S				9.9 U	9.9 U	**26 J_P**	**42**	**37**	9.9 U	9.9 U
Y2-WC05-S	7 U	7 U	7 U	9.8 U	9.8 U	**31 J_P**	**56**	**48**	9.8 U	9.8 U
Y2-RC05-S				9.8 U	9.8 U	**29 J_P**	**60**	**53**	9.8 U	9.8 U
Y2-WC09-S	7 U	7 U	7 U	9.7 U	9.7 U	**32 J_P**	**56**	**48**	9.7 U	9.7 U
Y2-RC09-S				9.8 U	9.8 U	**46 J_P**	**94**	**86**	9.8 U	9.8 U
Y2-WC13-S	7 U	7 U	7 U	9.7 U	9.7 U	**26**	**54**	**51**	9.7 U	9.7 U
Y2-WC14-S	7 U	7 U	7 U	9.8 U	9.8 U	**38 J_P**	**77**	**72**	9.8 U	9.8 U
Y2-S15-S	7 U	7 U	7 U	9.6 U	9.6 U	9.6 U	**12**	**11**	9.6 U	9.6 U
Y2-S19-S	7 U	7 U	7 U	9.8 U	9.8 U	9.8 U	**11 J**	**12**	9.8 U	9.8 U
Y2-RB-01	0.1 U	0.1 U	0.1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Y2-SC04-S	7 U	7 U	7 U	9.8 U	9.8 U	20 U	**44**	**31 J_C**	9.8 U	20 U
Y2-SC03-S	7 U	7 U	7 U	9.9 U	9.9 U	20 U	**36**	**35 J_C**	9.9 U	20 U
Y2-RC01-S				9.9 U	9.9 U	20 U	**40**	**55 J_C**	9.9 U	20 U
Y2-WC01-S	7 U	7 U	7 U	9.9 U	9.9 U	9.9 U	**28**	**44 J_C**	9.9 U	15 U
Y2-RC14-S				9.9 U	9.9 U	15 U	**24**	**38 J_C**	9.9 U	15 U
Y2-RC14B-S				9.8 U	9.8 U	15 U	**28**	**53 J_C**	9.8 U	15 U
Y2-RC13-S				9.9 U	9.9 U	20 U	**40**	**58 J_C**	9.9 U	20 U
Y2-WC07-S	7 U	7 U	7 U	9.8 U	9.8 U	20 U	**38**	**50 J_C**	9.8 U	20 U
Y2-WC10-S	7 U	7 U	7 U	9.9 U	9.9 U	9.9 U	**8 J**	**10 J**	9.9 U	9.9 U
Y2-RC07-S				9.9 U	9.9 U	20 U	**43**	**54 J_C**	9.9 U	20 U

Head of Thea Foss Waterway
Post-Construction Monitoring
May 2006

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organics - µg/kg, dry

Field Sample I.D.	4,4'-DDE 72-55-9	4,4'-DDD 72-54-8	4,4'-DDT 50-29-3	Aroclor 1016 12674-11-2	Aroclor 1242 53469-21-9	Aroclor 1248 12672-29-6	Aroclor 1254 11097-69-1	Aroclor 1260 11096-82-5	Aroclor 1221 11104-28-2	Aroclor 1232 11141-16-5
Y2-RC10-S				9.9 U	9.9 U	9.9 U	**11 J**	**17 J**	9.9 U	9.9 U
Y2-RC12-S				9.8 U	9.8 U	9.8 U	**16 J**	**27 J_C**	9.8 U	9.8 U
Y2-WC12-S	7 U	7 U	7 U	9.7 U	9.7 U	9.7 U	**5 J**	**7 J**	9.7 U	9.7 U
Y2-SC01-S	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U
Y2-SC02-S	2 U	2 U	2 U	9.9 U	9.9 U	9.9 U	**28**	**32 J_C**	9.9 U	9.9 U
Y2-RB-02	0.1 U	0.1 U	0.1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Y2-WC01B-C3	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U
Y2-WC06-C3	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U
Y2-RB-03	0.1 U	0.1 U	0.1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Y2-WC04-C3	2 U	2 U	2 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U
Y2-WC05-C3	2 U	2 U	2 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U
Y2-CI-01										
Y2-CI-02										
Y2-WC12-C3	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U
Y2-WC10-C3	2 U	2 U	2 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U

U = nondetected at the associated value
U_J = nondetected, with low recovery of matrix spike
J = associated value is considered an estimate; less than verifiable lower calibration point
J_B = estimate; value less than 2x method blank level
J_C = estimate; noncompliant continuing calibration response
J_{IS} = estimate; noncompliant internal standard area
J_P = estimate; dual-column quant. confirmation > 40% difference

APPENDIX G.2

BIOASSAY DATA QA/QC

APPENDIX G-2
SEDIMENT BIOASSAY DATA QUALITY REVIEW
THEA FOSS WATERWAY

Introduction

This appendix summarizes the sediment bioassay data quality review of the amphipod, *Rhepoxynius abronius,* the juvenile polychaete, *Neanthes arenaceodentata,* and the bivalve, *Mytilus galloprovincialis,* sediment bioassays conducted by Northwestern Aquatic Sciences (NAS) of Newport, Oregon. These sediment bioassays were conducted as part of the Head of the Thea Foss Waterway Remediation Project.

The sediment bioassay tests were conducted on four test sediments: Y2-WC02-S, Y2-WC04-S, Y2-WC05-S, and Y2-WC06-S. The bioassay results for the four test sediments were compared against reference sediments, Y2-CI-01 and Y2-CI-02. The reference sediment selected for comparison with each test sediment was based on grain size characteristics of the sediment. The sediment bioassays were conducted in accordance with the protocols presented in the Puget Sound Estuary Program (PSEP), with modifications as specified by the Dredge Material Management Plan (DMMP, formerly Puget Sound Dredge Disposal Analysis Program or PSDDA), Washington State Sediment Management Standards (SMS), and in the EPA-approved work plan (Tetra Tech EC, 2003).

This data quality review was conducted to ensure that the results of the sediment bioassays were of sufficient quality for use in this remediation project.

Sediment Bioassay Data Quality Review

The test sediment samples were collected by Tetra Tech EC on May 12 and 15, 2006, and were submitted for toxicity testing to NAS Laboratory on May 16, 2006. Reference Sediments were collected by Tetra Tech EC on May 18, 2006, and were submitted for toxicity testing to NAS Laboratory on May 23, 2006.

The negative control sediment for the amphipod, *Rhepoxynius abronius,* was collected on June 16, 2006, from West Beach, Whidbey Island, Washington. The negative control sediment for the juvenile polychaete, *Neanthes arenaceodentata,* was collected on June 14, 2006, from lower Yaquina Bay, Oregon.

The following three sediment toxicity tests were used in this study:

- Acute 10-Day Amphipod Survival Test *(Rhepoxynius abronius)*;
- Chronic 20-Day Polychaete Survival/Growth Test *(Neanthes arenaceodentata)*; and
- Acute 48-Hour Larval Survival/Abnormality Test *(Mytilus galloprovincialis)*.

These saltwater sediment toxicity tests were conducted in accordance with available standard protocols (PSEP, 1995) by NAS.

The following criteria were evaluated as part of this data quality review:

- Holding times;
- Bioassay performance in negative control and reference sediments;
- Bioassay performance in positive control tests; and
- Bioassay test conditions.

Amphipod, Rhepoxynius abronius, 10-day Survival Test

The amphipod bioassay was initiated on June 23, 2006, which was within the 56-day PSEP holding time limit. The sediments were held in the dark at 4^{o}C during the holding period.

The water quality observations of overlying water temperature, pH, and dissolved oxygen were within the protocol-specified ranges. Several of the overlying water salinity measurements were measured slightly above the protocol-specified range of 28 ± 1 ppt (maximum measurement = 31 ppt). Additionally, two overlying water salinity measurements were inadvertently omitted by NAS on Day 6 of testing. These minor exceedances and omissions are unlikely to have affected the test results. Interstitial sulfide concentrations ranged from 0.2 to 49.4 mg/L on day zero and 0.4 to 6.3 mg/L on day 10; on both days, the maximum value was recorded from sample Y2-WC02-S. However, dissolved sulfides were not detected in the overlying water (detection limit 0.02 mg/L) at either the beginning or end of the test. Ammonia-N in the overlying water ranged from <0.1 mg/L (detection limit) to 7.8 mg/L.

The reference toxicant test 96-hour 50% Lethal Concentration (96-h LC_{50}) of 0.91 mg Cd/L was within the laboratory's control chart warning limits (0.10 to 2.05 mg Cd/L) obtained by NAS.

The reported mean mortality of 5.0% in the negative control for this bioassay was well within the DMMP performance standard of <10%. The mean mortality responses from the reference sediments Y2-CI-01 (9.0%) and Y2-CI-02 (6.0%) were well within the DMMP performance standard of $<$20%.

Final QA Determination. The amphipod, *Rhepoxynius abronius*, data are of acceptable quality and fully usable.

Polychaete, Neanthes arenaceodentata, 20-Day Survival and Growth Test

The polychaete bioassay was initiated on June 23, 2006, which was within the 56-day PSEP holding time limit. The sediments were held in the dark at 4^{o}C during the holding period.

The water quality observations of overlying water temperature, salinity, dissolved oxygen, and pH were within the protocol-specified ranges. Temperature, pH, salinity, and dissolved oxygen measurements were omitted from two water quality beakers on day zero. Additionally, water was not changed on day 3 as specified in the test procedures. This oversight was discovered on day 4 and as a result, the water change was conducted on day 4 and temperature, pH, salinity, and dissolved oxygen measurements were recorded. These minor omissions are unlikely to have affected the test results as all of the water quality observations were within the protocol-specified ranges and test organism mean survival rates were all above 92%. Sulfides were not detected in the overlying water (detection limit 0.02 mg/L) at either the beginning or end of the test. Ammonia-N in the overlying water ranged from 0.2 mg/L to 11.5 mg/L (maximum un-ionized ammonia reported was 0.038 mg/L).

The reference toxicant test 96-h LC_{50} of 8.46 mg Cd/L was within the laboratory's control chart warning limits (4.96 to 10.8 mg Cd/L) obtained by NAS.

The reported mean mortality of 0% in the negative control for this bioassay was well within the DMMP performance standard of <10%. The mean mortality responses from the reference sediments Y2-CI-01 (8.0%) and Y2-CI-02 (4.0%) were well within the DMMP performance standard of $<$20%.

The individual growth rate in the negative controls averaged 1.01 mg/day/worm. This meets DMMP performance criteria for a minimum growth rate of 0.72 mg/day/worm for *Neanthes*. The average initial weight of worms was 0.80 mg, which is within the recommended range of 0.5 to 1.0 mg. The reference sediments Y2-CI-01 (96%) and Y2-CI-02 (89%) were within DMMP performance criteria of >80% of the mean individual growth rate in the control sediment.

Final QA Determination. The *Neanthes arenaceodentata* data are of acceptable quality and fully usable.

Larval, Mytilus galloprovincialis, 48-Hour Survival/Abnormality Test

The larval bioassay was initiated on June 20, 2006, which was within the 56-day PSEP holding time limit. The sediments were held in the dark at 4^{o}C during the holding period.

The water quality observations of overlying water temperature, salinity, dissolved oxygen, and pH were within the protocol-specified ranges. Sulfides were not detected in the overlying water (detection limit 0.02 mg/L) at either the beginning or end of the test. Ammonia-N in the overlying water ranged from <0.1 mg/L (detection limit) to 0.7 mg/L.

The reference toxicant test 48-h EC_{50} of 10.3 µg Cu/L was within the laboratory's control chart ±2 standard deviation warning limits (6.44 to 13.6 µg Cu/L) obtained by NAS.

The reported mean percent normality of 100.4% in the seawater control for this bioassay was well within the DMMP performance standard of >70% normal. The mean seawater-normalized combined mortality and abnormality (NCMA) in reference sediments Y2-CI-01 and Y2-CI-02 was 44.1% and 28.8%, respectively. Therefore, Y2-CI-02 was within the DMMP performance standard of <35%. However, reference sediment Y2-CI-01 was above the performance standard by 9.1%. High mortalities in the seawater control and/or reference sediments are occasionally observed. The cause is unknown, but may be related to normal factors that reduce embryo quality (PSEP, 1995).

Final QA Determination. Since the positive control result was within control limits, the control criterion was met, and the reference acceptance criterion was met for one reference sediment, it is concluded that the *Mytilus galloprovincialis* data are provisionally acceptable data for use.

APPENDIX H

HEAD OF THE THEA FOSS CHEMISTRY DATA 2004-2006

Table H. Head of the Thea Foss Results 2004 - 2006

Location	Sample ID	Monitoring Type	Sample Date	Depth Below Mudline	Easting	Northing	Total Solids	TOC	TPH Diesel	TPH Motor Oil	Sb	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt	Clay	Percent Fines
		SQO									150	57	5.1		390	450	0.59	140	6.1	410									
OMMP Locations		Units					Percent	Percent	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	%	%	%	%	%	%	%	%	%
RC/WC-01	RC-01	Year 0 OMMP	4/8/2004	0-2 cm	1160586	702003	79.8	2.44			6 U	6	0.2 U	33.2	44.1	25	0.06 U	28	0.3 U	74.3	25		40	17		6.1	7.2	4.9	12
RC/WC-01	RC-01	City Sampling	12/9/2004	0-2 cm	1160586	702003	77.7		96	430		7			39.7	27	0.06	24		71.9	25.8	19.7	31.5	14		1.8	3.8	2.5	6.3
RC/WC-01	RC-01	Year 1 OMMP	5/12/2005	0-2 cm	1160586	702003	6.93	45.2	1200	4800		10			81.7	104	0.2	37		289	21.3	8.6	15	10.1	7.3	7.9	18.1	11.7	29.8
RC/WC-01	Y2-RC01-S	Year 2 OMMP	5/16/2006	0-2 cm	1160586	702003	40.4	9.92	900	4700	10 U	10 U	0.6		76.5	90	0.1	59	0.8 U	287	22	10.1	10.1	11.2	9.9	9.6	15.4	11.7	27.1
RC/WC-01	WC-01	Year 0 OMMP	4/8/2004	0-10 cm	1160586	702003	86.9	1.47			5 U	5 U	0.2 U	19.1	28.9	6	0.04 U	23	0.3 U	41	28		42	16		6.1	4.8	3	7.8
RC/WC-01	WC-01	City Sampling	12/9/2004	0-10 cm	1160586	702003	78.9		91	440		6 U			37.4	22	0.07	25		68.5	46.8	10.4	18.8	12.2		3.3	4.7	2.5	7.2
RC/WC-01	Y2-WC01-S	Year 2 OMMP	5/16/2006	0-10 cm	1160586	702003	36.4	7.11	1100	5100	10 U	10 U	0.6		69.4	86	0.1	34	0.8 U	269	20.5	9.1	808	10.8	8.9	7.1	20.1	14.7	34.8
WC-01B/R-01B	Y2-WC01B-C3	Year 2 OMMP	5/17/2006	2-3 ft	1160609	702093	85.6	0.548			6 U	6 U	0.2 U		31.1	3	0.05 U	15	0.3 U	29.5	28.4	16.3	17.9	21.3	11.9	1.5	1.7	0.9	2.6
RC/WC-02	RC-02	Year 0 OMMP	4/8/2004	0-2 cm	1160700	702125	50.7	5.32			9 U	9 U	0.4 U	27.5	71.3	20	0.1 U	27	0.6 U	71	1.2		8.7	21		33	19	18	36
RC/WC-02	RC-02	Year 1 OMMP	5/12/2005	0-2 cm	1160700	702125	7.11	41.7	1300	5900		10			107	122	0.3	34		261	0.4	1	6.4	15	17.2	9	34.7	16.2	50.9
RC/WC-02	RC-2A (Dup of RC-2)	Year 1 OMMP	5/12/2005	0-2 cm	1160700	702125	6.54	40.8	880	3700		10			106	123	0.3	34		267	0.2	0.9	6.6	14.7	16.6	9	37.2	14.8	52
RC/WC-02	Y2-RC02-S	Year 2 OMMP	5/12/2006	0-2 cm	1160700	702125	41.6	5.17	1000	5300	10 U	10 U	1		88.4	97	0.2	31	0.7 U	254	0.8	3.8	16.2	15.9	11.6	0	34.7	17	51.7
RC/WC-02	RC-02	City Sampling	12/2/2004	0-8 cm	1160700	702125	48.9		340	1700		10 U			91.3	70	0.1	30		164	0.7	1.7	5.1	18.4		6.8	30.6	13.7	44.3
RC/WC-02	WC-02	Year 0 OMMP	4/8/2004	0-10 cm	1160700	702125	61.6	3.45			8 U	8 U	0.3 U	23.6	60.9	15	0.08 U	23	0.5 U	58	8.2		14	23		32	14	10	24
RC/WC-02	WC-02 (City)	City Sampling	12/2/2004	0-10 cm	1160700	702125	52	4.2								49.4	0.075			107 B									
RC/WC-02	WC-02	Year 1 OMMP	5/12/2005	0-10 cm	1160700	702125	4.9	65.3	440	2100		10			72.5	54	0.12	26		127	1.3	0.7	5.4	22	25.8	8	26.1	10.7	36.8
RC/WC-02	Y2-WC02-S	Year 2 OMMP	5/12/2006	0-10 cm	1160700	702125	47	6.37	840	4000	10 U	10 U	1.2		90.8	92	0.22	32	0.7 U	252	0.6	3	5	11.7	19	10.9	33.6	23.7	57.3
RC/WC-03	RC-03	Year 0 OMMP	4/8/2004	0-2 cm	1160508	702105	37.8	6.68			10 U	10 U	0.5 U	40	112	44	0.1	36	0.8 U	115	0.1		4.9	3.7		18	40	34	73
RC/WC-03	RC-03	Year 1 OMMP	5/12/2005	0-2 cm	1160508	702105	5.44	50.4	400	1600		10 U			69.3	55	0.21	25		123	0.1	1	6.4	18.4	23.3	12.3	26.2	12.3	38.5
RC/WC-03	Y2-RC03-S	Year 2 OMMP	5/15/2006	0-2 cm	1160508	702105	47.9	4.98	530	2300	10 U	10 U	0.6		73.6	62	0.16	28	0.7 U	166	3.8	2.4	5	15.4	17.8	9.2	32.7	13.6	46.3
RC/WC-03	WC-03	Year 0 OMMP	4/8/2004	0-10 cm	1160508	702105	50.8	7.12			10 U	10 U	0.4 U	26	65.6	20	0.07	24	0.6 U	63	0.5		8.4	16		33	26	17	43
RC/WC-03	WC-03 (City)	City Sampling	12/2/2004	0-10 cm	1160508	702105	42	6.5								42	0.081			93 B									
RC/WC-03	Y2-WC03-S	Year 2 OMMP	5/15/2006	0-10 cm	1160508	702105	54.4	5.32	340	1400	10 U	10 U	0.4 U		55.7	37	0.13	21	0.6 U	99	1.53	1.9	5.3	15.7	23.1	12.3	26.2	14	40.2
RC/WC-03	RC-03	City Sampling	12/2/2004	0-12 cm	1160508	702105	48.1		93	420		10 U			84.4	34	0.1	29		90	1.1	0.7	1.5	9.9		18.5	33.7	20.5	54.2
RC/WC-04/R-02	RC-04	Year 0 OMMP	4/8/2004	0-2 cm	1160566	702220	55.2	6.34			9 U	9 U	0.4 U	27.1	71.8	19	0.08	25	0.5 U	70	4.1		18	20		24	18	16	34
RC/WC-04/R-02	RC-04	Year 1 OMMP	5/12/2005	0-2 cm	1160566	702220	6.26	35.4	1000	3500		20			119	140	0.5	37		254	0.2	0.6	5.7	8.7	9.5	7.5	49.7	18.1	67.8
RC/WC-04/R-02	Y2-RC04-S	Year 2 OMMP	5/12/2006	0-2 cm	1160566	702220	46.4	7.41	680	3000	10 U	10 U	0.5 U		46.7	44	0.2	19	0.7 U	108	2.8	3.5	5.9	13.8	17.6	10.3	33.2	12.9	46.1
RC/WC-04/R-02	RC-04	City Sampling	12/1/2004	0-9 cm	1160566	702220	49.1		40	210		10			76.8	49	0.16	27		128	5.9	5.1	8.7	14.3		7.7	29.7	15.8	45.5
RC/WC-04/R-02	WC-04	Year 0 OMMP	4/8/2004	0-10 cm	1160566	702220	70	4.6			7 U	7 U	0.3 U	24	55.2	13	0.06 U	22	0.4 U	52.2	14		25	20		25	9.8	6.4	16
RC/WC-04/R-02	WC-04-Duplicate	Year 0 OMMP	4/8/2004	0-10 cm	1160566	702220	67.7	6.23			7 U	7 U	0.3 U	23.2	62	13	0.05	21	0.4 U	48.2	14		24	20		25	11	6.7	18
RC/WC-04/R-02	S-34 (Dup of WC-04)	City Sampling	12/1/2004	0-10 cm	1160566	702220	55.1		31	100		9 U			67.7	33	0.11	26		98	3	5.3	7.8	19.3		7.8	23.6	14.8	38.4
RC/WC-04/R-02	WC-04	City Sampling	12/1/2004	0-10 cm	1160566	702220	54.3		71	380		9 U			67.2	35	0.12	25		95	4.5	4	9.6	18.9		7.6	22.6	14.8	37.4
RC/WC-04/R-02	WC-04	Year 1 OMMP	5/12/2005	0-10 cm	1160566	702220	6.28	52.5	350	1400		10			80.9	50	0.25	26		113	9.3	5.8	10.4	17.1	12.9	7	24.6	12.8	37.4
RC/WC-04/R-02	Y2-WC04-S	Year 2 OMMP	5/12/2006	0-10 cm	1160566	702220	55.3	3.2	470	2100	9 U	9 U	0.6		61.2	54	0.18	23	0.6 U	133	7.1	5.2	9.5	19.3	15.7	7.2	24	12.1	36.1
RC/WC-04/R-02	WCBU-4A	Year 0 OMMP	4/7/2004	0-1 ft	1160566	702220	84.1	0.886			6 U	6 U	0.2 U	19.7	36	3	0.04 U	20	0.3 U	35.3	15		33	26		22	2.6	1.3	3.9
RC/WC-04/R-02	WCBU-4B	Year 0 OMMP	4/7/2004	1-2 ft	1160566	702220	91.7	0.14			10 U	10 U	0.5 U	26	37	5 U	0.05 U	22	0.8 U	38	25		43	21		9.8	0.8	0.5	1.3
RC/WC-04/R-02	WCBU-4C	Year 0 OMMP	4/7/2004	2-3 ft	1160566	702220	90.8	0.0364			5 U	5 U	0.2 U	18.3	40.8	2 U	0.05 U	18	0.3 U	36.9	28		44	19		7.3	1.1	0.5	1.6
RC/WC-04/R-02	Y2-WC04-C3	Year 2 OMMP	5/17/2006	1.5-3 ft	1160566	702220	87.5	0.866			6 U	6 U	0.2 U		43.8	5	0.06 U	21	0.3 U	40.8	20.5	17.1	20.3	23.8	12.7	2.9	2.7	0	2.7
RC/WC-05	RC-05	Year 0 OMMP	4/8/2004	0-2 cm	1160639	702359	46.2	5.34			10 U	10 U	0.4 U	33	87.3	19	0.09	29	0.6 U	70	0.1		5.3	8		32	32	22	54
RC/WC-05	RC-05-Duplicate	Year 0 OMMP	4/8/2004	0-2 cm	1160639	702359	45.4	5.2			10 U	10 U	0.4 U	31	85.1	19	0.09 U	28	0.6 U	69	3.4		3.6	7.9		33	31	21	53
RC/WC-05	RC-05	Year 1 OMMP	5/12/2005	0-2 cm	1160639	702359	5.2	41.6	880	3000		10			100	108	0.3	31		187	0.1	0.6	3.6	9.9	16	9.9	45.4	14.6	60
RC/WC-05	Y2-RC05-S	Year 2 OMMP	5/15/2006	0-2 cm	1160639	702359	44.6	6.58	720	3200	10 U	10 U	0.7		83.5	76	0.19	32	0.7 U	189	0.4	3.7	4.8	12	16.5	11.2	34.4	16.9	51.3
RC/WC-05	WC-05	Year 0 OMMP	4/8/2004	0-10 cm	1160639	702359	58.7	4.48			8 U	8 U	0.3 U	24.2	60.4	10	0.11	23	0.5 U	48	3.2		13	17		36	20	11	31
RC/WC-05	WC-05	City Sampling	12/2/2004	0-10 cm	1160639	702359	44.9		190	790		10 U			100	70	0.3	31		138	0.5	0.4	1	6.2		16.2	41.7	19.5	61.2
RC/WC-05	WC-05	Year 1 OMMP	5/12/2005	0-10 cm	1160639	702359	4.89	49.4	390	1400		10			80.3	54	0.2	27		111	2.6	3.4	5.4	11.3	16.3	13.2	32.6	15.2	47.8
RC/WC-05	Y2-WC05-S	Year 2 OMMP	5/15/2006	0-10 cm	1160639	702359	49	5.16	580	2300	10 U	10 U	0.4 U		31.6	29	0.2	11	0.6 U	63	1.4	2.2	3.6	11.6	19	11.3	35.5	15.3	50.8
RC/WC-05	RC-05	City Sampling	12/2/2004	0-11 cm	1160639	702359	46.9		140	710		10 U			92.6	54	0.2	30		117	0.2	0.6	1	7.8		17.8	39.4	18.7	58.1
RC/WC-05	WCBU-5A	Year 0 OMMP	4/7/2004	0-1.3 ft	1160639	702359	89	0.251			6 U	6 U	0.2 U	16.5	30.4	2 U	0.05 U	16	0.3 U	28.9	29		30	22		18	0.8	0.4	1.2
RC/WC-05	Y2-WC05-C3	Year 2 OMMP	5/17/2006	1-2.5 ft	1160639	702359	87.9	0.527			6 U	6 U	0.2 U		35.3	3	0.05 U	19	0.3 U	34.7	21.1	13.9	17.9	24.7	17	2.8	2.6	0	2.6
RC/WC-06	RC-06	Year 0 OMMP	4/8/2004	0-2 cm	1160432	702254	57.4	4.65			9 U	9 U	0.4 U	22.9	54.5	18	0.08 U	21	0.5 U	56	2.2		2.6	17		52	14	12	26
RC/WC-06	RC-06	Year 1 OMMP	5/12/2005	0-2 cm	1160432	702254	5.63	42.2	580	1800		10 U			100	114	0.3	32		216	0.3	1.1	5.4	15	15.7	8	39.2	15.3	54.5
RC/WC-06	Y2-RC06-S	Year 2 OMMP	5/15/2006	0-2 cm	1160432	702254	58.7	5.47	380	1700	8 U	8 U	0.3		56.8	47	0.11	24	0.5 U	121	3.6	4.4	11	24.9	19.8	6.9	20.7	8.9	29.6
RC/WC-06	Y2-RC15-S	Year 2 OMMP	5/15/2006	0-2 cm	1160432	702254	59.8	6.67	400	1700	9 U	9 U	0.3 U		57.7	47	0.12	24	0.5 U	122	6.3	4.5	10.7	23.7	20.2	6.6	19.9	8	27.9
RC/WC-06	RC-06	City Sampling	12/2/2004	0-5 cm	1160432	702254	49		220	870		10			94.4	83	0.24	28		153	0.9	0.6	3.2	16.5		3.4	37	15.6	52.6
RC/WC-06	WC-06	Year 0 OMMP	4/8/2004	0-10 cm	1160432	702254	73	3.45			7 U	7 U	0.3 U	19.1	40	7	0.06 U	18	0.4 U	38.8	0.7		16	36		37	6.5	4.2	11
RC/WC-06	Y2-WC06-S	Year 2 OMMP	5/15/2006	0-10 cm	1160432	702254	66.1	5.02	190	810	8 U	8 U	0.3 U		52.2	28	0.08	20	0.5 U	80.7	1	2.1	6.4	25.7	30.4	8.4	16.8	9.3	26.1
RC/WC-06	WCBU-6A	Year 0 OMMP	4/7/2004	0-1 ft	1160432	702254	82.8	1.59			6 U	6 U	0.2 U	18	40.5	3	0.04 U	18	0.3 U	39.4	28		27	21		21	2	1.2	3.2
RC/WC-06	WCBU-6B	Year 0 OMMP	4/7/2004	1-2 ft	1160432	702254	86.4	0.397			6 U	6 U	0.2 U	26	42.6	3	0.04 U	21	0.3 U	40	35		34	18		10	1.9	1.5	3.4
RC/WC-06	Y2-WC06-C3	Year 2 OMMP	5/17/2006	2-3 ft	1160432	702254	85.3	1.04			6 U	6 U	0.2 U		33.6	3	0.05 U	17	0.3 U	31.5	13.1	14.9	20.3	28	16.8	3.3	2	1.7	3.7
RC/WC-07	RC-07	Year 0 OMMP	4/8/2004	0-2 cm	1160463	702383	84.1	1.32			6 U	6 U	0.2 U	19.9	49.5	6	0.05 U	19	0.3 U	40.6	26		27	22		18	3	3.2	6.2
RC/WC-07	RC-07	Year 1 OMMP	5/11/2005	0-2 cm	1160463	702383	5.5	56.8	480	2100		10			73.9	70	0.22	25		141	11.5	5.3	9.6	23	16.6	7.8	17.3	8.9	26.2
RC/WC-07	Y2-RC07-S	Year 2 OMMP	5/16/2006	0-2 cm	1160463	702383	52.7	6.01	600	2700	10 U	10 U	0.6		69.9	70	0.15	26	0.6 U	169	4	3.3	7.73	18.5	18	7.7	32.7	8.07	40.8
RC/WC-07	RC-07	City Sampling	12/2/2004	0-4 cm	1160463	702383	37.6		550	2100		20			118	140	0.4	32		238	47.3	1.2	2.3	6.3		6.3	23.9	9.3	33.2
RC/WC-07	WC-07	Year 0 OMMP	4/8/2004	0-10 cm	1160463	702383	86.6	0.189			6 U	6 U	0.2 U	18.2	32.2	2	0.04 U	16	0.3 U	30.7	33		37	18		9.2	2	0.5	2.5
RC/WC-07	WC-07	City Sampling	12/2/2004	0-10 cm	1160463	702383	63.8		140	740		9 U			56	42	0.11	20		93	21.3	2.8	6.7	24.1		3.8	11.3	6	17.3
RC/WC-07	WC-07	Year 1 OMMP	5/11/2005	0-10 cm	1160463	702383	2.53	80.2	140	600		7			45.3	23	0.07	20		62.2	40.4	8.5	10.5	21.3	10.4	1.7	4.3	2.9	7.2
RC/WC-07	Y2-WC07-S	Year 2 OMMP	5/16/2006	0-10 cm	1160463	702383	68.7	4.22	220	1100	8 U	8 U	0.4		59	45	0.11	26	0.5 U	112	9.7	4.2	10.8	27.8	21.8	4.4	14.7	6.6	21.3
RC/WC-08/R-03	RC-08	Year 0 OMMP	4/8/2004	0-2 cm	1160586	702435	79.7	0.923			6 U	6 U	0.3 U	17.8	32.8	5	0.06 U	16	0.4 U	33	1.6		18	39		37	2.5	2.7	5.2
RC/WC-08/R-03	RC-08	Year 1 OMMP	5/11/2005	0-2 cm	1160586	702435	4.65	41.3	1000	3200		20			111	145	0.5	31		215	2.7	3.6	7.6	9.9	8	5.9	42.5	19.6	62.1
RC/WC-08/R-03	Y2-RC08-S	Year 2 OMMP	5/12/2006	0-2 cm	1160586	702435	52.9	5.63	550	2200	10 U	10	0.8		73.6	73	0.22	30	0.6 U	150	2.3	2.4	7	17.8	16	7.6	31.8	15	46.8
RC/WC-08/R-03	RC-08	City Sampling	12/1/2004	0-5 cm	1160586	702435	52.1		370	850		10			89	100	0.34	30		180	4.1	4.2	10.7	17.7		4.2	31.1	16	47.1
RC/WC-08/R-03	WC-08	Year 0 OMMP	4/8/2004	0-10 cm	1160586	702435	82.6	0.881			6 U	6 U	0.2 U	17.2	33.9	4	0.05 U	16	0.3 U	31.8	19		28	27		23	1.6	1.7	3.3
RC/WC-08/R-03	WC-8	Year 1 OMMP	5/11/2005	0-10 cm	1160586	702435	1.4	72.5									0.07												
RC/WC-08/R-03	Y2-WC08-S	Year 2 OMMP	5/12/2006	0-10 cm	1160586	702435	59.4	4.17	470	1800	9 U	9 U	0.8		72	64	0.19	24	0.6	134	2.8	2.9	7.7	20	20	8.4	24.5	13.7	38.2
RC/WC-09	RC-09	Year 0 OMMP	4/8/2004	0-2 cm	1160653	702452	67.3	2.86			8 U	8 U	0.3 U	25.6	64	15	0.07 U	23	0.5 U	53.3	2.2		9.3	25		39	14	10	25
RC/WC-09	RC-09	Year 1 OMMP	5/11/2005	0-2 cm	1160653	702452	4.66	40.9	1100	3700		20			117	144	0.5	32		211	0.2	0.5	4.6	11.5	12.3	7.2	43.6	20.2	63.8
RC/WC-09	Y2-RC09-S	Year 2 OMMP	5/15/2006	0-2 cm	1160653	702452	47.9	5.12	740	2800	10 U	10 U	0.7		73.5	76	0.28	26	0.7 U	158	0.2	3.4	5.6	13.2	13.3	6.7	38.9	18.6	57.5
RC/WC-09	RC-09	City Sampling	12/1/2004	0-6 cm	1160653	702452	56.4		130	350		10			76.8	64	0.21	26		126	0	0.5	3.5	19.3		26.3	25.8	14.4	40.2
RC/WC-09	WC-09	Year 0 OMMP	4/8/2004	0-10 cm	1160653	702452	71.7	2.99			7 U	7 U	0.3 U	18.4	39.8	7	0.05 U	18	0.4 U	37.4	4.4		13	26		45	7.1	4	11
RC/WC-09	WC-09	City Sampling	12/1/2004	0-10 cm	1160653	702452	61.4		37	110		9			57.4	32	0.11	22		81	1.1	0.6	2	17.7		34.6	19.5	11.8	31.3
RC/WC-09	WC-9	Year 1 OMMP	5/11/2005	0-10 cm	1160653	702452	1.8	65.4									0.09												
RC/WC-09	Y2-WC09-S	Year 2 OMMP	5/15/2006	0-10 cm	1160653	702452	59.3	4.43	350	1300	9 U	9 U	0.7		70.6	66	0.18	25	0.5 U	130	0.5	3.1	7.4	21.7	20.3	6.8	25.9	14.4	40.3
RC/WC-10	RC-10	Year 0 OMMP	4/9/2004	0-2 cm	1160571	702584	68.1	3.22			7 U	7 U	0.3 U	21.9	54.7	11	0.06 U	20	0.5	43.7	5.3		11	16		48	12	7.6	20
RC/WC-10	RC-10	Year 1 OMMP	5/11/2005	0-2 cm	1160571	702584	4.7	44.5	1200	3800		20			115	159	**0.6**	32		203	2.2	2.7	3	9.2	11.1	6.6	44.9	20.1	65
RC/WC-10	Y2-RC10-S	Year 2 OMMP	5/16/2006	0-2 cm	1160571	702584	84.3	2.96	110	510	6 U	6 U	0.2 U		24.3	15	0.04 U	20	0.4 U	52	55.6	12.7	11.6	8	3.2	1.3	4.9	2.6	7.5

Table H. Head of the Thea Foss Results 2004 - 2006

Location	Sample ID	Phenol	1,3-Dichloro benzene	1,4-Dichloro benzene	1,2-Dichloro benzene	Dibenzo furan	Benzyl Alcohol	2-Methyl phenol	4-Methyl phenol	Hexachloro ethane	2,4-Dimethyl phenol	Benzoic Acid	1,2,4-Trichloro benzene	Hexachloro butadiene	N-Nitroso diphenyl amine	Hexa chloro benzene	Penta chloro phenol	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	2-Methyl naphthalene	Total LPAH	Fluoranthene	Pyrene	Benzo(a) anthracene	Chrysene
		420	170	110	50	540	73	63	670		29	650	51	11	28	22	360	2100	1300	500	540	1500	960	670	5200	2500	3300	1600	2800
OMMP Locations		UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG
RC/WC-01	RC-01																	39 U	39 U	39 U	39 U	160	39 U	39 U	160	480	360	140	260
RC/WC-01	RC-01					57 U												120	57 U	57 U	57 U	340	91	57 U	550	680	560	250	380
RC/WC-01	RC-01					220 U												260	220 U	220 U	220 U	**1700**	380	220 U	2300	**4300**	**4000**	1200	2000
RC/WC-01	Y2-RC01-S					160 U												160 U	160 U	160 U	100 J	**1600**	230	160 U	1900 J	**3900**	2200	1100	1800
RC/WC-01	WC-01		39 U	39 U	39 U								39 U					39 U	39 U	39 U	39 U	85	39 U	39 U	85	250	140	75	130
RC/WC-01	WC-01					59 U												59 U	59 U	59 U	59 U	220	59 U	59 U	220	490	390	180	290
RC/WC-01	Y2-WC01-S	**650**	190 U	190 U	190 U	190 U	190 U	190 U	650	190 U	190 U	1900 U	190 U	3.5 U	190 U	3.5 U	960 U	190 U	190 U	190 U	190 U	810	160 J	190 U	970 J	2100	1400	670	1100
WC-01B/R-01B	Y2-WC01B-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	1 U	20 U	1 U	98 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
RC/WC-02	RC-02																	47	20 U	22	20 U	99	29	20 U	200	230	160	70	100
RC/WC-02	RC-02					78												420	74	220	190	1300	490	150	2800	**3900**	**3800**	1300	2000
RC/WC-02	RC-2A (Dup of RC-2)					230 U												530	230 U	250	230 U	**1600**	570	230 U	3000	**4600**	**4600**	**1600**	2300
RC/WC-02	Y2-RC02-S					160 U												190	160 U	140 J	150 J	**1700**	370	160 U	2600 J	**5300**	**3500**	**1600**	2700
RC/WC-02	RC-02					120 U												140	120 U	120 U	120 U	650	210	120 U	1000	1500	1100	540	790
RC/WC-02	WC-02		39 U	39 U	39 U								39 U					39 U	39 U	39 U	39 U	70	39 U	39 U	70	150	120	54	78
RC/WC-02	WC-02 (City)					11.8												52.7	18 J	34.5	31.7	230 J	92.9	22.3	480	820	441	183	265 B
RC/WC-02	WC-02					39												140	29 U	82	70	650	190	51	1200	1700	1600	540	780
RC/WC-02	Y2-WC02-S	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	1200 U	120 U	3.5 U	120 U	3.5 U	580 U	210	60 J	130	110 J	1400	360	120 U	2300 J	**4200**	3100	1200	2200
RC/WC-03	RC-03																	130	20 U	67	41	240	73	35	590	500	360	150	220
RC/WC-03	RC-03					51												320	50	160	120	700	290	100	1700	2000	2000	650	920
RC/WC-03	Y2-RC03-S					120 U												150	120 U	120 U	120 U	820	210	120 U	1200	2400	1700	790	1200
RC/WC-03	WC-03		40 U	40 U	40 U								40 U					78	40 U	41	40 U	85	40 U	40 U	200	120	110	45	60
RC/WC-03	WC-03 (City)					9.1 J												65.4	20.9 J	33.4	28	152 J	62.5	19.9	380	356	393	121	170
RC/WC-03	Y2-WC03-S	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	730 U	73 U	3.5 U	73 U	3.5 U	370 U	99	73 U	73 U	73 U	440	140	73 U	680	1200	920	400	570
RC/WC-03	RC-03					99 U												120	99 U	99 U	99 U	270	120	99 U	510	590	520	230	300
RC/WC-04/R-02	RC-04																	44	19 U	24	19 U	98	25	19 U	190	180	150	56	82
RC/WC-04/R-02	RC-04					120												980	140	480	350	**1600**	860	320	4700	**4500**	**4600**	**1600**	2100
RC/WC-04/R-02	Y2-RC04-S					320 U												320 U	320 U	190 J	190 J	1400	270 J	320 U	2100 J	**2900**	2600	960	1500
RC/WC-04/R-02	RC-04					120 U												220	120 U	130	120 U	600	240	120 U	1200	1500	940	480	660
RC/WC-04/R-02	WC-04		20 U	20 U	20 U								20 U					78	20 U	51	26	120	40	21	340	160	120	54	72
RC/WC-04/R-02	WC-04-Duplicate		20 U	20 U	20 U								20 U					92	20 U	61	30	140	45	24	390	190	140	64	81
RC/WC-04/R-02	S-34 (Dup of WC-04)					98 U												170	98 U	110	98 U	440	190	98 U	910	1100	730	360	490
RC/WC-04/R-02	WC-04					140 U												160	140 U	140 U	140 U	400	170	140 U	730	950	600	320	440
RC/WC-04/R-02	WC-04					36 U												170	36 U	86	61	400	180	57	950	1200	1200	390	540
RC/WC-04/R-02	Y2-WC04-S	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	1000 U	100 U	3.5 U	100 U	3.5 U	520 U	190	100 U	120	120	840	220	100 U	1500	2400	1900	780	1100
RC/WC-04/R-02	WCBU-4A		19 U	19 U	19 U	19 U							19 U					19 U	19 U	19 U	19 U	33	19 U	19 U	33	54	50	20	27
RC/WC-04/R-02	WCBU-4B		19 U	19 U	19 U	19 U							19 U					19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
RC/WC-04/R-02	WCBU-4C		19 U	19 U	19 U	19 U							19 U					19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
RC/WC-04/R-02	Y2-WC04-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	1 U	20 U	1 U	98 U	20 U	20 U	20 U	20 U	36	20 U	20 U	36	66	68	25	34
RC/WC-05	RC-05																	34	20 U	20 U	20 U	40	20 U	20 U	74	73	49	22	30
RC/WC-05	RC-05-Duplicate																	36	20 U	20 U	20 U	47	20 U	20 U	83	72	53	23	30
RC/WC-05	RC-05					130												1000	170	**530**	360	**1700**	**1000**	350	5100	**4500**	**4900**	**1700**	2000
RC/WC-05	Y2-RC05-S					150 U												150 U	150 U	150 U	150 U	690	220	150 U	910	1700	1600	690	1100
RC/WC-05	WC-05		20 U	20 U	20 U								20 U					25	20 U	20 U	20 U	39	20 U	20 U	64	63	50	20 U	24
RC/WC-05	WC-05					120 U												180	120 U	140	120 U	580	260	120 U	1200	1100	890	420	550
RC/WC-05	WC-05					41 U												280	49	140	100	550	300	95	1500	1600	1700	550	690
RC/WC-05	Y2-WC05-S	99 U	99 U	99 U	99 U	99 U	99 U	99 U	99 U	99 U	99 U	990 U	99 U	3.5 U	99 U	3.5 U	500 U	200	99 U	140	130	**1500**	310	99 U	2300	**2700**	2400	760	1800
RC/WC-05	RC-05					110 U												110	110 U	110 U	110 U	320	150	110 U	580	580	500	230	300
RC/WC-05	WCBU-5A		19 U	19 U	19 U	19 U							19 U					19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
RC/WC-05	Y2-WC05-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	1 U	20 U	1 U	100 U	20 U	20 U	20 U	20 U	11 J	20 U	20 U	11 J	27	32	12 J	15 J
RC/WC-06	RC-06																	54	39 U	39 U	39 U	110	39 U	39 U	160	230	160	75	110
RC/WC-06	RC-06					76												650	100	260	200	1100	540	220	3100	**3100**	**3300**	1100	1400
RC/WC-06	Y2-RC06-S					87 U												87 U	87 U	87 U	87 U	610	130	87 U	740	1400	1300	540	820
RC/WC-06	Y2-RC15-S					86 U												86 U	86 U	86 U	86 U	600	140	86 U	740	1300	1300	510	800
RC/WC-06	RC-06					130 U												430	130 U	220	130	740	320	130 U	1800	1200	930	500	630
RC/WC-06	WC-06		20 U	20 U	20 U								20 U					20 U	20 U	20 U	20 U	33	20 U	20 U	33	78	67	24	38
RC/WC-06	Y2-WC06-S	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	600 U	60 U	3.4 U	60 U	3.4 U	300 U	62	60 U	60 U	60 U	290	85	60 U	440	760	580	270	390
RC/WC-06	WCBU-6A		20 U	20 U	20 U	20 U							20 U					20 U	20 U	20 U	20 U	30	20 U	20 U	30	41	30	20 U	20 U
RC/WC-06	WCBU-6B		20 U	20 U	20 U	20 U							20 U					20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
RC/WC-06	Y2-WC06-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	1 U	20 U	1 U	98 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	21	23	20 U	10 J
RC/WC-07	RC-07																	19 U	19 U	19 U	19 U	26	19 U	19 U	26	55	39	20	32
RC/WC-07	RC-07					69												490	72	220	160	880	400	160	2400	2400	2400	810	1000
RC/WC-07	Y2-RC07-S					120 U												120 J	120 U	110 J	100 J	800	220	120 U	1400 J	2200	1600	760	1200
RC/WC-07	RC-07					180 U												860	180 U	**530**	320	**1800**	760	280	4600	**3100**	2200	1300	1600
RC/WC-07	WC-07		19 U	19 U	19 U								19 U					19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
RC/WC-07	WC-07					62 U												120	62 U	78	62 U	270	120	62 U	590	490	380	200	280
RC/WC-07	WC-07					25 U												120	25 U	46	29	180	87	36	500	700	660	200	250
RC/WC-07	Y2-WC07-S	83 U	83 U	83 U	83 U	83 U	83 U	83 U	83 U	83 U	83 U	830 U	83 U	3.5 U	83 U	3.5 U	410 U	90	83 U	54 J	83 U	310	110	83 U	560 J	880	700	320	450
RC/WC-08/R-03	RC-08																	19 U	19 U	19 U	19 U	28	19 U	19 U	28	50	37	20	28
RC/WC-08/R-03	RC-08					120 U												960	150	430	300	**1600**	890	310	4600	**3800**	**4600**	**1600**	1700
RC/WC-08/R-03	Y2-RC08-S					92 U												330	84 J	170	130	950	310	120	2100 J	2400	2000	930	1300
RC/WC-08/R-03	RC-08					150 U												990	200	**710**	420	**1800**	**1000**	360	**5500**	**3300**	2800	1300	1500
RC/WC-08/R-03	WC-08		19 U	19 U	19 U								19 U					19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	26	19 U	19 U	19 U
RC/WC-08/R-03	WC-8																	171	36.2	64.1	43.9	226	165	51.9	760	570	645	217	208
RC/WC-08/R-03	Y2-WC08-S	94 U	94 U	94 U	94 U	94 U	94 U	94 U	94 U	94 U	94 U	940 U	94 U	3.5 U	94 U	3.5 U	470 U	290	64 J	150	110	710	270	99	1700 J	1600	1700	700	890
RC/WC-09	RC-09																	56	38 U	38 U	38 U	74	38 U	38 U	130	120	110	51	69
RC/WC-09	RC-09					120 U												1200	130	460	320	**1600**	940	380	5000	**3900**	**4700**	**1700**	1800
RC/WC-09	Y2-RC09-S					110 U												340	110 U	180	110 U	940	330	120	1900	2000	2100	950	1300
RC/WC-09	RC-09					120 U												580	140	380	240	1100	660	200	3300	**2500**	2000	950	1100
RC/WC-09	WC-09		20 U	20 U	20 U								20 U					21	20 U	20 U	20 U	36	20 U	20 U	57	67	53	22	30
RC/WC-09	WC-09					89 U												190	89 U	140	89 U	440	250	89 U	1000	1000	690	360	420
RC/WC-09	WC-9																	277	65.3	114	83.4	382	319	89.8	1300	717	1050	323	276
RC/WC-09	Y2-WC09-S	90 U	90 U	90 U	90 U	90 U	90 U	90 U	90 U	90 U	90 U	900 U	90 U	3.5 U	90 U	3.5	450 U	300	90 U	170	120	700	280	100	1700	1200	1600	660	800
RC/WC-10	RC-10																	44	19 U	22	19 U	67	26	19 U	160	91	74	36	44
RC/WC-10	RC-10					180												2000	310	**1000**	**640**	**3000**	**1900**	**720**	**9600**	**5300**	**6500**	**2500**	2600
RC/WC-10	Y2-RC10-S					26 U												26 U	26 U	26 U	26 U	65	14 J	26 U	79 J	160	130	62	94

Table H. Head of the Thea Foss Results 2004 - 2006

Location	Sample ID	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(b+k) fluoranthenes	Benzo(a) pyrene	Indeno (1,2,3-cd) pyrene	Dibenz(a,h) anthracene	Benzo (g,h,i) perylene	Total HPAH	Dimethyl phthalate	Diethyl phthalate	Di-n- Butyl phthalate	Butyl benzyl phthalate	bis(2- Ethylhexyl) phthalate	Di-n- Octyl phthalate	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCBs	Fines Thickness
				3600	1600	690	230	720	17000	160	200	1400	900	1300	6200	16	9	34								300	
OMMP Locations		UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	CM
RC/WC-01	RC-01	320	220	540	170	90	39 U	87	2700	39 U	39 U	48	91	**1300**	45	0.44	0.38 U	2.3 U	3.8 U	7.6 U	3.8 U	3.8 U	3.8 U	5.7	3.8 U	5.7	N/A
RC/WC-01	RC-01	280	280	560	320	230	57 U	180	3200	57 U	57 U	57 U	120	**1300 B**	57 U	2 U	2 U	2 U	20 U	20 U	20 U	20 U	20 U	20 U	39 U	39 U	1
RC/WC-01	RC-01	2400	2000	**4400**	**1600**	540	220 U	530	**19000**	220 U	220 U	410	520	**8200**	330	4.4 J	9.4 U	15 J	20 U	20 U	20 U	20 U	36 J	92 J	72	200 J	1.5
RC/WC-01	Y2-RC01-S	1600	1700	3300	1400	410	160 U	480	15000					**8300**					9.9 U	9.9 U	20 U	9.9 U	20 U	40	55 J	95 J	N/A
RC/WC-01	WC-01	120	85	210	79	53	39 U	50	1200	39 U	39 U	39 U	39 U	550	41	0.39 U	0.39 U	0.39 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.8 U	N/A
RC/WC-01	WC-01	220	220	440	240	160	59 U	130	2300	59 U	59 U	59 U	70	810 B	59 U	2 U	2 U	2 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	1
RC/WC-01	Y2-WC01-S	1200	660	1900	690	260	190 U	330	8400	190 U	190 U	160 J	180 J	**4300**	420	7 U	7 U	7 U	9.9 U	9.9 U	15 U	9.9 U	9.9 U	28	44 J	72 J	N/A
WC-01B/R-01B	Y2-WC01B-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20	20 U	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	19
RC/WC-02	RC-02	100	79	180	64	27	20 U	24	1000	20 U	20 U	20 U	29	470	120	0.68	0.39 U	1.3 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	6.3	3.9 U	6.3	N/A
RC/WC-02	RC-02	1700	1700	3400	**1600**	600	190	600	**17000**	67 U	67 U	320	540	**7300**	230	9.1 U	4.5 J	18 U	20 U	20 U	20 U	20 U	50 J	130 J	120	**300 J**	9
RC/WC-02	RC-2A (Dup of RC-2)	2300	1900	**4200**	**1900**	660	230 U	640	**21000**	230 U	230 U	470	580	**13000**	320	10 J	15 U	27 J	59 U	59 U	59 U	59 U	61	180 J	110	**350 J**	9
RC/WC-02	Y2-RC02-S	2700	2300	**5000**	**2100**	620	100 J	**790**	**22000 J**					**8700**					9.8 U	9.8 U	9.8 U	9.8 U	23	77	69	170	16
RC/WC-02	RC-02	670	670	1300	680	340	120 U	280	6600	120 U	120 U	120 U	270	**2700 B**	120 U	2.4	1.9 U	3.7 U	19 U	19 U	19 U	19 U	19 U	30	23	53	8
RC/WC-02	WC-02	74	62	140	50	39 U	39 U	39 U	720	39 U	39 U	39 U	39 U	330	39 U	0.64	0.39 U	1.1 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.8 U	N/A
RC/WC-02	WC-02 (City)			340	194	106	39.3	130	2500	3.7 J	6.7 J	58.5 J	4	371 J	54	5.5	3.47 J	12.5	5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	34.5	31.9	66	8
RC/WC-02	WC-02	710	710	1400	670	250	89	240	7300	29 U	29 U	130	200	**2700**	70	5.1 J	2 U	5 U	20 U	20 U	20 U	20 U	25 J	57 J	43	130 J	9
RC/WC-02	Y2-WC02-S	2200	1800	**4000**	**1600**	480	81 J	620	**17000 J**	120 U	120 U	170 J	380	**7700**	190	7 U	7 U	12 U	9.8 U	9.8 U	9.8 U	9.8 U	27	69	64	160	16
RC/WC-03	RC-03	190	210	400	140	56	20 U	53	2300	20 U	20 U	19 J	62	1100	58	0.78	1.1 U	1.4 U	3.9 U	7.9 U	3.9 U	3.9 U	3.9 U	7.2	3.9 U	7.2	N/A
RC/WC-03	RC-03	830	830	1700	810	240	83	240	8600	44 U	44 U	150	240	**3200**	130	7.3 J	8.4 U	18 U	20 U	20 U	20 U	20 U	34 J	71 J	73 J	180 J	10
RC/WC-03	Y2-RC03-S	1100	1000	2100	970	410	120 U	520	10000					**5100**					9.8 U	9.8 U	9.8 U	9.8 U	32 J	58	44	130 J	11
RC/WC-03	WC-03	58	42	100	40 U	40 U	40 U	40 U	540	40 U	40 U	40 U	40 U	240	40 U	0.68	0.4 U	1.1 U	4 U	7.9 U	4 U	4 U	4 U	5.7	4 U	5.7	N/A
RC/WC-03	WC-03 (City)			240	125	89.4	34.9	92.9	1600	4.5 UJ	8.2 UJ	35.7 B	4.9 U	275 B	4.2 U	3.74 J	3.72 J	12.2	5.6 U	5.6 U	5.6 U	5.6 U	5.6 U	30.3	25.5	56 J	12
RC/WC-03	Y2-WC03-S	530	480	1000	480	250	73 U	320	5200	73 U	73 U	200 J	130	**2300**	100	7 U	7 U	7 U	10 U	10 U	10 U	10 U	24	47	36	110	11
RC/WC-03	RC-03	250	250	500	260	120	99 U	99 U	2500	99 U	99 U	99 U	99 U	940 B	99 U	2 U	2 U	2 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	12
RC/WC-04/R-02	RC-04	76	74	150	56	23	19 U	21	870	19 U	19 U	19 U	27	360	19 U	0.75	0.39 U	1.3 U	3.9 U	7.7 U	3.9 U	3.9 U	3.9 U	5.7	3.9 U	5.7	N/A
RC/WC-04/R-02	RC-04	1900	1900	**3800**	**1900**	550	200	580	**20000**	72 U	72 U	250	520	**6700**	250	5.8	8.1 U	11	20 U	20 U	20 U	20 U	37	71 J	64	170 J	13
RC/WC-04/R-02	Y2-RC04-S	1600	920	2500	1100	670	320 U	**910**	13000					**5900**					10 U	10 U	10 U	10 U	20	46	42	110	9 to 17
RC/WC-04/R-02	RC-04	600	600	1200	610	260	120 U	220	5900	120 U	120 U	120 U	180	**1800 B**	120 U	1.4 J	2 U	2 U	20 U	20 U	20 U	20 U	20 U	22 J	20 U	22	9
RC/WC-04/R-02	WC-04	54	66	120	47	20 U	20 U	20 U	690	20 U	20 U	20 U	20 U	260	20 U	0.77	0.39 U	0.93 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	5.4	3.9 U	5.4	N/A
RC/WC-04/R-02	WC-04-Duplicate	70	66	140	55	20 U	20 U	20 U	800	20 U	20 U	20 U	20 U	290	25	0.89	0.4 U	1.1 U	4 U	8 U	4 U	4 U	4 U	5.6	4 U	5.6	N/A
RC/WC-04/R-02	S-34 (Dup of WC-04)	450	450	900	440	200	98 U	160	4400	98 U	98 U	98 U	140	**1300 B**	98 U	1.5 J	2 U	2 U	20 U	20 U	20 U	20 U	20 U	21 J	20 U	21	9
RC/WC-04/R-02	WC-04	400	400	800	400	170	140 U	140	3800	140 U	140 U	140 U	140 U	1000 B	140 U	2.1	2 U	20	20 U	20 U	20 U	20 U	20 U	22 J	20 U	22	9
RC/WC-04/R-02	WC-04	580	510	1100	490	150	50	140	5300	36 U	36 U	92	160	**1700**	70	5.7 U	2 U	11 J	20 U	20 U	20 U	20 U	21 J	39 J	29	89 J	13
RC/WC-04/R-02	Y2-WC04-S	1400	640	2000	860	300	63 J	350	9800 J	100 U	100 U	290	200	**4600**	180	7 U	7 U	7 U	9.8 U	9.8 U	9.8 U	9.8 U	17	36	33	86	9 to 17
RC/WC-04/R-02	WCBU-4A	22	19 J	41 J	20	19 U	19 U	19 U	190	19 U	19 U	19 U	23	73	19 U	0.38 U	0.38 U	0.38 U	3.8 U	7.6 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	7.6 U	N/A
RC/WC-04/R-02	WCBU-4B	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	0.39 U	0.39 U	0.39 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.8 U	N/A
RC/WC-04/R-02	WCBU-4C	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	0.39 U	0.39 U	0.39 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.8 U	N/A
RC/WC-04/R-02	Y2-WC04-C3	38	19 J	57 J	26	16 J	20 U	22	310 J	20 U	20 U	14 J	20 U	120	20 U	2 U	2 U	2 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	N/A
RC/WC-05	RC-05	23	19 J	42	20	20 U	20 U	20 U	260	20 U	20 U	20 U	20 U	110	20 U	0.66	0.39 U	0.39 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	4.3	3.9 U	4.3	N/A
RC/WC-05	RC-05-Duplicate	20	18 J	38	20 J	20 U	20 U	20 U	240	20 U	20 U	20 U	20 U	100	20 U	0.39 U	0.39 U	0.39 U	3.9 U	7.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.9 U	N/A
RC/WC-05	RC-05	1800	1800	**3600**	**1900**	490	180	510	**20000**	75 U	75 U	220	480	**5600**	240	12 J	10 U	19 J	20 U	20 U	20 U	20 U	53 J	120 J	100 J	270 J	10
RC/WC-05	Y2-RC05-S	820	1100	1900	840	240	150 U	280	8400					**5400**					9.8 U	9.8 U	9.8 U	9.8 U	29 J	60	53	140 J	12
RC/WC-05	WC-05	21	20	41	20 U	20 U	20 U	20 U	220	20 U	20 U	20 U	20 U	76	20 U	0.39 U	0.39 U	0.5 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.8 U	N/A
RC/WC-05	WC-05	350	350	700	490	340	120 U	290	4800	120 U	120 U	120 U	230	**1300 B**	120 U	2.4	2 U	2 U	20 U	20 U	20 U	20 U	20 U	24	20 U	24	11
RC/WC-05	WC-05	640	640	1300	650	180	56	170	6900	41 U	41 U	92	170	**2200**	92	6.7 U	8.8 U	12	20 U	20 U	20 U	20 U	20 U	47 J	37	84 J	10
RC/WC-05	Y2-WC05-S	1200	760	2000	810	230	99 U	280	11000	99 U	99 U	240 J	160 J	**3600**	150 J	7 U	7 U	7 U	9.8 U	9.8 U	9.8 U	9.8 U	31 J	56	48	140 J	12
RC/WC-05	RC-05	200	200	400	280	190	110 U	150	2600	110 U	110 U	110 U	120	940 B	110 U	2 U	2 U	2 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	11
RC/WC-05	WCBU-5A	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	46	19 U	0.39 U	0.39 U	0.39 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.8 U	N/A
RC/WC-05	Y2-WC05-C3	19 J	20 U	19 J	11 J	20 U	20 U	10 J	130 J	20 U	20 U	11 J	20 U	63	20 U	2 U	2 U	2 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U	N/A
RC/WC-06	RC-06	91	69	160	68	44	39 U	43	1100	39 U	39 U	39 U	38 J	500	38 J	0.65	0.39 U	1.7 U	3.9 U	7.9 U	3.9 U	3.9 U	3.9 U	9.2	3.9 U	9.2	N/A
RC/WC-06	RC-06	1300	1300	2600	1300	340	120	350	14000	67 U	67 U	210	350	**4400**	150	8 J	7.3 U	12 J	20 U	20 U	20 U	20 U	40 J	92 J	60	190 J	4.5
RC/WC-06	Y2-RC06-S	750	780	1500	660	220	87 U	280	6800					**3900**					9.8 U	9.8 U	9.8 U	9.8 U	26 J	49	38	110 J	1 to 10
RC/WC-06	Y2-RC15-S	900	590	1500	640	210	86 U	240	6500					**3800**					9.9 U	9.9 U	9.9 U	9.9 U	26 J	42	37	110 J	1 to 10
RC/WC-06	RC-06	510	510	1000	610	260	130 U	220	5400	130 U	130 U	130 U	190	**1700 B**	130 U	2.9	1.9 U	1.9 U	19 U	19 U	19 U	19 U	19 U	34	24	58	5
RC/WC-06	WC-06	28	32	60	27	18 J	20 U	18 J	350	20 U	20 U	20 U	20 U	160	20 U	0.4 U	0.4 U	0.55 U	4 U	8 U	4 U	4 U	4 U	4 U	4 U	8 U	N/A
RC/WC-06	Y2-WC06-S	400	280	680	310	150	60 U	200	3300	60 U	60 U	210 J	110	**1600**	60 U	7 U	7 U	7 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	25	19	44	1 to 10
RC/WC-06	WCBU-6A	20 U	20 U	20 U	20 U	20 U	20 U	20 U	71	20 U	20 U	20 U	20 U	92	20 U	0.4 U	0.4 U	0.4 U	4 U	8 U	4 U	4 U	4 U	4 U	4 U	8 U	N/A
RC/WC-06	WCBU-6B	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	63	20 U	0.4 U	0.4 U	0.4 U	4 U	8 U	4 U	4 U	4 U	4 U	4 U	8 U	N/A
RC/WC-06	Y2-WC06-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	54 J	20 U	20 U	10 J	20 U	29	20 U	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	N/A
RC/WC-07	RC-07	25	27	52	20	19 U	19 U	19 U	270	19 U	19 U	19 U	19 U	180	19	0.38 U	0.38 U	0.38 U	3.8 U	7.6 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	7.6 U	N/A
RC/WC-07	RC-07	840	810	1700	880	290	88 J	300	9800	42 U	42 U	200	270	**4400**	120	4.8 J	5.8 U	7.4 U	19 U	19 U	19 U	19 U	25	46 J	49	120 J	3
RC/WC-07	Y2-RC07-S	890	890	1800	780	450	120 U	610	9400					**5400**					9.9 U	9.9 U	20 U	9.9 U	20 U	43	54 J	97 J	6
RC/WC-07	RC-07	1300	1300	2600	**1600**	650	180 U	550	14000	180 U	180 U	180 U	420	**4500 B**	180 U	3	2 U	2 U	20 U	20 U	20 U	20 U	20 U	31	23	54	4
RC/WC-07	WC-07	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	0.39 U	0.39 U	0.39 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.8 U	N/A
RC/WC-07	WC-07	200	200	400	240	120	62 U	99	2200	62 U	62 U	62 U	100	**3800 B**	62 U	1.7 J	1.9 U	1.9 U	19 U	19 U	19 U	19 U	19 U	21 J	19 U	21	4
RC/WC-07	WC-07	220	280	500	210	52	25 U	51	2600	25 U	25 U	62	150	730	30	2 U	2 U	5 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	2
RC/WC-07	Y2-WC07-S	500	320	820	370	110	83 U	130	3800	83 U	83 U	45 J	120	**1800**	53 J	7 U	7 U	7 U	9.8 U	9.8 U	20 U	9.8 U	20 U	38	50 J	88 J	6
RC/WC-08/R-03	RC-08	20	19 J	39	19	19 U	19 U	19 U	210	19 U	19 U	19 U	19 U	110	19 U	0.39 U	0.39 U	0.39 U	3.9 U	7.7 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.7 U	N/A
RC/WC-08/R-03	RC-08	1700	1000	2700	**1700**	530	170	510	**17000**	120 U	120 U	160	370	**3500**	130	11 J	9 U	14 U	20 U	20 U	20 U	20 U	45	75 J	68	190 J	4
RC/WC-08/R-03	Y2-RC08-S	1600	1000	2600	1100	330	130	410	11000					**5400**					9.8 U	9.8 U	9.8 U	9.8 U	22	50	40	110	7
RC/WC-08/R-03	RC-08	1300	1300	2600	1500	600	150 U	500	14000	150 U	150 U	150 U	400	**3100 B**	150 U	3.5	2 U	2 U	19 U	19 U	19 U	19 U	25	32	21 J	78	5
RC/WC-08/R-03	WC-08	19 U	19 U	19 U	19 U	19 U	19 U	19 U	26	19 U	19 U	19 U	19 U	49	19 U	0.38 U	0.38 U	0.38 U	3.8 U	7.6 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	7.6 U	N/A
RC/WC-08/R-03	WC-8			300	237	115	34.1	129	2500					220		5.68	4.28		39.4 U	39.4 U	39.4 U	39.4 U	39.4 U	21.6 U	67.4 J	67 J	4
RC/WC-08/R-03	Y2-WC08-S	1000	790	1800	850	230	94 U	280	8000	94 U	94 U	94 U	170	**3400**	130	7 U	7 U	7 U	9.8 U	9.8 U	9.8 U	9.8 U	18	47	46	110	7
RC/WC-09	RC-09	44	47	91	45	38 U	38 U	38 U	580	38 U	38 U	38 U	38 U	230	38 U	0.88	0.38 U	1.7 U	3.8 U	7.6 U	3.8 U	3.8 U	3.8 U	6.5	3.8 U	6.5	N/A
RC/WC-09	RC-09	2600	2600	**5200**	**1800**	600	190	600	**20000**	**350**	120 U	180	360	**3500**	170	14 J	11 U	18 U	20 U	20 U	20 U	20 U	46	90 J	83	220 J	5.5
RC/WC-09	Y2-RC09-S	1600	940	2500	1200	270	110 U	320	11000					**4700**					9.8 U	9.8 U	9.8 U	9.8 U	46 J	94	86	230 J	7
RC/WC-09	RC-09	980	980	2000	1100	480	120 U	390	10000	120 U	120 U	120 U	290	**2600 B**	120 U	3.9	1.9 U	1.9 U	19 U	19 U	19 U	19 U	25	42	27	94	6
RC/WC-09	WC-09	34	20 U	34	21	20 U	20 U	20 U	260	20 U	20 U	20 U	20 U	120	20 U	0.39 U	0.39 U	0.39 U	3.9 U	7.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.9 U	N/A
RC/WC-09	WC-09	380	380	760	410	180	89 U	140	4000	89 U	89 U	89 U	130	900 B	89 U	2 U	2 U	2 U	20 U	20 U	20 U	20 U	18 J	28	18 J	64	6
RC/WC-09	WC-9			520	386	198	51.8 J	206	3700					289		1.12 J	1.7 J		37.9 U	37.9 U	37.9 U	37.9 U	37.9 U	20.8 U	107 J	110 J	5.5
RC/WC-09	Y2-WC09-S	840	760	1600	800	200	90 U	250	7100	90 U	90 U	340 J	210 J	**4700**	120 J	7 U	7 U	7 U	9.7 U	9.7 U	9.7 U	9.7 U	32 J	56	48	140 J	7
RC/WC-10	RC-10	28	29	57	33	19 U	19 U	19 U	390	19 U	19 U	19 U	19 U	80	19 U	0.55	0.39 U	0.39 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.8 U	N/A
RC/WC-10	RC-10	2300	1800	**4100**	**2800**	670	**240**	620	**25000**	150 U	150 U	250	390	**3600**	150 U	**17 J**	12 U	20 U	20 U	20 U	20 U	20 U	52	110 J	110	270 J	5
RC/WC-10	Y2-RC10-S	97	56	150	59	45	26 U	61	760					420					9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	11 J	17 J	28 J	0.5

Table H. Head of the Thea Foss Results 2004 - 2006

Location	Sample ID	Monitoring Type	Sample Date	Depth Below Mudline	Easting	Northing	Total Solids	TOC	TPH Diesel	TPH Motor Oil	Sb	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt	Clay	Percent Fines
		SQO									150	57	5.1		390	450	0.59	140	6.1	410									
OMMP Locations		Units					Percent	Percent	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	%	%	%	%	%	%	%	%	%
RC/WC-10	RC-10	City Sampling	12/1/2004	0-3 cm	1160571	702584	49.6		520	1700		10			95.3	123	0.48	27		182	6.9	1.8	4.7	15.1		5.6	35.6	16.3	51.9
RC/WC-10	WC-10	Year 0 OMMP	4/9/2004	0-10 cm	1160571	702584	79.4	1.4			6 U	6 U	0.3 U	19.1	35.9	4	0.06 U	17	0.4 U	34.5	7.9		18	29		38	4.3	2.8	7.1
RC/WC-10	WC-10	City Sampling	12/1/2004	0-10 cm	1160571	702584	78.3		110	250		7			48.2	27	0.13	19		66	10.5	6.6	10.7	26.3		5.6	9.7	5.3	15
RC/WC-10	WC-10 (City)	City Sampling	12/1/2004	0-10 cm	1160571	702584	74.4	1.4								30.8	0.06			54.9 B									
RC/WC-10	Y2-WC10-S	Year 2 OMMP	5/16/2006	0-10 cm	1160571	702584	84.1	1.99	68	290	6 U	6 U	0.2 U		20.6	12	0.05 U	18	0.4 U	44	47.4	11.5	15.5	15.4	4.6	1	2.9	1.8	4.7
RC/WC-10	WCBU-10A	Year 0 OMMP	4/7/2004	0-1 ft	1160571	702584	88.7	0.402			5 U	5 U	0.2 U	17.4	31.2	3	0.04 U	17	0.3 U	33.7	11		24	31		32	1.5	0.6	2.1
RC/WC-10	WCBU-10A-Dup	Year 0 OMMP	4/7/2004	0-1 ft	1160571	702584	88.3	0.323			6 U	6 U	0.2 U	16.1	31.2	3	0.04 U	17	0.3 U	31	14		23	31		31	1.1	0.7	1.8
RC/WC-10	WCBU-10B	Year 0 OMMP	4/7/2004	1-2 ft	1160571	702584	94.7	0.145			5 U	5 U	0.2 U	20.2	46.7	2	0.05 U	20	0.3 U	35.6	34		35	20		10	0.2	0.6	0.8
RC/WC-10	WCBU-10C	Year 0 OMMP	4/7/2004	2-3.3 ft	1160571	702584	93.1	0.299			5 U	5 U	0.2 U	13.1	21.1	2 U	0.04 U	12	0.3 U	19.9	35		40	17		7.2	0.4	0.9	1.3
RC/WC-10	Y2-WC10-C3	Year 2 OMMP	5/17/2006	1-3 ft	1160571	702584	87.4	0.225			5 U	5 U	0.2 U		37.8	2	0.05 U	20	0.3 U	33.7	26.2	13.7	19.4	25.9	12.5	1.3	1	0	1
RC/WC-11/R-04	RC-11	Year 0 OMMP	4/8/2004	0-2 cm	1160665	702725	67.6	2.95			8 U	20	0.5	25.2	132	35	0.13	28	0.5 U	82.8	48		17	0.7		10	15	9	24
RC/WC-11/R-04	RC-11(pre-City dredge)-CITY	City (pre-City dredge)	8/30/2004	0-2 cm	1160665	702725	58.9	1.6								45.7	0.191			99.6									
RC/WC-11/R-04	RC-11(pre-City dredge)-UTL	Utilities' (pre-City dredge)	8/30/2004	0-2 cm	1160665	702725	71.3					18			127	30	0.1	22		86.3									
RC/WC-11/R-04	RC-11(post-City dredge)-CITY	City (post-City dredge)	9/18/2004	0-2 cm	1160665	702725	39.1	3.2								160	**0.828**			205									
RC/WC-11/R-04	RC-11(post-City dredge)-UTL	Utilities' (post-City dredge)	9/18/2004	0-2 cm	1160665	702725	34.4					20			168	238	**0.8**	37		280									
RC/WC-11/R-04	RC-11	Year 1 OMMP	5/11/2005	0-2 cm	1160665	702725	4.52	41.8	2200	5700		20			132	178	**0.84**	35		231	0.2	0.8	2	3.5	6.2	8.1	54.6	24.6	79.2
RC/WC-11/R-04	Y2-RC11-S	Year 2 OMMP	5/12/2006	0-2 cm	1160665	702725	84.9	4.32	140	660	6 U	6 U	0.2 U		25.3	13	0.06 U	18	0.4 U	56.9	59.6	10.4	10.7	7.1	2.4	1	5.7	3	8.7
RC/WC-11/R-04	WC-11	Year 0 OMMP	4/8/2004	0-10 cm	1160665	702725	84.2	2.07			6 U	16	0.2 U	21.5	168	14	0.05	24	0.4 U	60.5	57		18	4.5		7.7	8.6	4.4	13
RC/WC-11/R-04	WC-11(pre-City dredge)-CITY	City (pre-City dredge)	8/20/2004	0-10 cm	1160665	702725	66.3	3.6								43.7	0.147			90.3									
RC/WC-11/R-04	WC-11(post-City dredge)-CITY	City (post-City dredge)	9/18/2004	0-10 cm	1160665	702725	54	2.8								167	0.428			239									
RC/WC-11/R-04	WC-11 (Utilities' core)	City Sampling	11/22/2004	0-10 cm	1160665	702725	60.4		190	545		15			139	91	0.36	25		135	36.3	6	5.4	7.2		7.1	20.3	12.4	32.7
RC/WC-11/R-04	WC-11 (City)	City Sampling	11/30/2004	0-10 cm	1160665	702725	59.6	4.8								158	0.24			168 B									
RC/WC-11/R-04	WC-11	Year 1 OMMP	5/11/2005	0-10 cm	1160665	702725	5.84	42.9	2100	5300		20			145	212	**0.7**	35		257	1	0.8	2.2	4.4	6.8	7.8	52.5	24.4	76.9
RC/WC-11/R-04	Y2-WC11-S	Year 2 OMMP	5/12/2006	0-10 cm	1160665	702725	86.1	3.64	130	580	6 U	6 U	0.2 U		17.9	11	0.06 U	16	0.4 U	44.2	49.4	15.4	14.4	9.4	2.6	1	5.5	2.6	8.1
RC/WC-11/R-04	Y2-WC15-S	Year 2 OMMP	5/12/2006	0-10 cm	1160665	702725	86.3	2.86	140	570	6 U	6 U	0.2 U		20.5	11	0.05	20	0.4 U	41.6	53.7	13.3	14.1	8.3	2.3	0.9	5	2.3	7.3
RC/WC-12	RC-12	Year 0 OMMP	4/9/2004	0-2 cm	1160502	702722	88.4	0.365			5 U	5 U	0.2 U	27.3	48.5	4	0.05 U	22	0.3 U	43.9	29		47	17		5	0.8	1.1	1.9
RC/WC-12	RC-12	Year 1 OMMP	5/11/2005	0-2 cm	1160502	702722	4.81	43.8	1600	4400		20			121	186	**0.8**	31		217	2	2.4	4	5.4	6.6	7.6	45.9	26.1	72
RC/WC-12	Y2-RC12-S	Year 2 OMMP	5/16/2006	0-2 cm	1160502	702722	76.2	3.74	160	720	6 U	6 U	0.3 U		24.7	19	0.05 U	19	0.4 U	59.9	42.2	8.5	12.2	17.5	6.4	2	8.1	3.3	11.4
RC/WC-12	RC-12	City Sampling	12/1/2004	0-3 cm	1160502	702722	46.1		380	720		20			123	190	**0.8**	33		241	5.9	2.6	4.3	7		6.9	47.3	19.5	66.8
RC/WC-12	WC-12	Year 0 OMMP	4/9/2004	0-10 cm	1160502	702722	86.9	0.192			6 U	6 U	0.2 U	19.8	35.6	3	0.05 U	19	0.3 U	35.9	20		44	23		11	1.1	0.9	2
RC/WC-12	WC-12(pre-City dredge)-CITY	City (pre-City dredge)	8/20/2004	0-10 cm	1160502	702722		0.898								14.5	0.0692			44.8									
RC/WC-12	WC-12	City Sampling	12/1/2004	0-10 cm	1160502	702722	68.6		120	270		9			65.6	68	0.24	23		111	33.6	13	10.7	10.3		5.2	16.7	8.4	25.1
RC/WC-12	WC-12 (City)	City Sampling	12/1/2004	0-10 cm	1160502	702722	65.7	3								71.9	0.122			89.7 B									
RC/WC-12	WC-12	Year 1 OMMP	5/11/2005	0-10 cm	1160502	702722	3	60.02									0.21												
RC/WC-12	Y2-WC12-S	Year 2 OMMP	5/16/2006	0-10 cm	1160502	702722	85.4	1.01	69	310	6 U	6 U	0.2 U		16.9	10	0.05 U	18	0.3 U	39.4	72.2	8.8	5.7	5.3	2.2	0.8	3.3	1.7	5
RC/WC-12	WCBU-12A	Year 0 OMMP	4/7/2004	0-1.7 ft	1160502	702722	90.9	0.02 U			5 U	5 U	0.2 U	20.1	39.4	2	0.04 U	20	0.3 U	34.3	27		35	24		13	1.1	0.4	1.5
RC/WC-12	Y2-WC12-C3	Year 2 OMMP	5/17/2006	1-2 ft	1160502	702722	89.7	0.139			6 U	6 U	0.2 U		44.3	3	0.05 U	25	0.3 U	38.1	28.7	15.4	20.4	23.9	9.5	0.9	1.2	0	1.2
RC-13	RC-13	Year 0 OMMP	4/8/2004	0-2 cm	1160566	701876	78.5	3.33			7 U	8	0.3 U	26.4	58.5	42	0.07	31	0.4 U	99.3	28		34	12		7.9	10	7.9	18
RC-13	RC-13	City Sampling	12/9/2004	0-2 cm	1160566	701876	75.2		96	450		6			38.6	23	0.06	25		71.2	46.3	12.2	18.9	11.2		3.5	3.9	2.4	6.3
RC-13	RC-13	Year 1 OMMP	5/12/2005	0-2 cm	1160566	701876	11.7	70.7	210	910		8 U			53.3	38	0.08	26		118	32.3	12.6	19.7	12.3	5	2.8	9.6	5.7	15.3
RC-13	Y2-RC13-S	Year 2 OMMP	5/16/2006	0-2 cm	1160566	701876	49.1	6.66	450	2800	10 U	10 U	0.4 U		62.3	73	0.12	34	0.6 U	208	7.6	8.1	12.2	9.4	12.5	14.4	25.3	10.5	35.8
RC-14	RC-14	Year 0 OMMP	4/8/2004	0-2 cm	1160719	701873	65.9	6.96			8 U	9	0.5	30.1	73.3	54	0.1	31	0.5 U	167	13		31	11		11	20	14	34
RC-14	RC-14	City Sampling	12/9/2004	0-2 cm	1160719	701873	66.7		230	1400		7			50.9	52	0.08	30		135	31.6	11.9	24.1	12.4		6.4	8.4	4.3	12.7
RC-14	RC-14	Year 1 OMMP	5/12/2005	0-2 cm	1160719	701873	7.43	61.3	390	1800		9			56.2	58	0.13	30		203	18.1	9.8	19.5	15	9.6	7.8	12.8	7.4	20.2
RC-14	Y2-RC14-S	Year 2 OMMP	5/16/2006	0-2 cm	1160719	701873	57	7.09	470	2300	8 U	9	0.4		63.9	67	0.13	31	0.5 U	219	31.5	7.5	12.4	9.9	8	7.7	15	8.2	23.2
RC-14B	RC-14B	Year 1 OMMP	5/12/2005	0-2 cm	1160728	701824	4.37	66.9	250	1200		7			44.6	37	0.08	26		117	25.5	13.2	21.8	13.3	4.6	3.3	11.4	6.8	18.2
RC-14B	Y2-RC14B-S	Year 2 OMMP	5/16/2006	0-2 cm	1160728	701824	58.7	6.25	360	2400	8 U	10	0.3 U		67.2	60	0.11	33	0.5 U	194	34.5	8.7	14.8	8.9	4.1	4.4	16.1	8.6	24.7
WC-13	WC-13	Year 0 OMMP	4/8/2004	0-10 cm	1160603	702460	84.7	0.955			5 U	5 U	0.2 U	24.2	44	4	0.05 U	22	0.3 U	38.5	31		30	19		14	3.4	2.3	5.7
WC-13	Y2-WC13-S	Year 2 OMMP	5/15/2006	0-10 cm	1160603	702460	62.2	3.92	330	1500	9 U	9 U	0.5		61.3	51	0.2	23	0.5 U	116	3.6	3.8	9	20.5	19.7	8.4	21.6	13.4	35
WC-14	WC-14	Year 0 OMMP	4/9/2004	0-10 cm	1160615	702409	74.4	2.3			7 U	7 U	0.3 U	18.2	36.1	4	0.05 U	18	0.4 U	34.4	2.8		18	30		41	5.4	3.6	9
WC-14	Y2-WC14-S	Year 2 OMMP	5/15/2006	0-10 cm	1160615	702409	46.8	4.51	650	3200	10 U	10 U	0.7		78.3	70	0.2	28	0.7 U	160	0.6	2.5	4.5	12.7	18	9.6	32.8	19.5	52.3
SC-01	SC-01	Year 0 OMMP	4/8/2004	0-10 cm	1160436	702702	91.5	0.223			5 U	5 U	0.2 U	18.9	30.7	3	0.05 U	19	0.3 U	33	13		27	32		27	0.7	0.6	1.3
SC-01	Y2-SC01-S	Year 2 OMMP	5/16/2006	0-10 cm	1160436	702702	94.3	0.462	14	75	5 U	5 U	0.2 U		24.1	5	0.04 U	19	0.3 U	36.6	56.2	10.6	10.6	11.9	7.3	1.8	0.7	1	1.7
SC-02	SC-02	Year 0 OMMP	4/8/2004	0-10 cm	1160366	702446	90.3	0.177			5 U	5 U	0.2 U	19.7	41.6	2 U	0.04 U	18	0.3 U	31.1	30		34	21		14	0.4	0.7	1.1
SC-02	Y2-SC02-S	Year 2 OMMP	5/16/2006	0-10 cm	1160366	702446	81	2.75	160	770	6 U	6 U	0.2 U		44.6	36	0.05 U	21	0.3 U	87.3	29.5	13.7	20.5	17	7.9	2.1	6.4	2.9	9.3
SC-03	SC-03	Year 0 OMMP	4/8/2004	0-10 cm	1160763	702186	89.3	0.536			5 U	5 U	0.2 U	19.8	33.9	4	0.04 U	20	0.3	36.3	18		37	24		15	4.3	2.4	6.7
SC-03	Y2-SC03-S	Year 2 OMMP	5/16/2006	0-10 cm	1160763	702186	60	5.52	380	2000	8 U	8 U	0.3		78.8	58	0.1	29	0.5 U	169	45.9	4.9	8.5	8.6	6.5	4.3	13.9	7.3	21.2
SC-04	SC-04	Year 0 OMMP	4/8/2004	0-10 cm	1160730	702746	91.9	0.31			5 U	5 U	0.2 U	20.4	52.3	4	0.04 U	22	0.3 U	35.7	20		43	25		11	0.9	0.2	1.1
SC-04	Y2-SC04-S	Year 2 OMMP	5/16/2006	0-10 cm	1160730	702746	72.1	5.33	210	1100	7 U	7 U	0.3 U		51.1	44	0.08	28	0.4 U	119	61.3	6	8.4	7.1	4.5	2.2	6.1	4.4	10.5
City Locations																													
S-15	Site 15(pre-City dredge)-CITY	City (pre-City dredge)	8/30/2004	0-2 cm	1160597	702760	62.6	1.6								72.1	0.307			79.6									
S-15	Site 15(post-City dredge)-UTL	Utilities' (post-City dredge)	9/18/2004	0-2 cm	1160597	702760	34.3					20			167	335	**1.4**	43		363									
S-15	Site 15(pre-City dredge)-UTL	Utilities' (pre-City dredge)	8/30/2004	0-10 cm	1160597	702760	64.8					20			81.5	80	0.2	27		79.6									
S-15	Site 15(post-City dredge)-CITY	City (post-City dredge)	9/18/2004	0-10 cm	1160597	702760	48.1	3.5								296	**1.48**			360									
S-15	S-15 (Utilities' core)	City Sampling	11/22/2004	0-10 cm	1160597	702760	53.1		1100	2300		11			104	140	**0.67**	27		179	5.4	3.9	5	10.5		8.8	34.6	17.8	52.4
S-15	S-15 (City)	City Sampling	11/30/2004	0-10 cm	1160597	702760	43.7	7.7								240	0.328			232 B									
S-15	S-15	Year 1 OMMP	5/10/2005	0-10 cm	1160597	702760	4.24	49	1600	4300		10			106	162	**0.7**	37		200	2.9	3.9	9.3	10.8	9.1	6.3	39.7	18	57.7
S-15	Y2-S15-S	Year 2 OMMP	5/15/2006	0-10 cm	1160597	702760	82.8	3.77	130	670	6 U	6 U	0.2 U		23.6	15	0.05 U	23	0.4 U	58.8	52.9	11.1	10.7	10.9	4.7	1.3	5.7	3.6	9.3
S-16	S-16	City Sampling	11/30/2004	0-10 cm	1160670	702641	49.9		760	4200		20			162	220	**0.75**	38		279	58.6	2.6	2.4	2.4		5.5	42.1	9.8	61.6
S-16	S-32 (Dup of S-16)	City Sampling	11/30/2004	0-10 cm	1160670	702641	51.1		580	1700		20			157	153	0.51	32		207	47.2	3.3	2.7	2.8		4.1	23.6	12.6	36.2
S-16	S-16	City Sampling	5/10/2005	0-10 cm	1160670	702641	3.7	59.9									0.12												
S-17	S-17	City Sampling	11/30/2004	0-2 cm	1160674	702547	49.8		800	2200		13			119	125	0.48	26		173	23.2	8.8	5.7	4.8		5.1	32.8	14.9	47.7
S-17	S-17 (City)	City Sampling	11/30/2004	0-10 cm	1160674	702547	74.4	1.9								38.6	0.075			64.3 B									

Table H. Head of the Thea Foss Results 2004 - 2006

Location	Sample ID	Phenol	1,3-Dichloro benzene	1,4-Dichloro benzene	1,2-Dichloro benzene	Dibenzo furan	Benzyl Alcohol	2-Methyl phenol	4-Methyl phenol	Hexachloro ethane	2,4-Dimethyl phenol	Benzoic Acid	1,2,4-Trichloro benzene	Hexachloro butadiene	N-Nitroso diphenyl amine	Hexa chloro benzene	Penta chloro phenol	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	2-Methyl naphthalene	Total LPAH	Fluoranthene	Pyrene	Benzo(a) anthracene	Chrysene
		420	170	110	50	540	73	63	670		29	650	51	11	28	22	360	2100	1300	500	540	1500	960	670	5200	2500	3300	1600	2800
OMMP Locations		UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG
RC/WC-10	RC-10					190												1800	410	**1600**	**870**	**3500**	**2200**	**690**	**11000**	**5500**	**4500**	**2400**	2500
RC/WC-10	WC-10		20 U	20 U	20 U								20 U					22	20 U	20 U	20 U	46	20	20 U	88	53	61	22	28
RC/WC-10	WC-10					67 U												270	67 U	240	130	570	340	110	1700	960	740	400	460
RC/WC-10	WC-10 (City)					30.4 J												274	90 U	201	115	507	268	125	1500	634	823	286	328
RC/WC-10	Y2-WC10-S	20 U	20 U	20 U	20 U	64	20 U	20 U	20 U	20 U	20 U	200 U	20 U	3.5 U	20 U	3.5 U	98 U	13 J	20 U	78	120	680	80	20 U	970 J	580	300	120	160
RC/WC-10	WCBU-10A		20 U	20 U	20 U	20 U							20 U					20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
RC/WC-10	WCBU-10A-Dup		20 U	20 U	20 U	20 U							20 U					20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
RC/WC-10	WCBU-10B		20 U	20 U	20 U	20 U							20 U					20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
RC/WC-10	WCBU-10C		19 U	19 U	19 U	19 U							19 U					19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
RC/WC-10	Y2-WC10-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	1 U	20 U	1 U	97 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
RC/WC-11/R-04	RC-11																	110	39 U	42	39 U	130	56	39 U	340	200	150	78	100
RC/WC-11/R-04	RC-11(pre-City dredge)-CITY					99 U												210	99 U	99	99 U	430	180	99 U	920	680	1000	330	420
RC/WC-11/R-04	RC-11(pre-City dredge)-UTL					200 U												200 U	200 U	200 U	200 U	240	200 U		240	520	360	200 U	230
RC/WC-11/R-04	RC-11(post-City dredge)-CITY		79	79	**85**	**740**							**85**					**3700**	410	**3100**	**2300**	**17000**	**4400**	**2200**	**31000**	**4400**	**19000**	**5800**	**6300**
RC/WC-11/R-04	RC-11(post-City dredge)-UTL					**800**												**4500**	980	**5500**	**3200**	**15000**	**5800**		**35000**	**12000**	**11000**	**5200**	**5300**
RC/WC-11/R-04	RC-11					190												1800	360	**1400**	**800**	**2900**	**1900**	**700**	**9900**	**5400**	**6700**	**2400**	2600
RC/WC-11/R-04	Y2-RC11-S					48 U												48 U	48 U	48 U	48 U	110	48 U	48 U	110	290	200	82	170
RC/WC-11/R-04	WC-11		39 U	39 U	39 U								39 U					41	39 U	39 U	39 U	53	39 U	39 U	94	110	73	41	52
RC/WC-11/R-04	WC-11(pre-City dredge)-CITY		5.87	5.8	4.68	18							5.85					115	45.3	106	58.2	330	146	55.3	800	452	490	163	195
RC/WC-11/R-04	WC-11(post-City dredge)-CITY		78	78	**78**	340							**78**					2000	220	**1500**	**970**	**6000**	**2200**	570	**13000**	**3800**	**9400**	**2100**	2400
RC/WC-11/R-04	WC-11 (Utilities' core)					83												500	160	**670**	360	**1500**	880	200	4300	1900	2000	860	910
RC/WC-11/R-04	WC-11 (City)					34 UJ												303	125	205	141	435	259	118	1600	876	947	357	471
RC/WC-11/R-04	WC-11					180												689	400	**608**	**710**	**2800**	**999**	**690**	**9200**	**5500**	**7500**	**2600**	**2800**
RC/WC-11/R-04	Y2-WC11-S	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	440 U	44 U	3.4 U	44 U	3.4 U	220 U	44 U	44 U	44 U	44 U	91	44 U	44 U	91	240	180	71	140
RC/WC-11/R-04	Y2-WC15-S	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	440 U	44 U	3.4 U	44 U	3.4 U	220 U	44 U	44 U	44 U	44 U	89	44 U	44 U	89	240	180	74	140
RC/WC-12	RC-12																	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	22	20 U	20 U	20 U
RC/WC-12	RC-12					340												**3000**	510	**2700**	**1400**	**6200**	**3600**	**1100**	**19000**	**8900**	**11000**	**3800**	**3500**
RC/WC-12	Y2-RC12-S					20 U												39	12 J	30	24	230	61	20 U	400 J	580	360	190	310
RC/WC-12	RC-12					250 U												760	250 U	**1200**	**620**	**2600**	**1500**	320	**7000**	**3100**	3100	1500	1600
RC/WC-12	WC-12		19 U	19 U	19 U								19 U					19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
RC/WC-12	WC-12(pre-City dredge)-CITY		5	4.9	3.98	5.4							4.98					59.2	17.6	34.4	18.4	93.8	41.2	18.2	280	145	174	60	70
RC/WC-12	WC-12					100 U												380	130	**630**	340	**1500**	820	170	4000	1700	1700	830	880
RC/WC-12	WC-12 (City)					39.3 J												297	100	306	199	712	401	137	2200	709	945	324	355
RC/WC-12	WC-12																	638	128	**525**	308	1460	765	244	4100	1730	2060	919	845
RC/WC-12	Y2-WC12-S	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	3.4 U	20 U	3.4 U	98 U	12 J	20 U	20 U	20 U	90	19 J	20 U	120 J	230	160	75	120
RC/WC-12	WCBU-12A		20 U	20 U	20 U	20 U							20 U					20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
RC/WC-12	Y2-WC12-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	1 U	20 U	1 U	99 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	15 J	20 U	20 U
RC-13	RC-13																	38 U	38 U	38 U	38 U	260	43	38 U	300	870	510	240	410
RC-13	RC-13					58 U												58 U	58 U	58 U	58 U	200	58 U	58 U	200	440	340	160	250
RC-13	RC-13					28 U												73	28 U	32	33	460	88	28 U	690	1300	1200	380	590
RC-13	Y2-RC13-S					120 U												120 U	120 U	120 U	120 U	970	160	120 U	1100	**2600**	1600	820	1300
RC-14	RC-14																	77 U	77 U	77 U	77 U	570	88	77 U	660	1600	890	460	760
RC-14	RC-14					69 U												69 U	69 U	69 U	69 U	260	69 U	69 U	260	580	430	200	300
RC-14	RC-14					40 U												70	40 U	48	48	710	120	40 U	1000	2100	1900	580	880
RC-14	Y2-RC14-S					110 U												110 U	110 U	110 U	110 U	710	120	110 U	830	1800	1100	590	920
RC-14B	RC-14B					86 U												86 U	86 U	86 U	86 U	380	86 U	86 U	380	1100	1000	320	520
RC-14B	Y2-RC14B-S					94 U												94 U	94 U	94 U	94 U	620	110	94 U	730	1800	1100	530	920
WC-13	WC-13		20 U	20 U	20 U								20 U					20 U	20 U	20 U	20 U	21	20 U	20 U	21	53	37	20 U	27
WC-13	Y2-WC13-S	69 U	69 U	69 U	69 U	69 U	69 U	69 U	69 U	69 U	69 U	690 U	69 U	3.5 U	69 U	3.5 U	350 U	210	69 U	150	110	590	210	69 U	1300	960	1200	510	630
WC-14	WC-14		19 U	19 U	19 U								19 U					19 U	19 U	19 U	19 U	20	19 U	19 U	20	38	28	19 U	19 U
WC-14	Y2-WC14-S	96 U	96 U	96 U	96 U	96 U	96 U	96 U	96 U	96 U	96 U	960 U	96 U	3.6 U	96 U	3.6 U	480 U	240	96 U	130	98	680	260	96 U	1400	1600	1700	690	880
SC-01	SC-01		19 U	19 U	19 U								19 U					19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
SC-01	Y2-SC01-S	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U	1 U	20 U	1 U	98 U	20 U	20 U	20 U	20 U	30	20 U	20 U	30	63	59	26	38
SC-02	SC-02		19 U	19 U	19 U								19 U					19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
SC-02	Y2-SC02-S	21 U	21 U	21 U	21 U	21 U	21 U	21 U	21 U	21 U	21 U	480	21 U	1 U	21 U	1 U	73 J	20 J	21 U	17 J	22	250	77	21 U	390 J	580	270	150	260
SC-03	SC-03		20 U	20 U	20 U								20 U					20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	43	30	20 U	23
SC-03	Y2-SC03-S	88 U	88 U	88 U	88 U	88 U	88 U	88 U	88 U	88 U	88 U	880 U	88 U	3.5 U	88 U	3.5 U	440 U	88 U	88 U	88 U	88 U	700	150	88 U	850	1800	1100	570	940
SC-04	SC-04		19 U	19 U	19 U								19 U					19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
SC-04	Y2-SC04-S	79 U	79 U	79 U	79 U	79 U	79 U	79 U	40 J	79 U	79 U	790 U	79 U	3.5 U	79 U	3.5 U	400 U	65 J	79 U	53 J	79 U	380	100	79 U	600 J	750	610	290	450
City Locations																													
S-15	Site 15(pre-City dredge)-CITY					99 U												950	99 U	**700**	460	560	230	99	**5400**	710	960	380	440
S-15	Site 15(post-City dredge)-UTL					**1800**												**11000**	**2000**	**14000**	**8000**	**35000**	**14000**		**84000**	**24000**	**22000**	**10000**	**10000**
S-15	Site 15(pre-City dredge)-UTL					200 U												780	210	**780**	460	580	360		**5600**	**3200**	690	400	480
S-15	Site 15(post-City dredge)-CITY		78	78	**78**	**2400**							**78**					**8200**	820	**7700**	**9300**	**48000**	**9200**	**4400**	**62000**	**26000**	**45000**	**7500**	**8100**
S-15	S-15 (Utilities' core)					250												890	320	**2300**	**1300**	**5800**	**2300**	410	**13000**	**3700**	**4800**	**1900**	2100
S-15	S-15 (City)					404												2010	**1390**	**3690**	**2410**	**8980**	**4260**	**1040**	**24000**	**7390**	**10200**	**3200**	**3350**
S-15	S-15					380												**3000**	560	**4200**	**1700**	**7300**	**4100**	**1300**	**22000**	**10000**	**13000**	**4600**	**4700**
S-15	Y2-S15-S	51 U	51 U	51 U	51 U	51 U	51 U	51 U	51 U	51 U	51 U	510 U	51 U	3.5 U	51 U	3.5 U	260 U	51 U	51 U	51 U	51 U	120	51 U	51 U	120	230	250	98 J	160 J
S-16	S-16					75												550	330	**560**	**700**	**2800**	800	500	**8900**	**4600**	**4500**	930	990
S-16	S-32 (Dup of S-16)					92												680	170	**770**	400	**1700**	**1100**	280	5100	**2700**	2600	1300	1400
S-16	S-16																	236	86.2	164	101	518	298	97.6	1500	744	939	410	413
S-17	S-17					91												850	190	**650**	370	**1500**	**1100**	310	5000	**2900**	2600	1400	1500
S-17	S-17 (City)					30.1 J												270	83	178	130	376	194	89.1	1300	790	988	269	293

Table H. Head of the Thea Foss Results 2004 - 2006

Location	Sample ID	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(b+k) fluoranthenes	Benzo(a) pyrene	Indeno (1,2,3-cd) pyrene	Dibenz(a,h) anthracene	Benzo (g,h,i) perylene	Total HPAH	Dimethyl phthalate	Diethyl phthalate	Di-n- Butyl phthalate	Butyl benzyl phthalate	bis(2- Ethylhexyl) phthalate	Di-n- Octyl phthalate	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCBs	Fines Thickness
				3600	1600	690	230	720	17000	160	200	1400	900	1300	6200	16	9	34								300	
OMMP Locations		UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	CM
RC/WC-10	RC-10	2000	2000	**4000**	**2700**	**930**	220	660	**23000**	180 U	180 U	470 B	360	**2800 B**	180 U	7	2 U	2 U	20 U	20 U	20 U	20 U	38	52	33	120	3
RC/WC-10	WC-10	20 U	20 U	20 U	22	20 U	20 U	20 U	190	20 U	20 U	20 U	20 U	63	20 U	0.4 U	0.4 U	0.4 U	4 U	7.9 U	4 U	4 U	4 U	4 U	4 U	7.9 U	N/A
RC/WC-10	WC-10	350	350	700	450	150	67 U	120	4000	67 U	67 U	67 U	67 U	620 B	67 U	1.3 J	2 U	2 U	20 U	20 U	20 U	20 U	20 U	19 J	20 U	19	3
RC/WC-10	WC-10 (City)			440 U	312	144	86.7	168	2800	25.5 U	47 UJ	50.5 UJ	27.9 U	464	24 U	1.98 J	1.66 J	5.91	3.7 U	3.7 U	3.7 U	3.7 U	3.7 U	36.6	36.1	73	3
RC/WC-10	Y2-WC10-S	110	130	240	88	29	20 U	36	1600	20 U	20 U	18 J	26	460	30	7 U	7 U	7 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	8 J	10 J	18 J	0.5
RC/WC-10	WCBU-10A	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	69	20 U	0.39 U	0.39 U	0.39 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.8 U	N/A
RC/WC-10	WCBU-10A-Dup	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	21	20 U	20 U	75	20 U	0.39 U	0.39 U	0.39 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.8 U	N/A
RC/WC-10	WCBU-10B	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	0.4 U	0.4 U	0.4 U	4 U	7.9 U	4 U	4 U	4 U	4 U	4 U	7.9 U	N/A
RC/WC-10	WCBU-10C	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	37	19 U	0.39 U	0.39 U	0.39 U	3.9 U	7.7 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.7 U	N/A
RC/WC-10	Y2-WC10-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	38	20 U	2 U	2 U	2 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	N/A
RC/WC-11/R-04	RC-11	74	66	140	73	39 U	39 U	39 U	880	39 U	39 U	39 U	39 U	280	39 U	1.7	1.6 U	2.4 U	3.9 U	7.9 U	3.9 U	3.9 U	3.9 U	11	3.9 U	11	N/A
RC/WC-11/R-04	RC-11(pre-City dredge)-CITY			700	350	220	99 U	280	4000	19	99 U	99 U	220	**1600**	140	2.4 U	2.4 U	3.6	13 U	13 U	13 U	13 U	13 U	27	35	62	1 to 3
RC/WC-11/R-04	RC-11(pre-City dredge)-UTL	200 U	200 U	200 U	220	200 U	200 U	200 U	1300	200 U	200 U	200 U	200 U	940	200 U	3.2 U	3.2 U	3.2 U	32 U	32 U	32 U	32 U	32 U	32 U	32 U	32 U	1 to 3
RC/WC-11/R-04	RC-11(post-City dredge)-CITY			**8100**	**5500**	**2500**	**950**	**2900**	**55000**	79 U	79 U	190	**1200**	**12000**	1800	**20.9**	**11.3**	18.6	19 U	19 U	19 U	19 U	19 U	162	139	**300**	3
RC/WC-11/R-04	RC-11(post-City dredge)-UTL	3600	3600	**7200**	**5100**	**1800**	**550**	**1500**	**50000**	470 U	470 U	470 U	820	**6400**	470 U	**29**	10 U	21 U	33 U	33 U	33 U	33 U	66	130	84	280	3
RC/WC-11/R-04	RC-11	1900	1900	**3800**	**2600**	**700**	**240**	650	**25000**	37 U	37 U	110	480	**3500**	99	**27 J**	18 U	33 U	20 U	20 U	20 U	20 U	81 J	150 J	150	**380 J**	10.5
RC/WC-11/R-04	Y2-RC11-S	140	120	260	99	49	48 U	61	1200					1100					9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	1
RC/WC-11/R-04	WC-11	39 U	44	44	41	39 U	39 U	39 U	410	39 U	39 U	39 U	39 U	220	39 U	0.54	0.38 U	0.96 U	3.8 U	7.6 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	7.6 U	N/A
RC/WC-11/R-04	WC-11(pre-City dredge)-CITY			280	170	115	54.6	130	2000	13.5 U	24.9 U	12.5 U	14.8 U	447 B	12.7 U	0.859	0.286 U	0.336 U	4.18 U	4.18 U	4.18 U	4.18 U	4.18 U	54.1	39.5	94	5
RC/WC-11/R-04	WC-11(post-City dredge)-CITY			**3900**	**2600**	**1300**	**340**	**1500**	**27000**	78 U	78 U	120	**940**	**4300**	1500	14.7	8.4	13.8	17 U	17 U	17 U	17 U	17 U	103	86	190	3
RC/WC-11/R-04	WC-11 (Utilities' core)	720	720	1400	990	390	90	290	8900	26 U	26 U	27	210	**1500**	26 U	6.5	1.9 U	1.9 U	19 U	19 U	19 U	19 U	23	48	28	99	7
RC/WC-11/R-04	WC-11 (City)			520	379	179	69	211	4000	32 U	59.1 UJ	56.3 UJ	186 J	675	88.6 J	13.3	**11**	16	4.9 U	4.9 U	4.9 U	4.9 U	4.9 U	111	96	210	7
RC/WC-11/R-04	WC-11	2000	2000	**4000**	**2800**	**760**	79.8	**803**	**27000**	38 U	38 U	160	520	**3500**	80	**19 J**	**19.3**	23 U	20 U	20 U	20 U	20 U	61 J	312	96	**620**	10.5
RC/WC-11/R-04	Y2-WC11-S	120	120	240	86	42 J	44 U	48	1000 J	44 U	44 U	44 U	51	960	84	7 U	7 U	7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	1
RC/WC-11/R-04	Y2-WC15-S	160	86	250	90	41 J	44 U	51	1100 J	44 U	44 U	63 J	41 J	990	86	7 U	7 U	7 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1
RC/WC-12	RC-12	20 U	20 U	20 U	20 U	20 U	20 U	20 U	22	20 U	20 U	20 U	20 U	60	20 U	0.39 U	0.39 U	0.39 U	3.9 U	7.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.9 U	N/A
RC/WC-12	RC-12	2400	3500	**5900**	**4200**	**1000**	**360**	**990**	**40000**	49 U	49 U	180	500	**3800**	63	**21 J**	14 U	21 J	20 U	20 U	20 U	20 U	65 J	110 J	100	280 J	5
RC/WC-12	Y2-RC12-S	300	230	530	210	82	14 J	100	2400 J					**1300**					9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	16 J	27 J	43 J	1
RC/WC-12	RC-12	1200	830	2000	**1600**	**890**	250 U	**750**	15000	250 U	250 U	250 U	300	**1800 B**	250 U	15	1.9 U	13 U	19 U	19 U	19 U	19 U	64	89	59	210	3
RC/WC-12	WC-12	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	0.38 U	0.38 U	0.38 U	3.8 U	7.7 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	7.7 U	N/A
RC/WC-12	WC-12(pre-City dredge)-CITY			110	59.6	41.5	24.2	48.6	730	11.5 U	21.2 U	18.3	12.6 U	171 B	10.8 U	0.237 U	0.232 U	0.273 U	3.41 U	3.41 U	3.41 U	3.41 U	3.41 U	13.7	14.7	28	5
RC/WC-12	WC-12	490	490	980	880	590	110	460	8100	100 U	100 U	100 U	180	880 B	100 U	5.7	2 U	2 U	20 U	20 U	20 U	20 U	24	41	27	92	3
RC/WC-12	WC-12 (City)			430	316	146	73.6	179	3500	150 U	150 UJ	150 B	299 U	309	299 U	2.86	6.1	8.1	4.4 U	4.4 U	4.4 U	4.4 U	4.4 U	81.7	75.5	160	3
RC/WC-12	WC-12			1100	1000	405	56.9	520	8600					823		3.2	8.5		11 U	11 U	11 U	11 U	11 U	144	163	**310**	5
RC/WC-12	Y2-WC12-S	120	88	210	84	45	20 U	60	980	20 U	20 U	23	28	590	32	7 U	7 U	7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	5 J	7 J	12 J	1
RC/WC-12	WCBU-12A	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	49	20 U	0.4 U	0.4 U	0.4 U	4 U	7.9 U	4 U	4 U	4 U	4 U	4 U	7.9 U	N/A
RC/WC-12	Y2-WC12-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	15 J	20 U	20 U	20 U	20 U	20 J	20 U	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	N/A
RC-13	RC-13	500	330	830	260	120	38 U	110	4200	38 U	38 U	57	130	**1400**	98	1.1	3.4 U	3.7 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	13 U	3.9 U	7.8 U	N/A
RC-13	RC-13	210	210	420	210	120	58 U	97	2000	58 U	58 U	58 U	85	830 B	58 U	2 U	2 U	2 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	1
RC-13	RC-13	800	570	1400	510	180	60	170	5800	28 U	28 U	120	170	**2100**	81	2 U	2 U	12 U	20 U	20 U	20 U	20 U	20 U	42 J	38	80 J	1
RC-13	Y2-RC13-S	1700	820	2500	960	280	120 U	340	10000					**3700**					9.9 U	9.9 U	20 U	9.9 U	20 U	40	58 J	98 J	2
RC-14	RC-14	740	640	1400	480	210	77 U	200	7400	77 U	77 U	77 U	180	**3000**	150	1.7	3.1 U	4.9 U	3.9 U	7.7 U	3.9 U	3.9 U	3.9 U	14 U	3.9 U	7.7 U	N/A
RC-14	RC-14	250	250	500	240	130	69 U	100	2500	69 U	69 U	69 U	85	790 B	69 U	1.9 U	1.9 U	3.2	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	1
RC-14	RC-14	930	930	1900	760	260	86	260	8700	40 U	40 U	320	190	**3600**	93	5.2 J	7.2 U	11 J	20 U	20 U	20 U	20 U	20 U	57 J	53 J	110 J	1.5
RC-14	Y2-RC14-S	860	820	1700	650	210	110 U	260	7200					**3600**					9.9 U	9.9 U	15 U	9.9 U	15 U	24	38 J	62 J	2
RC-14B	RC-14B	580	550	1100	430	150	86 U	140	4800	86 U	86 U	100	140	**1900**	86 U	2 U	2 U	5 U	20 U	20 U	20 U	20 U	20 U	20 U	19 J	19 J	1.5
RC-14B	Y2-RC14B-S	1100	620	1700	680	210	94 U	250	7200					**3800**					9.8 U	9.8 U	15 U	9.8 U	15 U	28	53 J	81 J	1
WC-13	WC-13	20 U	21	21	20 U	20 U	20 U	20 U	160	20 U	20 U	20 U	20 U	100	20 U	0.39 U	0.39 U	0.39 U	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.8 U	N/A
WC-13	Y2-WC13-S	570	670	1200	610	140	69 U	180	5500	69 U	69 U	160 J	140 J	**2000**	87 J	7 U	7 U	7 U	9.7 U	9.7 U	9.7 U	9.7 U	26	54	51	130	7
WC-14	WC-14	19 U	19 U	19 U	19 U	19 U	19 U	19 U	66	19 U	19 U	32	19 U	76	19 U	0.39 U	0.39 U	0.39 U	3.9 U	7.7 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.7 U	N/A
WC-14	Y2-WC14-S	1300	560	1900	790	200	96 U	240	8000	96 U	96 U	150 J	180 J	**3700**	170 J	7 U	7 U	7 U	9.8 U	9.8 U	9.8 U	9.8 U	38 J	77	72	190 J	14
SC-01	SC-01	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	26	19 U	0.39 U	0.39 U	0.39 U	3.9 U	7.7 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	7.7 U	N/A
SC-01	Y2-SC01-S	31	31	62	28	24	20 U	24	320	20 U	20 U	20 U	20 U	85	20 U	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	N/A
SC-02	SC-02	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	35	19 U	31	19 U	0.4 U	0.4 U	0.4 U	4 U	7.9 U	4 U	4 U	4 U	4 U	4 U	7.9 U	N/A
SC-02	Y2-SC02-S	200 J	200 J	400 J	180 J	130 J	36 J	120 J	2100 J	21 U	21 U	38	62	1000	57	2 U	2 U	2 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	28	32 J	60 J	N/A
SC-03	SC-03	25	22	22	20 U	20 U	20 U	20 U	170	20 U	20 U	24	20 U	91	20 U	0.4 U	0.4 U	0.4 U	4 U	8 U	4 U	4 U	4 U	4 U	4 U	8 U	N/A
SC-03	Y2-SC03-S	900	700	1600	670	260	88 U	340	7300	88 U	88 U	110	190	**3400**	140	7 U	7 U	7 U	9.9 U	9.9 U	20 U	9.9 U	20 U	36	35 J	71 J	N/A
SC-04	SC-04	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	94	19 U	0.38 U	0.38 U	0.38 U	3.8 U	7.7 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	7.7 U	N/A
SC-04	Y2-SC04-S	490	250	740	340	170	79 U	220	3600	79 U	79 U	50 J	130	**1500**	62 J	7 U	7 U	7 U	9.8 U	9.8 U	20 U	9.8 U	20 U	44	31 J	75 J	N/A
City Locations																											
S-15	Site 15(pre-City dredge)-CITY			750	450	**740**	99 U	**890**	4300	24	99 U	99 U	450	**3100**	99 U	6.9	3.4 U	3.4	19 U	19 U	19 U	19 U	19 U	48	46	94	1 to 2
S-15	Site 15(post-City dredge)-UTL	6200	6200	**12000**	**9900**	**3100**	**1100**	**2600**	**95000**	510 U	510 U	510 U	630	**5100**	510 U	**64**	16 U	16 U	33 U	33 U	33 U	33 U	130	230	180	**540**	3 to 5
S-15	Site 15(pre-City dredge)-UTL	420	360	780	460	560	200 U	470	3800	200 U	200 U	200 U	480	980	200 U	9	3.2 U	3.2 U	32 U	32 U	32 U	32 U	32 U	72	47	35	1 to 2
S-15	Site 15(post-City dredge)-CITY			**19000**	**7800**	**5500**	**2000**	**6400**	**81000**	78 U	78 U	250	**940**	**4500**	1600	**53.9**	**13.8**	**47**	20 U	20 U	20 U	20 U	20 U	287	243	**530**	3 to 5
S-15	S-15 (Utilities' core)	1200	1200	2400	**2100**	**860**	**310**	620	**19000**	48 U	48 U	48 U	120	1100	48 U	**28**	10 U	23 U	19 U	19 U	19 U	19 U	62	120	93	280	12
S-15	S-15 (City)			**3900**	**3600**	**1330**	**651**	**1450**	**35000**	43.6 U	80.3 UJ	193 UJ	47.6 U	1250	40.9 U	**35.3**	**23.3**	30.2	6.2 U	6.2 U	6.2 U	6.2 U	6.2 U	165	170	**340**	12
S-15	S-15	2900	2900	**5800**	**4700**	**1500**	**510**	**1500**	**46000**	140 U	140 U	210	260	**3000**	140 U	**22 J**	9.8 U	**34 J**	20 U	20 U	20 U	20 U	98	180 J	180	**460 J**	
S-15	Y2-S15-S	200	110	310	120	51 U	51 U	51 U	1200 J	51 U	51 U	65 J	51 U	930	76 J	7 U	7 U	7 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U	12	11	23	2
S-16	S-16	800	800	**3600**	**2500**	**850**	60	680	9300	60 U	60 U	47 U	460	**3600**	60 U	6.2	5.6 U	2 U	20 U	20 U	20 U	20 U	43	50	79	220	5
S-16	S-32 (Dup of S-16)	1000	1000	2000	1400	520	140	420	12000	44 U	44 U	64	240	**2400**	44 U	3	2 U	2 U	20 U	20 U	20 U	20 U	20 U	31	20 U	31	5
S-16	S-16			650	451	264	56	255	4200					629		2.67 J	1.67 J		7.5 U	7.5 U	7.5 U	7.5 U	7.5 U	104	99.7	200	5
S-17	S-17	1400	1200	2600	**1600**	560	200	480	14000	47 U	47 U	84	320	**2900**	47 U	4.8	1.9 U	1.9 U	19 U	19 U	19 U	19 U	20 J	42	26	88	2
S-17	S-17 (City)			510	333	170	93.2	175	3600	25.4 U	46.8 UJ	62.8 UJ	27.7 U	698 J	124	2.5	2.27 U	6.42	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	41.4	34.7	76	2

Table H. Head of the Thea Foss Results 2004 - 2006

Location	Sample ID	Monitoring Type	Sample Date	Depth Below Mudline	Easting	Northing	Total Solids	TOC	TPH Diesel	TPH Motor Oil	Sb	As	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt	Clay	Percent Fines
		SQO									150	57	5.1		390	450	0.59	140	6.1	410									
OMMP Locations		Units					Percent	Percent	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	%	%	%	%	%	%	%	%	%
S-17	S-17	Year 1 OMMP	5/11/2005	0-10 cm	1160674	702547	4.09	55.1	680	2700		13			92.2	87	0.29	26		134	7	2.7	5.4	14.7	18.8	8.6	29	13.7	42.7
S-17	Y2-S17-S	Year 2 OMMP	5/12/2006	0-10 cm	1160674	702547	86.8	3.91	95	400	6 U	6 U	0.2 U		19.9	9	0.04 U	14	0.3 U	43.4	59.1	14.1	12.1	6.9	0.8	1.3	3.4	2.1	5.5
S-18	S-18	City Sampling	12/1/2004	0-7 cm	1160700	702482	53.7		39	110		10			77	56	0.16	26		122	2	1.4	3.6	16.9		25.4	25	14.8	39.8
S-18	S-18 (City)	City Sampling	12/1/2004	0-10 cm	1160700	702482	65.1	2.5								26.4	0.097			54.6 B									
S-19	S-19	City Sampling	11/30/2004	0-10 cm	1160599	702671	57.5		610	4500		20			127	182	**0.7**	29		220	52.4	7.1	7.1	3.2		6.6	40.4	8.9	59.5
S-19	S-19	City Sampling	5/10/2005	0-10 cm	1160599	702671	5.7	51.1									0.23												
S-19	Y2-S19-S	Year 2 OMMP	5/15/2006	0-10 cm	1160599	702671	84.1	1.28	120	590	6 U	6 U	0.2 U		22	16	0.05 U	18	0.4 U	50	52.3	12	12.2	9.1	2.8	1.4	6.2	4.2	10.4
S-20	S-20	City Sampling	11/30/2004	0-2 cm	1160603	702537	62.7		620	2000		11			126	74	0.43	21		111	37.8	3.4	5.8	14		4.5	13.1	7.6	20.7
S-20	S-20 (City)	City Sampling	11/30/2004	0-10 cm	1160603	702537	61.5	2.2								55.7	0.118			83.9 B									
S-20	S-20	City Sampling	5/10/2005	0-10 cm	1160603	702537	3.7	46.7									0.16												
S-21	S-21	City Sampling	12/1/2004	0-7 cm			42.3		660	1200		20			127	207	**0.9**	34		257	0.7	1	3.2	7.9		8.4	47.5	21.2	68.7
S-21	S-33 (Dup of S-21)	City Sampling	12/1/2004	0-7 cm			41.9		490	960		20			145	202	**0.81**	32		251	0.4	0.8	3	7.6		8	49.3	20.7	70
S-21	S-21 (City)	City Sampling	12/1/2004	0-10 cm			48.7	4.1								147	0.239			159 B									
S-22	S-22	City Sampling	12/1/2004	0-8 cm	1160543	702648	49.4		860	1800		10			73.1	89	0.42	22		133	1.8	0.9	4.5	18.6		6.8	32.3	15.5	47.9
S-22	S-22 (City)	City Sampling	12/1/2004	0-10 cm	1160543	702648	66.5	1.9								44.8	0.123 J			71.6 B									
S-23	S-23	City Sampling	12/1/2004	0-3 cm			56.1		230	500		12			75.8	98	0.35	24		145	1.6	1.5	6.2	26.3		4.6	25.3	13.4	38.7
S-24	S-24	City Sampling	12/1/2004	0-3 cm	1160509	702551	52.9		180	420		10			89.8	113	0.4	28		175	5.6	2.9	7	18.1		6.1	29.2	13.8	43
S-24	S-24 (City)	City Sampling	12/1/2004	0-10 cm	1160509	702551	78.2	1								25.8	0.052			48.6 B									
S-24	S-24	Year 1 OMMP	5/11/2005	0-10 cm	1160509	702551	4.39	60.1	430	1700		9 U			66	59	0.2	22		105	4.4	4.5	7.8	25.4	26.3	6.5	16.5	8.6	25.1
S-24	Y2-S24-S	Year 2 OMMP	5/12/2006	0-10 cm	1160509	702551	86.8	2.48	97	410	5 U	5 U	0.2 U		18.7	11	0.17	14	0.3 U	40.3	67.5	11.4	7.3	5.8	3	0.9	2.7	1.5	4.2
S-29	S-29 (City)	City Sampling	12/1/2004	0-10 cm	1160549	702609	70.3	1.7								48.6	0.0932			71.7 B									
S-29	S-29	City Sampling	5/10/2005	0-10 cm	1160549	702609	3.4	56.3									0.19												
S-30	S-30	City Sampling	5/11/2005	0-10 cm	1160511	702471	2.1	83.2									0.02												
CA-19B	CA-19B-03	City Sampling	5/10/2005	0-10 cm	1160456	702958	3.4	62.4									0.13												
CA-19B	CA-19B-06	City Sampling	5/10/2005	0-10 cm	1160456	702958	3	47.5									0.28												
CA-20	CA-20-01	City Sampling	5/10/2005	0-10 cm	1160659	702858	0.71	88.8									0.013 J												
CA-20	CA-20-04	City Sampling	5/10/2005	0-10 cm	1160659	702858	1.8	88.3									0.04												
CA-22	CA-22-02	City Sampling	5/10/2005	0-10 cm	1160556	702849	4.1	57.5									0.23												
CA-22	CA-22-05	City Sampling	5/10/2005	0-10 cm	1160556	702849	1.3	84.7									0.05												
Reference Locations																													
CI-1	Y2-CI-01	Year 2 OMMP	5/18/2006	0-10 cm	1103838	737636	63.7	0.796													0	0.2	0.5	5.8	22.8	22.8	39.3	8.5	47.8
CI-2	Y2-CI-02	Year 2 OMMP	5/18/2006	0-10 cm	1103838	737636	73.5	0.692													0.1	0.2	1.5	12.7	37.2	21	22.3	5.2	27.5
Rinsate Blanks																													
FIELDQC	Y2-RB-01	Year 2 OMMP	5/15/2006	NA	NA	NA			0.25 U	0.5 U	0.05 U	0.05 U	0.002 U		0.002	0.04	0.0001 U	0.01 U	0.003 U	0.016									
FIELDQC	Y2-RB-02	Year 2 OMMP	5/16/2006	NA	NA	NA			0.25 U	0.5 U	0.05 U	0.05 U	0.002 U		0.002 U	0.02 U	0.0001 U	0.01 U	0.003 U	0.014									
FIELDQC	Y2-RB-03	Year 2 OMMP	5/17/2006	NA	NA	NA					0.05 U	0.05 U	0.002 U		0.004	0.02 U	0.0001 U	0.01 U	0.003 U	0.017									

Note: Bold = SQO exceedance

Table H. Head of the Thea Foss Results 2004 - 2006

Location	Sample ID	Phenol	1,3-Dichloro benzene	1,4-Dichloro benzene	1,2-Dichloro benzene	Dibenzo furan	Benzyl Alcohol	2-Methyl phenol	4-Methyl phenol	Hexachloro ethane	2,4-Dimethyl phenol	Benzoic Acid	1,2,4-Trichloro benzene	Hexachloro butadiene	N-Nitroso diphenyl amine	Hexa chloro benzene	Penta chloro phenol	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	2-Methyl naphthalene	Total LPAH	Fluoranthene	Pyrene	Benzo(a) anthracene	Chrysene
		420	170	110	50	540	73	63	670		29	650	51	11	28	22	360	2100	1300	500	540	1500	960	670	5200	2500	3300	1600	2800
OMMP Locations		UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG
S-17	S-17					86 U												590	86 U	240	140	870	510	190	2500	2100	2700	900	980
S-17	Y2-S17-S	40 U	40 U	40 U	40 U	40 U	40 U	40 U	40 U	40 U	40 U	400 U	40 U	3.4 U	40 U	3.4 U	200 U	40 U	40 U	40 U	40 U	71	40 U	40 U	71	170	150	59	100
S-18	S-18					120 U												300	120 U	240	150	760	440	120 U	1900	1800	1400	680	820
S-18	S-18 (City)					11												122	34.8 J	62.1	52.6	202 J	123	45.3	640	659	323	176	199
S-19	S-19					95												660	340	**760**	**980**	**3900**	**2400**	640	4900	**5800**	**5700**	**2600**	2600
S-19	S-19																	405	112	296	162	812	474	141	2400	1030	1280	553	553
S-19	Y2-S19-S	48 U	48 U	48 U	48 U	48 U	48 U	48 U	48 U	48 U	48 U	480 U	48 U	3.5 U	48 U	3.5 U	240 U	54	48 U	48 U	48 U	160	59	48 U	270	350	290	140	200
S-20	S-20					50												420	110	320	210	940	600	160	2800	1700	1600	800	870
S-20	S-20 (City)					80.6												521	235	**572**	344	1380	620	286	4000	1530	2070	687	730
S-20	S-20																	306	132	297	159	903	490	120	2400	1330	1500	665	702
S-21	S-21					300												1400	530	**3100**	**1600**	**6700**	**3400**	**740**	**17000**	**5900**	**5400**	**2800**	**3100**
S-21	S-33 (Dup of S-21)					410												1900	660	**4000**	**2100**	**8600**	**4300**	**900**	**22000**	**8000**	**7200**	**3700**	**3900**
S-21	S-21 (City)					206												1070	816	**1840**	**1330**	**4400**	**1960**	**719**	**12000**	**3530**	**4760**	**1760**	1860
S-22	S-22					160 U												1000	280	**1200**	**620**	**2400**	**1600**	410	**7500**	**3800**	3200	**1700**	1800
S-22	S-22 (City)					76.9												610	150	469	362	1190	717	243	3700	1390	1760	762	872
S-23	S-23					140 U												500	190	**650**	350	**1600**	940	220	4500	2400	2100	1100	1300
S-24	S-24					150 U												**2600**	170	**1000**	420	**1600**	860	**730**	**7400**	2400	1900	1100	1200
S-24	S-24 (City)					16.6 J												199	48.2	127	82.5	326	181	72.2	1000	522	645	212	314
S-24	S-24					42												390	72	190	130	680	390	140	2000	1400	1600	600	730
S-24	Y2-S24-S	39 U	39 U	39 U	39 U	39 U	39 U	39 U	39 U	39 U	39 U	390 U	39 U	3.4 U	39 U	3.4 U	200 U	39 U	39 U	39 U	39 U	100	24 J	39 U	120 J	230	200	80	120
S-29	S-29 (City)					93.8												844	182	**515 J**	384	1260	757	328	4300	1620	2070 J	908	1070
S-29	S-29																	324	100	237	131	662	359	120	1900	931	1070	460	484
S-30	S-30																	157	37.9	63.9	48.6	233	167	47.1	750	490	565	289	216
CA-19B	CA-19B-03																	365	97.7	406	207	934	540	132	2700	900	1090	449	434
CA-19B	CA-19B-06																	486	180	**759**	436	**1760**	912	227	4800	1550	1850	838	809
CA-20	CA-20-01																	78.9	21.2 J	58.8	32	130	73.3	22.1 J	420	190	212	108	117
CA-20	CA-20-04																	87.4	15.9 J	56.9	38.6	146	70.5	23.7	440	191	198	89	93.6
CA-22	CA-22-02																	**2560**	469	**2960**	**1680**	**6720**	**2560**	**839**	**18000**	**4090**	**5680**	**2290**	2170
CA-22	CA-22-05																	99.9	25.5	77.9	38.5	174	107	35.9	560	257	255	125	127
Reference Locations																													
CI-1	Y2-CI-01																												
CI-2	Y2-CI-02																												
Rinsate Blanks																													
FIELDQC	Y2-RB-01	1 U	1 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	10 U	1 U	0.05 U	1 U	0.05 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
FIELDQC	Y2-RB-02	1 U	1 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	10 U	1 U	0.05 U	1 U	0.05 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
FIELDQC	Y2-RB-03	1 U	1 U	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	10 U	1 U	0.05 U	1 U	0.05 U	5 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Note: Bold = SQO exceedance

Table H. Head of the Thea Foss Results 2004 - 2006

Location	Sample ID	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(b+k) fluoranthenes	Benzo(a) pyrene	Indeno (1,2,3-cd) pyrene	Dibenz(a,h) anthracene	Benzo (g,h,i) perylene	Total HPAH	Dimethyl phthalate	Diethyl phthalate	Di-n- Butyl phthalate	Butyl benzyl phthalate	bis(2- Ethylhexyl) phthalate	Di-n- Octyl phthalate	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCBs	Fines Thickness
				3600	1600	690	230	720	17000	160	200	1400	900	1300	6200	16	9	34								300	
OMMP Locations		UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	CM
S-17	S-17	760	750	1500	960	380	120	400	10000	86 U	86 U	98	190	**2000**	86 U	4.5 J	4.3 U	5 U	20 U	20 U	20 U	20 U	20 U	30 J	29 J	59 J	6
S-17	Y2-S17-S	120	74	190	76	30 J	40 U	38 J	820 J	40 U	40 U	40 U	28 J	570	45	7 U	7 U	7 U	9.9 U	15 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	15 U	0.5
S-18	S-18	740	740	1500	800	340	120 U	270	7600	120 U	120 U	120 U	270	**2000 B**	120 U	2.9	2 U	2 U	20 U	20 U	20 U	20 U	22 J	35	23 J	80	7
S-18	S-18 (City)			260	170	78	27.7	88.1	2000	2.9 UJ	5.4 UJ	43.3 B	92.4	313 B	2.8 U	2.55	1.42	8.63	4.2 U	4.2 U	4.2 U	4.2 U	4.2 U	38.1	31.8	70	7
S-19	S-19	860	860	**4000**	**2800**	450	**260**	**790**	**26000**	70 U	70 U	72	410	**3200**	70 U	7.9	3.4 U	2 U	20 U	20 U	20 U	20 U	30	61	44	140	4
S-19	S-19			890	639	346	70.8	329	5700					601		15.4	**12.3**		11.6 U	11.6 U	11.6 U	11.6 U	11.6 U	219	178	**400**	8
S-19	Y2-S19-S	240	140	380	170	48 U	48 U	53	1600	48 U	48 U	62 J	48 U	880	66	7 U	7 U	7 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	11 J	12	23 J	2
S-20	S-20	730	730	1500	950	340	94	270	8100	31 U	31 U	55	460	**1500**	31 U	1.7	2 U	2 U	20 U	20 U	20 U	20 U	20 U	18	20 U	18	2
S-20	S-20 (City)			960	741	348	171	347	7600	30.5 U	56.2 UJ	84 UJ	274 J	674	28.6 U	4.43	2.87 UJ	10.7	4.4 U	4.4 U	4.4 U	4.4 U	4.4 U	61.9	59.9	120	2
S-20	S-20			1200	777	440	92.4	423	7100					965		11	**12.4**		7.9 U	7.9 U	7.9 U	7.9 U	7.9 U	96.2	85.7	180	3.5
S-21	S-21	1700	1700	3400	**3100**	**1100**	**320**	**820**	**26000**	230 U	230 U	230 U	280	**2000 B**	230 U	**26**	8.8 U	26 U	20 U	20 U	20 U	20 U	90	160	120	**370**	7
S-21	S-33 (Dup of S-21)	2400	2400	**4800**	**4000**	**1300**	**390**	**960**	**34000**	230 U	230 U	230 U	340	**2600 B**	230 U	5.2	2 U	2 U	20 U	20 U	20 U	20 U	25	35	22 J	82	7
S-21	S-21 (City)			2200	**1740**	**770**	**277**	**875**	**18000**	39.4 U	72.6 UJ	36.6 UJ	43 U	652	187 J	**17.5**	**13.6**	18.5	5.8 U	5.8 U	5.8 U	5.8 U	5.8 U	145	145	290	7
S-22	S-22	1300	1300	2600	**1800**	660	160	490	16000	160 U	160 U	160 U	320	**2200 B**	160 U	3.5	2 U	2 U	20 U	20 U	20 U	20 U	23	32	19 J	74	8
S-22	S-22 (City)			1000	763	385	114	421	7500	28.5 U	52.5 U	121 J	220 J	**1310**	63 J	5.18	2.44 J	7.75	3.86 U	3.86 U	3.86 U	3.86 U	3.86 U	60.3	47.5	110	8
S-23	S-23	740	740	1500	1300	600	190	460	11000	140 U	140 U	140 U	190	**1500 B**	140 U	4.6	2 U	2 U	20 U	20 U	20 U	20 U	30	40	26	96	3
S-24	S-24	830	830	1700	1200	520	150 U	390	10000	150 U	150 U	150 U	260	**2000 B**	150 U	6.5	1.9 U	1.9 U	19 U	19 U	19 U	19 U	36	56	37	130	2
S-24	S-24 (City)			340	231	129	73.1	128	2600	24.6 U	45.3 UJ	22.9 UJ	26.9 U	558	23.1 U	1.84 J	0.963 J	5.66	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	27.4	29	56	2
S-24	S-24	640	640	1300	690	160	58	160	6700	28 U	28 U	110	200	**2000**	43	6.6 J	5.5 U	8.9 J	20 U	20 U	20 U	20 U	24	52 J	56	130 J	6
S-24	Y2-S24-S	150	98	250	96	39 J	39 U	45	1100 J	39 U	39 U	39 U	26 J	550	34 J	7 U	7 U	7 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	0.5
S-29	S-29 (City)			1300	931	448	100	516	8900	28.5 U	51.9 UJ	130 J	307	**1940**	95.6 J	4.94	2.07 J	7.67	3.86 U	3.86 U	3.86 U	3.86 U	3.86 U	66	49.7	120	4
S-29	S-29			760	531	295	62.4	290	4900					687		7.4	**9.8**		7.6 U	7.6 U	7.6 U	7.6 U	7.6 U	140	129	270	5
S-30	S-30			260	189	114	20.3	131	2300					224		0.571 J	1.82 J		33.5 U	33.5 U	33.5 U	33.5 U	33.5 U	18.4 U	33.1 J	33 J	3
CA-19B	CA-19B-03			660	505	238	49.3	229	4600					209		6.7	**9.9**		5.3 U	5.3 U	5.3 U	5.3 U	5.3 U	118	113	230	5
CA-19B	CA-19B-06			1200	956	452	102	426	8200					363		5.6	**18.1**		7 U	7 U	7 U	7 U	7 U	210	216	**430**	8
CA-20	CA-20-01			190	135	85.9	16.1 J	74.5	1100					169 J		0.215 U	0.75 J		3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	11.1 J	9.4 J	21 J	1
CA-20	CA-20-04			150	98.9	65.9	11.4 J	55.2	960					159 J		0.71 J	1.15 J		3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	21.3	19	40	1
CA-22	CA-22-02			3200	**2590**	**1210**	**267**	**1150**	**23000**					580		2.27 J	**14.4**		8.6 U	8.6 U	8.6 U	8.6 U	8.6 U	240	239	**480**	7
CA-22	CA-22-05			210	134	86.1	15.7 J	76.7	1300					206 J		1.45 J	1.25 J		4.3 U	4.3 U	4.3 U	4.3 U	4.3 U	24.1	25.6	50	1.5
Reference Locations																											
CI-1	Y2-CI-01																										
CI-2	Y2-CI-02																										
Rinsate Blanks																											
FIELDQC	Y2-RB-01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.1 U	0.1 U	0.1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	
FIELDQC	Y2-RB-02	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.1 U	0.1 U	0.1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	
FIELDQC	Y2-RB-03	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.1 U	0.1 U	0.1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	

Note: Bold = SQO exceedance

APPENDIX I

LABORATORY DATA REPORTS

APPENDIX I.1

CHEMISTRY DATA

(Located on Enclosed CD)

APPENDIX I.2

BIOASSAY DATA

(Bioassay Test Reports Located on Enclosed CD)

APPENDIX J

YEAR 2 ASSESSMENT OF UTILITIES' CAP RECONTAMINATION

YEAR 2 ASSESSMENT OF UTILITIES' CAP RECONTAMINATION
HEAD OF THEA FOSS WATERWAY PROJECT
TACOMA, WASHINGTON

Prepared for:

PacifiCorp Environmental Remediation Company

And

Puget Sound Energy

Dalton, Olmsted & Fuglevand, Inc. *Environmental Consultants*

October, 2006

YEAR 2 ASSESSMENT OF UTILITIES' CAP RECONTAMINATION
HEAD OF THEA FOSS WATERWAY PROJECT
TACOMA, WASHINGTON

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YEAR 2 ASSESSMENT OF UTILITIES' CAP RECONTAMINATION
HEAD OF THEA FOSS WATERWAY PROJECT
TACOMA, WASHINGTON

1.0 INTRODUCTION

This report was prepared on behalf of the "*Utilities*" consisting of the Advance Ross Sub Company, PacifiCorp Environmental Remediation Company and Puget Sound Energy. The purpose of the report is to present an updated assessment of the cause of recontamination of the Utilities' cap in the Thea Foss Waterway since the cap was installed in February 2004. Previous recontamination assessments are presented in the following reports:

- Assessment of Utilities' Cap Recontamination And Data Summary Report, Head of Thea Foss Waterway Remediation Project by Dalton, Olmsted & Fuglevand, Inc. and TetraTech EC, Inc., July 2005.

- Results of Year 1 Operation, Maintenance and Monitoring Plan Sampling, Head of Thea Foss Waterway Remediation Project by Dalton, Olmsted & Fuglevand, Inc., October 2005.

This updated assessment incorporates the results of Year 2 monitoring completed as part of the Utilities' Operation, Maintenance and Monitoring Plan or OMMP (TetraTech FW and DOF 2003). Year 2 OMMP sampling occurred in May 2006.

The Thea Foss Waterway is part of the CB/NT Superfund site, located in Tacoma, Washington. The waterway (previously known as the City Waterway) extends north to south along approximately 1.5 miles of the downtown shoreline of the City of Tacoma (City)(Figure 1). For remediation purposes, the waterway was divided into the "*City Work Area*" and the "*Utilities' Work Area*".

In the Remedial Design/Remedial Action (RD/RA) Consent Decree (CD) between EPA and the Utilities, the Utilities are responsible for cleanup of Remedial Action Areas (RAs) 23 and 24 (RA23/24) from waterway station 72+00 to 80+00. As a result of CD negotiations with the City, the Utilities also agreed to take responsibility for the southern portions of RAs 19b, 20 and 22. As a result, the Utilities' Work Area (also known as the "*Head of Thea Foss Waterway Project*") extends from waterway station 70+10 located north of the SR509 bridge, to the southern end of the waterway (station 80+00), including shoreline areas at or below an elevation of +12 feet mean lower low water (MLLW National Tidal Datum Epoch 1960-1978) (Figure 2). A "*transition zone*" is present between the City's Work Area and the Utilities' Work Area and extends from waterway station 70+00 to 70+10. A structural submarine sheet pile wall was installed as a delineator between the two work areas. The Utilities' Work Area covers an area of approximately 9.0 acres.

Construction of the remedy for the Utilities' Work Area was completed in February 2004 (DOF 2004). The Utilities' received Certification of Completion of Remedial Action Construction from the Environmental Protection Agency (EPA) on September 29, 2006 (EPA 2006). The selected remedy for the Utilities' area of responsibility was containment of contaminated sediments south of waterway station 70+10. The primary components of the remedy are listed below and are shown on Figure 2.

- Installation of a sheet pile wall at waterway station 70+10.
- Dredging beneath the current location of the scour protection apron at the head of the waterway and placement of capping and scour protection material where stormwater discharges from outfalls known as the "Twin 96" outfalls".
- Placement of a high density polyethylene (HDPE) cap over the former location of the "SR509 seep".
- Placement of a sand cap over contaminated sediments and over the HDPE cap.
- Placement of slope cap and armor material on waterway slopes.

The City is responsible for remediation north of the sheet pile wall installed at waterway station 70+10. Immediately north of the Utilities' Work Area, the City's selected remedy consisted of dredging and capping to maintain the required navigation depth of –19 feet mean lower low water (MLLW). During the 2003 to 2005 construction seasons, the City completed dredging and capping in part of the area next to the Utilities' sheet pile wall (RA19B, RA20 and RA22 – shown on Figure 3). In September 2004, it was discovered that City dredging had caused suspension and migration of contaminated sediments in the water column. Some of the suspended sediment accumulated on and recontaminated the northern portion of the Utilities' cap (DOF and TetraTech EC 2005; DOF 2005). To respond to the dredging recontamination, in December 2005, the City recapped the contaminated portion of the Utilities' cap (generally north of the SR509 bridge) with 6 to 18 inches of fine to medium sand (City of Tacoma et al. 2006). The recapped area is also shown on Figure 2.

2.0 YEAR 2 OMMP SAMPLING

Year 2 OMMP sampling occurred between May 12 and May 18, 2006. Sample locations are shown on Figure 3. Sampling was completed by TetraTech, EC in accordance with the Utilities' OMMP and amendments. In March 2006, the Utilities worked with the City to develop revisions to the original OMMP.

The first set of OMMP revisions called for the addition of a number of sampling locations to monitor the effectiveness of the capping material placed in December 2005 within the northern portion of the Utilities Work Area. The samples were added to address dredging recontamination that occurred during the last quarter of 2004. and included locations S-15, S-17, S-19 and S-24. The second set of OMMP revisions was developed to respond to SQO exceedances for bis(2-ethylhexyl)phthalate (BEHP) and outlined an approach for the collection of samples for biological testing. The City submitted the proposed revisions to the Environmental Protection Agency (EPA) on March 23, 2006.

In April 2006, the Utilities and the City worked with EPA and the U.S. Corps of Engineers (Corps) to finalize the OMMP amendments. EPA approved the biological testing plan on May 1, 2004 and the additional cap sampling locations on May 4, 2006

During March and April 2006, the OMMP monitoring schedule was also revised and approved by EPA (PERCo 2006). This schedule provides for cap integrity monitoring and recontamination sampling. The revised table replaces Table 2-2 of the OMMP. Monitoring is to be completed on an annual basis for the first five years and in years seven and ten. Specific monitoring tasks vary between years.

Field sampling procedures and observations, data summaries, and comparison of sediment quality data to the SQOs are presented in a TetraTech report (TetraTech EC 2006). Chemical analysis of sediment samples was completed by Analytical Resources Inc. (ARI). DMD, Inc. (Raleigh Farlow) completed the data quality review (DMD 2006). Year 2 OMMP analytical data is summarized in Table 1.

Consistent with the OMMP, three types of samples were collected:

- **Early Warning Recontamination Samples**. Early warning samples (0 to 2 cm depth interval) are being collected to provide warning from possible *"top-down"* recontamination in surface sediments from sources such as stormwater. Early warning samples were collected from the sediment surface at fifteen locations (RC-1 to RC-14B). At any given point in time, this sediment represents the newest deposited sediment for the sample location. Early warning samples were analyzed for the following constituents:
    - Total organic carbon (TOC)
    - Grain size
    - Petroleum hydrocarbons (diesel and heavy-oil range hydrocarbons)
    - Metals (arsenic, antimony, cadmium, copper, lead, mercury, nickel, silver and zinc)
    - Polycyclic aromatic hydrocarbons (PAHs)
    - Bis(2-ethylhexyl)phthalate (BEHP)
    - Polychlorinated biphenyls

- **Compliance Samples**. These are surface sediment samples collected from the depth interval of 0 to 10 cm. The 0 to 10 cm depth interval is the point of compliance (POC) for application of the Sediment Quality Objectives (SQOs). Samples were obtained from eighteen locations. Locations WC-1 to WC-14 are part of the original OMMP. Supplemental sample locations S15, S17, S19 and S24 were added to further assess the area of dredging recontamination that was capped by the City in December 2005. Compliance samples were analyzed for the same constituents as the early warning samples with the addition of:

- Phenols and Chlorobenzenes
- Phthalate esters
- Hexachlorobutadiene
- Dibenzofuran
- Pesticides (DDE, DDD, DDT)

- **Core Samples**. Core samples are being collected to provide data to evaluate possible future *"bottom-up"* recontamination of the waterway cap. Cores were obtained at six locations (WC-01B, WC-04, WC-05, WC-06, WC-10 and WC-12). One sample from each core was analyzed for the same constituents as the compliance samples (except for petroleum hydrocarbons). Sample depths are summarized in Table 1.

In addition to the OMMP sample locations collected in May 2006, Figure 3 shows other locations that were sampled in 2004 and 2005 to assess the impacts of dredging recontamination. These include supplemental surface sample locations S16, S18, S20, S22, S29 and S30, and core locations S15 and WC11. The results of the sample analyses for these and other locations were used to confirm the top down source of dredging recontamination and define the impacted area. The 2004 and 2005 sample results are discussed in DOF and TetraTech EC (2005).

3.0 POSSIBLE SEDIMENT CONTAMINATION SOURCES

As discussed above, the POC is the 0 to 10 cm interval below the sediment surface (or mudline). Sources of contamination to surface sediment that were considered in this analysis include:

- **Bottom-up contamination.** This potential source consists of contaminated sediment and coal tar derived material that underlie and are contained by the Utilities' cap (including the SR-509 seep).

- **Top-down contamination.** Two sources of top-down recontamination were considered. These include City dredging contamination that occurred during the fall of 2004 and stormwater discharges to the head of the Thea Foss Waterway. Four stormwater outfalls discharge to the head of the waterway including 237A and 237B (together termed the *"Twin 96" Outfalls"*), 235 and 243 (Figures 2 and 3). The drainage areas and general land uses upstream of these outfalls are summarized below (City of Tacoma 2005):

Outfall	Drainage Area (acres)	Landuse
o 237A	2,794	residential, commercial, industrial
o 237B	1,821	residential
o 235	181	residential, commercial, industrial
o 243	45	industrial

4.0 DATA EVALUATION AND INTERPRETATION

Available data continue to indicate that recontamination of waterway sediments, after the Utilities' cap was installed in the southern portion of the Thea Foss Waterway, occurred from top-down sources. This finding is based on the following lines of evidence.

4.1 Accumulation of Fine-Grained Sediment

Since the Utilities' cap was installed, fine-grained sediment has accumulated on the top of cap. Table 2 summarizes the thicknesses and percent fines for sampling rounds completed in April 2004 (Year 0 OMMP), November/December 2004, May 2005 (Year 1 OMMP) and May 2006 (Year 2 OMMP). By May 2006, approximately 7 to 19 cm of fine-grained sediment had accumulated within the small boat turning basin south of the bridge as illustrated on Figure 4. Lesser thicknesses (0.5 to 2 cm) were present on the scour protection apron and within the area capped by the City in December 2005.

Figure 5 illustrates how thicknesses of accumulated sediment varied between April 2004 and May 2006. At most locations south of the bridge, the greatest thickness of accumulated sediment was measured in May 2006. Thicknesses of fine-grained sediment were lower north of the bridge because of the relatively recent capping work completed by the City to resolve the dredging recontamination issue.

The accumulated fine-grained sediment is distinctly different from the more granular underlying capping material. The capping material, based on grain size analyses of core samples (Table 1), has a fines content (herein defined as particle sizes less than 62.5 microns) generally less than 4 percent. This compares with a fines content of between 21 and 58 percent for accumulated sediment beneath and south of the bridge as summarized below:

Percent Fines Content of Accumulated Sediment by Area

	0 to 2 cm		0 to 10 cm	
	Range (%)	Avg. (%)	Range (%)	Avg. (%)
Scour Protection Apron	23-36	28	na	na
Turning Basin	30-58	46	21-57	37
City Capped Area	7.5-11	9	4.2-10	7

The fines content of accumulated sediment in the City capped area ranged between 4.2 and 11 percent. This area had been capped five to six months prior to the Year 2 OMMP sampling and the samples likely include a mixture of capping material and accumulated sediment.

The source of accumulated fine-grained sediment above the capping material is predominately stormwater that discharges to the head of the waterway. This finding is based on comparison of the chemical quality of the accumulated fine-grained sediment with stormwater sediment (collected by in-line sediment traps) that discharges to the waterway as discussed further below.

4.2 SQO Exceedances

Comparison of the analytical results of the compliance samples (0 to 10 cm) with the Sediment Quality Objectives (SQOs) indicates that BEHP exceeds the SOQ (1,300 ug/kg) throughout the southern portion of the Utilities' Work Area (Figure 7). Exceedance factors (sample concentration divided by the SQO) ranged between approximately 1.2 and 5.9. The greatest exceedance factor was detected in sample location WC-02. In the northern area that was capped in December 2005, BEHP concentrations in compliance samples collected approximately five months after the capping material was placed, ranged between 460 ug/kg and 990 ug/kg.

Concentrations of one or more high molecular weight polycyclic aromatic hydrocarbons (HPAHs) also exceeded the SQOs. The greatest number of HPAH exceedances occurred at location WC-02 where fluoranthene, pyrene, total benzofluoranthene, benzo(a)pyrene, benzo(ghi)perylene and the sum of HPAHs exceeded their respective SQO as summarized in Table 1. Fluoranthene also exceeded it's SQO at location WC-05. Exceedance factors ranged between approximately 1.1 and 1.7. The pattern of PAH concentrations in surface sediment, based on the sum of HPAHs, is shown on Figure 9.

4.3 Comparison of Accumulated Sediment Quality with Stormwater Sediment Quality

Stormwater sediment contains a typical suite of chemicals. These chemicals include petroleum hydrocarbons, metals and organic chemicals such as polycyclic aromatic hydrocarbons (PAHs) and phthalates. Pesticides and polychlorinated biphenyls (PCBs) are also commonly detected in stormwater sediments. In 1991 and 1992 the Washington State Department of Ecology (Ecology) completed an assessment of vactor truck wastes from sites located in King and Snohomish Counties, Washington (Sedar 1992, 1993). Vactor trucks are widely used in urban areas to remove sediments from storm drain facilities such as catch basins. The vactor truck wastes had elevated concentrations of metals (especially zinc, lead, chromium, copper, nickel and arsenic) and organic compounds including PAHs, petroleum hydrocarbons and phthalates (BEHP was the second most commonly detected organic constituent).

Since the mid to late 1990's, Tacoma has implemented, with oversight by Ecology and EPA, a program to assess stormwater quality using in-line sediment-traps placed within portions of their stormwater conveyance system. Sediments collected by these traps are recovered and analyzed on an annual basis. Typically the traps are deployed in the fall (beginning of the wet season) and are recovered in the spring (near the end of the wet season). Several of the traps are placed immediately upstream of where stormwater discharges into the head of Thea Foss. Stormwater sediment quality data for outfalls that discharge to the head of Thea Foss are summarized for the period 2002 to 2005 in Table 3. Metals, petroleum hydrocarbons, PAHs, phthalates, and PCBs were detected in stormwater sediment collected by the sediment traps. These constituents were also detected in Thea Foss fine-grained bottom sediment present on top of the Utilites' cap. Figures 6 to 9 show the distribution of BEHP and PAHs in 0 to 2 cm and 0 to 10 cm sediment samples collected in May 2006 as part of the Utilities' OMMP.

Table 4 presents a comparison of the range of stormwater contaminant concentrations in vactor truck wastes, sediment collected by in-line sediment traps positioned near the outfalls that discharge to the head of Thea Foss, and 0 to 2 cm sediment samples composed of accumulated fine-grain sediment collected beneath and south of the SR509 bridge in May 2006. As shown, the May 2006 surface sediment concentrations in Thea Foss are within similar ranges of concentrations of both the vactor truck wastes and stormwater sediment discharged from the outfalls.

4.4 Sediment Quality Correlations and Trends – HPAHs and BEHP

The connection between surface sediment concentrations in Thea Foss and top-down contaminant sources is corroborated by the high degree of correlation between sediment contaminant concentrations, and their concentration trends. The following discussion focuses on BEHP and HPAHs in 0 to 2 cm samples because these contaminants have historically been the primary contaminants of concern in Thea Foss sediment, and 0 to 2 cm sediment samples represent the most recently deposited sediment, at a given time and location. Year 2 (May 06) OMMP data are summarized in Table 1. The May 2006 spatial distribution of BEHP and HPAH in the Utilities' work area for 0 to 2 cm and 0 to 10 cm samples are shown on Figures 6 to 9. The results of earlier analyses are summarized in previously submitted reports (DOF and TetraTech EC 2005; DOF 2005).

Figure 10 shows a line fit plot for HPAH and BEHP concentrations for April 2004 (Year 0), May 2005 (Year 1) and May 2006 (Year 2) early warning sediment samples. Within the April 2004 and May 2006 sample sets, the concentrations are highly correlated (R>0.90) with a consistent trend between HPAH and BEHP (R^2>0.89). The trend of the May 2005 data is similar to the April 2004 and May 2006 data, however, three to five samples are enriched with HPAHs as compared to the other samples.

Figure 11 (upper plot) shows a combined plot of data for April 2004, May 2005 and May 2006. The plot confirms a similar HPAH v. BEHP trend for most of the early warning OMMP samples. The samples that do not fall on the predominate trend line are samples obtained in May 05 from beneath and north of the SR509 bridge. These samples (RC8 to RC12) are interpreted to have been significantly impacted by the dredging recontamination that occurred during the fall of 2004. Some of the dredge material contained coal tar derived materials with high concentrations of HPAHs. Samples RC8 to RC12 are enriched with HPAHs relative to BEHP, similar to the contaminated dredge material. Furthermore, samples RC8 and RC9 appear to be less impacted as compared to the other samples which would be expected because these samples lie further away from the dredging area as compared to samples RC10 to RC12. The remaining sample concentrations (Figure 11, lower plot) are highly correlated (R=0.95) and show a definite trend (R^2=0.90).

The source of contamination for most of the early warning OMMP sediment samples is interpreted to be stormwater discharges to the Head of the Thea Foss Waterway. Figure 12 shows a plot of stormwater sediment-trap sediment concentrations installed near the outlets of outfalls that discharge to the head of Thea Foss. Data used to prepare the plots are summarized in Table 3. Two concentration patterns are evident in the data. Sediment from the larger outfalls (237A and 237B) are enriched with HPAHs relative to BEHP as compared to the smaller outlfalls (235 and 243).

To compare the relationship between HPAH and BEHP in early warning sediment samples (not significantly impacted by the dredging recontamination) and stormwater sediment collected by the sediment traps, the data shown on Figure 12 are combined with those shown on Figure 11 (lower plot) on Figure 13. As shown in Figure 13, the comparison indicates a similar relationship exists between HPAH and BEHP in the early warning sediment in the waterway and sediment being discharged from outfalls 237A and 237B. This relationship indicates the primary sources of BEHP and HPAHs to surface sediment are the Twin 96" Outfalls.

4.5 Surface and Core Sample Sediment Concentrations

Contaminant concentrations in surface sediment are substantially higher as compared to concentrations in underlying capping material. Higher concentrations in surface sediment indicate a top-down source of contamination. Figure 14 illustrates this relationship using bar charts for core locations RC/WC-04, RC/WC-05, RC/WC-06, RC/WC-10 and RC/WC-12. RC/WC-01 was not included on the figure because surface sample and cores were not co-located at this sampling station. Data used to prepare the figures are summarized in Table 5.

At the five core locations, BEHP, HPAHs, LPAHs, lead, zinc and PCBs were substantially higher in the 0 to 2 cm, and 0 to 10 cm sample intervals than in the underlying core samples. For example, at stations south of the SR-509 Bridge, BEHP concentrations ranged between 1,600 ug/kg and 5,900 ug/kg in samples taken from the top ten centimeters while concentrations in the underlying capping material ranged between 29 ug/kg and 120 ug/kg. Stations south of the bridge were capped by February 2004 and fine grained sediment had accumulated over a period of approximately 27 months (2.25 years).

The differences in concentrations in overlying and capping material were less pronounced in samples obtained north of the bridge were sediment had accumulated over a period of approximately five months (December 2005 to May 2006). At locations RC/WC-10 and RC/WC-12, BEHP concentrations ranged between 420 ug/kg and 1,300 ug/kg in 0 to 2 cm samples and between 20 ug/kg and 38 ug/kg in underlying core samples.

5.0 SUMMARY AND FINDINGS

- Remediation of the Utilities' Work Area was completed in February 2004 with final placement of capping material. OMMP sampling was completed in April 2004 (Year 0 – baseline), May 2005 (Year 1) and May 2006 (Year 2) that consisted of collecting early warning "*top-down*" recontamination samples (0 to 2 cm), compliance samples (0 to 10 cm) and core samples (to assess the potential for "*bottom up*" recontamination).

- Potential sediment recontamination sources identified near the Head of Thea Foss Waterway between February 2004 and May 2006 include stormwater and dredging top-down sources and upward migration of contaminants contained by the Utilities' cap (bottom up source).

- Core sampling indicates that the Utilities' cap is functioning as intended.

- Contamination of the Utilities' Work Area (top of cap) began soon after the cap was installed. Fine grained sediment began to accumulate and concentrations of BEHP, PAHs and other contaminants began to increase. The source of this contamination appears to be stormwater discharges based on the following lines of evidence:

    - Accumulation of fine grained sediment on top of the Utilities' cap that contains contaminants typical of stormwater discharges.

    - High correlation and similar concentration trends between HPAHs and BEHP in early warning sediment samples between April 2004 and May 2006 that indicate a similar source.

   - Similarity of the HPAH and BEHP trend relationship in early warning sediment samples with the trend relationship of stormwater sediment samples collected near the end of the Twin 96” outfalls. These data indicate that the Twin 96” outfalls are the primary source of PAHs and BEHP to the Head of the Thea Foss Waterway.

- In September 2004 it was discovered that City dredging, completed after the Utilities’ cap was installed, had caused contaminated sediment to be suspended in the water column and to migrate and settle on a portion of the Utilities’ cap. The primary area of dredging recontamination was located generally north of the SR509 bridge. The dredging recontamination was differentiated from the stromwater contamination by the relative enrichment in HPAHs as compared to BEHP. The dredging recontamination area was capped by the City in December 2005.

- The May 2006 early warning sediment sample HPAH and BEHP correlation and trend indicate that by May 2006, surface sediment is being primarily impacted by stormwater discharges.

6.0 REFERENCES

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7.0 CLOSING

The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, expressed or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

Dalton, Olmsted & Fuglevand, Inc.

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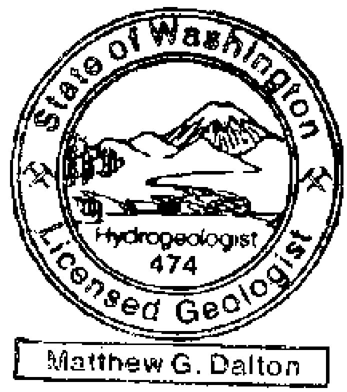

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	Location	Comments	Sample Date	Lab I.D.	% solids	% TOC	TPH-Dx (mg/kg) Diesel-range	TPH-Dx (mg/kg) Lube-range	As 7440-38-2	Sb 7440-36-0	Cd 7440-43-9
SQOs							na	na	57	150	5.1
Early Warning Spls.											
Y2-RC01-S	RC/WC-01	0-2 cm	5/16/2006	068436-JJ54C	40	9.9	900	**4700**	10 U	10 U_J	**0.6**
Y2-RC02-S	RC/WC-02	0-2 cm	5/12/2006	068234-JJ17H	42	5.2	1000	**5300**	10 U	10 U_J	**1.0**
Y2-RC03-S	RC/WC-03	0-2 cm	5/15/2006	068309-JJ31B	48	5.0	530	**2300**	10 U	10 U_J	**0.6**
Y2-RC04-S	RC/WC-04/R-02	0-2 cm	5/12/2006	068227-JJ17A	46	7.4	680	**3000**	10 U	10 U_J	0.5 U
Y2-RC05-S	RC/WC-05	0-2 cm	5/15/2006	068314-JJ31G	45	6.6	720	**3200**	10 U	10 U_J	**0.7**
Y2-RC06-S	RC/WC-06	0-2 cm	5/15/2006	068311-JJ31D	59	5.5	380	**1700**	8 U	8 U_J	**0.3**
Y2-RC07-S	RC/WC-07	0-2 cm	5/16/2006	068443-JJ54J	53	6.0	600	**2700**	10 U	10 U_J	**0.6**
Y2-RC08-S	RC/WC-08/R-03	0-2 cm	5/12/2006	068232-JJ17F	53	5.6	550	**2200**	**10**	10 U_J	**0.8**
Y2-RC09-S	RC/WC-09	0-2 cm	5/15/2006	068316-JJ31I	48	5.1	740	**2800**	10 U	10 U_J	**0.7**
Y2-RC10-S	RC/WC-10	0-2 cm	5/16/2006	068444-JJ54K	84	3.0	110	**510**	6 U	6 U_J	0.2 U
Y2-RC11-S	RC/WC-11/R-04	0-2 cm	5/12/2006	068229-JJ17C	85	4.3	140	**660**	6 U	6 U_J	0.2 U
Y2-RC12-S	RC/WC-12	0-2 cm	5/16/2006	068445-JJ54L	76	3.7	160	**720**	6 U	6 U_J	0.3 U
Y2-RC13-S	RC-13	0-2 cm	5/16/2006	068440-JJ54G	49	6.7	450	**2800**	10 U	10 U_J	0.4 U
Y2-RC14-S	RC-14	0-2 cm	5/16/2006	068438-JJ54E	57	7.1	470	**2300**	**9**	8 U_J	**0.4**
Y2-RC14B-S	RC-14B	0-2 cm	5/16/2006	068439-JJ54F	59	6.3	360	**2400**	**10**	8 U_J	0.3 U
Compliance Samples											
Y2-WC01-S	RC/WC-01	0-10 cm	5/16/2006	068437-JJ54D	36	7.1	1100	**5100**	10 U	10 U_J	**0.6**
Y2-WC02-S	RC/WC-02	0-10 cm	5/12/2006	068235-JJ17I	47	6.4	840	**4000**	10 U	10 U_J	**1.2**
Y2-WC03-S	RC/WC-03	0-10 cm	5/15/2006	068308-JJ31A	54	5.3	340	**1400**	10 U	10 U_J	0.4 U
Y2-WC04-S	RC/WC-04/R-02	0-10 cm	5/12/2006	068228-JJ17B	55	3.2	470	**2100**	9 U	9 U_J	**0.6**
Y2-WC05-S	RC/WC-05	0-10 cm	5/15/2006	068313-JJ31F	49	5.2	580	**2300**	10 U	10 U_J	0.4 U
Y2-WC06-S	RC/WC-06	0-10 cm	5/15/2006	068310-JJ31C	66	5.0	190	**810**	8 U	8 U_J	0.3 U
Y2-WC07-S	RC/WC-07	0-10 cm	5/16/2006	068441-JJ54H	69	4.2	220	**1100**	8 U	8 U_J	**0.4**
Y2-WC08-S	RC/WC-08/R-03	0-10 cm	5/12/2006	068233-JJ17G	59	4.2	470	**1800**	9 U	9 U_J	**0.8**
Y2-WC09-S	RC/WC-09	0-10 cm	5/15/2006	068315-JJ31H	59	4.4	350	**1300**	9 U	9 U_J	**0.7**
Y2-WC10-S	RC/WC-10	0-10 cm	5/16/2006	068442-JJ54I	84	2.0	68	**290**	6 U	6 U_J	0.2 U
Y2-WC11-S	RC/WC-11/R-04	0-10 cm	5/12/2006	068230-JJ17D	86	3.6	130	**580**	6 U	6 U_J	0.2 U
Y2-WC12-S	RC/WC-12	0-10 cm	5/16/2006	068446-JJ54M	85	1.0	69	**310**	6 U	6 U_J	0.2 U
Y2-WC13-S	WC-13	0-10 cm	5/15/2006	068317-JJ31J	62	3.9	330	**1500**	9 U	9 U_J	**0.5**
Y2-WC14-S	WC-14	0-10 cm	5/15/2006	068318-JJ31K	47	4.5	650	**3200**	10 U	10 U_J	**0.7**
Y2-S15-S	S-15	0-10 cm	5/15/2006	068319-JJ31L	83	3.8	130	**670**	6 U	6 U_J	0.2 U
Y2-S17-S	S-17	0-10 cm	5/12/2006	068237-JJ17K	87	3.9	95	**400**	6 U	6 U_J	0.2 U
Y2-S19-S	S-19	0-10 cm	5/15/2006	068320-JJ31M	84	1.3	120	**590**	6 U	6 U_J	0.2 U
Y2-S24-S	S-24	0-10 cm	5/12/2006	068236-JJ17J	87	2.5	97	**410**	5 U	5 U_J	0.2 U
Slope Samples											
Y2-SC01-S	SC-01c (composite)	0-10 cm	5/16/2006	068447-JJ54N/JQ90A	94	0.46	14	**75**	5 U	5 U_J	0.2 U
Y2-SC02-S	SC-02c (composite)	0-10 cm	5/16/2006	068448-JJ54O/JQ90B	81	2.8	160	**770**	6 U	6 U_J	0.2 U
Y2-SC03-S	SC-03c (composite)	0-10 cm	5/16/2006	068435-JJ54B	60	5.5	380	**2000**	8 U	8 U_J	**0.3**
Y2-SC04-S	SC-04d (composite)	0-10 cm	5/16/2006	068434-JJ54A	72	5.3	210	**1100**	7 U	7 U_J	0.3 U

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	Location	Comments	Sample Date	Lab I.D.	% solids	% TOC	TPH-Dx (mg/kg) Diesel-range	TPH-Dx (mg/kg) Lube-range	As 7440-38-2	Sb 7440-36-0	Cd 7440-43-9
SQOs							na	na	57	150	5.1
Core Samples											
Y2-WC01B-C3	WC-01B/R-01B	1.5-2.2 ft	5/17/2006	068524-JJ68C	86	0.55	-----	-----	6 U	6 U_J	0.2 U
Y2-WC04-C3	RC/WC-04/R-02	0.7-1.5 ft	5/17/2006	068622-JJ84B	88	0.87	-----	-----	6 U	6 U_J	0.2 U
Y2-WC05-C3	RC/WC-05	0.3-1.5 ft	5/17/2006	068623-JJ84C	88	0.53	-----	-----	6 U	6 U_J	0.2 U
Y2-WC06-C3	RC/WC-06	1.2-1.8 ft	5/17/2006	068527-JJ68F	85	1.0	-----	-----	6 U	6 U_J	0.2 U
Y2-WC10-C3	RC/WC-10	1.0-2.5 ft	5/17/2006	068629-JJ84I	87	0.23	-----	-----	5 U	5 U_J	0.2 U
Y2-WC12-C3	RC/WC-12	0.4-1.1 ft	5/17/2006	068627-JJ84G	90	0.14	-----	-----	6 U	6 U_J	0.2 U
QA/QC Samples											
Y2-RC15-S	RC/WC-06	0-2 cm; dup.	5/15/2006	068312-JJ31E	60	6.7	400	**1700**	9 U	9 U_J	0.3 U
Y2-WC15-S	RC/WC-11/R-04	0-10 cm; dup.	5/12/2006	068231-JJ17E	86	2.9	140	**570**	6 U	6 U_J	0.2 U
Y2-RB-01	field QC	Rinsate Blank	5/15/2006	068321-JJ31N	0.0	-----	0.25 U	0.5 U	0.05 U	0.05 U	0.002 U
Y2-RB-02	field QC	Rinsate Blank	5/16/2006	068449-JJ54P	0.0	-----	0.25 U	0.5 U	0.05 U	0.05 U	0.002 U
Y2-RB-03	field QC	Rinsate Blank	5/17/2006	068528-JJ68G	0.0	-----	-----	-----	0.05 U	0.05 U	0.002 U

Notes: *U = nondetected at the associated value*
U_J = nondetected, with low recovery of matrix spike
J = associated value is considered an estimate; less than verifiable lower calibration point
J_B = estimate; value less than 2x method blank level
J_C = estimate; noncompliant continuing calibration response
J_{IS} = estimate; noncompliant internal standard area
J_P = estimate; dual-column quant. confirmation > 40% difference
SQO - Sediment Quality Objective
Note: Table adaped from DMD 2006

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	Cu 7440-50-8	Pb 7439-92-1	Hg 7439-97-6	Ni 7440-02-0	Ag 7440-22-4	Zn 7440-66-6	% gravel > 2000 µm	% v. coarse sand 1000-2000 µm	% coarse sand 500-1000 µm	% med. sand 250-500 µm	% fine sand 125-250 µm	% v. fine sand 62-125 µm	% silt 3.9-62.5 µm	% clay < 3.9 µm	% fines < 62.5 µm
SQOs	390	450	0.59	140	6.1	410									
Early Warning Spls.															
Y2-RC01-S	76.5	90	0.1	59	0.8 U	287	22	10	10	11	9.9	9.6	15	12	27
Y2-RC02-S	88.4	97	0.2	31	0.7 U	254	0.8	3.8	16	16	12	0	35	17	52
Y2-RC03-S	73.6	62	0.16	28	0.7 U	166	3.8	2.4	5.0	15	18	9.2	33	14	46
Y2-RC04-S	46.7	44	0.2	19	0.7 U	108	2.8	3.5	5.9	14	18	10	33	13	46
Y2-RC05-S	83.5	76	0.19	32	0.7 U	189	0.4	3.7	4.8	12	17	11	34	17	51
Y2-RC06-S	56.8	47	0.11	24	0.5 U	121	3.6	4.4	11	25	20	6.9	21	8.9	30
Y2-RC07-S	69.9	70	0.15	26	0.6 U	169	4.0	3.3	7.7	19	18	7.7	33	8.1	41
Y2-RC08-S	73.6	73	0.22	30	0.6 U	150	2.3	2.4	7.0	18	16	7.6	32	15	47
Y2-RC09-S	73.5	76	0.28	26	0.7 U	158	0.2	3.4	5.6	13	13	6.7	39	19	58
Y2-RC10-S	24.3	15	0.04 U	20	0.4 U	52.0	56	13	12	8.0	3.2	1.3	4.9	2.6	7.5
Y2-RC11-S	25.3	13	0.06 U	18	0.4 U	56.9	60	10	11	7.1	2.4	1.0	5.7	3.0	8.7
Y2-RC12-S	24.7	19	0.05 U	19	0.4 U	59.9	42	8.5	12	18	6.4	2.0	8.1	3.3	11
Y2-RC13-S	62.3	73	0.12	34	0.6 U	208	7.6	8.1	12	9.4	13	14	25	11	36
Y2-RC14-S	63.9	67	0.13	31	0.5 U	219	32	7.5	12	9.9	8.0	7.7	15	8.2	23
Y2-RC14B-S	67.2	60	0.11	33	0.5 U	194	35	8.7	15	8.9	4.1	4.4	16	8.6	25
Compliance Samples															
Y2-WC01-S	69.4	86	0.1	34	0.8 U	269	21	9.1	808	11	8.9	7.1	20	15	35
Y2-WC02-S	90.8	92	0.22	32	0.7 U	252	0.6	3.0	5.0	12	19	11	34	24	57
Y2-WC03-S	55.7	37	0.13	21	0.6 U	99	1.5	1.9	5.3	16	23	12	26	14	40
Y2-WC04-S	61.2	54	0.18	23	0.6 U	133	7.1	5.2	9.5	19	16	7.2	24	12	36
Y2-WC05-S	31.6	29	0.2	11	0.6 U	63	1.4	2.2	3.6	12	19	11	36	15	51
Y2-WC06-S	52.2	28	0.08	20	0.5 U	80.7	1.0	2.1	6.4	26	30	8.4	17	9.3	26
Y2-WC07-S	59.0	45	0.11	26	0.5 U	112	9.7	4.2	11	28	22	4.4	15	6.6	21
Y2-WC08-S	72.0	64	0.19	24	0.6	134	2.8	2.9	7.7	20	20	8.4	25	14	38
Y2-WC09-S	70.6	66	0.18	25	0.5 U	130	0.5	3.1	7.4	22	20	6.8	26	14	40
Y2-WC10-S	20.6	12	0.05 U	18	0.4 U	44.0	47	12	16	15	4.6	1.0	2.9	1.8	4.7
Y2-WC11-S	17.9	11	0.06 U	16	0.4 U	44.2	49	15	14	9.4	2.6	1.0	5.5	2.6	8.1
Y2-WC12-S	16.9	10	0.05 U	18	0.3 U	39.4	72	8.8	5.7	5.3	2.2	0.8	3.3	1.7	5.0
Y2-WC13-S	61.3	51	0.20	23	0.5 U	116	3.6	3.8	9.0	21	20	8.4	22	13	35
Y2-WC14-S	78.3	70	0.2	28	0.7 U	160	0.6	2.5	4.5	13	18	9.6	33	20	52
Y2-S15-S	23.6	15	0.05 U	23	0.4 U	58.8	53	11	11	11	4.7	1.3	5.7	3.6	9.3
Y2-S17-S	19.9	9	0.04 U	14	0.3 U	43.4	59	14	12	6.9	0.8	1.3	3.4	2.1	5.5
Y2-S19-S	22.0	16	0.05 U	18	0.4 U	50.0	52	12	12	9.1	2.8	1.4	6.2	4.2	10
Y2-S24-S	18.7	11	0.17	14	0.3 U	40.3	68	11	7.3	5.8	3.0	0.9	2.7	1.5	4.2
Slope Samples															
Y2-SC01-S	24.1	5	0.04 U	19	0.3 U	36.6	56	11	11	12	7.3	1.8	0.7	1.0	1.7
Y2-SC02-S	44.6	36	0.05 U	21	0.3 U	87.3	30	14	21	17	7.9	2.1	6.4	2.9	9.3
Y2-SC03-S	78.8	58	0.10	29	0.5 U	169	46	4.9	8.5	8.6	6.5	4.3	14	7.3	21
Y2-SC04-S	51.1	44	0..08	28	0.4 U	119	61	6.0	8.4	7.1	4.5	2.2	6.1	4.4	11

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	Cu 7440-50-8	Pb 7439-92-1	Hg 7439-97-6	Ni 7440-02-0	Ag 7440-22-4	Zn 7440-66-6	% gravel > 2000 µm	% v. coarse sand 1000-2000 µm	% coarse sand 500-1000 µm	% med. sand 250-500 µm	% fine sand 125-250 µm	% v. fine sand 62-125 µm	% silt 3.9-62.5 µm	% clay < 3.9 µm	% fines < 62.5 µm
SQOs	390	450	0.59	140	6.1	410									
Core Samples															
Y2-WC01B-C3	**31.1**	**3**	0.05 U	**15**	0.3 U	**29.5**	28	16	18	21	12	1.5	1.7	0.9	2.6
Y2-WC04-C3	**43.8**	**5**	0.06 U	**21**	0.3 U	**40.8**	21	17	20	24	13	2.9	-----	-----	2.7
Y2-WC05-C3	**35.3**	**3**	0.05 U	**19**	0.3 U	**34.7**	21	14	18	25	17	2.8	-----	-----	2.6
Y2-WC06-C3	**33.6**	**3**	0.05 U	**17**	0.3 U	**31.5**	13	15	20	28	17	3.3	2.0	1.7	3.7
Y2-WC10-C3	**37.8**	**2**	0.05 U	**20**	0.3 U	**33.7**	26	14	19	26	13	1.3	-----	-----	0.8
Y2-WC12-C3	**44.3**	**3**	0.05 U	**25**	0.3 U	**38.1**	29	15	20	24	9.5	0.9	-----	-----	1.2
QA/QC Samples															
Y2-RC15-S	**57.7**	**47**	**0.12**	**24**	0.5 U	**122**	6.3	4.5	11	24	20	6.6	20	8.0	28
Y2-WC15-S	**20.5**	**11**	**0.05**	**20**	0.4 U	**41.6**	54	13	14	8.3	2.3	0.9	5.0	2.3	7.3
Y2-RB-01	**0.002**	**0.04**	0.0001 U	0.01 U	0.003 U	**0.016**	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RB-02	0.002 U	0.02 U	0.0001 U	0.01 U	0.003 U	**0.014**	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RB-03	**0.004**	0.02 U	0.0001 U	0.01 U	0.003 U	**0.017**	-----	-----	-----	-----	-----	-----	-----	-----	-----

Notes: *U = nondetected at the associated value*
U_J = nondetected, with low recovery of matrix spike
J = associated value is considered an estimate; less than verifiable lower calibration point
J_B = estimate; value less than 2x method blank level
J_C = estimate; noncompliant continuing calibration response
J_{IS} = estimate; noncompliant internal standard area
J_P = estimate; dual-column quant. confirmation > 40% difference
SQO - Sediment Quality Objective
Note: Table adaped from DMD 2006

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

Field Sample I.D.	Phenol 108-95-2	1,3-Dichloro-benzene 541-73-1	1,4-Dichloro-benzene 106-46-7	Benzyl alcohol 100-51-6	1,2-Dichloro-benzene 95-50-1	2-Methyl-phenol 95-48-7	4-Methyl-phenol 106-44-5	Hexachloro-ethane 67-72-1	2,4-Dimethyl-phenol 105-67-9	Benzoic acid 65-85-0	1,2,4-Trichloro-benzene 120-82-1
SQOs	420	170	110	73	50	63	670	na	29	640	51
Early Warning Spls.											
Y2-RC01-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC02-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC03-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC04-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC05-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC06-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC07-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC08-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC09-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC10-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC11-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC12-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC13-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC14-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-RC14B-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Compliance Samples											
Y2-WC01-S	**650**	190 U	190 U	190 U	190 U	190 U	**650**	190 U	190 U	1900 U	190 U
Y2-WC02-S	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	1200 U	120 U
Y2-WC03-S	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	73 U	730 U	73 U
Y2-WC04-S	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	1000 U	100 U
Y2-WC05-S	99 U	99 U	99 U	99 U	99 U	99 U	99 U	99 U	99 U	990 U	99 U
Y2-WC06-S	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	600 U	60 U
Y2-WC07-S	83 U	83 U	83 U	83 U	83 U	83 U	83 U	83 U	83 U	830 U	83 U
Y2-WC08-S	94 U	94 U	94 U	94 U	94 U	94 U	94 U	94 U	94 U	940 U	94 U
Y2-WC09-S	90 U	90 U	90 U	90 U	90 U	90 U	90 U	90 U	90 U	900 U	90 U
Y2-WC10-S	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U
Y2-WC11-S	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	440 U	44 U
Y2-WC12-S	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U
Y2-WC13-S	69 U	69 U	69 U	69 U	69 U	69 U	69 U	69 U	69 U	690 U	69 U
Y2-WC14-S	96 U	96 U	96 U	96 U	96 U	96 U	96 U	96 U	96 U	960 U	96 U
Y2-S15-S	51 U	51 U	51 U	51 U	51 U	51 U	51 U	51 U	51 U	510 U	51 U
Y2-S17-S	40 U	40 U	40 U	40 U	40 U	40 U	40 U	40 U	40 U	400 U	40 U
Y2-S19-S	48 U	48 U	48 U	48 U	48 U	48 U	48 U	48 U	48 U	480 U	48 U
Y2-S24-S	39 U	39 U	39 U	39 U	39 U	39 U	39 U	39 U	39 U	390 U	39 U
Slope Samples											
Y2-SC01-S	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U
Y2-SC02-S	21 U	21 U	21 U	21 U	21 U	21 U	21 U	21 U	21 U	**480**	21 U
Y2-SC03-S	88 U	88 U	88 U	88 U	88 U	88 U	88 U	88 U	88 U	880 U	88 U
Y2-SC04-S	79 U	79 U	79 U	79 U	79 U	79 U	**40 J**	79 U	79 U	790 U	79 U

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	Phenol 108-95-2	1,3-Dichloro-benzene 541-73-1	1,4-Dichloro-benzene 106-46-7	Benzyl alcohol 100-51-6	1,2-Dichloro-benzene 95-50-1	2-Methyl-phenol 95-48-7	4-Methyl-phenol 106-44-5	Hexachloro-ethane 67-72-1	2,4-Dimethyl-phenol 105-67-9	Benzoic acid 65-85-0	1,2,4-Trichloro-benzene 120-82-1
SQOs	420	170	110	73	50	63	670	na	29	640	51
Core Samples											
Y2-WC01B-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U
Y2-WC04-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U
Y2-WC05-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U
Y2-WC06-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U
Y2-WC10-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U
Y2-WC12-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	200 U	20 U
QA/QC Samples											
Y2-RC15-S	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Y2-WC15-S	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	44 U	440 U	44 U
Y2-RB-01	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U
Y2-RB-02	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U
Y2-RB-03	1 U	1 U	1 U	5 U	1 U	1 U	1 U	1 U	1 U	10 U	1 U

Notes: *U = nondetected at the associated value*
U_J = nondetected, with low recovery of matrix spike
J = associated value is considered an estimate; less than verifiable lower calibration point
J_B = estimate; value less than 2x method blank level
J_C = estimate; noncompliant continuing calibration response
J_{IS} = estimate; noncompliant internal standard area
J_P = estimate; dual-column quant. confirmation > 40% difference
SQO - Sediment Quality Objective
Note: Table adaped from DMD 2006

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	2-Methyl-naphthalene 91-57-6	Acenaphthene 83-32-9	Acenaph-thylene 208-96-8	Anthracene 120-12-7	Fluorene 86-73-7	Naphthalene 91-20-3	Phenanthrene 85-01-8	LPAHs	Fluoranthene 206-44-0
SQOs	670	500	1300	960	540	2100	1500	5200	2500
Early Warning Spls.									
Y2-RC01-S	160 U	160 U	160 U	**230**	**100 J**	160 U	**1600**	**1930**	**3900**
Y2-RC02-S	160 U	**140 J**	160 U	**370**	**150 J**	**190**	**1700**	**2550**	**5300**
Y2-RC03-S	120 U	120 U	120 U	**210**	120 U	**150**	**820**	**1180**	**2400**
Y2-RC04-S	320 U	**190 J**	320 U	**270 J**	**190 J**	320 U	**1400**	**2050**	**2900**
Y2-RC05-S	150 U	150 U	150 U	**220**	150 U	150 U	**690**	**910**	**1700**
Y2-RC06-S	87 U	87 U	87 U	**130**	87 U	87 U	**610**	**740**	**1400**
Y2-RC07-S	120 U	**110 J**	120 U	**220**	**100 J**	**120 J**	**800**	**1350**	**2200**
Y2-RC08-S	**120**	**170**	**84 J**	**310**	**130**	**330**	**950**	**1974**	**2400**
Y2-RC09-S	**120**	**180**	110 U	**330**	110 U	**340**	**940**	**1790**	**2000**
Y2-RC10-S	26 U	26 U	26 U	**14 J**	26 U	26 U	**65**	**79**	**160**
Y2-RC11-S	48 U	48 U	48 U	48 U	48 U	48 U	**110**	**110**	**290**
Y2-RC12-S	20 U	**30**	**12 J**	**61**	**24**	**39**	**230**	**396**	**580**
Y2-RC13-S	120 U	120 U	120 U	**160**	120 U	120 U	**970**	**1130**	**2600**
Y2-RC14-S	110 U	110 U	110 U	**120**	110 U	110 U	**710**	**830**	**1800**
Y2-RC14B-S	94 U	94 U	94 U	**110**	94 U	94 U	**620**	**730**	**1800**
Compliance Samples									
Y2-WC01-S	190 U	190 U	190 U	**160 J**	190 U	190 U	**810**	**970**	**2100**
Y2-WC02-S	120 U	**130**	**60 J**	**360**	**110 J**	**210**	**1400**	**2270**	**4200**
Y2-WC03-S	73 U	73 U	73 U	**140**	73 U	**99**	**440**	**679**	**1200**
Y2-WC04-S	100 U	**120**	100 U	**220**	**120**	**190**	**840**	**1490**	**2400**
Y2-WC05-S	99 U	**140**	99 U	**310**	**130**	**200**	**1500**	**2280**	**2700**
Y2-WC06-S	60 U	60 U	60 U	**85**	60 U	**62**	**290**	**437**	**760**
Y2-WC07-S	83 U	**54 J**	83 U	**110**	83 U	**90**	**310**	**564**	**880**
Y2-WC08-S	**99**	**150**	**64 J**	**270**	**110**	**290**	**710**	**1594**	**1600**
Y2-WC09-S	**100**	**170**	90 U	**280**	**120**	**300**	**700**	**1570**	**1200**
Y2-WC10-S	20 U	**78**	20 U	**80**	**120**	**13 J**	**680**	**971**	**580**
Y2-WC11-S	44 U	44 U	44 U	44 U	44 U	44 U	**91**	**91**	**240**
Y2-WC12-S	20 U	20 U	20 U	**19 J**	20 U	**12 J**	**90**	**121**	**230**
Y2-WC13-S	69 U	**150**	69 U	**210**	**110**	**210**	**590**	**1270**	**960**
Y2-WC14-S	96 U	**130**	96 U	**260**	**98**	**240**	**680**	**1408**	**1600**
Y2-S15-S	51 U	51 U	51 U	51 U	51 U	51 U	**120**	**120**	**230**
Y2-S17-S	40 U	40 U	40 U	40 U	40 U	40 U	**71**	**71**	**170**
Y2-S19-S	48 U	48 U	48 U	**59**	48 U	**54**	**160**	**273**	**350**
Y2-S24-S	39 U	39 U	39 U	**24 J**	39 U	39 U	**100**	**124**	**230**
Slope Samples									
Y2-SC01-S	20 U	20 U	20 U	20 U	20 U	20 U	**30**	**30**	**63**
Y2-SC02-S	21 U	**17 J**	21 U	**77**	**22**	**20 J**	**250**	**386**	**580**
Y2-SC03-S	88 U	88 U	88 U	**150**	88 U	88 U	**700**	**850**	**1800**
Y2-SC04-S	79 U	**53 J**	79 U	**100**	79 U	**65 J**	**380**	**598**	**750**

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metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	2-Methyl-naphthalene 91-57-6	Acenaphthene 83-32-9	Acenaph-thylene 208-96-8	Anthracene 120-12-7	Fluorene 86-73-7	Naphthalene 91-20-3	Phenanthrene 85-01-8	LPAHs	Fluoranthene 206-44-0
SQOs	670	500	1300	960	540	2100	1500	5200	2500
Core Samples									
Y2-WC01B-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Y2-WC04-C3	20 U	20 U	20 U	20 U	20 U	20 U	**36**	**36**	**66**
Y2-WC05-C3	20 U	20 U	20 U	20 U	20 U	20 U	**11 J**	**11 J**	**27**
Y2-WC06-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	**21**
Y2-WC10-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Y2-WC12-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
QA/QC Samples									
Y2-RC15-S	86 U	86 U	86 U	**140**	86 U	86 U	**600**	**740**	**1300**
Y2-WC15-S	44 U	44 U	44 U	44 U	44 U	44 U	**89**	**89**	**240**
Y2-RB-01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Y2-RB-02	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Y2-RB-03	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes: *U = nondetected at the associated value*
U_J = nondetected, with low recovery of matrix spike
J = associated value is considered an estimate; less than verifiable lower calibration point
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J_{IS} = estimate; noncompliant internal standard area
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TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	Pyrene	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Benzofluor-anthenes	Benzo(a)-pyrene	Indeno(1,2,3-cd)pyrene	Dibenz(a,h)-anthracene	Benzo(ghi)-perylene	HPAHs	Hexachloro-butadiene	Dimethyl-phthalate	Dibenzo-furan
	129-00-0	56-55-3	218-01-9	205-99-2	207-08-9		50-32-8	193-39-5	53-70-3	191-24-2		87-68-3	131-11-3	132-64-9
SQOs	3300	1600	2800	na	na	3600	1600	690	230	720	17000	11	160	540
Early Warning Spls.														
Y2-RC01-S	2200	1100	1800	1600	1700	3300	1400	410	160 U	480	17890	-----	-----	160 U
Y2-RC02-S	3500	1600	2700	2700	2300	5000	2100	620	100 J	790	26710	-----	-----	160 U
Y2-RC03-S	1700	790	1200	1100	1000	2100	970	410	120 U	520	12190	-----	-----	120 U
Y2-RC04-S	2600	960	1500	1600	920	2520	1100	670	320 U	910	15680	-----	-----	320 U
Y2-RC05-S	1600	690	1100	820	1100	1920	840	240	150 U	280	10290	-----	-----	150 U
Y2-RC06-S	1300	540	820	750	780	1530	660	220	87 U	280	8280	-----	-----	87 U
Y2-RC07-S	1600	760	1200	890	890	1780	780	450	120 U	610	11160	-----	-----	120 U
Y2-RC08-S	2000	930	1300	1600	1000	2600	1100	330	130	410	13800	-----	-----	92 U
Y2-RC09-S	2100	950	1300	1600	940	2540	1200	270	110 U	320	13220	-----	-----	110 U
Y2-RC10-S	130	62	94	97	56	153	59	45	26 U	61	917	-----	-----	26 U
Y2-RC11-S	200	82	170	140	120	260	99	49	48 U	61	1471	-----	-----	48 U
Y2-RC12-S	360	190	310	300	230	530	210	82	14 J	100	2906	-----	-----	20 U
Y2-RC13-S	1600	820	1300	1700	820	2520	960	280	120 U	340	12940	-----	-----	120 U
Y2-RC14-S	1100	590	920	860	820	1680	650	210	110 U	260	8890	-----	-----	110 U
Y2-RC14B-S	1100	530	920	1100	620	1720	680	210	94 U	250	8930	-----	-----	94 U
Compliance Samples														
Y2-WC01-S	1400	670	1100	1200	660	1860	690	260	190 U	330	10270	3.5 U	190 U	190 U
Y2-WC02-S	3100	1200	2200	2200	1800	4000	1600	480	81 J	620	21481	3.5 U	120 U	120 U
Y2-WC03-S	920	400	570	530	480	1010	480	250	73 U	320	6160	3.5 U	73 U	73 U
Y2-WC04-S	1900	780	1100	1400	640	2040	860	300	63 J	350	11833	3.5 U	100 U	100 U
Y2-WC05-S	2400	760	1800	1200	760	1960	810	230	99 U	280	12900	3.5 U	99 U	99 U
Y2-WC06-S	580	270	390	400	280	680	310	150	60 U	200	4020	3.4 U	60 U	60 U
Y2-WC07-S	700	320	450	500	320	820	370	110	83 U	130	4600	3.5 U	83 U	83 U
Y2-WC08-S	1700	700	890	1000	790	1790	850	230	94 U	280	9830	3.5 U	94 U	94 U
Y2-WC09-S	1600	660	800	840	760	1600	800	200	90 U	250	8710	3.5 U	90 U	90 U
Y2-WC10-S	300	120	160	110	130	240	88	29	20 U	36	1793	3.5 U	20 U	64
Y2-WC11-S	180	71	140	120	120	240	86	42 J	44 U	48	1287	3.4 U	44 U	44 U
Y2-WC12-S	160	75	120	120	88	208	84	45	20 U	60	1190	3.4 U	20 U	20 U
Y2-WC13-S	1200	510	630	570	670	1240	610	140	69 U	180	6710	3.5 U	69 U	69 U
Y2-WC14-S	1700	690	880	1300	560	1860	790	200	96 U	240	9820	3.6 U	96 U	96 U
Y2-S15-S	250	98 J	160 J	200	110	310	120	51 U	51 U	51 U	1478	3.5 U	51 U	51 U
Y2-S17-S	150	59	100	120	74	194	76	30 J	40 U	38 J	1011	3.4 U	40 U	40 U
Y2-S19-S	290	140	200	240	140	380	170	48 U	48 U	53	1963	3.5 U	48 U	48 U
Y2-S24-S	200	80	120	150	98	248	96	39 J	39 U	45	1306	3.4 U	39 U	39 U
Slope Samples														
Y2-SC01-S	59	26	38	31	31	62	28	24	20 U	24	386	1 U	20 U	20 U
Y2-SC02-S	270	150	260	200 J	200 J	400	180 J	130 J	36 J	120 J	2526	1 U	21 U	21 U
Y2-SC03-S	1100	570	940	900	700	1600	670	260	88 U	340	8880	3.5 U	88 U	88 U
Y2-SC04-S	610	290	450	490	250	740	340	170	79 U	220	4310	3.5 U	79 U	79 U

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	Pyrene 129-00-0	Benzo(a)-anthracene 56-55-3	Chrysene 218-01-9	Benzo(b)-fluoranthene 205-99-2	Benzo(k)-fluoranthene 207-08-9	Benzofluor-anthenes	Benzo(a)-pyrene 50-32-8	Indeno(1,2,3-cd)pyrene 193-39-5	Dibenz(a,h)-anthracene 53-70-3	Benzo(ghi)-perylene 191-24-2	HPAHs	Hexachloro-butadiene 87-68-3	Dimethyl-phthalate 131-11-3	Dibenzo-furan 132-64-9
SQOs	3300	1600	2800	na	na	3600	1600	690	230	720	17000	11	160	540
Core Samples														
Y2-WC01B-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	1 U	20 U	20 U
Y2-WC04-C3	**68**	**25**	**34**	**38**	**19 J**	**57**	**26**	**16 J**	20 U	**22**	**336**	1 U	20 U	20 U
Y2-WC05-C3	**32**	**12 J**	**15 J**	**19 J**	20 U	**19**	**11 J**	20 U	20 U	**10 J**	**126**	1 U	20 U	20 U
Y2-WC06-C3	**23**	20 U	**10 J**	20 U	20 U	20 U	20 U	20 U	20 U	20 U	**54**	1 U	20 U	20 U
Y2-WC10-C3	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	1 U	20 U	20 U
Y2-WC12-C3	**15 J**	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	**15 J**	1 U	20 U	20 U
QA/QC Samples														
Y2-RC15-S	**1300**	**510**	**800**	**900**	**590**	**1490**	**640**	**210**	86 U	**240**	**7980**	-----	-----	86 U
Y2-WC15-S	**180**	**74**	**140**	**160**	**86**	**246**	**90**	**41 J**	44 U	**51**	**1308**	3.4 U	44 U	44 U
Y2-RB-01	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.05 U	1 U	1 U
Y2-RB-02	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.05 U	1 U	1 U
Y2-RB-03	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.05 U	1 U	1 U

Notes: *U = nondetected at the associated value*

U_J = nondetected, with low recovery of matrix spike

J = associated value is considered an estimate; less than verifiable lower calibration point

J_B = estimate; value less than 2x method blank level

J_C = estimate; noncompliant continuing calibration response

J_{IS} = estimate; noncompliant internal standard area

J_P = estimate; dual-column quant. confirmation > 40% difference

SQO - Sediment Quality Objective

Note: Table adaped from DMD 2006

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	Diethyl-phthalate 84-66-2	N-Nitroso-diphenylamine 86-30-6	Hexachloro-benzene 118-74-1	Pentachloro-phenol 87-86-5	Di-n-butyl-phthalate 84-74-2	Butylbenzyl-phthalate 85-68-7	*bis* (2-Ethylhexyl)-phthalate 117-81-7	Di-n-octyl-phthalate 117-84-0
SQOs	200	28	22	360	1400	900	1300	6200
Early Warning Spls.								
Y2-RC01-S	-----	-----	-----	-----	-----	-----	**8300**	-----
Y2-RC02-S	-----	-----	-----	-----	-----	-----	**8700**	-----
Y2-RC03-S	-----	-----	-----	-----	-----	-----	**5100**	-----
Y2-RC04-S	-----	-----	-----	-----	-----	-----	**5900**	-----
Y2-RC05-S	-----	-----	-----	-----	-----	-----	**5400**	-----
Y2-RC06-S	-----	-----	-----	-----	-----	-----	**3900**	-----
Y2-RC07-S	-----	-----	-----	-----	-----	-----	**5400**	-----
Y2-RC08-S	-----	-----	-----	-----	-----	-----	**5400**	-----
Y2-RC09-S	-----	-----	-----	-----	-----	-----	**4700**	-----
Y2-RC10-S	-----	-----	-----	-----	-----	-----	**420**	-----
Y2-RC11-S	-----	-----	-----	-----	-----	-----	**1100**	-----
Y2-RC12-S	-----	-----	-----	-----	-----	-----	**1300**	-----
Y2-RC13-S	-----	-----	-----	-----	-----	-----	**3700**	-----
Y2-RC14-S	-----	-----	-----	-----	-----	-----	**3600**	-----
Y2-RC14B-S	-----	-----	-----	-----	-----	-----	**3800**	-----
Compliance Samples								
Y2-WC01-S	190 U	190 U	3.5 U	960 U	**160 J**	**180 J**	**4300**	**420**
Y2-WC02-S	120 U	120 U	3.5 U	580 U	**170 J_{B}**	**380**	**7700**	**190**
Y2-WC03-S	73 U	73 U	3.5 U	370 U	**200 J_{B}**	**130**	**2300**	**100**
Y2-WC04-S	100 U	100 U	3.5 U	520 U	**290**	**200**	**4600**	**180**
Y2-WC05-S	99 U	99 U	3.5 U	500 U	**240 J_{B}**	**160 J_{IS}**	**3600**	**150 J_{IS}**
Y2-WC06-S	60 U	60 U	3.4 U	300 U	**210 J_{B}**	**110**	**1600**	60 U
Y2-WC07-S	83 U	83 U	3.5 U	410 U	**45 J**	**120**	**1800**	**53 J**
Y2-WC08-S	94 U	94 U	3.5 U	470 U	94 U	**170**	**3400**	**130**
Y2-WC09-S	90 U	90 U	**3.5**	450 U	**340 J_{B}**	**210 J_{IS}**	**4700**	**120 J_{IS}**
Y2-WC10-S	20 U	20 U	3.5 U	98 U	**18 J**	**26**	**460**	**30**
Y2-WC11-S	44 U	44 U	3.4 U	220 U	44 U	**51**	**960**	**84**
Y2-WC12-S	20 U	20 U	3.4 U	98 U	**23**	**28**	**590**	**32**
Y2-WC13-S	69 U	69 U	3.5 U	350 U	**160 J_{B}**	**140 J_{IS}**	**2000**	**87 J_{IS}**
Y2-WC14-S	96 U	96 U	3.6 U	480 U	**150 J_{B}**	**180 J_{IS}**	**3700**	**170 J_{IS}**
Y2-S15-S	51 U	51 U	3.5 U	260 U	**65 J_{B}**	51 U	**930**	**76 J_{IS}**
Y2-S17-S	40 U	40 U	3.4 U	200 U	40 U	**28 J**	**570**	**45**
Y2-S19-S	48 U	48 U	3.5 U	240 U	**62 J_{B}**	48 U	**880**	**66**
Y2-S24-S	39 U	39 U	3.4 U	200 U	39 U	**26 J**	**550**	**34 J**
Slope Samples								
Y2-SC01-S	20 U	20 U	1 U	98 U	20 U	20 U	**85**	20 U
Y2-SC02-S	21 U	21 U	1 U	**73 J**	**38**	**62**	**1000**	**57**
Y2-SC03-S	88 U	88 U	3.5 U	440 U	**110**	**190**	**3400**	**140**
Y2-SC04-S	79 U	79 U	3.5 U	400 U	**50 J**	**130**	**1500**	**62 J**

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	Diethyl-phthalate 84-66-2	N-Nitroso-diphenylamine 86-30-6	Hexachloro-benzene 118-74-1	Pentachloro-phenol 87-86-5	Di-n-butyl-phthalate 84-74-2	Butylbenzyl-phthalate 85-68-7	*bis* (2-Ethylhexyl)-phthalate 117-81-7	Di-n-octyl-phthalate 117-84-0
SQOs	200	28	22	360	1400	900	1300	6200
Core Samples								
Y2-WC01B-C3	20 U	20 U	1 U	98 U	20 U	20 U	**20**	20 U
Y2-WC04-C3	20 U	20 U	1 U	98 U	**14 J**	20 U	**120**	20 U
Y2-WC05-C3	20 U	20 U	1 U	100 U	**11 J**	20 U	**63**	20 U
Y2-WC06-C3	20 U	20 U	1 U	98 U	**10 J**	20 U	**29**	20 U
Y2-WC10-C3	20 U	20 U	1 U	97 U	20 U	20 U	**38**	20 U
Y2-WC12-C3	20 U	20 U	1 U	99 U	20 U	20 U	**20 J**	20 U
QA/QC Samples								
Y2-RC15-S	-----	-----	-----	-----	-----	-----	**3800**	-----
Y2-WC15-S	44 U	44 U	3.4 U	220 U	**63 J_B**	**41 J**	**990**	**86**
Y2-RB-01	1 U	1 U	0.05 U	5 U	1 U	1 U	1 U	1 U
Y2-RB-02	1 U	1 U	0.05 U	5 U	1 U	1 U	1 U	1 U
Y2-RB-03	1 U	1 U	0.05 U	5 U	1 U	1 U	1 U	1 U

Notes: *U = nondetected at the associated value*
U_J = nondetected, with low recovery of matrix spike
J = associated value is considered an estimate; less than verifiable lower calibration point
J_B = estimate; value less than 2x method blank level
J_C = estimate; noncompliant continuing calibration response
J_{IS} = estimate; noncompliant internal standard area
J_P = estimate; dual-column quant. confirmation > 40% difference
SQO - Sediment Quality Objective
Note: Table adaped from DMD 2006

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	4,4'-DDE 72-55-9	4,4'-DDD 72-54-8	4,4'-DDT 50-29-3	Aroclor 1016 12674-11-2	Aroclor 1242 53469-21-9	Aroclor 1248 12672-29-6	Aroclor 1254 11097-69-1	Aroclor 1260 11096-82-5	Aroclor 1221 11104-28-2	Aroclor 1232 11141-16-5	Total PCBs ----
SQOs	9	16	34	na	na	na	na	na	na	na	300
Early Warning Spls.											
Y2-RC01-S	-----	-----	-----	9.9 U	9.9 U	20 U	**40**	**55 J_C**	9.9 U	20 U	**95**
Y2-RC02-S	-----	-----	-----	9.8 U	9.8 U	**23**	**77**	**69**	9.8 U	9.8 U	**169**
Y2-RC03-S	-----	-----	-----	9.8 U	9.8 U	**32 J_P**	**58**	**44**	9.8 U	9.8 U	**134**
Y2-RC04-S	-----	-----	-----	10 U	10 U	**20**	**46**	**42**	10 U	10 U	**108**
Y2-RC05-S	-----	-----	-----	9.8 U	9.8 U	**29 J_P**	**60**	**53**	9.8 U	9.8 U	**142**
Y2-RC06-S	-----	-----	-----	9.8 U	9.8 U	**26 J_P**	**49**	**38**	9.8 U	9.8 U	**113**
Y2-RC07-S	-----	-----	-----	9.9 U	9.9 U	20 U	**43**	**54 J_C**	9.9 U	20 U	**97**
Y2-RC08-S	-----	-----	-----	9.8 U	9.8 U	**22**	**50**	**40**	9.8 U	9.8 U	**112**
Y2-RC09-S	-----	-----	-----	9.8 U	9.8 U	**46 J_P**	**94**	**86**	9.8 U	9.8 U	**226**
Y2-RC10-S	-----	-----	-----	9.9 U	9.9 U	9.9 U	**11 J**	**17 J**	9.9 U	9.9 U	**28**
Y2-RC11-S	-----	-----	-----	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U
Y2-RC12-S	-----	-----	-----	9.8 U	9.8 U	9.8 U	**16 J**	**27 J_C**	9.8 U	9.8 U	**43**
Y2-RC13-S	-----	-----	-----	9.9 U	9.9 U	20 U	**40**	**58 J_C**	9.9 U	20 U	**98**
Y2-RC14-S	-----	-----	-----	9.9 U	9.9 U	15 U	**24**	**38 J_C**	9.9 U	15 U	**62**
Y2-RC14B-S	-----	-----	-----	9.8 U	9.8 U	15 U	**28**	**53 J_C**	9.8 U	15 U	**81**
Compliance Samples											
Y2-WC01-S	7 U	7 U	7 U	9.9 U	9.9 U	9.9 U	**28**	**44 J_C**	9.9 U	15 U	**72**
Y2-WC02-S	7 U	7 U	12 U	9.8 U	9.8 U	**27**	**69**	**64**	9.8 U	9.8 U	**160**
Y2-WC03-S	7 U	7 U	7 U	10 U	10 U	**24**	**47**	**36**	10 U	10 U	**107**
Y2-WC04-S	7 U	7 U	7 U	9.8 U	9.8 U	**17**	**36**	**33**	9.8 U	9.8 U	**86**
Y2-WC05-S	7 U	7 U	7 U	9.8 U	9.8 U	**31 J_P**	**56**	**48**	9.8 U	9.8 U	**135**
Y2-WC06-S	7 U	7 U	7 U	9.8 U	9.8 U	9.8 U	**25**	**19**	9.8 U	9.8 U	**44**
Y2-WC07-S	7 U	7 U	7 U	9.8 U	9.8 U	20 U	**38**	**50 J_C**	9.8 U	20 U	**88**
Y2-WC08-S	7 U	7 U	7 U	9.8 U	9.8 U	**18**	**47**	**46**	9.8 U	9.8 U	**111**
Y2-WC09-S	7 U	7 U	7 U	9.7 U	9.7 U	**32 J_P**	**56**	**48**	9.7 U	9.7 U	**136**
Y2-WC10-S	7 U	7 U	7 U	9.9 U	9.9 U	9.9 U	**8 J**	**10 J**	9.9 U	9.9 U	**18**
Y2-WC11-S	7 U	7 U	7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U
Y2-WC12-S	7 U	7 U	7 U	9.7 U	9.7 U	9.7 U	**5 J**	**7 J**	9.7 U	9.7 U	**12**
Y2-WC13-S	7 U	7 U	7 U	9.7 U	9.7 U	**26**	**54**	**51**	9.7 U	9.7 U	**131**
Y2-WC14-S	7 U	7 U	7 U	9.8 U	9.8 U	**38 J_P**	**77**	**72**	9.8 U	9.8 U	**187**
Y2-S15-S	7 U	7 U	7 U	9.6 U	9.6 U	9.6 U	**12**	**11**	9.6 U	9.6 U	**23**
Y2-S17-S	7 U	7 U	7 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	15 U	9.9 U	9.9 U
Y2-S19-S	7 U	7 U	7 U	9.8 U	9.8 U	9.8 U	**11 J**	**12**	9.8 U	9.8 U	**23**
Y2-S24-S	7 U	7 U	7 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U	9.9 U
Slope Samples											
Y2-SC01-S	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U
Y2-SC02-S	2 U	2 U	2 U	9.9 U	9.9 U	9.9 U	**28**	**32 J_C**	9.9 U	9.9 U	**60**
Y2-SC03-S	7 U	7 U	7 U	9.9 U	9.9 U	20 U	**36**	**35 J_C**	9.9 U	20 U	**71**
Y2-SC04-S	7 U	7 U	7 U	9.8 U	9.8 U	20 U	**44**	**31 J_C**	9.8 U	20 U	**75**

TABLE 1 - Summary of Sediment Quality Data - May 2006 (Year 2)

metals - mg/kg, dry wt.
organics - ug/kg, dry wt.

Field Sample I.D.	4,4'-DDE 72-55-9	4,4'-DDD 72-54-8	4,4'-DDT 50-29-3	Aroclor 1016 12674-11-2	Aroclor 1242 53469-21-9	Aroclor 1248 12672-29-6	Aroclor 1254 11097-69-1	Aroclor 1260 11096-82-5	Aroclor 1221 11104-28-2	Aroclor 1232 11141-16-5	Total PCBs ----
SQOs	9	16	34	na	na	na	na	na	na	na	300
Core Samples											
Y2-WC01B-C3	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U
Y2-WC04-C3	2 U	2 U	2 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U
Y2-WC05-C3	2 U	2 U	2 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U	9.6 U
Y2-WC06-C3	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U
Y2-WC10-C3	2 U	2 U	2 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U	9.8 U
Y2-WC12-C3	2 U	2 U	2 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U	9.7 U
QA/QC Samples											
Y2-RC15-S	-----	-----	-----	9.9 U	9.9 U	**26 J_P**	**42**	**37**	9.9 U	9.9 U	**105**
Y2-WC15-S	7 U	7 U	7 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Y2-RB-01	0.1 U	0.1 U	0.1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Y2-RB-02	0.1 U	0.1 U	0.1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Y2-RB-03	0.1 U	0.1 U	0.1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes: *U = nondetected at the associated value*

U_J = nondetected, with low recovery of matrix spike

J = associated value is considered an estimate; less than verifiable lower calibration point

J_B = estimate; value less than 2x method blank level

J_C = estimate; noncompliant continuing calibration response

J_{IS} = estimate; noncompliant internal standard area

J_P = estimate; dual-column quant. confirmation > 40% difference

SQO - Sediment Quality Objective

Note: Table adaped from DMD 2006

TABLE 2 - Fine Grained Layer Thicknesses and "Fines" Contents of Samples

Location	Apr-04			Nov./Dec-04			May -05			May -06		
	Fines Thickness (cm)	Sample Thickness (cm)(a)	% Fines (GS)(b)	Fines Thickness (cm)	Sample Thickness (cm)(a)	% Fines (GS)(b)	Fines Thickness (cm)	Sample Thickness (cm)	% Fines (GS)(b)	Fines Thickness (cm)	Sample Thickness (cm)	% Fines (GS)(b)
Early Warning Samples												
RC-1	(c)	2	12	1	2	6.3	1.5	2	30	-----	2	27
RC-1B	-----	-----	-----	-----	-----	----	-----	-----	----	19	-----	-----
RC-2	(c)	2	36	8	8	44	9	2	51	16	2	52
RC-3	(c)	2	73	12	12	54	10	2	39	11	2	46
RC-4	(c)	2	34	9	9	46	13	2	68	9 to 17	2	46
RC-5	(c)	2	54	11	11	58	10	2	60	12	2	51
RC-6	(c)	2	26	5	5	53	4.5	2	55	1 to 10	2	30
RC-7	(c)	2	6.2	4	4	33	3	2	26	6	2	41
RC-8	(c)	2	5.2	5	5	47	4	2	62	7	2	47
RC-9	(c)	2	25	6	6	40	5.5	2	64	7	2	58
RC-10	(c)	2	20	3	3	52	5	2	65	0.5	2	7.5
RC-11	(c)	2	24	7	-----	-----	10.5	2	79	1	2	8.7
RC-12	(c)	2	1.9	3	3	67	5	2	72	1	2	11
RC-13	(c)	2	18	1	2	6.3	1	2	15	2	2	36
RC-14	(c)	2	34	1	2	13	1.5	2	20	2	2	23
RC-14B	-----	-----	-----	-----	-----	-----	1.5	2	18	1	2	25
S-16	-----	-----	-----	5	5	62	5	-----	-----	-----	-----	-----
S-17	-----	-----	-----	2	2	48	6	-----	-----	0.5	-----	-----
S-18	-----	-----	-----	7	7	40	3	-----	-----	-----	-----	-----
S-19	-----	-----	-----	4	4	60	8	-----	-----	2	-----	-----
S-20	-----	-----	-----	2	2	21	3.5	-----	-----	-----	-----	-----
S-21	-----	-----	-----	7	7	69	-----	-----	-----	-----	-----	-----
S-22	-----	-----	-----	8	8	48	6.5	-----	-----	-----	-----	-----
S-23	-----	-----	-----	3	3	39	-----	-----	-----	-----	-----	-----
S-24	-----	-----	-----	2	3	43	6	-----	-----	0.5	-----	-----
Compliance Samples												
WC-1	(c)	10	7.8	1	10	7.2	1.5	10	-----	-----	10	35
WC-1B	-----	-----	-----	-----	-----	-----	-----	-----	-----	19	-----	-----
WC-2	(c)	10	24	8	10	-----	9	10	37	16	10	57
WC-3	(c)	10	43	12	10	-----	10	10	-----	11	10	40
WC-4	(c)	10	16	9	10	37	13	10	37	9 to 17	10	36
WC-5	(c)	10	31	11	10	61	10	10	48	12	10	51
WC-6	(c)	10	11	5	-----	-----	4.5	10	-----	1 to 10	10	26

TABLE 2 - Fine Grained Layer Thicknesses and "Fines" Contents of Samples

Location	Apr-04			Nov./Dec-04			May -05			May -06		
	Fines Thickness (cm)	Sample Thickness (cm)(a)	% Fines (GS)(b)	Fines Thickness (cm)	Sample Thickness (cm)(a)	% Fines (GS)(b)	Fines Thickness (cm)	Sample Thickness (cm)	% Fines (GS)(b)	Fines Thickness (cm)	Sample Thickness (cm)	% Fines (GS)(b)
WC-7	(c)	10	2.5	4	10	17	3	10	7.2	6	10	21
WC-8	(c)	10	3.3	5	-----	-----	4	10	-----	7	10	38
WC-9	(c)	10	11	6	10	31	5.5	10	-----	7	10	40
WC-10	(c)	10	7.1	3	10	15	5	10	-----	0.5	10	4.7
WC-11	(c)	10	13	7	10	33	10.5	10	77	1	10	8.1
WC-12	(c)	10	2	3	10	25	5	10	-----	1	10	5
WC-13	(c)	10	5.7	-----	-----	-----	-----	-----	-----	7	10	35
WC-14	(c)	10	9.0	-----	-----	-----	-----	-----	-----	7	10	52
S-15	-----	-----	-----	12	10	52	11.5	10	58	2	10	9.3
S-16	-----	-----	-----	5	10	28	5	10	-----	-----	-----	-----
S-17	-----	-----	-----	2	10	-----	6	10	43	0.5	10	5.5
S-18	-----	-----	-----	7	10	-----	3	10	-----	-----	-----	-----
S-19	-----	-----	-----	4	10	25	8	10	-----	2	10	10
S-20	-----	-----	-----	2	10	-----	3.5	10	-----	-----	-----	-----
S-21	-----	-----	-----	7	10	-----	-----	-----	-----	-----	-----	-----
S-22	-----	-----	-----	8	10	-----	6.5	10	-----	-----	-----	-----
S-23	-----	-----	-----	3	-----	-----	-----	-----	-----	-----	-----	-----
S-24	-----	-----	-----	2	10	-----	6	10	25	0.5	10	4.2
S-25	-----	-----	-----	7	-----	-----	-----	-----	-----	-----	-----	-----
S-26	-----	-----	-----	2	-----	-----	-----	-----	-----	-----	-----	-----
S-27	-----	-----	-----	5	-----	-----	-----	-----	-----	-----	-----	-----
S-28	-----	-----	-----	2	-----	-----	-----	-----	-----	-----	-----	-----
S-29	-----	-----	-----	4	10	-----	5	10	-----	-----	-----	-----
S-30	-----	-----	-----	1	-----	-----	3	10	-----	-----	-----	-----

Notes: (a) - In Nov./Dec. 2004, "RC" designated samples consisted of the full thickness of the fine grained sediment that had accumulated on the Utilities' Cap, except where accumulations were less than 2 cm. Where less than 2 cm of fine grained sediment was present, a 0 to 2 cm thick sample was obtained that also included some of the underlying capping material.

(b) - Based on grain size analysis (GS), less than 62.5 micron (um) in size

(c) - A variable thickness of a fine sandy silt material was observed to have accumulated since the final capping material was placed. This fine-grained material ranged from a thin coating up to approximately 1 cm thick and comprised a larger percentage of the 0 to 2 cm samples as compared to the 0 to 10 cm samples.

TABLE 3 - Sediment Trap Concentrations - 2002 to 2005

	Lead	Mercury	Zinc	Diesel	Heavy Oil	LPAH	HPAH	BEHP	4,4'-DDD	4,4'-DDE	4,4'-DDT	T-PCBs
Units	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(ug/kg)**	**(ug/kg)**	**(ug/kg)**	**(ug/kg)**	**(ug/kg)**	**(ug/kg)**	**(ug/kg)**
SQO	450	0.59	410	None	None	5200	17000	1300	16	9	34	300
237A-FD2												
3/26/2002	78.9	0.04	220 J	160	2100	2263	17850	4600	6.3 U	6.3 U	8.5	84
4/28/2003	114 J	0.11 J	365 J	130	3700	5920	40020	22000	4 UJ	4 U	28.6 J	62
4/8/2004	114	0.07 J	307	97	2000	5840	35220	11000	8 UJ	8 UJ	11 J	110
4/19/2005	74.5	0.06 J	290	72	2400	5750	36000	14000	9.5 U	9.5 U	9.5 U	101
237B-FD1												
3/26/2002	56.7	0.05	185 J	37 J	1400	823	4193	3000	1.4 B	1.3 B	4.2 B	30
4/28/2003	129 J	0.16 J	277 J	72	3000	4509	28310	17000	4 UJ	4 U	12.9 J	8 U
4/8/2004	72.3	0.10 J	233	60	1800	3349	20100	8500	8 UJ	8 UJ	9.3 J	75 U
4/19/2005	35.7	0.04 UJ	123	25 U	750	1960	6090	3600	8.2 U	8.2 U	8.2 U	35
235-FD6												
3/26/2002	144	0.08	348	110	3100	1158	6550	9700	5.8 U	5.8 U	14	79
4/28/2003	202	0.08	332	130 UJ	2300	2200	11030	22000	6.3 UJ	6.3 U	6.3 U	40.6
4/8/2004	96.4	0.06 J	296	92	1700	1322	5588	10000	7.9 UJ	7.9 UJ	7.9 UJ	65 U
4/19/2005	94.9	0.05 J	219	86	1600	1400	4680	15000	10 U	10 U	10 U	23
243-FD23												
3/26/2002	388	0.60	742	670	3800	1529	7440	16000	-----	-----	-----	-----
4/28/2003	-----	-----	-----	190	7200	4830	15720	41000	34 U	34 U	34 U	220
4/8/2004	430	0.97 J	649	220	4700	2037	10020	18000	8 UJ	8 UJ	9.6 J	206
4/19/2005	-----	-----	-----	240	6600	3140	8500	37000	-----	-----	-----	-----

Range (detections)

	Lead	Mercury	Zinc	Diesel	Heavy Oil	LPAH	HPAH	BEHP	4,4'-DDD	4,4'-DDE	4,4'-DDT	T-PCBs
High	430	0.972	742	670	7200	5920	40020	41000	1.4 B	1.3 B	34	220
Low	35.7	0.036	123	25	750	823	4193	3000	1.4 B	1.3 B	6.3	8
Average	145	0.18	328	149	3009	3002	16082	15775	-----	-----	13	81
Geomean	114	0.10	295	110	2564	2507	12221	12466	-----	-----	11	60

Notes: Source - Table E-15 in Stormwater Monitoring, August 2001-2005 Report, Thea Foss and Wheeler-Osgood Waterways, Prepared by City of Tacoma, January 2006.
U - Not detected at indicated value
J - Estimated concentration
C - Analyte detected in laboratory blank
----- - Not reported
SQO - Commencement Bay Sediment Quality Objective

TABLE 4 - Comparison of Concentration Ranges in Stormwater Sediment

Contituent	Units	Vactor Truck Wastes (a)	In-Line Sediment Traps (2002-2005)(b)	Thea Foss Sediment (0 to 2 cm, May 2006)
Lead	mg/kg	47-194	36-430	47-90
Mercury	mg/kg	0.04-0.17	0.04-0.97	0.1-0.28
Zinc	mg/kg	90-558	123-742	108-287
Petroleum Hydrocarbons	mg/kg	440-4600(d)	750-7200(e)	1700-4700(e)
LPAHs (f)	ug/kg	160-13050	823-5920	730-2550
HPAHs (g)	ug/kg	1430-136800	4193-40020	6750-14590
BEHP	ug/kg	1700-30000	3000-41000	3600-8700
PCBs	ug/kg	nd(c)	<8-220	62-226

Notes:

(a) - From Sedar (1992) - Includes residential, commercial and industrial properties.

(b) - From Tacoma (2005)

(c') - Relatively high reporting limits (230 ug/kg to 540 ug/kg) are reported. PCBs may have been present at lower concentrations.

(d) - Based on EPA Method 418.1

(e) - Heavy-oil range hydrocarbons

(f) - Sum of acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene conc.

(f) Sum of fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, benzo(g,h,i)perylene conc.

TABLE 5 - Comparison of Surface and Core Sediment Quality - May 06 (Year 2) Data

Sample Interval	RC/WC-04					
	BEHP (ug/kg)	HPAHs (ug/kg)	LPAHs (ug/kg)	Lead (mg/kg)	Zinc (mg/kg)	PCBs (ug/kg)
0 to 2 cm	5900	13160	2050	44	108	108
0 to 10 cm	4600	9793	1490	54	133	86
Cap (0.7 to 1.5 ft.)	120	279	36	5	41	<10

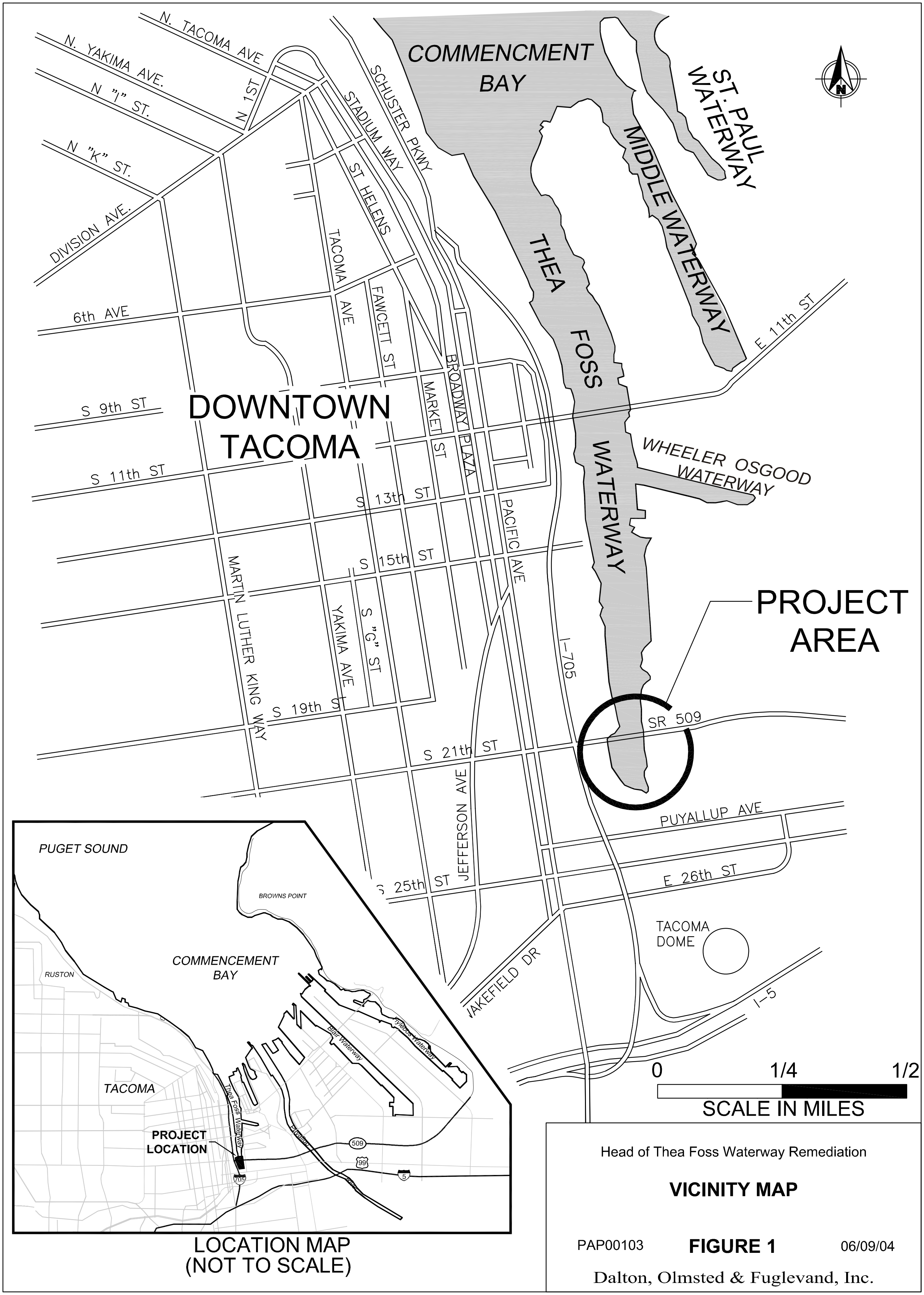
Sample Interval	RC/WC-05					
	BEHP (ug/kg)	HPAHs (ug/kg)	LPAHs (ug/kg)	Lead (mg/kg)	Zinc (mg/kg)	PCBs (ug/kg)
0 to 2 cm	5400	8370	910	76	189	142
0 to 10 cm	3600	10940	2280	29	63	135
Cap (0.3 to 1.5 ft.)	63	126	11	3	35	<10

Sample Interval	RC/WC-06					
	BEHP (ug/kg)	HPAHs (ug/kg)	LPAHs (ug/kg)	Lead (mg/kg)	Zinc (mg/kg)	PCBs (ug/kg)
0 to 2 cm	3900	6750	740	47	121	113
0 to 10 cm	1600	3340	437	28	81	44
Cap (1.2 to 1.8 ft.)	29	54	<20	3	32	<10

Sample Interval	RC/WC-10					
	BEHP (ug/kg)	HPAHs (ug/kg)	LPAHs (ug/kg)	Lead (mg/kg)	Zinc (mg/kg)	PCBs (ug/kg)
0 to 2 cm	420	764	79	15	52	28
0 to 10 cm	460	1553	971	12	44	18
Cap (1.0 to 2.5 ft.)	38	<20	<20	2	34	<10

Sample Interval	RC/WC-12					
	BEHP (ug/kg)	HPAHs (ug/kg)	LPAHs (ug/kg)	Lead (mg/kg)	Zinc (mg/kg)	PCBs (ug/kg)
0 to 2 cm	1300	2376	396	19	60	43
0 to 10 cm	590	982	121	10	39	12
Cap (0.4 to 1.1 ft.)	20	15	<20	3	38	<10

Notes: BEHP - bis(2-ethylhexl)phthalate
HPAH - Sum of high molecular weight PAHs
LPAH - Sum of low molecular weight PAHs
PCBs - Polychlorinated biphenyls



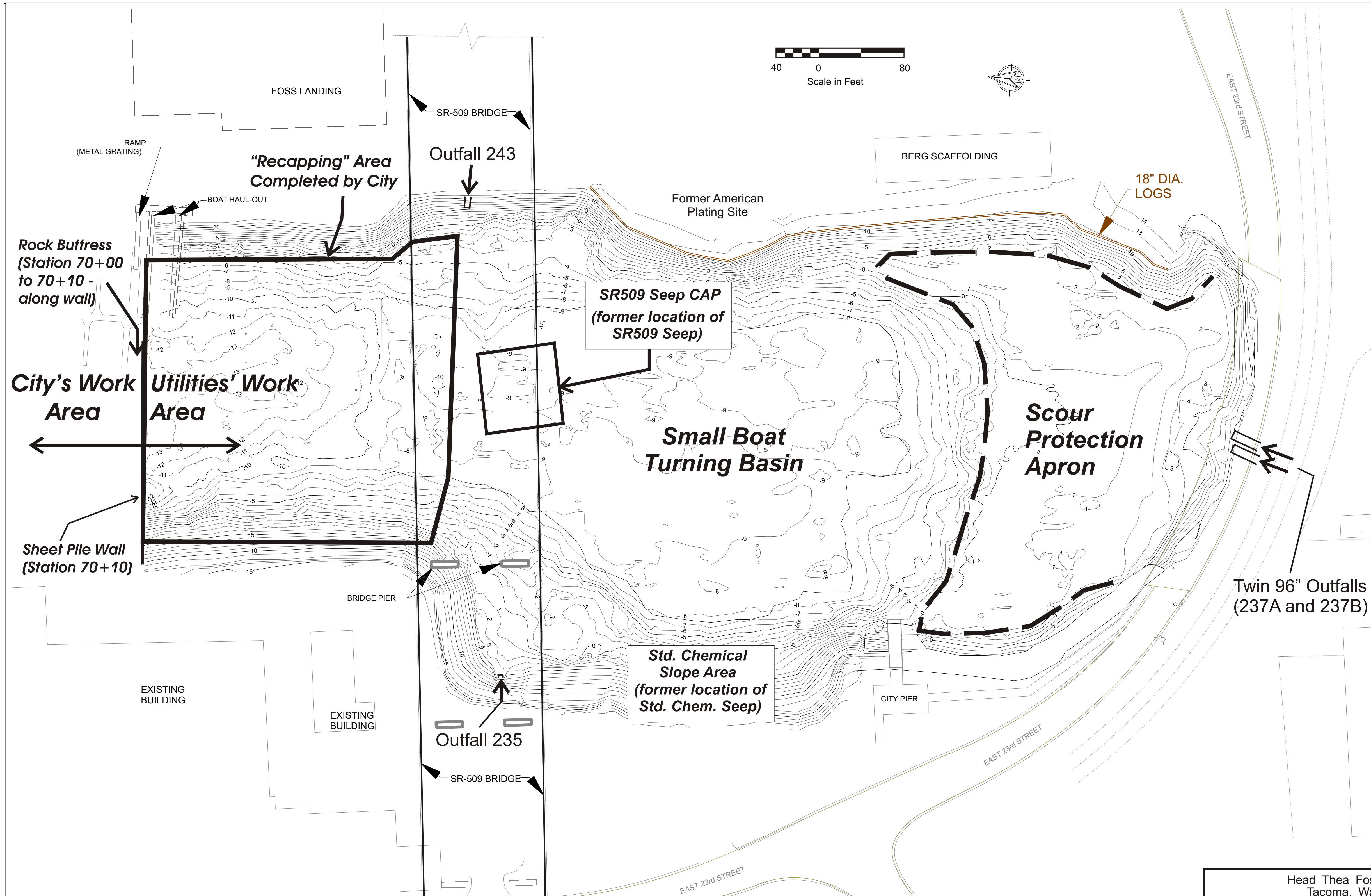
Head of Thea Foss Waterway Remediation

VICINITY MAP

PAP00103 **FIGURE 1** 06/09/04

Dalton, Olmsted & Fuglevand, Inc.

PAP00103-11



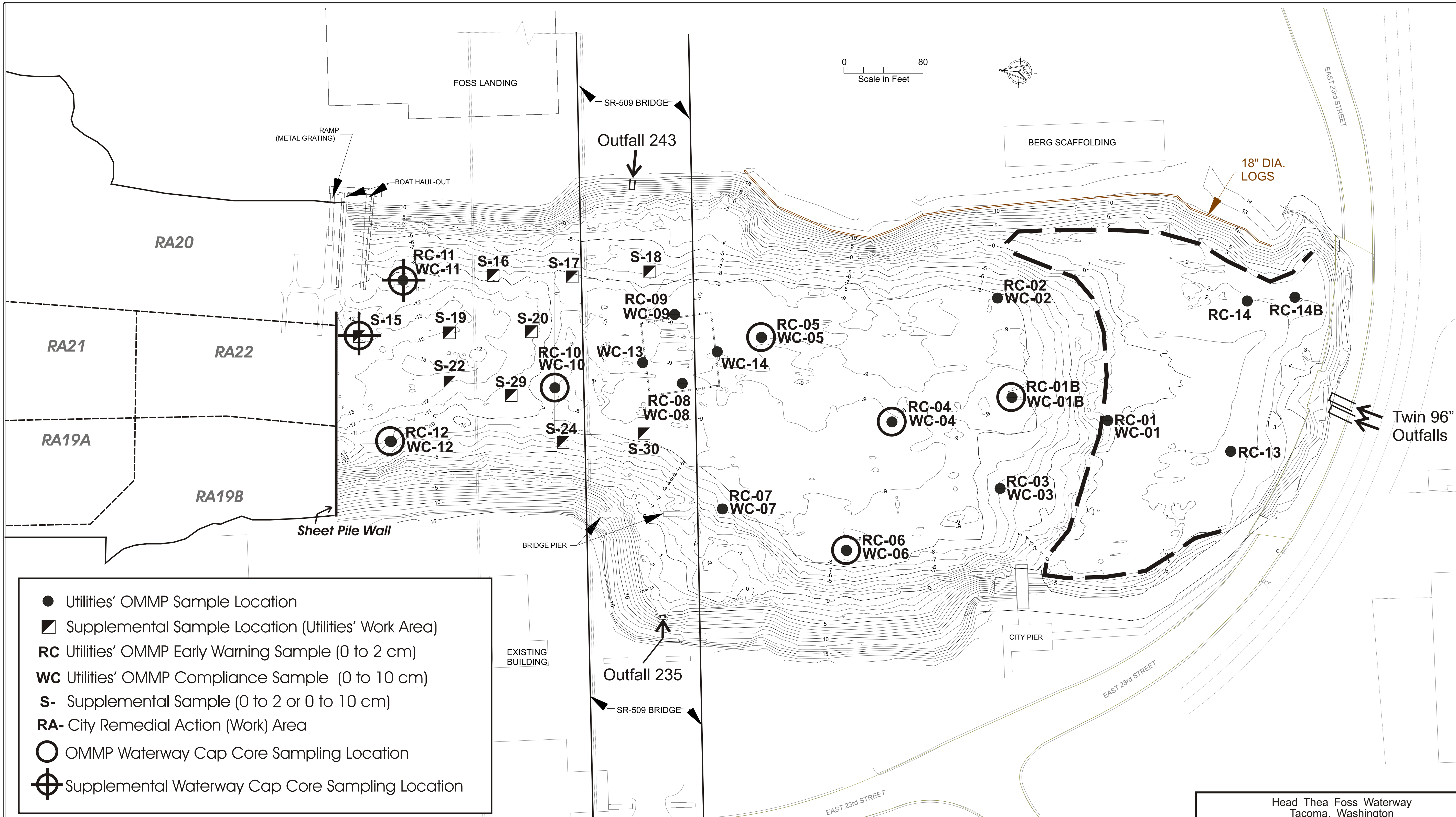
Head Thea Foss Waterway
Tacoma, Washington

Remedial Features
Utilities' Work Area

PAP-001-04 **FIGURE 2** Sept. 2006

Dalton, Olmsted & Fuglevand, Inc.

Ref: Head of waterway b 2006.cdr



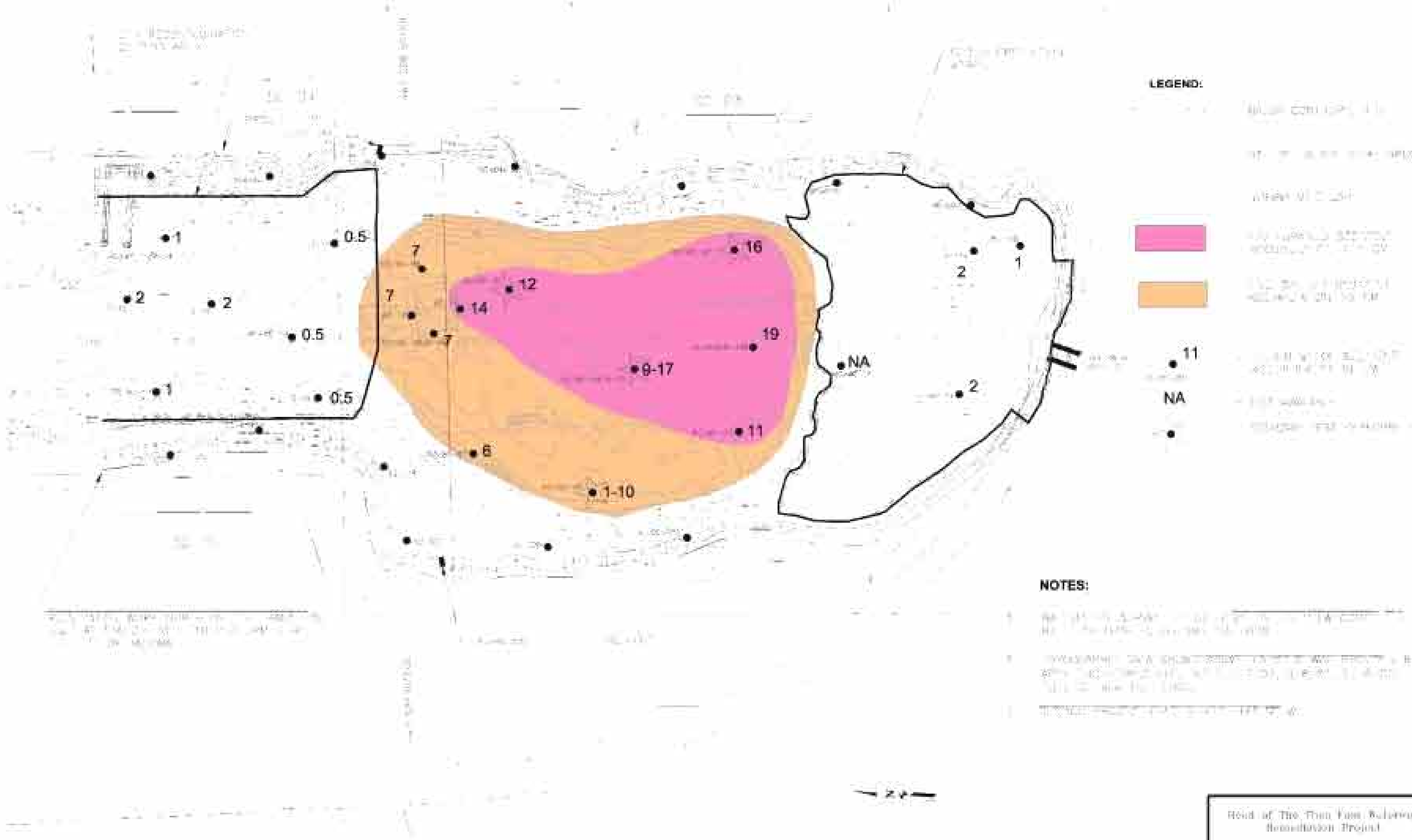
Ref: Sur Spl Loc Map 2006.cdr

Head Thea Foss Waterway
Tacoma, Washington

Sediment Sampling Locations
Utilities Work Area
April 2004 to May 2006

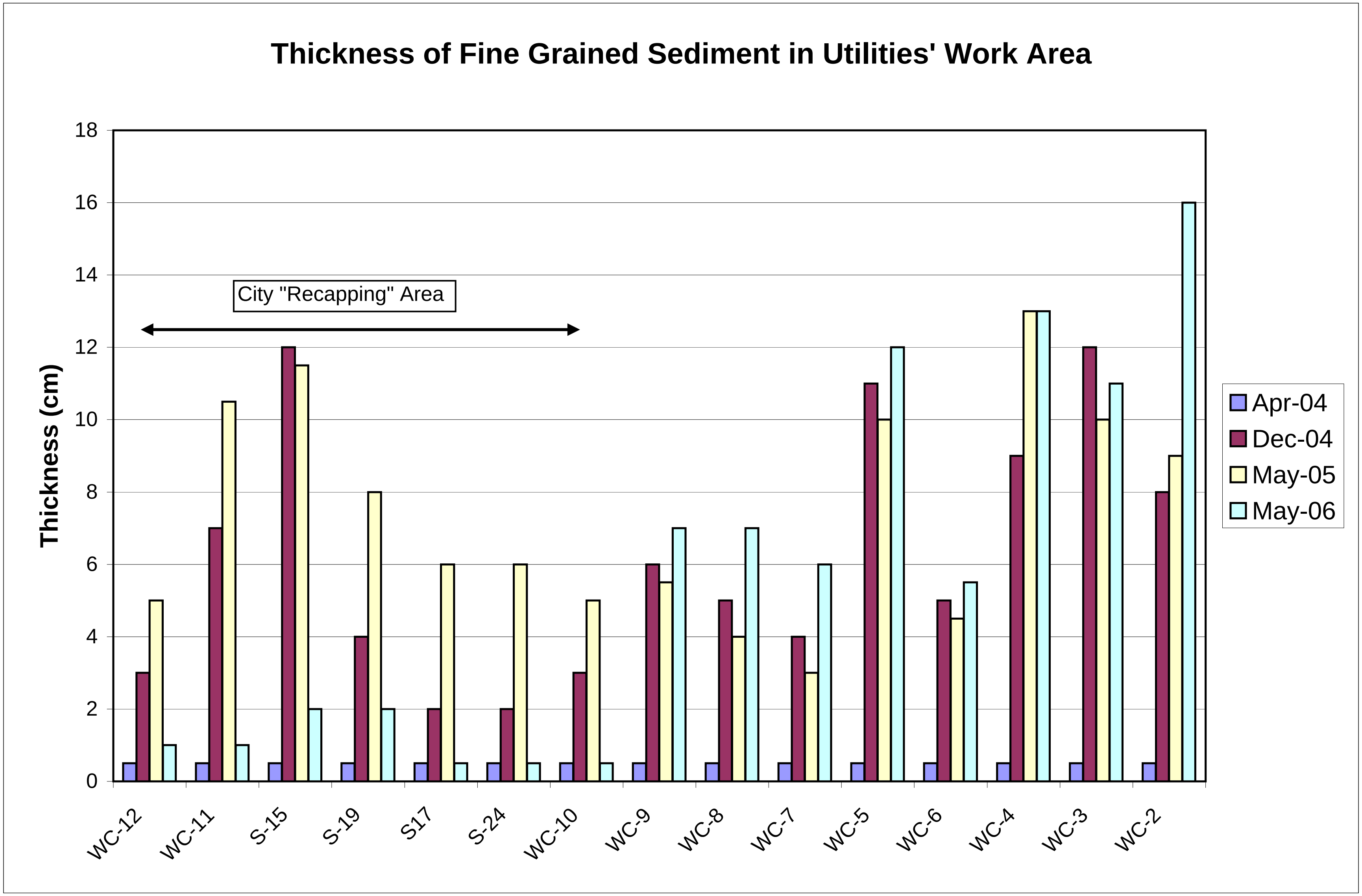
PAP-001-04 **FIGURE 3** Sept. 2006

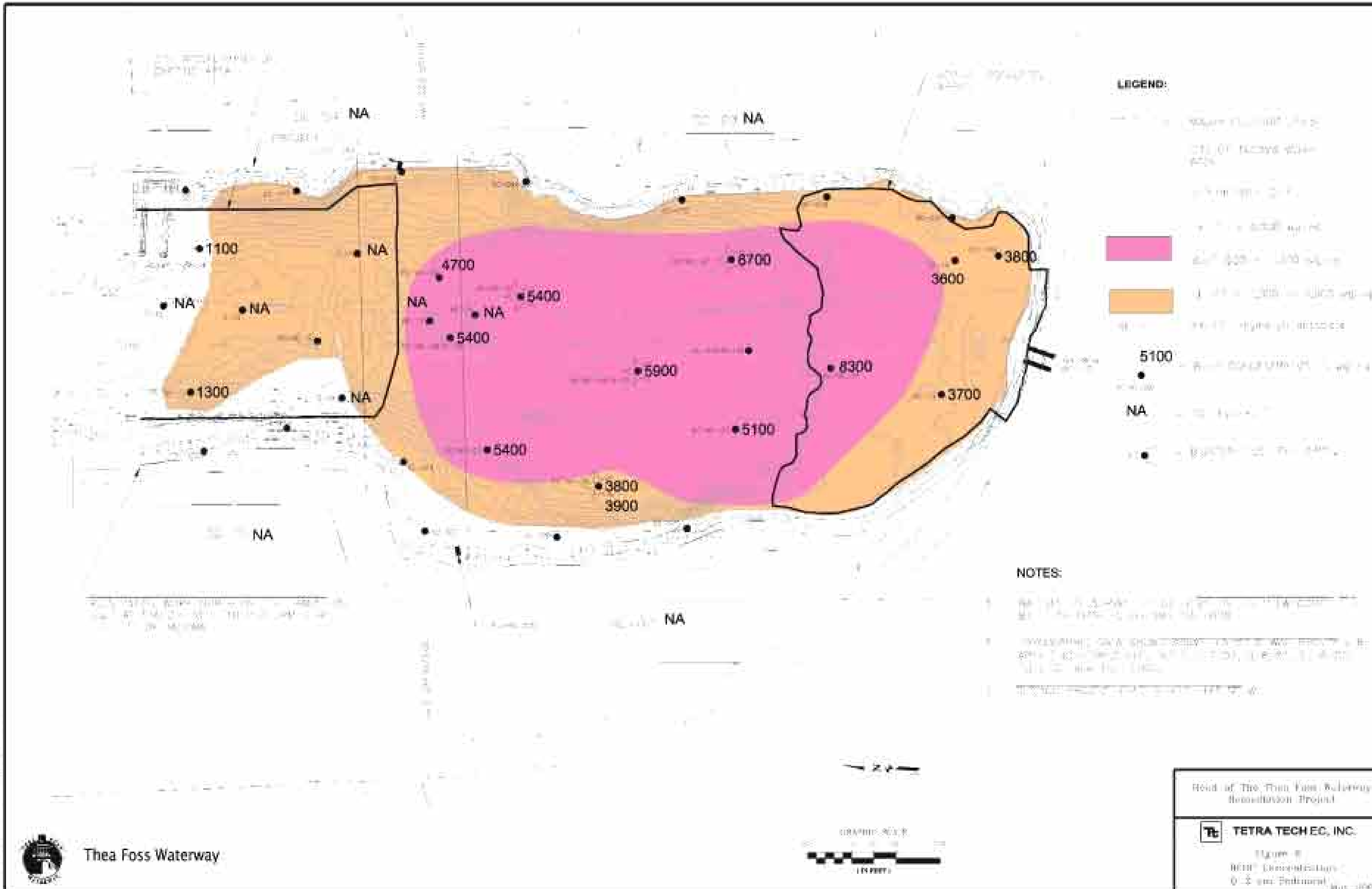
Dalton, Olmsted & Fuglevand, Inc.



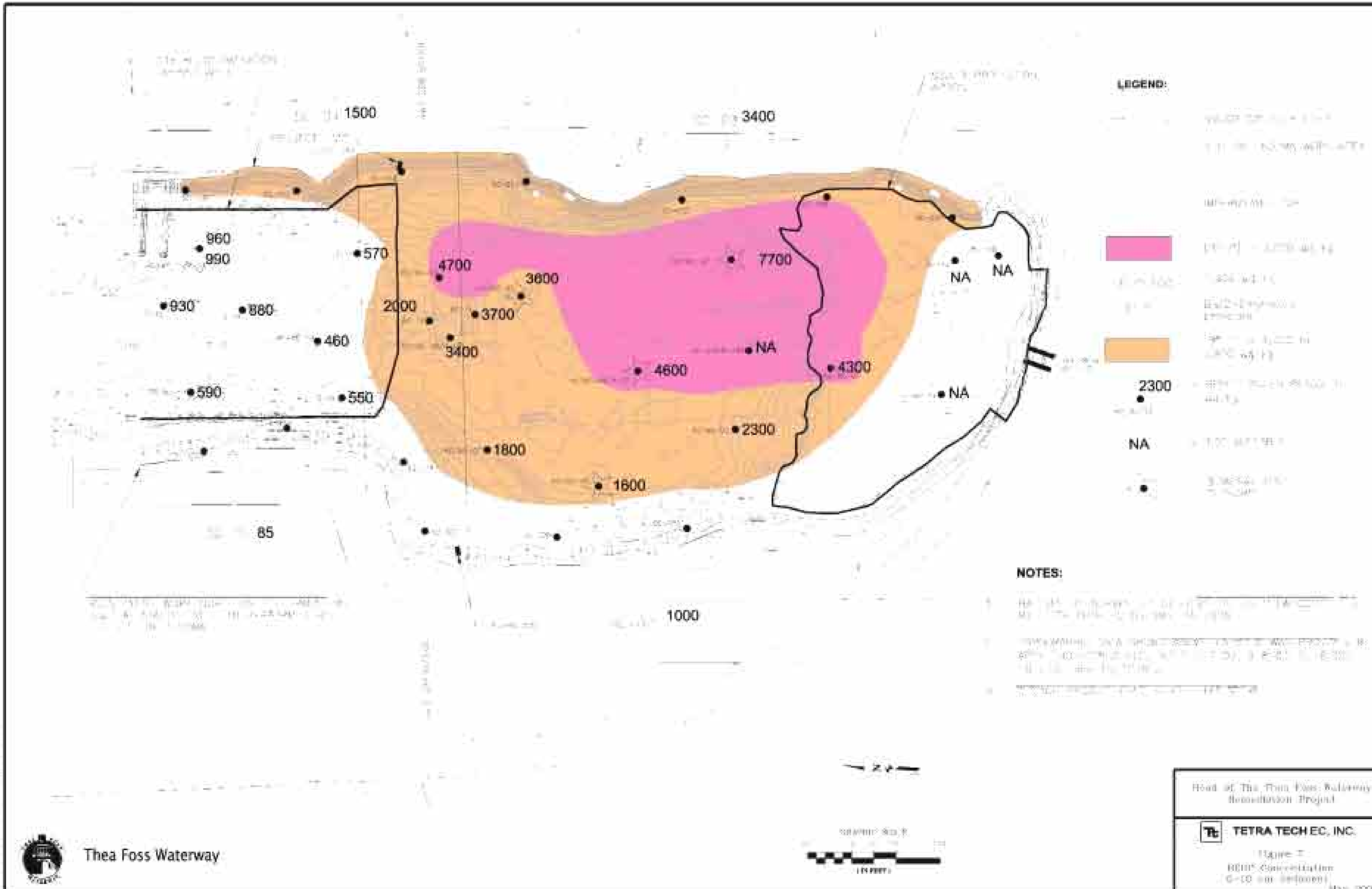
Thea Foss Waterway

TETRA TECH EC, INC.

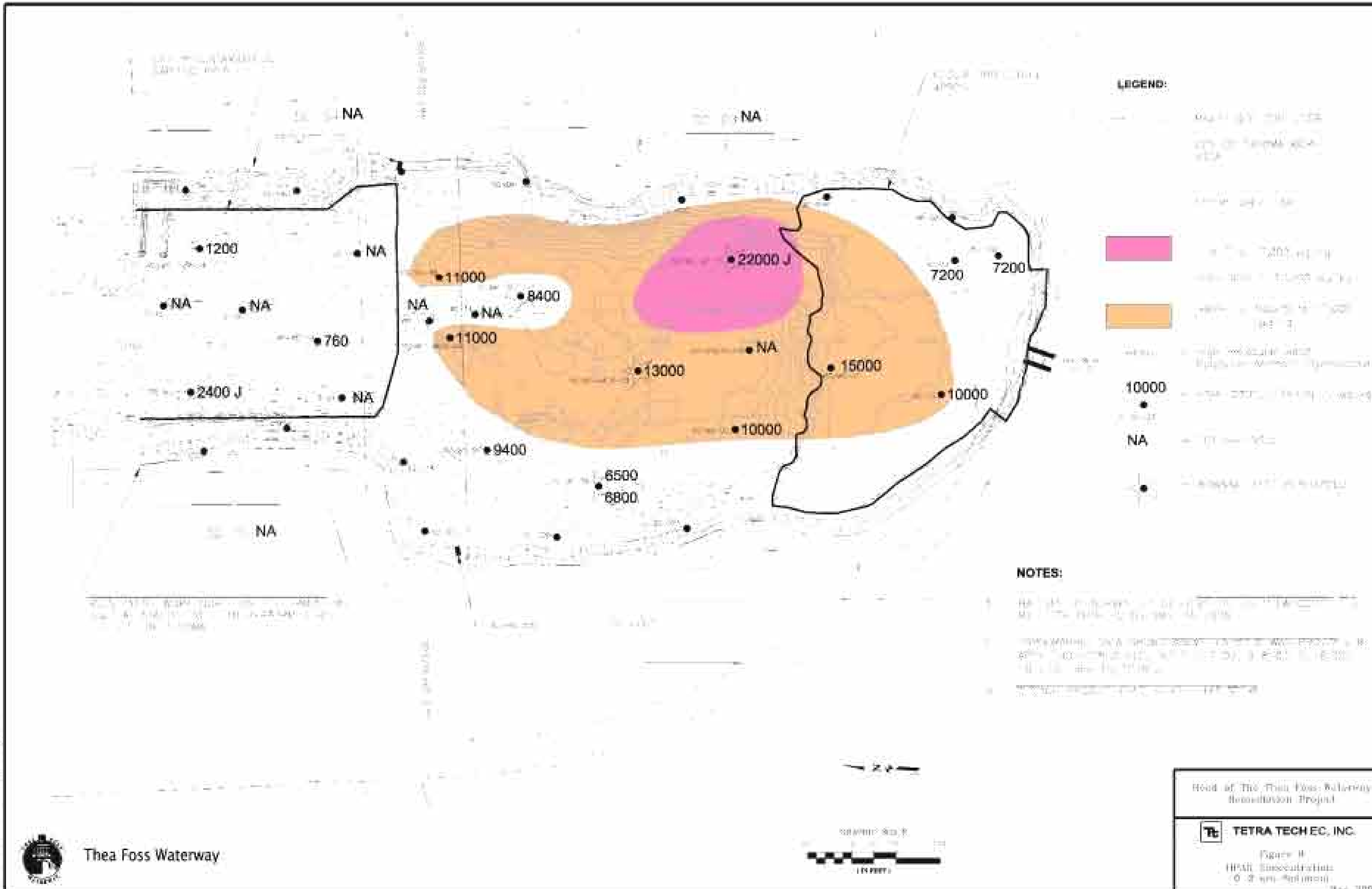

Thickness of Fine Grained Sediment in Utilities' Work Area
Thickness (cm)
0
2
4
6
8
10
12
14
16
18
City "Recapping" Area
WC-12
WC-11
S-15
S-19
S17
S-24
WC-10
WC-9
WC-8
WC-7
WC-5
WC-6
WC-4
WC-3
WC-2
Apr-04
Dec-04
May-05
May-06



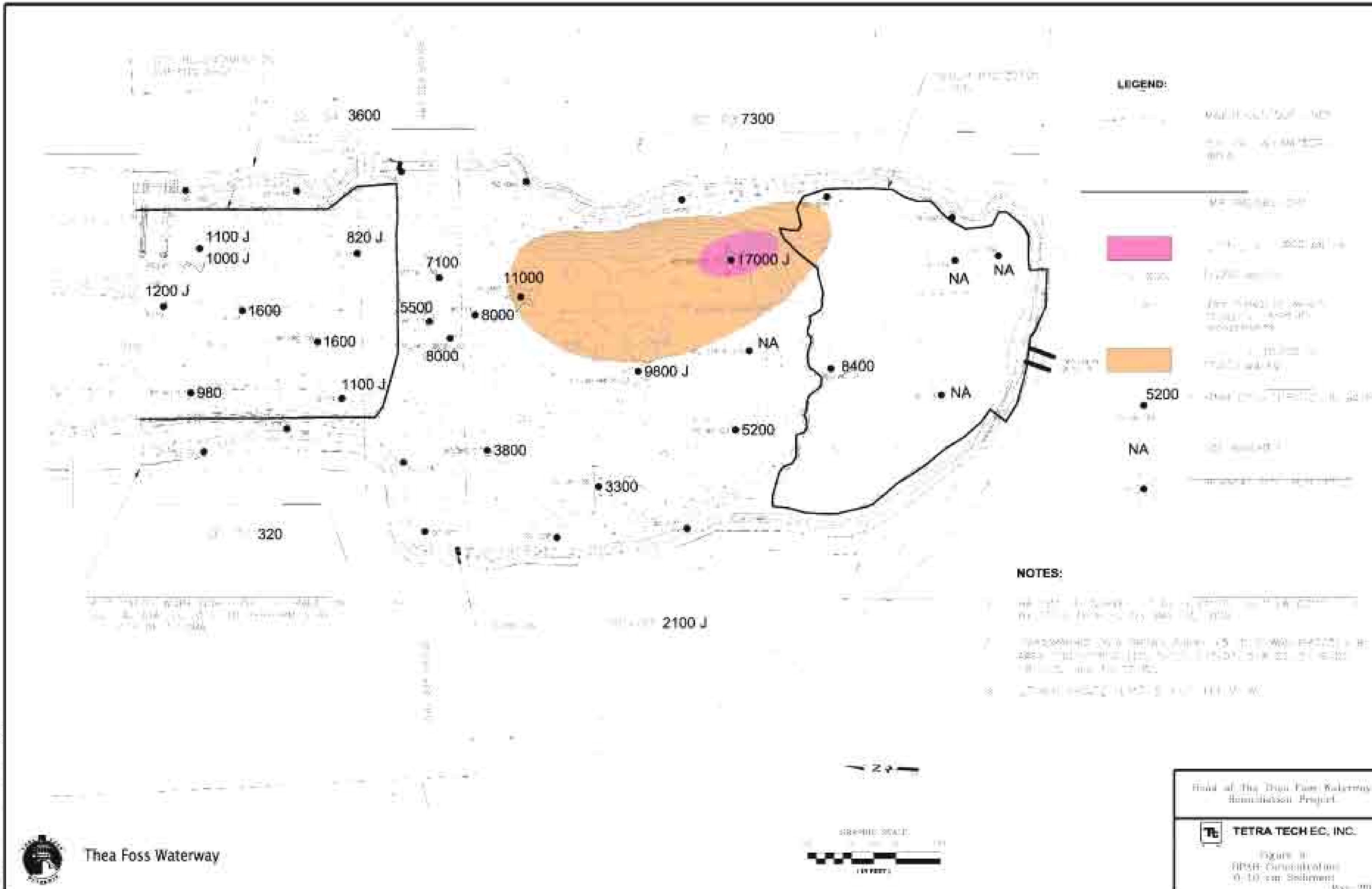
LEGEND:
5100
NA
NOTES:
NA
NA
1100
NA
NA
NA
4700
NA
5400
NA
5400
8700
3800
3600
1300
NA
5900
8300
3700
5100
5400
3800
3900
NA
NA
TETRA TECH EC, INC.
Thea Foss Waterway

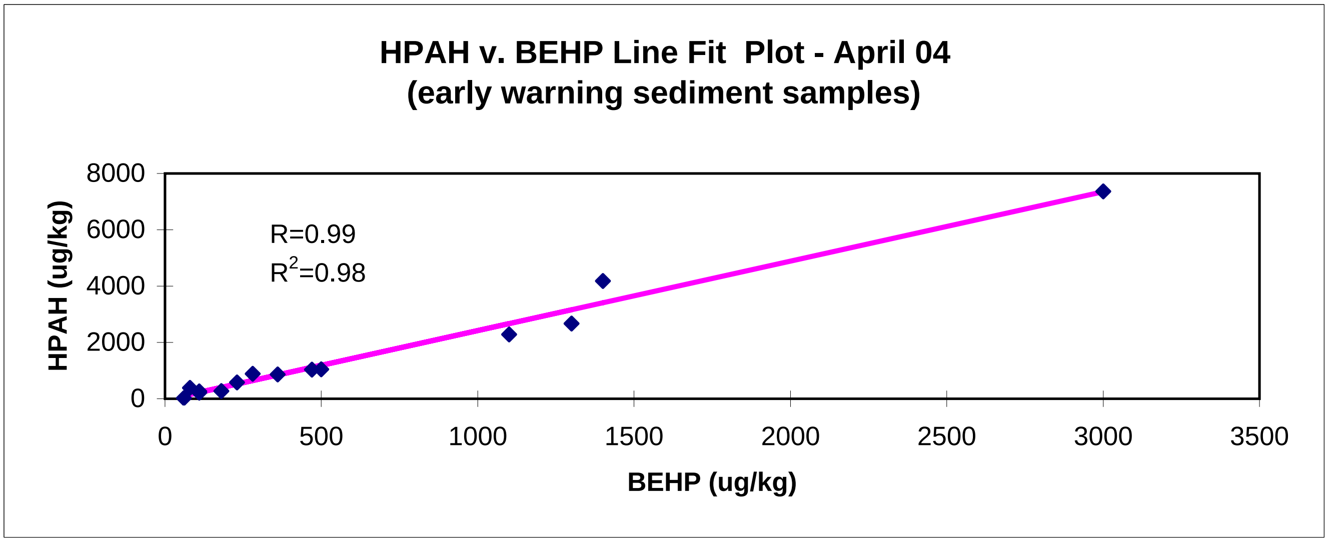


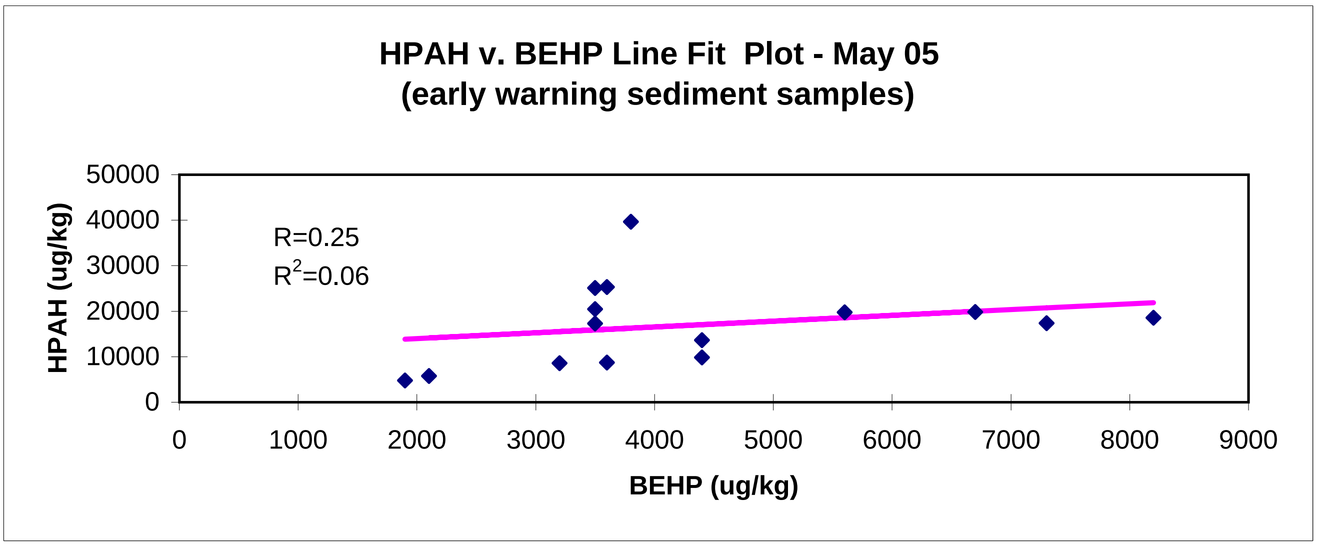
LEGEND:
NOTES:
1500
3400
960
990
570
4700
3600
7700
930
880
2000
3700
460
3400
NA
4600
4300
590
550
2300
1800
1600
85
1000
NA
NA
NA
2300
NA
Thea Foss Waterway
TETRA TECH EC, INC.



LEGEND:
10000
NA
NOTES:
NA
NA
1200
NA
11000
22000 J
7200
7200
NA
NA
NA
8400
NA
760
11000
NA
15000
13000
2400 J
NA
10000
10000
9400
6500
6800
NA
Thea Foss Waterway
TETRA TECH EC, INC.


3600
7300
LEGEND:
1100 J
1000 J
820 J
7100
11000
17000 J
NA
NA
1200 J
1600
5500
8000
1600
8000
NA
9800 J
8400
1100 J
980
NA
5200
5200
NA
3800
3300
320
NOTES:
2100 J
TETRA TECH EC, INC.
Thea Foss Waterway





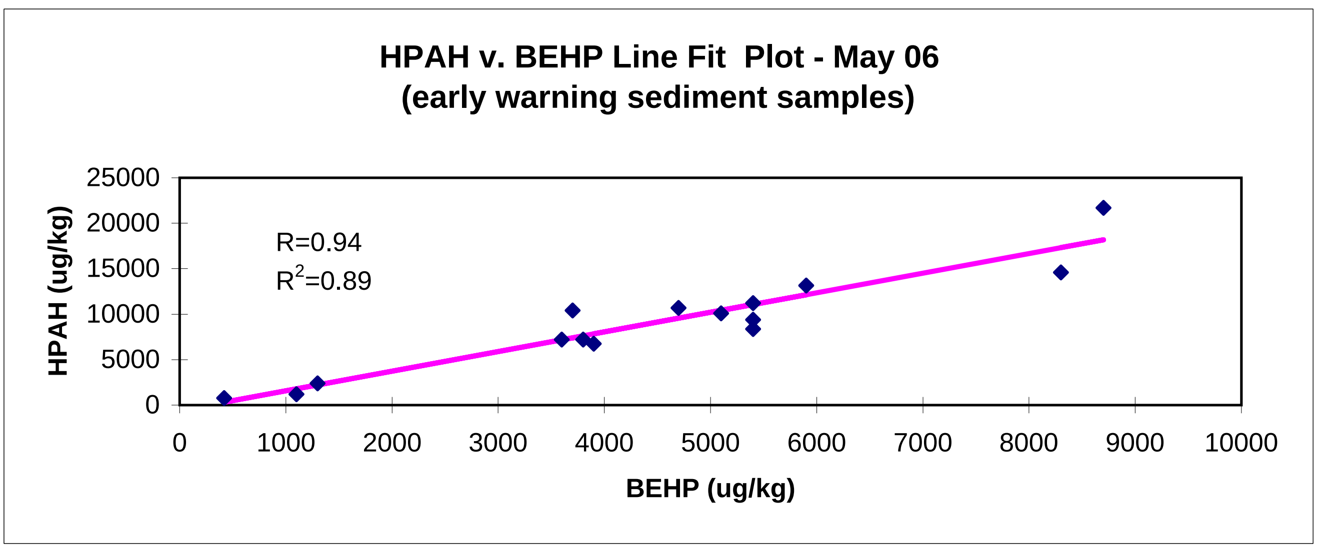
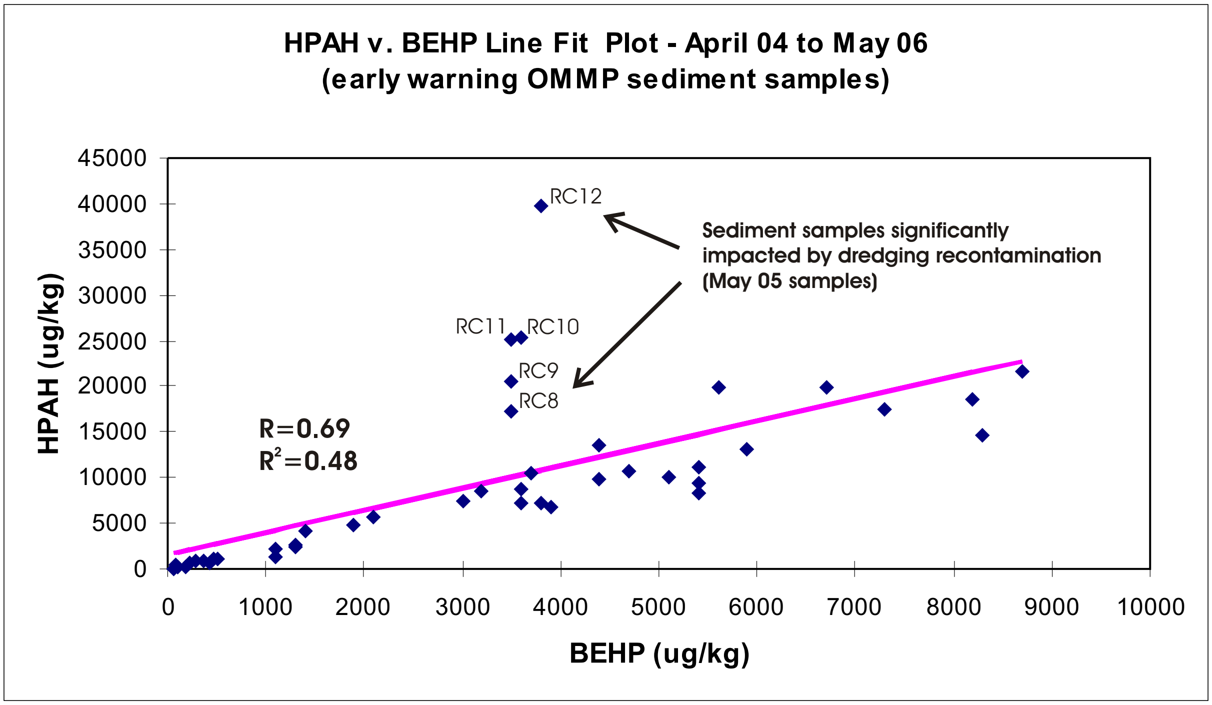
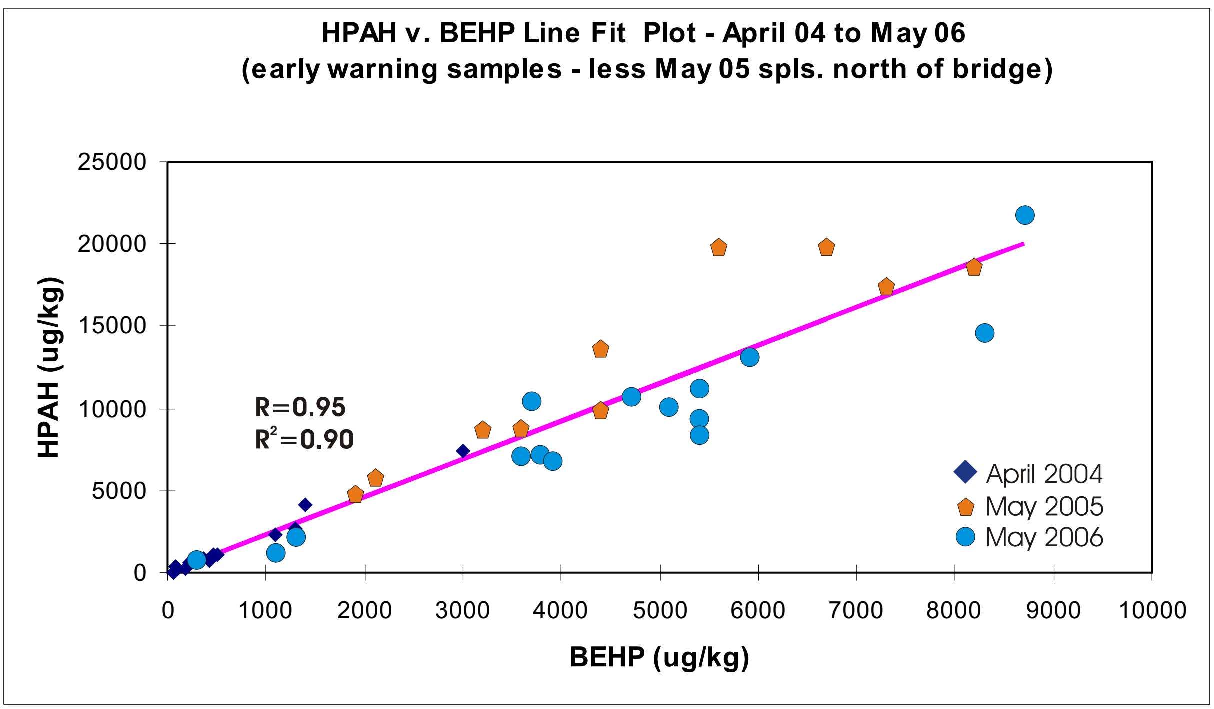


FIGURE 10
HPAH v. BEHP Line Fit Plots
OMMP Early Warning Samples





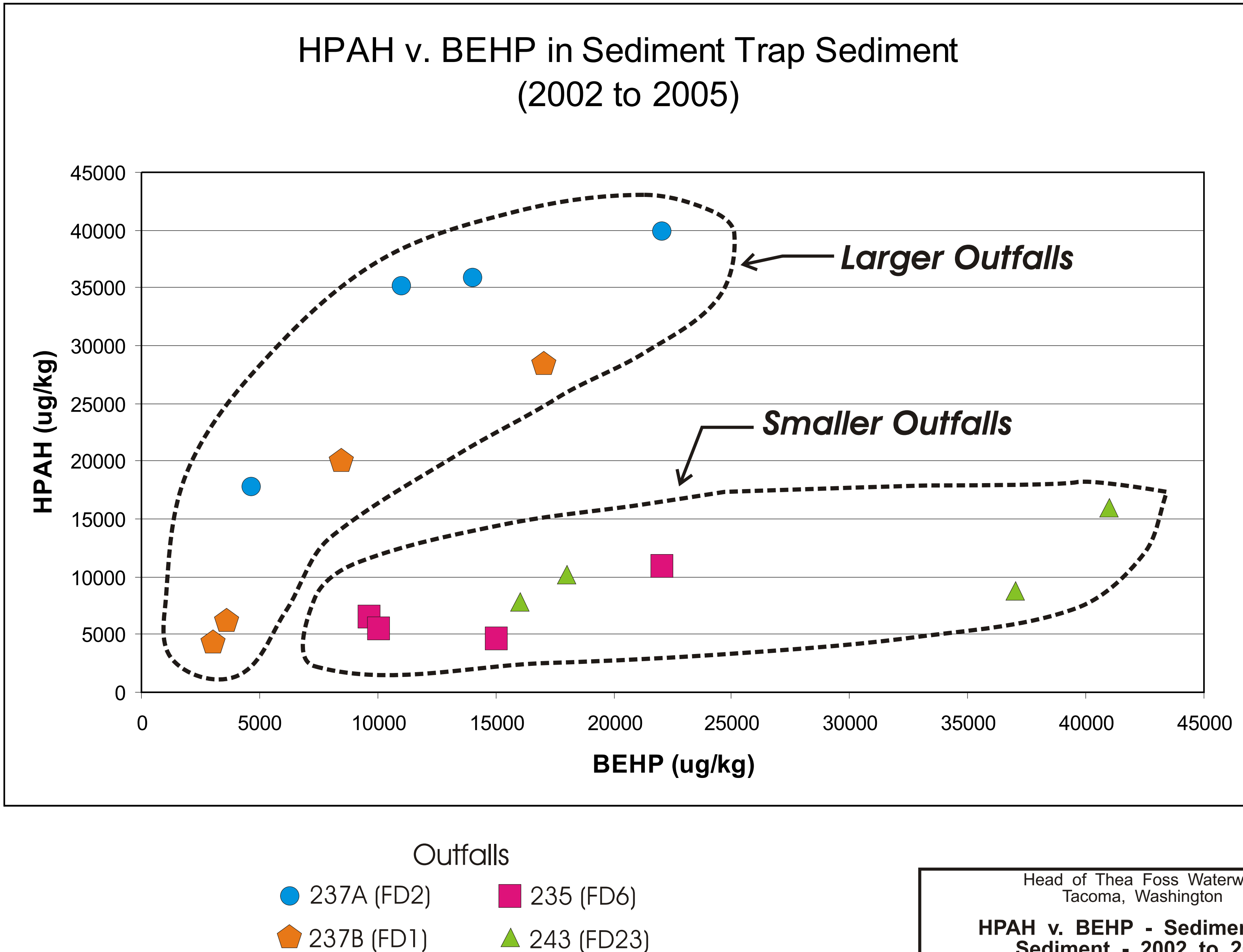
Ref: Thea Foss May 2006 Trends-EW Comb.cdr

Head of Thea Foss Waterway Project
Tacoma, Washington

HPAH v. BEHP Line Fit Plots
Early Warning OMMP Samples
April 04 to May 06

PAP-001-04 **FIGURE 11** September 06

Dalton, Olmsted & Fuglevand, Inc.



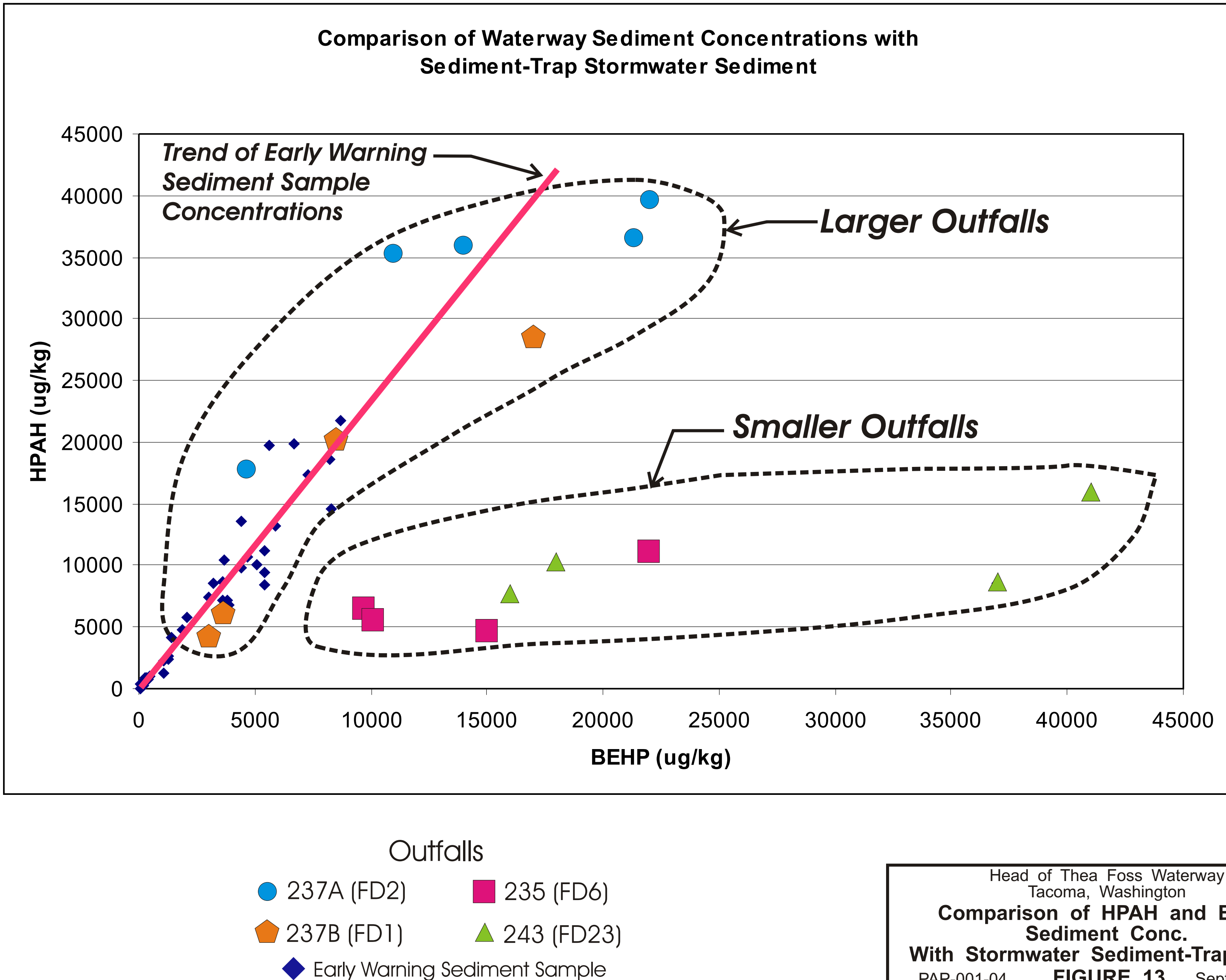
Head of Thea Foss Waterway
Tacoma, Washington

HPAH v. BEHP - Sediment Trap Sediment - 2002 to 2005

PAP-001-04 **FIGURE 12** September 2006

Dalton, Olmsted & Fuglevand, Inc.

Ref: Thea Foss Sed Trap 02 to 05.cdr



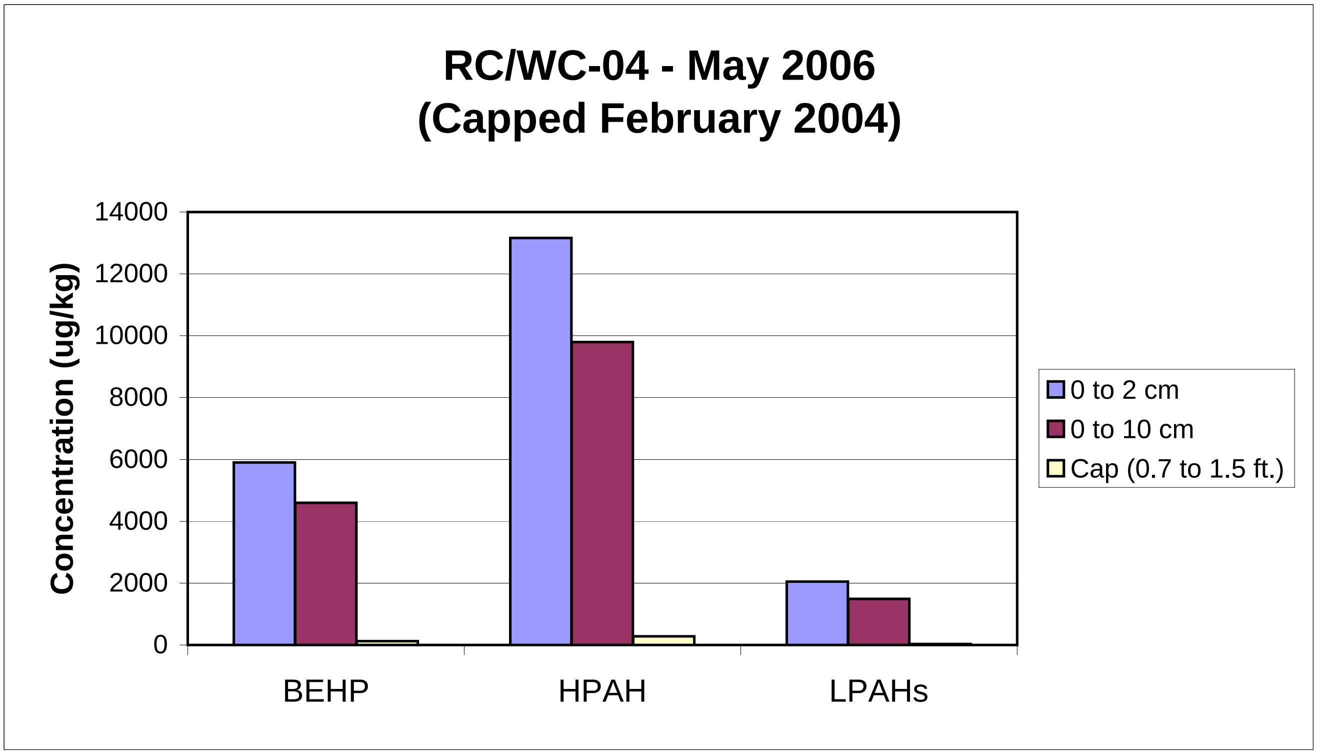
Ref: Comparison Sed w Sed Trap Thea Foss 1.cdr

Head of Thea Foss Waterway
Tacoma, Washington

Comparison of HPAH and BEHP Sediment Conc. With Stormwater Sediment-Trap Conc.

PAP-001-04 **FIGURE 13** September 2006

Dalton, Olmsted & Fuglevand, Inc.



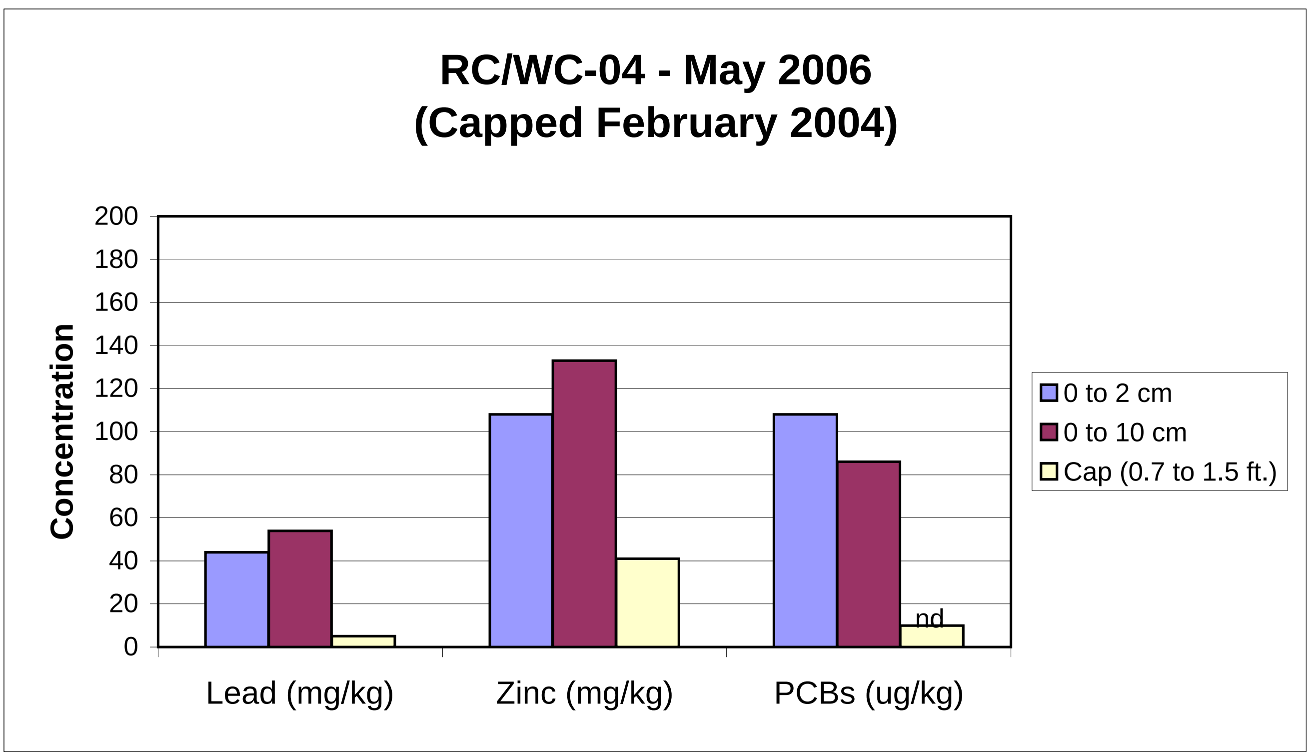
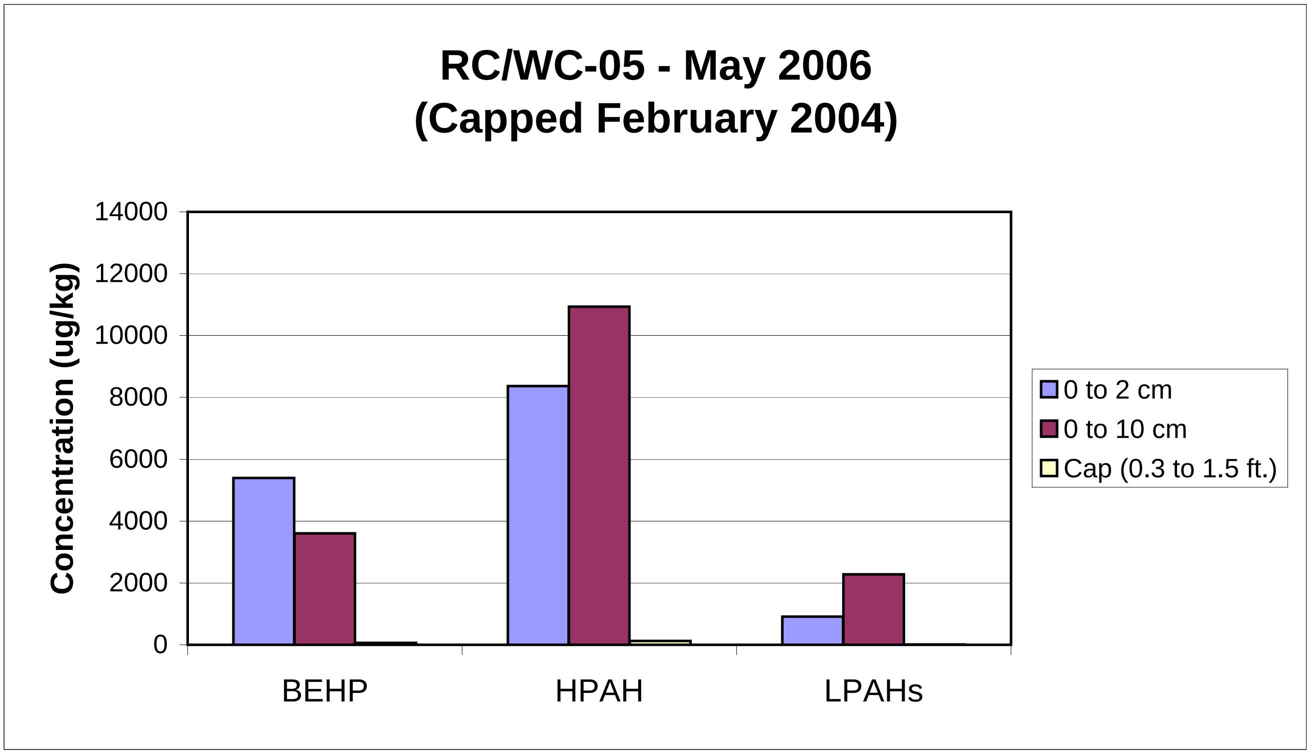


FIGURE 14
Comparison of Surface and
Core Samples Sediment Quality



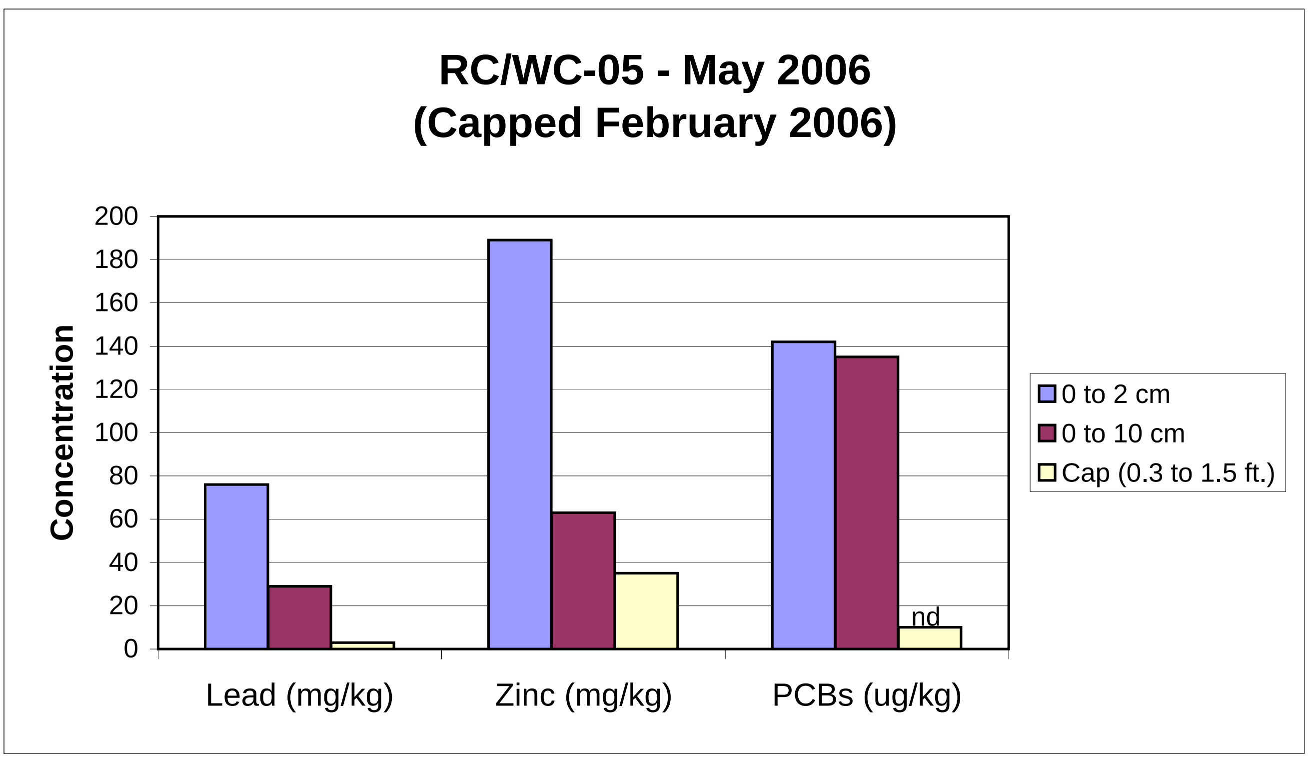
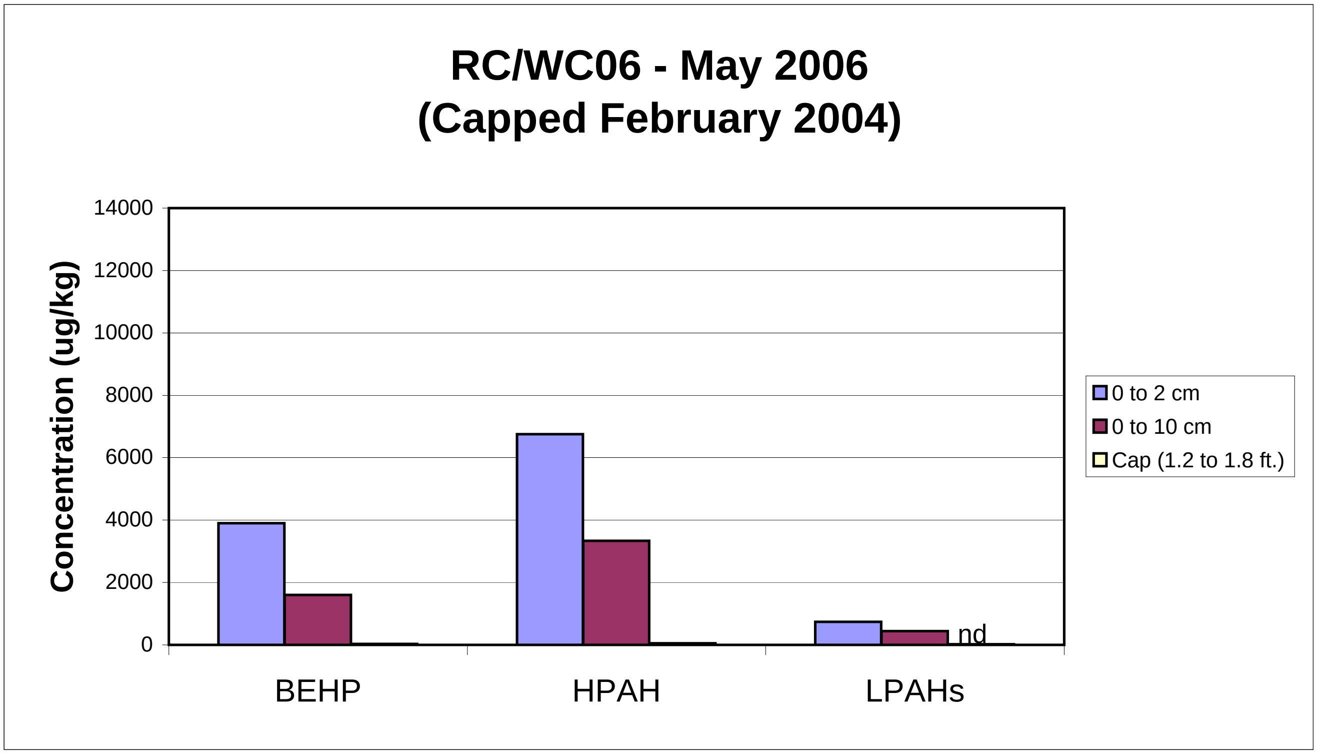
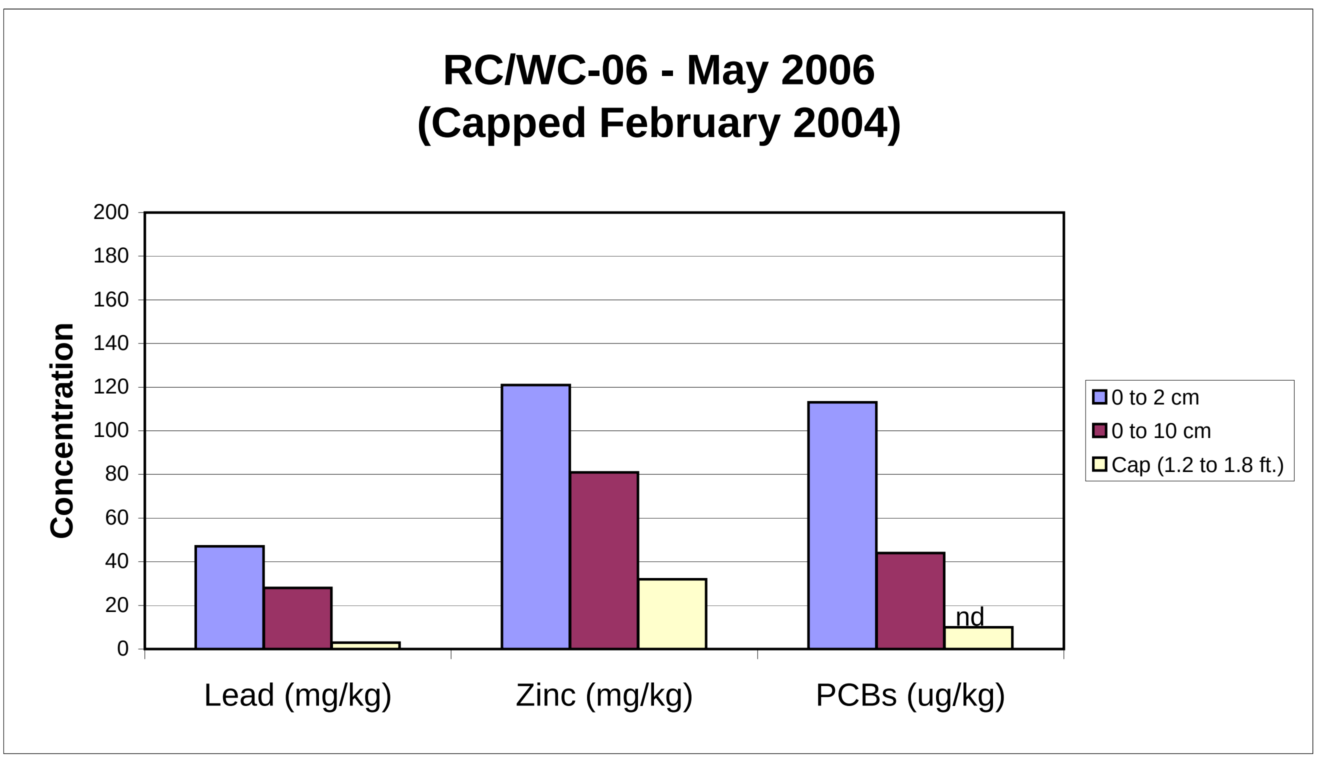


FIGURE 14
Comparison of Surface and
Core Samples Sediment Quality





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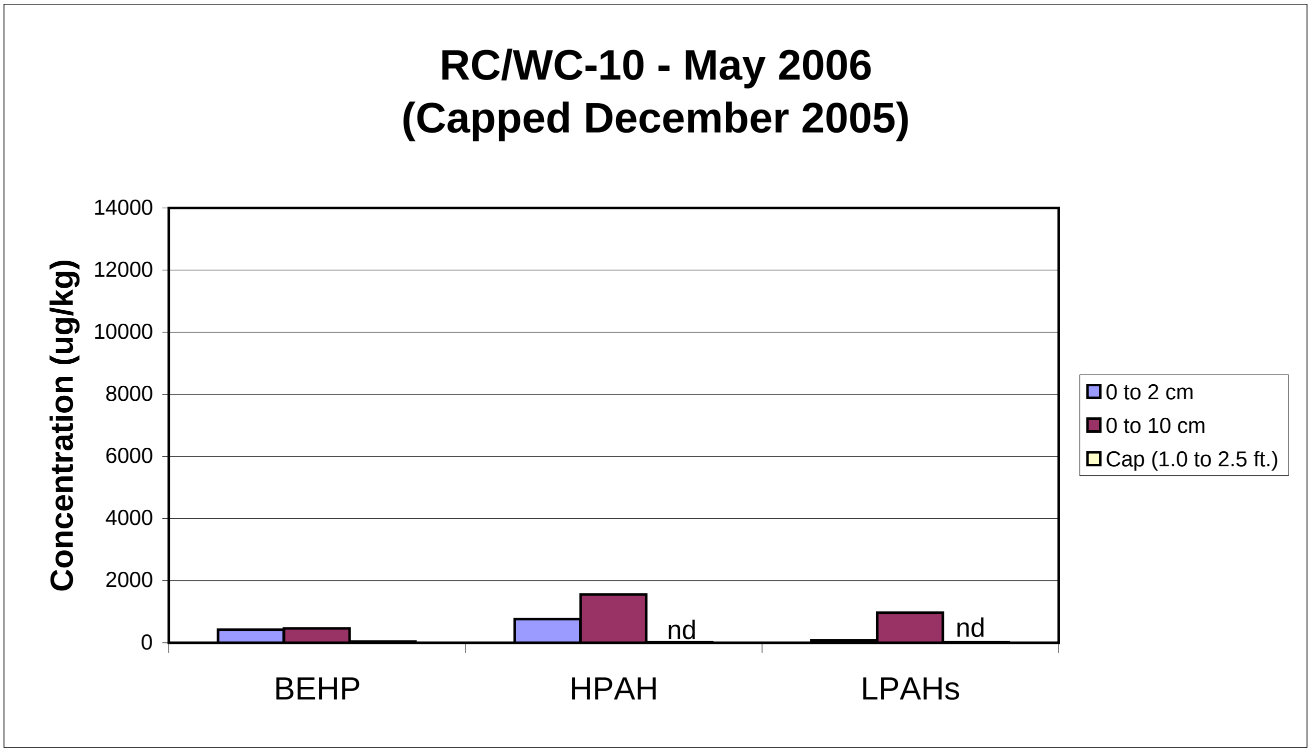

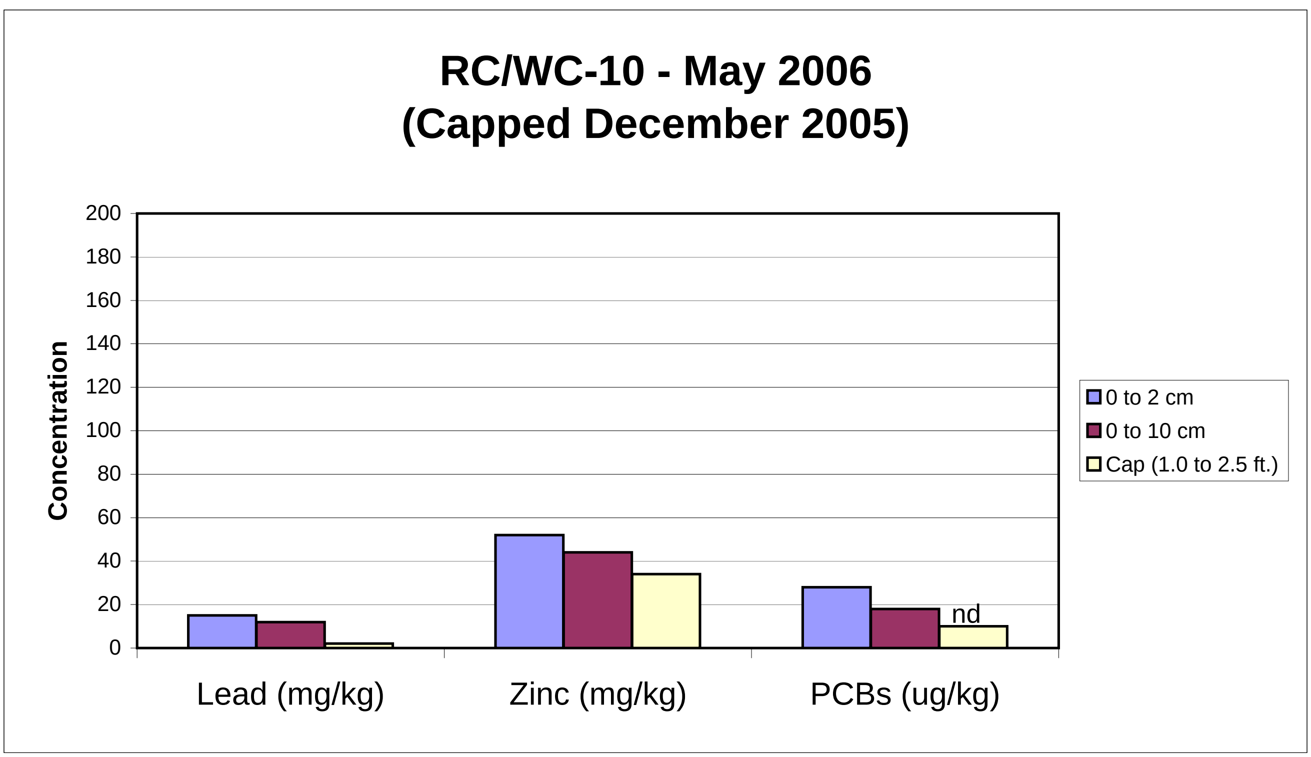

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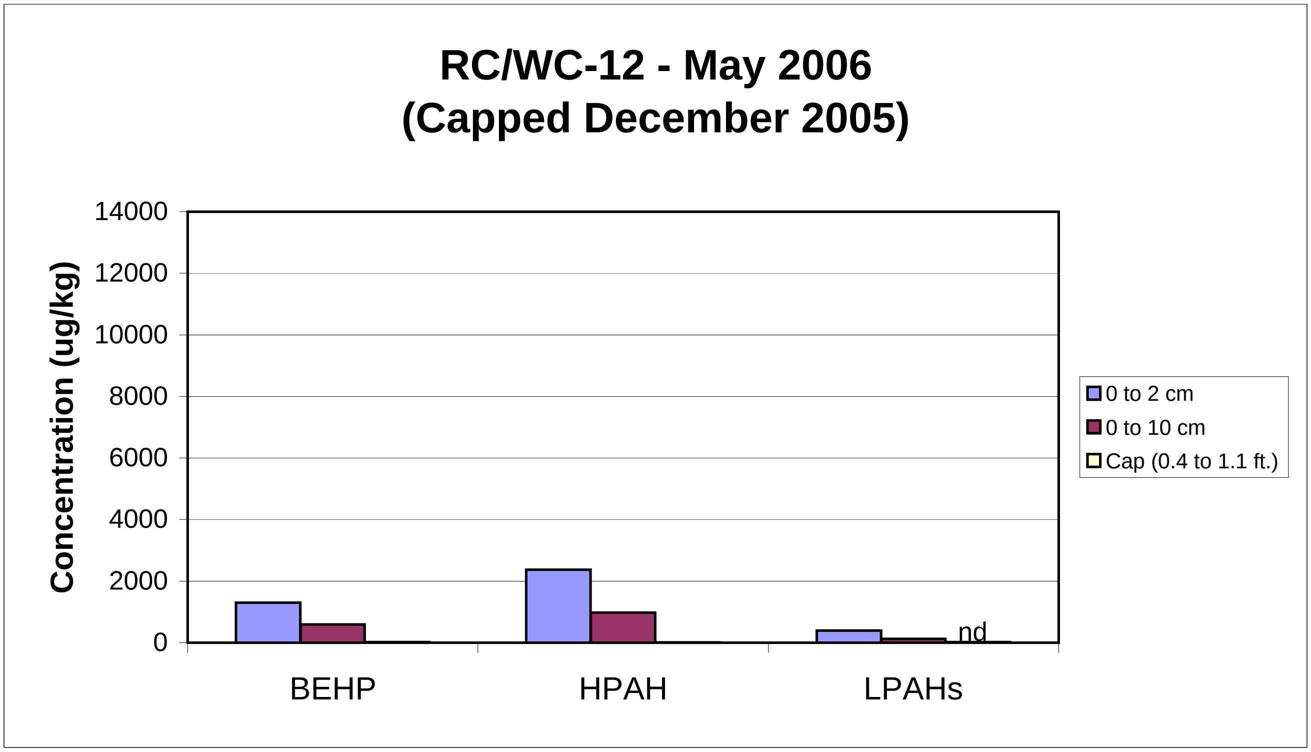

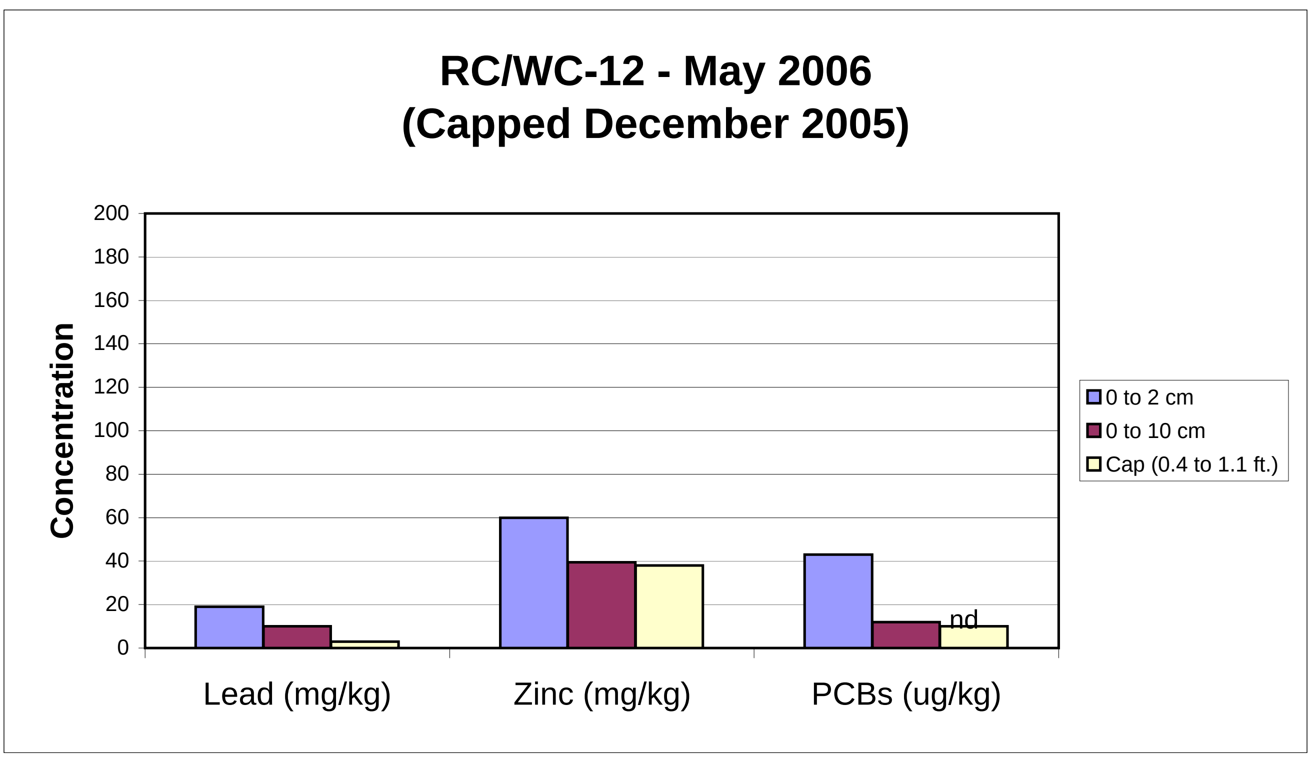

FIGURE 14
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