



**PacifiCorp Environmental  
Remediation Company**

October 6, 2005

Ms. Piper Peterson Lee  
U.S. EPA, Region 10  
1200 Sixth Ave.  
Seattle, WA 98101

**Subject:** Results of Year 1 Operation, Maintenance and Monitoring Plan Sampling  
Head of the Thea Foss Waterway Remediation, Tacoma, WA

Dear Ms. Lee:

The Utilities are pleased to submit the results of the Year 1 Operation, Maintenance and Monitoring Plan (OMMP) sampling for the Utilities' Work Area in the Head of the Thea Foss Waterway. The Year 1 OMMP Report is being submitted for EPA's review and approval. Two copies of the report are enclosed. Copies are also being sent to others as listed below.

The preparation of the Year 1 OMMP Report was consistent with the requirements of the Consent Decree, Statement of Work, and the EPA approved OMMP.

If you have any questions or comments, please call me at 503-813-5036, or email me at [jackie.wetzsteon@pacificorp.com](mailto:jackie.wetzsteon@pacificorp.com).

Sincerely,

A handwritten signature in black ink, appearing to read "Jackie Thiehl Wetzsteon".

Jacqueline Thiehl Wetzsteon  
Utilities' Project Coordinator

**Enclosure:** Year 1 OMMP Report (October 2005)

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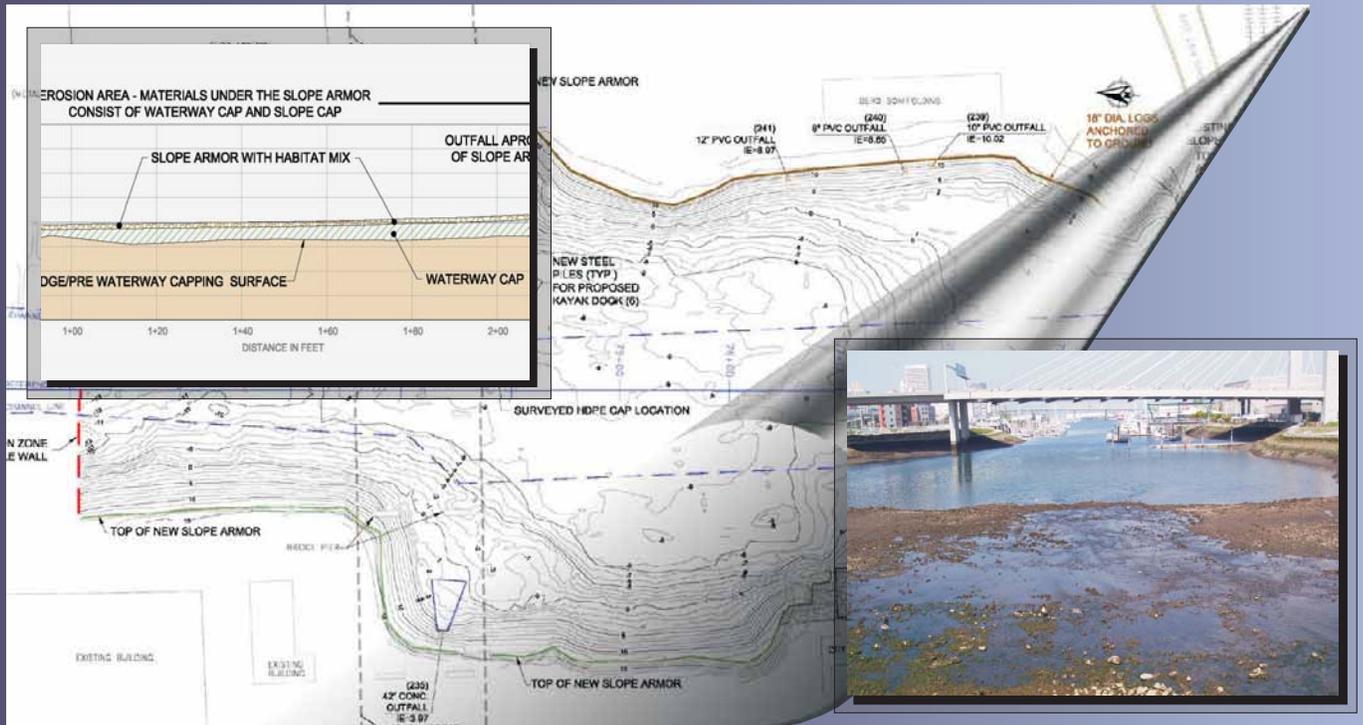
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# RESULTS OF YEAR 1 OPERATON, MAINTENANCE AND MONITORING PLAN SAMPLING

## Head of Thea Foss Waterway Remediation Project



Prepared for:

PacifiCorp Environmental Remediation Company  
And  
Puget Sound Energy

Prepared by:

Dalton, Olmsted & Fuglevand, Inc.

October 2005

**RESULTS OF YEAR 1 OPERATION, MAINTENANCE AND  
MONITORING PLAN SAMPLING  
HEAD OF THEA FOSS WATERWAY REMEDIATION  
TACOMA, WASHINGTON**

**Prepared for:**

**PacifiCorp Environmental Remediation Company**

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**Puget Sound Energy**

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

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October 2005

**RESULTS OF YEAR 1 OPERATION, MAINTENANCE AND  
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TACOMA, WASHINGTON**

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April 2004

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# **RESULTS OF YEAR 1 OPERATION, MAINTENANCE AND MONITORING PLAN SAMPLING HEAD OF THEA FOSS WATERWAY REMEDIATION TACOMA, WASHINGTON**

## **1.0 INTRODUCTION**

This report was prepared on behalf of the “*Utilities*” consisting of the Advance Ross Sub Company, PacifiCorp, and Puget Sound Energy and presents the results of Year 1 Operation, Maintenance and Monitoring Plan (OMMP) observation and sampling for the southern portion of the Thea Foss Waterway (Figures 1 and 2). The sampling and analyses were accomplished in accordance with the requirements of the OMMP prepared by TetraTech-FW et al (2003). The Utilities are responsible for Remedial Action Areas 23 and 24 (RA23/24) consistent with the Consent Decree (CD) and portions of RAs 19b, 20 and 22 as described in a confidential agreement with the City of Tacoma (hereinafter referred to as “the City”). Portions of the waterway south of a sheet pile wall installed at Station 70+10 (Figure 2) are the responsibility of the Utilities (herein termed 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 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.

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.
- **Institutional Control Plan.** The Utilities are working with the City, EPA and others to finalize the plan. Based on EPA comments, the Utilities’ submitted a revised draft to EPA on November 19, 2004. Once the plan is approved by EPA, the Utilities will implement the provisions of the plan.

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 consists 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 (RA20 and RA22). Placement of a grout mat and final cap was completed in RA19B (also adjacent to the sheet pile wall) during the previous 2003 to 2004 construction season.

## 2.0 OMMP ACTIVITIES

As part of the remedial design work, the Utilities prepared an Operation, Maintenance and Monitoring Plan (OMMP) that was approved by EPA (Tetra Tech-FW et al. 2003). 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.

To meet these objectives, the OMMP includes both physical observation and sediment sampling and analysis. 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 in surface sediments from sources such as stormwater. The early warning samples are being collected from depths of 0 to 2 cm from the sediment 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.

Table 2-2 of the OMMP outlines the schedule for physical cap integrity monitoring and recontamination sampling. Monitoring is to be completed on an annual basis for the first five years and in years seven and ten. 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 bis(2-Ethylhexyl)phthalate (BEHP) were highly correlated ( $R=0.99$ ) indicating a common source.

### ***2.2 Year “1” OMMP Activities***

The requirements for Year “1” include the collection of early warning (0 to 2 cm) samples from the fourteen established OMMP sampling locations (RC-1 to RC-14). The OMMP also requires visual monitoring of the former SR509 seep area. Observation of the former SR509 seep area is to be accomplished during low daylight tides in June or July.

In March 2004, EPA requested that the Utilities’ make more frequent physical observation of the Utilities’ Work Area than anticipated by the OMMP (EPA 2004). Physical observations were made in May, July, September and December 2004 and April 2005 as described in DOF 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 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) were 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 (2005) and indicated the cause of recontamination (primarily north of the SR509 Bridge) was City remedial construction work largely completed between September and December 2004. Recontamination constituents included PAHs, phthalates, pesticides, and PCBs.

Collection of early warning sediment samples was completed on May 11 and 12, 2005. In addition to the early warning sediment samples specified in the Utilities’ OMMP, supplemental “*compliance*” samples (0 to 10 cm) were obtained and analyzed by the Utilities and the City on May 11 and 12, 2005. The City also collected sediment samples

from their work area in RA-19B, RA-20, and RA-22. Sample locations are shown on Figure 3.

Physical observation of the former SR509 seep area was completed on June 22, 2005. Physical observation of the former SR509 seep area was supplemented with a underwater video survey completed on August 19, 2005.

### 3.0 PHYSICAL OBSERVATIONS

#### 3.1 May 2004 to June 2005

The OMMP schedule required that physical observations be made during daylight low tides in June or July 2005. As noted above, in March 2004 EPA requested that additional physical observations be made to detect any erosion that might effect the integrity of the cap during the first year of operation and maintenance. To meet these requirements, physical observations of the Utilities' Work Area were made during predicted low tides as listed below.

- May 7, 2004 -3.32 feet MLLW (DOF 2004b)
- July 1, 2004 -3.6 feet MLLW (DOF 2004b)
- July 2, 2004 -4.1 feet MLLW (DOF 2004b)
- September 24, 2004 -0.52 feet MLLW (DOF 2005)
- December 9, 2004 +6.8 feet MLLW (DOF 2005)
- April 27, 2005 -2.4 feet MLLW (DOF 2005)
- June 21, 2005 -3.29 feet MLLW (Appendix A)
- June 22, 2005 -3.85 feet MLLW (Appendix A)

Overall, similar conditions were observed during the site visits between May 2004 and June 2005. Observations made during these visits indicate the following:

- The scour protection apron is functioning as intended. No obvious signs of significant erosion were observed during any site visit.
- Side slopes show no visible evidence of slope erosion, sloughing etc.
- Some minor erosional channels in the waterway cap were observed near the northeast edge of the scour protection apron and outfall 235. Observations indicate that the channel bottoms are "*self armoring*" in that coarser materials were observed in the bottom of the channels that minimizes the potential for additional erosion. The minor erosion is local in nature and does not appear to have adversely impacted the overall integrity of the cap. No corrective action, other than to monitor these features during future low tides, is recommended at this time.

- Gas bubbles were observed to occur throughout the head of the waterway during lower tides, however, no rising NAPL sheens were observed in the former SR509 seep area or elsewhere in the Utilities' Work Area during the OMMP site visits.

### **3.2 Underwater Survey of SR509 Cap Area**

An underwater video survey was conducted by Tetra Tech EC (2005b) for the Utilities on August 19, 2005 over and in the vicinity of the SR509 hard cap area. The survey was completed between 1100 and 1400 hours just after a low tide of -2.71 feet MLLW that occurred at 1000 hours. The survey procedures and results, including a DVD, are presented in Appendix E.

No surface sheens or evidence of non-aqueous phase liquid (NAPL) were observed during the survey activities. A review of the video indicated that the sediment/water interface is composed of silt and that the sand cap material is no longer exposed on the waterway bottom.

## **4.0 SEDIMENT SAMPLE COLLECTION – MAY 2005**

Sediment samples were collected by Tetra Tech EC (2005a) for the Utilities on May 10 to 12, 2005. The Year 1 OMMP sampling was performed simultaneously with post-dredge monitoring conducted for the City of Tacoma by Parametrix. The Utilities were represented by staff from Tetra Tech EC. In all, forty-four surface sediment samples (0 to 2 cm and 0 to 10 cm) were obtained from thirty-one locations using van Veen and Eckman samplers. Sample locations are shown on Figure 3. Sampling procedures and handling, and field observations are presented in Appendix B of this report. During the sampling, samples from the Utilities' Work Area were split between City and Utilities representatives.

## **5.0 CHEMICAL ANALYSES AND DATA VALIDATION**

Section 2.3.4 of the OMMP outlines the constituents to be analyzed as part of the OMMP sampling. The chemical analytes for monitoring "early warning" signs of top-down recontamination in newly deposited sediment (0 to 2 cm) include:

- Polycyclic Aromatic Hydrocarbons (PAHs)
- Metals (lead, zinc, and mercury)
- bis(2-Ethylhexyl) phthalate (BEHP)
- Polychlorinated biphenyls (PCBs)
- Conventional parameters (TOC and grain size)

In addition to the analytes listed above, several other constituents were analyzed in the Utilities' samples (both 0 to 2 cm and 0 to 10 cm samples) because of the City construction recontamination of the cap and possible recontamination by stormwater discharges. These analytes included:

- Diesel and heavy-oil range petroleum hydrocarbons
- Metals (arsenic, copper, nickel)
- Dibenzofuran
- Other phthalates (see Table 2)
- Pesticides (4-4'-DDE, 4-4'-DDD and 4,4'-DDT)

The City analyzed the following constituents in their split samples:

- Polycyclic Aromatic Hydrocarbons (PAHs)
- Mercury
- bis(2-Ethylhexyl) phthalate (BEHP)
- Polychlorinated biphenyls (PCBs)
- Pesticides (4-4'-DDE and 4-4'-DDD)

The Utilities' samples were analyzed by Analytical Resources, Inc. (ARI) and were validated by R. Farlow of DMD, Inc. (DMD 2005a – see Appendix C). 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 2005 Utilities' analyses, DMD completed the equivalent of an EPA QA-4 review. DMD concluded that the ARI data could be relied on for its intended use.

The City's samples were analyzed by Severn Trent Laboratories (STL). Concentrations of SVOCs reported by STL for split samples obtained in May 2005 were substantially below the concentrations reported by ARI. The Utilities received a QC package (prepared by Parametrix dated May 25, 2005) from the City during a meeting on July 26, 2005 at EPA. DMD reviewed this package and concluded that the STL data quality is unknown and that a more comprehensive review, similar to that completed by the Utilities, would be necessary before any comparison of data sets can be performed (DMD 2005b, see Appendix D).

In their memorandum, DMD further reported that it is likely that STL used an Ion Trap (IT) mass spectrometer for the SVOC analyses. The Utilities have repeatedly requested the manufacturer, model, and instrument type from the City and other supporting validation information but have not yet received this information from the City. The Utilities initially requested the raw data files, laboratory Standard Operating Procedures (SOPs) and instrument information on June 16. Additional requests for this information were made on July 15, August 29 and September 13. As noted in the memorandum prepared by DMD (Appendix D), the U.S. Army Corps of Engineers (ACOE) Center of

Expertise (CX) has determined that IT instrumentation is unreliable for the analysis of highly contaminated samples, and should not be allowed for the analyses of contaminated soils/sediments under ACOE contracts. Based on the lack of adequate documentation of the quality of the STL SVOC data, this report relies primarily on SVOC data reported by ARI and validated by DMD.

## **6.0 ACCUMULATION OF FINE-GRAINED SEDIMENT ON UTILITIES' CAP**

The Utilities' waterway cap consists of uncontaminated sandy material meeting the requirements of the project plans and specifications. The waterway cap installation was completed by the end of February 2004 (DOF 2004a). In early April 2004, during Year "0" OMMP sampling (DOF 2004b), a thin layer of fine-grained sediment was observed to have accumulated since the Utilities' cap was placed. The fine-grained material ranged from a thin coating up to approximately 1 cm thick and appeared to decrease in thickness in a northerly direction from the head of the waterway.

In late August 2004 and prior to dredging by the City along the north boundary of the Utilities' Work Area, approximately 1 cm of fine-grained sediment was observed on top of the Utilities' cap surface near the sheet pile wall (stations WC/RC11, WC-12 and Site 15 on August 20<sup>th</sup> and 30<sup>th</sup> – DOF 2004b). By September 18, 2004, after dredging was completed but before the City placed a partial cap, the accumulated fine-grained sediment thickness had increased to between 3 cm and 7 cm near the sheet pile wall. The data indicated the thickest deposits were near the sheet pile wall where dredging had occurred and thinned in a southerly direction.

During supplemental sampling completed in late November and early December 2004, the thickness of fine-grained sediment was measured at various locations near the head of the waterway as summarized in Table 1, based on measurements documented in DOF (2005). The Utilities' thickness data is plotted on Figure 4. As shown on the figure, relatively greater thicknesses of fine-grained sediment were measured near the sheet pile wall (5 cm to 12 cm) and in the turning basin south of the SR509 Bridge (5 cm to 12 cm). A portion of the surface sediment in the south turning basin is likely from winnowing of the fish mix placed on the scour protection apron. Surface sediment samples from the turning basin were different in appearance from those obtained north of the bridge (DOF and TetraTech, 2005).

OMMP sampling in May 2005, found approximately 1 to 11.5 cm of fine grained material over capping material within the Utilities' Work Area and the southern portion of the City Work Area (Table 1 and Figure 5). Fine-grained sediment thicknesses appear to have increased in the area immediately north of the SR509 Bridge and within the southern portion of the City Work Area. For example, fine-grained sediment thicknesses increased from 4 cm to 8 cm at station S-19 and from 2.5 cm to 7 cm at station CA22-02. At station RC/WC-11, the thickness of fine grained sediment increased from 7 cm to 10.5

cm between December 2004 and May 2005. Comparison of the fine grained thickness patterns for December 2004 (Figure 4) and May 2005 (Figure 5) indicates some redistribution of fine grained sediment near the Head of the Thea Foss Waterway is occurring.

## **7.0 SEDIMENT SAMPLE DESCRIPTIONS**

### ***7.1 Early Warning Samples (0 to 2 cm)***

During OMMP sampling in May 2005, early warning samples were obtained from fifteen 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 3). The samples generally consisted of olive to black silt with fines (<62.5 microns) contents between 15.3% and 79.2% (Table 1 and Appendix B).

### ***7.2 Compliance Samples (0 to 10 cm)***

In addition to the early warning samples collected as part of the Utilities' OMMP, 0 to 10 cm samples were collected by the Utilities and City to provide data to further assess the extent of recontamination. Most of the samples were obtained in the Utilities' Work Area north of the SR509 Bridge. The Utilities analyzed samples at OMMP stations WC-02, WC-04, WC-05, WC-07, and WC-11 and supplemental stations S-15, S-16 and S-24. The City analyzed samples from OMMP stations W-07, WC-08, WC-09, WC-11 and WC-12 and supplemental stations S-15, S-16, S-19, S-20, S-29 and S-30. The City also analyzed several sediment samples in the City Work Area near the sheet pile wall (in remediation areas RA19B, RA20 and RA 22 – see Figure 3).

The compliance samples generally consisted of olive black silt over either sand or gravel (see Appendix B). The portion of silt versus sand or gravel in the samples varied depending on the thickness of the accumulated fine grained deposits. The fines content of the Utilities' 0 to 10 cm samples ranged between 7.2% and 76.9% (Table 1). The City did not conduct grain size analyses.

## **8.0 SUMMARY OF ANALYTICAL RESULTS AND COMPARISON TO SEDIMENT QUALITY OBJECTIVES**

The following discussion summarizes the analytical results of sediment samples collected in May 2005 and compares those results to the Sediment Quality Objectives (SQOs). Sediment quality data is presented in Table 2, with the SQOs. Interpretative discussions follow the analytical results.

In addition to the SQOs, the analytical results of waterway capping material (DOF 2004a), prior to placement are also listed in Table 2 for comparison purposes. No semivolatile organic compounds, pesticides, PCBs, arsenic and mercury were detected in the capping material. Copper, lead, nickel and zinc were detected at concentrations less than natural background for Washington State (DOF 2004a, Attachment 5, Appendix B). With the possible exception of arsenic, metal concentrations in sediment samples collected in 2005 are substantially higher than the concentrations in the underlying waterway capping material.

### ***8.1 Compliance (0 to 10 cm) Sediment Samples***

SQOs were exceeded in one or more compliance samples for the constituents listed in Table 3. They include mercury, individual PAHs, total LPAHs, total HPAHs, BEHP, 4'4'-DDE, 4'4'-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 1.2 (mercury) and 8.4 (acenaphthene).

Figures 6 to 12 show the concentration patterns and extent of SQO exceedances for compliance samples collected in May 2005. Mercury was exceeded in samples from WC-11 and S-15 (Figure 6). Total LPAH (Figure 7) and total HPAH (Figure 8) show similar patterns. SQOs are exceeded in the general vicinity of stations WC-11 and S-15, extending in a northwesterly direction into RA22 within the City Work Area.

4,4'-DDE (Figure 9) and total PCBs (Figure 11) also show similar exceedance patterns as for LPAHs and HPAHs, although the area of SQO exceedance is larger. 4,4'-DDE concentrations exceed its SQO in most of the waterway cap area north of the SR509 Bridge in the Utilities' Work Area and in a northwesterly direction into RA22 and RA19B within the City Work Area.

4'4'-DDD concentrations (Figure 10) exceed the SQO in the immediate vicinity of WC-11 and S-15. The exceedance area generally lies within the exceedance area for the constituents discussed above.

BEHP in compliance samples exceeds the SQO in two areas, WC-11 and S-15 (Figure 12). Concentrations may also exceed the SQO in a larger portion of the City Work Area, than that shown on Figure 12. As discussed earlier in this report, SVOC concentrations analyzed by the City contract laboratory appear to be biased low and sediment samples from the City Work Area were only analyzed by the City contract laboratory.

BEHP also exceeds the SQO in compliance samples in the general area beneath and south of the SR509 Bridge to the edge of the scour protection apron (Figure 12). This exceedance pattern is different from the other constituents of concern and indicates a source other than the City dredging. Possible sources other than the September 2004 City dredging are discussed below.

## **8.2 Early Warning (0 to 2 cm) Sediment Samples**

Sediment concentrations were higher than the SQOs in one or more early-warning samples for the constituents listed in Table 4. 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).

Figures 13 to 18 show the concentration patterns and extent of the estimated areas where concentrations are higher than the SQOs in early warning samples collected in May 2005. Mercury (Figure 13), total LPAH (Figure 14), 4'-4'-DDD (Figure 16), and total PCBs (Figure 17) show similar patterns. Concentrations above SQOs are present in the general area between the sheet pile wall and the SR509 Bridge<sup>i</sup>.

Figure 15 shows the area where HPAH concentrations are above the SQO of 17,000 ug/kg in 0 to 2 cm sediment. The SQO is exceeded from the scour protection apron to the sheet pile wall, although the higher concentrations are located north of the SR509 Bridge.

BEHP concentrations are higher than the SQO of 1,300 ug/kg in all the early warning samples collected in May 2005 (Figure 18). The highest concentrations were detected in samples collected within the southern portion of the Utilities' Work Area between the SR509 Bridge and the scour protection apron.

## **9.0 DATA EVALUATION AND INTERPRETATION**

The available data indicate that recontamination of the waterway bottom in the southern portion of the Thea Foss Waterway occurred from top-down sources. Coring completed in late 2004 (DOF and Tetra Tech 2005) indicates that the sand cap installed by the Utilities' is functioning as intended. Furthermore, visual observations of the Utilities' Work Area, before and after the dredging by the City, indicated that the Utilities' cap was functioning as designed, including in the area of the former SR509 seep (i.e. no rising NAPL sheens were observed). Top down contaminant sources include:

- Contaminant migration from dredging, and
- Discharge from stormwater outfalls.

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<sup>i</sup> It is likely early warning sediment sample concentrations were higher than the SQOs in the southern portion of the City Work Area, however, "early-warning samples" were not analyzed north of the sheet pile wall.

### ***9.1 Dredging Recontamination***

Figure 19 shows the general area where the SQOs are exceeded in 0 to 10 cm sediment for one or more constituents. The area north of the SR509 Bridge was recontaminated by City dredging in 2004. This conclusion was based on the timing of recontamination, comparison of pre-dredge and post-dredge sediment sample analyses, core data, and construction methods. The basis for this conclusion is presented in DOF and TetraTech (2005). The portion of the Utilities' Work Area generally north of the SR509 Bridge is the same area where the City identified the cause of SQO exceedances to be City dredging, based on their recontamination corrective action proposal submitted to EPA (Tacoma 2005).

### ***9.2 Stormwater Discharge Recontamination***

Stormwater outfalls that discharge into the head of the Thea Foss Waterway include outfalls 235, 237A, 237B and 243 (Figures 3 and 20). Outfalls 237A and 237B are collectively termed the "Twin 96" Outfalls. The combined outfalls drain an area of approximately 7 to 8 square miles.

Stormwater particulates contain a typical "suite" of constituents including (but not limited to) PAHs, phthalates (including BEHP), metals (e.g. mercury, lead, zinc), PCBs, pesticides, and petroleum hydrocarbons (Sedar 1993; Tacoma 2004; DOF 1999). The possibility of contaminated particulate recontamination from stormwater discharges of sediment in the Thea Foss Waterway is recognized by the Washington State Department of Ecology (Ecology) and EPA. As part of Administrative Order No. DE01WQH-3241, Tacoma is required to monitor stormwater discharges, including the quality of particulates. Particulate monitoring is being accomplished by the deployment of in-line sediment traps in the major outfalls that discharge to the waterway. Sediment trap data is presented in Appendix E (Table E15) of Tacoma (2004) for 2002, 2003 and 2004. The results of selected sediment trap particulate analyses are summarized in Table 5.

The presence of dredging recontamination complicates the analysis of the impacts of stormwater discharges; however, as discussed below, sufficient data is available to assess how stormwater discharges have adversely impacted Thea Foss sediment quality. Available "early warning" sediment quality data indicate that stormwater constituents are recontaminating the southern portion of the Utilities' Work Area, based on analysis of early warning sediment samples collected in April 2004 (DOF 2004b) and May 2005.

The following paragraphs present several lines of evidence that indicate stormwater discharge is recontaminating the waterway cap in the Utilities' work area:

- ***Contaminants Typical of Stormwater Are Present on Particulates Discharging to the Waterway***

Review of catch basin data from the Puget Sound region indicate that a variety of contaminants are present in stormwater sediments. Essentially, a suite of contaminants with varying solubilities and sorptive properties are discharged with stormwater. Data from Sedar (1993) indicate that lead and zinc are the most commonly detected metals and that individual PAHs and bis(2-ethylhexyl)phthalate (BEHP) constitute eight of the ten most commonly detected organic compounds in stormwater sediment.

Analysis of stormwater in-line sediment trap samples detected the presence of common stormwater contaminants on particulates discharging into Thea Foss. As summarized in Table 5, lead, zinc, low molecular weight PAHs, high molecular weight PAHs and BEHP were all detected in sediment trap samples from outfalls that discharge to Thea Foss collected in the period 2002 to 2004. Other common stormwater contaminants were also detected including mercury, petroleum hydrocarbons, PCBs and pesticides (predominantly 4,4'-DDT).

As shown on Figure 21, HPAH vs. BEHP concentrations in sediment trap samples collected between 2002 and 2004 are highly correlated ( $R = 0.86$  to  $0.97$ ). This means that as HPAH concentrations rise, BEHP concentrations also rise, suggesting similar sources. The correlation trends appear to be different in the larger outfalls as compared to the smaller outfalls which may reflect the differing land uses within the drainage basins.

- ***Typical Stormwater Contaminants Are Present In Surface Sediment Recently Deposited in the Thea Foss Waterway***

Tables 2 and 6 summarize sediment quality data for early warning (0 to 2 cm) sediment samples collected in April 2004 (DOF 2004b) and May 2005 from the Utilities' Work Area. The April 2004 samples (Table 6) represent conditions soon after the Utilities' sand cap was placed in the waterway while the May 2005 samples (Table 2) represent conditions approximately a year later (or about a year and a half after the sand cap was placed). Tables 2 and 6 include the results of the analysis of capping material prior to placement in the waterway.

In April 2004, a trace to approximately one centimeter of fine grained sediment was present on top of the Utilities' cap. Throughout the Utilities' Work Area, concentrations of typical stormwater contaminants were higher in early warning sediment samples that contained a portion of the accumulated fine grained sediment when compared to concentrations found in the capping material. Analyses of capping material and the April 2004 early warning samples are

summarized in Table 6. Lead and zinc concentrations were higher in the early warning samples as compared to the underlying capping material and organic contaminants such as PAHs and BEHP were detected in the April 2004 early warning samples (PAHs and BEHP were not detected in the capping material prior to placement).

By May 2005, concentrations of metals and organic contaminants in early warning (0 to 2 cm) sediment samples throughout the Utilities' Work Area were higher than those detected in April 2004. For example, lead increased from a high of 54 mg/kg in April 2004 to a high of 186 mg/kg in May 2005 in the 0 to 2 cm interval. Similarly, HPAH and BEHP concentrations substantially increased during this same period.

- ***Sources of Top-Down Recontamination of Surface Sediment in the Waterway***

Two primary sources of top-down recontamination existed within the time period in which the sediment samples were collected (February 2004 to May 2005). These include dredging residuals of contaminated sediment that migrated into the Utilities' Work Area from remedial work completed by the City in September to December 2004 and on-going discharges from the stormwater outfalls<sup>ii</sup>.

The available data indicate that dredging recontamination predominately impacted early warning samples collected in the area generally beneath and north of the SR509 Bridge and that stormwater discharges generally impacted the area south of the SR509 Bridge as shown on Figure 22. Dredging of contaminated sediments occurred in the City Work Area located on the immediate north side of the Utilities' sand cap in Remedial Action areas RA20 and RA22. The primary stormwater outfalls near the head of the waterway discharge to the area beneath and south of the SR509 Bridge.

While a similar suite of contaminants are present in the dredged material and the stormwater discharges, the relative proportions are expected to be different. The dredge material included sediment deposited since the early 1900's, including coal tar (from Standard Chemical), historic stormwater discharges and other materials such as from boatyards and marinas (DOF 1999). Of particular importance is the relationship between HPAHs and BEHP concentrations (discussed below).

The relationship between HPAHs and BEHP concentrations are illustrated on Figure 23 for two data subsets from the early warning samples collected in May

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<sup>ii</sup> During the recontamination evaluations completed in November/December 2004, the potential for upward migration through the Utilities' cap was evaluated by coring (DOF 2005a). Data from the cores indicated that "bottom-up" recontamination of the Utilities' cap surface was not contributing to the detected recontamination of the cap surface and that the cap was functioning as designed.

2005. One data subset includes samples from the area interpreted to have been predominantly impacted from the City dredging activities (north portion of City Work Area). The other data subset includes samples from the area interpreted to have been predominately impacted by stormwater (south of the SR509 bridge). HPAH and BEHP concentrations are highly correlated ( $R > 0.90$ ) for both sets of samples, however the slopes of the trend lines are very different. The slope of the trend line defined by sample concentrations north of the bridge (dredge material impacts) is steeper than that of the samples located south of the bridge indicating enrichment of HPAHs as compared to BEHP. This enrichment of HPAHs was caused by dredging of coal tar material containing very high concentrations of HPAHs.

A predominant stormwater source of recontamination south of the bridge is indicated by comparing the April 2004 and May 2005 early warning sample results (Figure 24). In April 2004, HPAH vs. BEHP concentrations were highly correlated and showed a consistent trend between the two contaminant concentrations. The April 2004 samples are representative of a time where stormwater discharges were the predominant source of top-down recontamination to the sand cap surface (City dredging activities did not begin until August 2004). In May 2005, HPAH and BEHP concentrations were also highly correlated in early warning samples south of the bridge and showed a very similar trend between the two contaminant concentrations as was detected in the April 2004 early warning samples. The high correlation between contaminant concentrations and the similar concentration trends indicate the same source.

Figure 25 is a plot of the combined sets of early warning samples collected in April 2004 and May 2005. The plot shows very similar correlations and trends for the combined set of early warning samples and is consistent with the plots in Figure 24. The April 2004 samples contained a greater portion of capping material that is uncontaminated as compared to the May 2005 samples, so the HPAH and BEHP concentrations are relatively lower as compared to the May 2005 samples. As stormwater sediment accumulated and became a greater percentage of the sample, concentrations increased but the trend relationship between HPAH and BEHP remained approximately the same. This trend, established prior to City dredging, is indicative of a stormwater source of recontamination.

## 10.0 SUMMARY AND FINDINGS

- Physical observations and sediment sampling were completed to meet the requirements of the Utilities' OMMP. Early warning sediment sampling was completed in May 2005 and physical observations were made in May, July, September, and December 2004, April 2005, and late June 2005 during one of the lowest daylight tides of the year. Supplemental sediment sampling and an

underwater video survey of the former SR509 seep area were also accomplished in May and August, respectively. The supplemental sampling was conducted to assist in assessing and evaluating alternatives for remediating recontamination caused by dredging by the City of Tacoma in 2004.

- Physical observations and sediment coring indicate that the Utilities' cap is functioning as intended. No rising NAPL sheens have been observed in the former SR509 seep area and analysis of core samples indicate the cap is containing the underlying contaminated sediments and upward contaminant migration through the cap is not the cause of recontamination.
- Surface sediment recontamination is from top-down sources. Based on evaluation of the previous sampling and analyses, two sources of top-down recontamination have been identified that have impacted recently deposited sediment on top of the Utilities' cap. These include City dredging of contaminated sediment north of the Utilities' Work Area and stormwater discharges. Dredging recontamination has adversely affected sediment quality on the north side of the SR509 Bridge where a number of constituents exceed SQOs in the 0 to 10 cm compliance zone. Stormwater discharges have adversely impacted sediment quality generally south of the SR509 Bridge where BEHP exceeds the SQO in the compliance zone. Future recontamination by PAHs also is likely based on analysis of stormwater sediment collected by in-line sediment traps. Northward spreading of stormwater discharge recontamination will continue with time.
- Within the stormwater impacted area, contaminant concentrations in early warning sediment samples substantially increased between April 2004 and May 2005. For example, between April 2004 and May 2005, maximum concentrations of HPAHs increased from 2,667 ug/kg to 19,830 ug/kg, and BEHP concentrations increased from a maximum of 1,300 ug/kg to 8,200 ug/kg. In May 2005, concentrations of total High Molecular Weight PAHs (HPAHs) and bis(2-ethylhexyl)phthalate (BEHP) were above SQO concentrations in early warning (0 to 2 cm) samples. In addition, mercury, pesticides and polychlorinated biphenyls (PCBs) were detected at concentrations greater than 50% of the SQOs in one or more early warning (0 to 2 cm) samples. Substantial concentrations (greater than 2,000 mg/kg<sup>iii</sup>) of petroleum hydrocarbons were also detected.
- Compliance samples (0 to 10 cm) obtained in May 2005 indicate that BEHP exceeds the SQO in most of the Utilities' Work Area. The magnitude of the constituent concentrations detected in the early warning samples and their increasing concentration between April 2004 and May 2005 indicate that recontamination above SQOs from stormwater discharges will likely occur in the

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<sup>iii</sup> Under the Model Toxics Control Act (MTCA) a diesel or heavy-oil concentration greater than 2,000 mg/kg assumes that free phase petroleum hydrocarbon is present in the sample (see WAC 173-340-900).

compliance zone for other constituents, such as polycyclic aromatic hydrocarbons (PAHs). Future monitoring as part of the OMMP will provide data to further assess recontamination from stormwater discharges to the Utilities' Work Area.

## **11.0 REFERENCES**

- DMD, Inc., 2005a, Data Validation Report, May 2005 Sampling Event, Head of Thea Foss Remediation Project, prepared for Puget Sound Energy and PacifiCorp Environmental Remediation Company.
- DMD, Inc., 2005b, City of Tacoma's Data Quality Assessment for May 2005 Sediment Monitoring in Thea Foss Waterway, prepared for Dalton, Olmsted & Fuglevand, Inc., August 2, 2005.
- DOF (Dalton, Olmsted & Fuglevand, Inc), 1999, Probable Contaminant Sources Based on Sediment Quality Data and Other Information, Thea Foss Waterway, Tacoma, Washington, prepared for Puget Sound Energy and PacifiCorp Environmental Remediation Company, September 29, 1999.
- DOF , 2004a, Remedial Action Construction Report, Head of The Thea Foss Waterway Remediation Project, Tacoma, Washington, prepared for Puget Sound Energy and PacifiCorp Environmental Remediation Company, June 9, 2004.
- DOF, 2004b, Results of Year 0 Operation, Maintenance and Monitoring Plan Sampling, Head of Thea Foss Waterway Remediation, Tacoma, Washington, prepared for Puget Sound Energy and PacifiCorp Environmental Remediation Company, August 27, 2004.
- DOF and TetraTech EC, 2005, Assessment of Utilities' Cap Recontamination and Data Summary, Head of Thea Foss Waterway Remediation, Tacoma, Washington, prepared for PacifiCorp Environmental Remediation Company and Puget Sound Energy, July 2005.
- EPA (Environmental Protection Agency), 1989 Commencement Bay Nearshore/Tideflats Record of Decision, EPA-Region 10, September 1989.
- EPA, 1997, Explanation of Significant Differences-PCB, Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, Washington, July 1997.
- EPA, 2000, Explanation of Significant Differences-PCB, Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, Washington, August 2000.

- EPA, 2004, Letter from EPA to PacifiCorp Environmental Remediation Company, titled “Confirmation/Baseline “Year “0” Sampling (CQAP/OMMP) – RA23 and RA 24 in Thea Foss Waterway, Commencement Bay/Nearshore Tideflats, Tacoma, Washington”, March 8, 2004.
- Floyd Snider, 2005, Supplemental Data Report, Thea Foss and Wheeler-Osgood Waterways Remediation Project, Prepared for the City of Tacoma, Draft – April 18, 2005.
- Sedar, D., 1993, Contaminants in Vector Truck Wastes, Ecology Publication No. 93-e49.
- Tacoma (City of Tacoma), 2004, August 2001-2004, Stormwater Monitoring Report, Thea Foss Wheeler-Osgood Waterways, prepared for the Department of Ecology, December 2004.
- Tacoma, 2005, Recontamination Corrective Action Proposal, Submitted to EPA on on September 15, 2005.
- Tetra Tech-FW, Dalton, Olmsted & Fuglevand, Inc., Geoengineers, Inc., 2003, Operations, Maintenance, and Monitoring Plan, Head of the Thea Foss Waterway Remediation Project, Tacoma, Washington , July 2003.
- Tetra Tech- EC, 2005a, Operations, Maintenance, and Monitoring Plan Sampling and Evaluation of Contamination in Capped Areas Sampling, Prepared for PacifiCorp Environmental Remediation Company and Puget Sound Energy, June 1, 2005.
- Tetra Tech- EC, 2005b, August 19, 2005 OMMP Underwater Video Survey, Prepared for PacifiCorp Environmental Remediation Company and Puget Sound Energy, September 21, 2005.

## **12.0 LIMITATIONS**

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 the requirements of the OMMP and our agreement with our client.

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.

Matthew G. Dalton  
Post-Remediation Quality Assurance Officer,  
Sr. Consulting Hydrogeologist, LG, LHG

**TABLE 1 - Fine Grained Layer Thicknesses and "Fines" Contents of Samples**

Location	Nov./Dec-04			May -05			Change Fine Layer Thickness (cm)
	Fines Thickness (cm)	Sample Thickness (cm)(a)	% Fines (GS)(b)	Fines Thickness (cm)	Sample Thickness (cm)	% Fines (GS)(b)	
Early Warning Samples							
RC-1	1	2	6.3	1.5	2	29.8	0.5
RC-2	8	8	44.3	9	2	50.9	1
RC-3	12	12	54.2	10	2	38.5	-2
RC-4	9	9	45.5	13	2	67.8	4
RC-5	11	11	58.1	10	2	60	-1
RC-6	5	5	52.6	4.5	2	54.5	-0.5
RC-7	4	4	33.2	3	2	26.2	-1
RC-8	5	5	47.1	4	2	62.1	-1
RC-9	6	6	40.2	5.5	2	63.8	-0.5
RC-10	3	3	51.9	5	2	65	2
RC-11	7	-----	-----	10.5	2	79.2	3.5
RC-12	3	3	66.8	5	2	72	2
RC-13	1	2	6.3	1	2	15.3	0
RC-14	1	2	12.7	1.5	2	20.2	0.5
RC-14B	-----	-----	-----	1.5	2	18.2	-----
S-16	5	5	61.6	5	-----	-----	0
S-17	2	2	47.7	6	-----	-----	4
S-18	7	7	39.8	3	-----	-----	-4
S-19	4	4	59.5	8	-----	-----	4
S-20	2	2	20.7	3.5	-----	-----	1.5
S-21	7	7	68.7	-----	-----	-----	-----
S-22	8	8	47.9	6.5	-----	-----	-1.5
S-23	3	3	38.7	-----	-----	-----	-----
S-24	2	3	43.0	6	-----	-----	4
Compliance Samples							
WC-1	1	10	7.2	1.5	10	-----	0.5
WC-2	8	10	-----	9	10	36.8	1
WC-3	12	10	-----	10	10	-----	-2
WC-4	9	10	37.4	13	10	37.4	4
WC-5	11	10	61.2	10	10	47.8	-1
WC-6	5	-----	-----	4.5	10	-----	-0.5
WC-7	4	10	17.3	3	10	7.2	-1
WC-8	5	-----	-----	4	10	-----	-1

**TABLE 1 - Fine Grained Layer Thicknesses and "Fines" Contents of Samples**

Location	Nov./Dec-04			May -05			Change Fine Layer Thickness (cm)
	Fines Thickness (cm)	Sample Thickness (cm)(a)	% Fines (GS)(b)	Fines Thickness (cm)	Sample Thickness (cm)	% Fines (GS)(b)	
WC-9	6	10	31.3	5.5	10	-----	-0.5
WC-10	3	10	15	5	10	-----	2
WC-11	7	10	32.7	10.5	10	76.9	3.5
WC-12	3	10	25.1	5	10	-----	2
S-15	12	10	52.4	11.5	10	57.7	-0.5
S-16	5	10	27.5	5	10	-----	0
S-17	2	10	-----	6	10	42.7	4
S-18	7	10	-----	3	10	-----	-4
S-19	4	10	25.1	8	10	-----	4
S-20	2	10	-----	3.5	10	-----	1.5
S-21	7	10	-----	-----	-----	-----	-----
S-22	8	10	-----	6.5	10	-----	-1.5
S-23	3	-----	-----	-----	-----	-----	-----
S-24	2	10	-----	6	10	25.1	4
S-25	7	-----	-----	-----	-----	-----	-----
S-26	2	-----	-----	-----	-----	-----	-----
S-27	5	-----	-----	-----	-----	-----	-----
S-28	2	-----	-----	-----	-----	-----	-----
S-29	4	10	-----	5	10	-----	1
S-30	1	-----	-----	3	10	-----	2
CA19B-03	3	-----	-----	5	10	-----	2
CA19B-06	5	-----	-----	8	10	-----	3
CA20-01	0.5	-----	-----	1	10	-----	0.5
CA20-04	3	-----	-----	1	10	-----	-2
CA22-02	3	-----	-----	7	10	-----	4
CA22-05	1.5	-----	-----	1.5	10	-----	0

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 underlying capping material.  
(b) - Based on grain size analysis (GS)

**TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005**

Head of Thea Foss Waterway  
Tacoma, Washington

PARAMETER					gravel	v. cs. sand	cs. sand	med. sand	fine sand	v. fine sand	silt	clay
Units					(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Waterway Cap (a)					----	----	----	----	----	----	----	----
SQO					----	----	----	----	----	----	----	----
Location	Depth Below Mudline	Sample Date	% TOC	% solids	> 2000 µm	1000-2000 µm	500-1000 µm	250-500 µm	125-250 µm	62-125 µm	3.9-62 µm	< 3.9 µm
<b>Fine Grained Sediment</b>												
RC-01	0-2 cm	5/12/2005	6.93	45.2	21.3	8.6	15.0	10.1	7.3	7.9	18.1	11.7
RC-02	0-2 cm	5/12/2005	7.11	41.7	0.4	1.0	6.4	15.0	17.2	9.0	34.7	16.2
RC-03	0-2 cm	5/12/2005	5.44	50.4	0.1	1.0	6.4	18.4	23.3	12.3	26.2	12.3
RC-04	0-2 cm	5/12/2005	6.26	35.4	0.2	0.6	5.7	8.7	9.5	7.5	49.7	18.1
RC-05	0-2 cm	5/12/2005	5.2	41.6	0.1	0.6	3.6	9.9	16.0	9.9	45.4	14.6
RC-06	0-2 cm	5/12/2005	5.63	42.2	0.3	1.1	5.4	15.0	15.7	8.0	39.2	15.3
RC-07	0-2 cm	5/11/2005	5.5	56.8	11.5	5.3	9.6	23.0	16.6	7.8	17.3	8.9
RC-08	0-2 cm	5/11/2005	4.65	41.3	2.7	3.6	7.6	9.9	8.0	5.9	42.5	19.6
RC-09	0-2 cm	5/11/2005	4.66	40.9	0.2	0.5	4.6	11.5	12.3	7.2	43.6	20.2
RC-10	0-2 cm	5/11/2005	4.7	44.5	2.2	2.7	3.0	9.2	11.1	6.6	44.9	20.1
RC-11	0-2 cm	5/11/2005	4.52	41.8	0.2	0.8	2.0	3.5	6.2	8.1	54.6	24.6
RC-12	0-2 cm	5/11/2005	4.81	43.8	2.0	2.4	4.0	5.4	6.6	7.6	45.9	26.1
RC-13	0-2 cm	5/12/2005	11.7	70.7	32.3	12.6	19.7	12.3	5.0	2.8	9.6	5.7
RC-14	0-2 cm	5/12/2005	7.43	61.3	18.1	9.8	19.5	15.0	9.6	7.8	12.8	7.4
RC-14B	0-2 cm	5/12/2005	4.37	66.9	25.5	13.2	21.8	13.3	4.6	3.3	11.4	6.8
<b>Compliance Samples</b>												
WC-02	0 - 10 cm	5/12/2005	4.9	65.3	1.3	0.7	5.4	22	25.8	8	26.1	10.7
WC-04	0 - 10 cm	5/12/2005	6.28	52.5	9.3	5.8	10.4	17.1	12.9	7.0	24.6	12.8
WC-05	0 - 10 cm	5/12/2005	4.89	49.4	2.6	3.4	5.4	11.3	16.3	13.2	32.6	15.2
WC-07	0 - 10 cm	5/11/2005	2.53	80.2	40.4	8.5	10.5	21.3	10.4	1.7	4.3	2.9
WC-11	0 - 10 cm	5/11/2005	4.98	42.1	1.0	0.8	2.2	4.4	6.8	7.8	52.5	24.4
S-15	0 - 10 cm	5/10/2005	4.24	49	2.9	3.9	9.3	10.8	9.1	6.3	39.7	18.0
S-17	0 - 10 cm	5/11/2005	4.09	55.1	7	2.7	5.4	14.7	18.8	8.6	29	13.7
S-24	0 - 10 cm	5/11/2005	4.39	60.1	4.4	4.5	7.8	25.4	26.3	6.5	16.5	8.6
<b>Duplicate Samples</b>												
RC-2A (Dup of RC-2)	0-2 cm	5/12/2005	6.54	40.8	0.2	0.9	6.6	14.7	16.6	9.0	37.2	14.8
<b>City Samples</b>												
WC-7	0 - 10 cm	5/11/2005	1.1	77.3	----	----	----	----	----	----	----	----
WC-8	0 - 10 cm	5/11/2005	1.4	72.5	----	----	----	----	----	----	----	----
WC-9	0 - 10 cm	5/11/2005	1.8	65.4	----	----	----	----	----	----	----	----
WC-11	0 - 10 cm	5/11/2005	5.84	42.9	----	----	----	----	----	----	----	----
S-15A	0 - 10 cm	5/10/2005	4.7	51.9	----	----	----	----	----	----	----	----
WC-12	0 - 10 cm	5/11/2005	3	60.02	----	----	----	----	----	----	----	----
S-15	0 - 10 cm	5/10/2005	3.1	51.2	----	----	----	----	----	----	----	----
S-16	0 - 10 cm	5/10/2005	3.7	59.9	----	----	----	----	----	----	----	----
S-19	0 - 10 cm	5/10/2005	5.7	51.1	----	----	----	----	----	----	----	----
S-20	0 - 10 cm	5/10/2005	3.7	46.7	----	----	----	----	----	----	----	----
S-29	0 - 10 cm	5/10/2005	3.4	56.3	----	----	----	----	----	----	----	----
S-30	0 - 10 cm	5/11/2005	2.1	83.2	----	----	----	----	----	----	----	----
CA-19B-03	0 - 10 cm	5/10/2005	3.4	62.4	----	----	----	----	----	----	----	----
CA-19B-06	0 - 10 cm	5/10/2005	3	47.5	----	----	----	----	----	----	----	----

**TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005**

Head of Thea Foss Waterway  
Tacoma, Washington

PARAMETER					gravel	v. cs. sand	cs. sand	med. sand	fine sand	v. fine sand	silt	clay
Units					(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Waterway Cap (a)					-----	-----	-----	-----	-----	-----	-----	-----
SQO					-----	-----	-----	-----	-----	-----	-----	-----
Location	Depth Below Mudline	Sample Date	% TOC	% solids	> 2000 µm	1000-2000 µm	500-1000 µm	250-500 µm	125-250 µm	62-125 µm	3.9-62 µm	< 3.9 µm
CA-20-01	0 - 10 cm	5/10/2005	0.71	88.8	-----	-----	-----	-----	-----	-----	-----	-----
CA-20-04	0 - 10 cm	5/10/2005	1.8	88.3	-----	-----	-----	-----	-----	-----	-----	-----
CA-22-02	0 - 10 cm	5/10/2005	4.1	57.5	-----	-----	-----	-----	-----	-----	-----	-----
CA-22-05	0 - 10 cm	5/10/2005	1.3	84.7	-----	-----	-----	-----	-----	-----	-----	-----

**Notes:** U - Not detected at indicated value  
 J - The numerical value is an estimated quantity.  
 B - The analyte was detected in the associated method blank.  
 nd - Not detected  
 ----- - Not analyzed  
 (a) - Analysis of waterway capping material prior to placement (DOF 2004a)

**TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005**

Head of Thea Foss Waterway  
Tacoma, Washington

PARAMETER		finest	TPH-Dx		As	Cu	Pb	Hg	Ni	Zn	Dibenzo-furan	2-Methyl-naphthalene
Units		(%)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)
Waterway Cap (a)		----	-----	-----	10 U	45.1	3	0.05 U	20	41	19 U	19 U
SQO		----	Diesel	Lube-Oil	57	390	450	0.59	140	410	540	670
Location	Depth Below Mudline	< 62.5 µm	Range	Range	-----	-----	-----	-----	-----	-----	-----	-----
<b>Fine Grained Sediment</b>												
RC-01	0-2 cm	29.8	1200	4800	10	81.7	104	0.2	37	289	220 U	220 U
RC-02	0-2 cm	50.9	1300	5900	10	107	122	0.3	34	261	78	150
RC-03	0-2 cm	38.5	400	1600	10 U	69.3	55	0.21	25	123	51	100
RC-04	0-2 cm	67.8	1000	3500	20	119	140	0.5	37	254	120	320
RC-05	0-2 cm	60.0	880	3000	10	100	108	0.3	31	187	130	350
RC-06	0-2 cm	54.5	580	1800	10 U	100	114	0.3	32	216	76	220
RC-07	0-2 cm	26.2	480	2100	10	73.9	70	0.22	25	141	69	160
RC-08	0-2 cm	62.1	1000	3200	20	111	145	0.5	31	215	120 U	310
RC-09	0-2 cm	63.8	1100	3700	20	117	144	0.5	32	211	120 U	380
RC-10	0-2 cm	65.0	1200	3800	20	115	159	0.6	32	203	180	720
RC-11	0-2 cm	79.2	2200	5700	20	132	178	0.84	35	231	190	700
RC-12	0-2 cm	72.0	1600	4400	20	121	186	0.8	31	217	340	1100
RC-13	0-2 cm	15.3	210	910	8 U	53.3	38	0.08	26	118	28 U	28 U
RC-14	0-2 cm	20.2	390	1800	9	56.2	58	0.13	30	203	40 U	40 U
RC-14B	0 - 2 cm	18.2	250	1200	7	44.6	37	0.08	26	117	86 U	86 U
<b>Compliance Samples</b>												
WC-02	0 - 10 cm	36.8	440	2100	10	72.5	54	0.12	26	127	39	51
WC-04	0 - 10 cm	37.4	350	1400	10	80.9	50	0.25	26	113	36 U	57
WC-05	0 - 10 cm	47.8	390	1400	10	80.3	54	0.2	27	111	41 U	95
WC-07	0 - 10 cm	7.2	140	600	7	45.3	23	0.07	20	62.2	25 U	36
WC-11	0 - 10 cm	76.9	2100	5300	20	145	212	0.7	35	257	180	690
S-15	0 - 10 cm	57.7	1600	4300	10	106	162	0.7	37	200	380	1300
S-17	0 - 10 cm	42.7	680	2700	13	92.2	87	0.29	26	134	86 U	190
S-24	0 - 10 cm	25.1	430	1700	9 U	66	59	0.20	22	105	42	140
<b>Duplicate Samples</b>												
RC-2A (Dup of RC-2)	0 - 2 cm	52.0	880	3700	10	106	123	0.3	34	267	230 U	230 U
<b>City Samples</b>												
WC-7	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.04	-----	-----	-----	30
WC-8	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.07	-----	-----	-----	51.9
WC-9	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.09	-----	-----	-----	89.8
WC-11	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.35	-----	-----	-----	310
S-15A	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.22	-----	-----	-----	470
WC-12	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.21	-----	-----	-----	244
S-15	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.25	-----	-----	-----	599
S-16	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.12	-----	-----	-----	97.6
S-19	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.23	-----	-----	-----	141
S-20	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.16	-----	-----	-----	120
S-29	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.19	-----	-----	-----	120
S-30	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.02	-----	-----	-----	47.1
CA-19B-03	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.13	-----	-----	-----	132
CA-19B-06	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.28	-----	-----	-----	227

**TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005**

Head of Thea Foss Waterway  
Tacoma, Washington

PARAMETER		finest	TPH-Dx		As	Cu	Pb	Hg	Ni	Zn	Dibenzo-furan	2-Methyl-naphthalene
Units		(%)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/kg)	(ug/kg)
Waterway Cap (a)		-----	-----	-----	10 U	<b>45.1</b>	<b>3</b>	0.05 U	<b>20</b>	<b>41</b>	19 U	19 U
SQO		-----	<b>Diesel</b>	<b>Lube-Oil</b>	<b>57</b>	<b>390</b>	<b>450</b>	<b>0.59</b>	<b>140</b>	<b>410</b>	<b>540</b>	<b>670</b>
Location	Depth Below Mudline	< 62.5 µm	Range	Range	-----	-----	-----	-----	-----	-----	-----	-----
CA-20-01	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.01 J	-----	-----	-----	22.1 J
CA-20-04	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.04	-----	-----	-----	23.7
CA-22-02	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.23	-----	-----	-----	839
CA-22-05	0 - 10 cm	-----	-----	-----	-----	-----	-----	0.05	-----	-----	-----	35.9

**Notes:**  
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 (a) - Analysis of waterway capping material prior to placement (DOF 2004a)

**TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005**

Head of Thea Foss Waterway  
Tacoma, Washington

PARAMETER		Acenaphthene	Acenaphthylene	Anthracene	Fluorene	Naphthalene	Phenanthrene	Total LPAHs	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b)-fluoranthene
Units		(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
<b>Waterway Cap (a)</b>		19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
<b>SQO</b>		<b>500</b>	<b>1300</b>	<b>960</b>	<b>540</b>	<b>2100</b>	<b>1500</b>	<b>5200</b>	<b>1600</b>	<b>1600</b>	----
Location	Depth Below Mudline	----	----	----	----	----	----	----	----	----	----
<b>Fine Grained Sediment</b>											
RC-01	0-2 cm	220 U	220 U	380	220 U	260	1700	2340	1200	1600	2400
RC-02	0-2 cm	220	74	490	190	420	1300	2844	1300	1600	1700
RC-03	0-2 cm	160	50	290	120	320	700	1740	650	810	830
RC-04	0-2 cm	480	140	860	350	980	1600	4730	1600	1900	1900
RC-05	0-2 cm	530	170	1000	360	1000	1700	5110	1700	1900	1800
RC-06	0-2 cm	260	100	540	200	650	1100	3070	1100	1300	1300
RC-07	0-2 cm	220	72	400	160	490	880	2382	810	880	840
RC-08	0-2 cm	430	150	890	300	960	1600	4640	1600	1700	1700
RC-09	0-2 cm	460	130	940	320	1200	1600	5030	1700	1800	2600
RC-10	0-2 cm	1000	310	1900	640	2000	3000	9570	2500	2800	2300
RC-11	0-2 cm	1400	360	1900	800	1800	2900	9860	2400	2600	1900
RC-12	0-2 cm	2700	510	3600	1400	3000	6200	18510	3800	4200	2400
RC-13	0-2 cm	32	28 U	88	33	73	460	686	380	510	800
RC-14	0-2 cm	48	40 U	120	48	70	710	996	580	760	930
RC-14B	0 - 2 cm	86 U	86 U	86 U	86 U	86 U	380	380	320	430	580
<b>Compliance Samples</b>											
WC-02	0 - 10 cm	82	29 U	190	70	140	650	1183	540	670	710
WC-04	0 - 10 cm	86	36 U	180	61	170	400	954	390	490	580
WC-05	0 - 10 cm	140	49	300	100	280	550	1514	550	650	640
WC-07	0 - 10 cm	46	25 U	87	29	120	180	498	200	210	220
WC-11	0 - 10 cm	1100	400	1800	710	1700	2800	9200	2600	2800	2000
S-15	0 - 10 cm	4200	560	4100	1700	3000	7300	22160	4600	4700	2900
S-17	0 - 10 cm	240	86 U	510	140	590	870	2540	900	960	760
S-24	0 - 10 cm	190	72	390	130	390	680	1992	600	690	640
<b>Duplicate Samples</b>											
RC-2A (Dup of RC-2)	0 -2 cm	250	230 U	570	230 U	530	1600	2950	1600	1900	2300
<b>City Samples</b>											
WC-7	0 - 10 cm	34.4	9.5 J	51.9	26.7	97.4	125	375	113	139	----
WC-8	0 - 10 cm	64.1	36.2	165	43.9	171	226	758	217	237	----
WC-9	0 - 10 cm	114	65.3	319	83.4	277	382	1331	323	386	----
WC-11	0 - 10 cm	608	204	999	381	689	1850	5041	1400	1640	----
S-15A	0 - 10 cm	1200	363	1450	649	1020	2510	7662	1510	1670	----
WC-12	0 - 10 cm	525	128	765	308	638	1460	4068	919	1000	----
S-15	0 - 10 cm	1430	444	1770	773	1340	2990	9346	1810	2100	----
S-16	0 - 10 cm	164	86.2	298	101	236	518	1501	410	451	----
S-19	0 - 10 cm	296	112	474	162	405	812	2402	553	639	----
S-20	0 - 10 cm	297	132	490	159	306	903	2407	665	777	----
S-29	0 - 10 cm	237	100	359	131	324	662	1933	460	531	----
S-30	0 - 10 cm	63.9	37.9	167	48.6	157	233	755	289	189	----
CA-19B-03	0 - 10 cm	406	97.7	540	207	365	934	2682	449	505	----
CA-19B-06	0 - 10 cm	759	180	912	436	486	1760	4760	838	956	----

**TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005**

Head of Thea Foss Waterway  
Tacoma, Washington

PARAMETER		Acenaphthene	Acenaphthylene	Anthracene	Fluorene	Naphthalene	Phenanthrene	Total LPAHs	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b)-fluoranthene
Units		(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
<b>Waterway Cap (a)</b>		19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
<b>SQO</b>		<b>500</b>	<b>1300</b>	<b>960</b>	<b>540</b>	<b>2100</b>	<b>1500</b>	<b>5200</b>	<b>1600</b>	<b>1600</b>	----
Location	Depth Below Mudline	----	----	----	----	----	----	----	----	----	----
CA-20-01	0 - 10 cm	58.8	21.2 J	73.3	32	78.9	130	416	108	135	----
CA-20-04	0 - 10 cm	56.9	15.9 J	70.5	38.6	87.4	146	439	89	98.9	----
CA-22-02	0 - 10 cm	2960	469	2560	1680	2560	6720	17788	2290	2590	----
CA-22-05	0 - 10 cm	77.9	25.5	107	38.5	99.9	174	559	125	134	----

**Notes:**

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- B - The analyte was detected in the associated method blank.
- nd - Not detected
- - Not analyzed
- (a) - Analysis of waterway capping material prior to placement (DOF 2004a)

**TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005**

Head of Thea Foss Waterway  
Tacoma, Washington

PARAMETER		Benzo(k)- fluoranthene	Benzofluor anthenes	Benzo(g,h,i)- perylene	Chrysene	Dibenz(a,h)- anthracene	Fluoranthene	Indeno(1,2,3- cd)pyrene	Pyrene	Total HPAHs
Units		(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Waterway Cap (a)		19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
SQO		----	<b>3600</b>	<b>720</b>	<b>2800</b>	<b>230</b>	<b>2500</b>	<b>690</b>	<b>3300</b>	<b>17000</b>
Location	Depth Below Mudline	----	----	----	----	----	----	----	----	----
<b>Fine Grained Sediment</b>										
RC-01	0-2 cm	2000	4400	530	2000	220 U	4300	540	4000	18570
RC-02	0-2 cm	1700	3400	600	2000	190	3900	600	3800	17390
RC-03	0-2 cm	830	1660	240	920	83	2000	240	2000	8603
RC-04	0-2 cm	1900	3800	580	2100	200	4500	550	4600	19830
RC-05	0-2 cm	1800	3600	510	2000	180	4500	490	4900	19780
RC-06	0-2 cm	1300	2600	350	1400	120	3100	340	3300	13610
RC-07	0-2 cm	810	1650	300	1000	88 J	2400	290	2400	9818
RC-08	0-2 cm	1000	2700	510	1700	170	3800	530	4600	17310
RC-09	0-2 cm	2600	5200	600	1800	190	3900	600	4700	20490
RC-10	0-2 cm	1800	4100	620	2600	240	5300	670	6500	25330
RC-11	0-2 cm	1900	3800	650	2600	240	5400	700	6700	25090
RC-12	0-2 cm	3500	5900	990	3500	360	8900	1000	11000	39650
RC-13	0-2 cm	570	1370	170	590	60	1300	180	1200	5760
RC-14	0-2 cm	930	1860	260	880	86	2100	260	1900	8686
RC-14B	0-2 cm	550	1130	140	520	86 U	1100	150	1000	4790
<b>Compliance Samples</b>										
WC-02	0 - 10 cm	710	1420	240	780	89	1700	250	1600	7289
WC-04	0 - 10 cm	510	1090	140	540	50	1200	150	1200	5250
WC-05	0 - 10 cm	640	1280	170	690	56	1600	180	1700	6876
WC-07	0 - 10 cm	280	500	51	250	25 U	700	52	660	2623
WC-11	0 - 10 cm	2000	4000	680	2800	280	5500	760	7500	26920
S-15	0 - 10 cm	2900	5800	1500	4700	510	10000	1500	13000	46310
S-17	0 - 10 cm	750	1510	400	980	120	2100	380	2700	10050
S-24	0 - 10 cm	640	1280	160	730	58	1400	160	1600	6678
<b>Duplicate Samples</b>										
RC-2A (Dup of RC-2)	0-2 cm	1900	4200	640	2300	230 U	4600	660	4600	20500
<b>City Samples</b>										
WC-7	0 - 10 cm	----	246	97.2	140	19.2 J	272	90.7	264	1381
WC-8	0 - 10 cm	----	304	129	208	34.1	570	115	645	2459
WC-9	0 - 10 cm	----	522	206	276	51.8 J	717	198	1050	3730
WC-11	0 - 10 cm	----	2200	803	1420	79.8	2440	659	3160	13802
S-15A	0 - 10 cm	----	2180	832	1480	188	2750	828	3400	14838
WC-12	0 - 10 cm	----	1060	520	845	56.9	1730	405	2060	8596
S-15	0 - 10 cm	----	2690	1050	1810	234	3230	1060	4140	18124
S-16	0 - 10 cm	----	648	255	413	56	744	264	939	4180
S-19	0 - 10 cm	----	891	329	553	70.8	1030	346	1280	5692
S-20	0 - 10 cm	----	1150	423	702	92.4	1330	440	1500	7079
S-29	0 - 10 cm	----	755	290	484	62.4	931	295	1070	4878
S-30	0 - 10 cm	----	262	131	216	20.3	490	114	565	2276
CA-19B-03	0 - 10 cm	----	663	229	434	49.3	900	238	1090	4557
CA-19B-06	0 - 10 cm	----	1240	426	809	102	1550	452	1850	8223

**TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005**

PARAMETER		Benzo(k)-fluoranthene	Benzofluoranthenes	Benzo(g,h,i)-perylene	Chrysene	Dibenz(a,h)-anthracene	Fluoranthene	Indeno(1,2,3-cd)pyrene	Pyrene	Total HPAHs
Units		(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
<b>Waterway Cap (a)</b>		19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U	19 U
<b>SQO</b>		----	<b>3600</b>	<b>720</b>	<b>2800</b>	<b>230</b>	<b>2500</b>	<b>690</b>	<b>3300</b>	<b>17000</b>
Location	Depth Below Mudline	----	----	----	----	----	----	----	----	----
CA-20-01	0 - 10 cm	----	193	74.5	117	16.1 J	190	85.9	212	1132
CA-20-04	0 - 10 cm	----	154	55.2	93.6	11.4 J	191	65.9	198	957
CA-22-02	0 - 10 cm	----	3200	1150	2170	267	4090	1210	5680	22647
CA-22-05	0 - 10 cm	----	205	76.7	127	15.7 J	257	86.1	255	1282

**Notes:**  
 U - Not detected at indicated value  
 J - The numerical value is an estimated quantity.  
 B - The analyte was detected in the associated method blank.  
 nd - Not detected  
 ---- - Not analyzed  
 (a) - Analysis of waterway capping material prior to placement (DOF 2004a)

TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005

Head of Thea Foss Waterway  
Tacoma, Washington

PARAMETER		Dimethyl-phthalate	Diethyl-phthalate	Di-n-butyl-phthalate	Butylbenzyl-phthalate	bis (2-Ethylhexyl)-phthalate	Di-n-octyl-phthalate	4,4'-DDE	4,4'-DDD	4,4'-DDT
Units		(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
Waterway Cap (a)		19 U	19 U	19 U	19 U	19 U	19 U	1.9 U	1.9 U	1.9 U
SQO		160	200	1400	900	1300	6200	9	16	34
Location	Depth Below Mudline	-----	-----	-----	-----	-----	-----	-----	-----	-----
<b>Fine Grained Sediment</b>										
RC-01	0-2 cm	220 U	220 U	410	520	8200	330	9.4 U	4.4 J	15 J
RC-02	0-2 cm	67 U	67 U	320	540	7300	230	4.5 J	9.1 U	18 U
RC-03	0-2 cm	44 U	44 U	150	240	3200	130	8.4 U	7.3 J	18 U
RC-04	0-2 cm	72 U	72 U	250	520	6700	250	8.1 U	5.8	11
RC-05	0-2 cm	75 U	75 U	220	480	5600	240	10 U	12 J	19 J
RC-06	0-2 cm	67 U	67 U	210	350	4400	150	7.3 U	8.0 J	12 J
RC-07	0-2 cm	42 U	42 U	200	270	4400	120	5.8 U	4.8 J	7.4 U
RC-08	0-2 cm	120 U	120 U	160	370	3500	130	9.0 U	11 J	14 U
RC-09	0-2 cm	350	120 U	180	360	3500	170	11 U	14 J	18 U
RC-10	0-2 cm	150 U	150 U	250	390	3600	150 U	12 U	17 J	20 U
RC-11	0-2 cm	37 U	37 U	110	480	3500	99	18 U	27 J	33 U
RC-12	0-2 cm	49 U	49 U	180	500	3800	63	14 U	21 J	21 J
RC-13	0-2 cm	28 U	28 U	120	170	2100	81	2.0 U	2.0 U	12 U
RC-14	0-2 cm	40 U	40 U	320	190	3600	93	7.2 U	5.2 J	11 J
RC-14B	0 - 2 cm	86 U	86 U	100	140	1900	86 U	2.0 U	2.0 U	5.0 U
<b>Compliance Samples</b>										
WC-02	0 - 10 cm	29 U	29 U	130	200	2700	70	2.0 U	5.1 J	5.0 U
WC-04	0 - 10 cm	36 U	36 U	92	160	1700	70	2.0 U	5.7 U	11 J
WC-05	0 - 10 cm	41 U	41 U	92	170	2200	92	8.8 U	6.7 U	12
WC-07	0 - 10 cm	25 U	25 U	62	150	730	30	2.0 U	2.0 U	5.0 U
WC-11	0 - 10 cm	38 U	38 U	160	520	3500	80	12 U	19 J	23 U
S-15	0 - 10 cm	140 U	140 U	210	260	3000	140 U	9.8 U	22 J	34 J
S-17	0 - 10 cm	86 U	86 U	98	190	2000	86 U	4.3 U	4.5 J	5.0 U
S-24	0 - 10 cm	28 U	28 U	110	200	2000	43	5.5 U	6.6 J	8.9 J
<b>Duplicate Samples</b>										
RC-2A (Dup of RC-2)	0 - 2 cm	230 U	230 U	470	580	13000	320	15 U	10 J	27 J
<b>City Samples</b>										
WC-7	0 - 10 cm	-----	-----	-----	-----	557	-----	1.87 J	0.56 J	-----
WC-8	0 - 10 cm	-----	-----	-----	-----	220	-----	4.3	5.7	-----
WC-9	0 - 10 cm	-----	-----	-----	-----	289	-----	1.7 J	1.1 J	-----
WC-11	0 - 10 cm	-----	-----	-----	-----	1330	-----	19.3	15.3	-----
S-15A	0 - 10 cm	-----	-----	-----	-----	775	-----	18	5.9	-----
WC-12	0 - 10 cm	-----	-----	-----	-----	823	-----	8.5	3.2	-----
S-15	0 - 10 cm	-----	-----	-----	-----	937	-----	17.4	7.9	-----
S-16	0 - 10 cm	-----	-----	-----	-----	629	-----	1.67 J	2.67 J	-----
S-19	0 - 10 cm	-----	-----	-----	-----	601	-----	12.3	15.4	-----
S-20	0 - 10 cm	-----	-----	-----	-----	965	-----	12.4	11	-----
S-29	0 - 10 cm	-----	-----	-----	-----	687	-----	9.8	7.4	-----
S-30	0 - 10 cm	-----	-----	-----	-----	224	-----	1.8 J	0.57 J	-----
CA-19B-03	0 - 10 cm	-----	-----	-----	-----	209	-----	9.9	6.7	-----
CA-19B-06	0 - 10 cm	-----	-----	-----	-----	363	-----	18.1	5.6	-----

**TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005**

Head of Thea Foss Waterway  
Tacoma, Washington

PARAMETER		Dimethyl-phthalate	Diethyl-phthalate	Di-n-butyl-phthalate	Butylbenzyl-phthalate	bis (2-Ethylhexyl)-phthalate	Di-n-octyl-phthalate	4,4'-DDE	4,4'-DDD	4,4'-DDT
Units		(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)	(ug/kg)
<b>Waterway Cap (a)</b>		19 U	19 U	19 U	19 U	19 U	19 U	1.9 U	1.9 U	1.9 U
<b>SQO</b>		<b>160</b>	<b>200</b>	<b>1400</b>	<b>900</b>	<b>1300</b>	<b>6200</b>	<b>9</b>	<b>16</b>	<b>34</b>
Location	Depth Below Mudline	-----	-----	-----	-----	-----	-----	-----	-----	-----
CA-20-01	0 - 10 cm	-----	-----	-----	-----	169 J	-----	0.75 J	0.2 U	-----
CA-20-04	0 - 10 cm	-----	-----	-----	-----	159 J	-----	1.15 J	0.71 J	-----
CA-22-02	0 - 10 cm	-----	-----	-----	-----	580	-----	14.4	2.3 J	-----
CA-22-05	0 - 10 cm	-----	-----	-----	-----	206 J	-----	1.3 J	1.5 J	-----

**Notes:** U - Not detected at indicated value

J - The numerical value is an estimated quantity.

B - The analyte was detected in the associated method blank.

nd - Not detected

----- - Not analyzed

(a) - Analysis of waterway capping material prior to placement (DOF 2004a)

**TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005**

Head of Thea Foss Waterway  
Tacoma, Washington

PARAMETER		Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCBs
Units		(ug/kg)	(ug/kg)						
Waterway Cap (a)		19 U	31 U	19 U	----	19 U	19 U	19 U	19 U
SQO		----	----	----	----	----	----	----	300
Location	Depth Below Mudline	-----	-----	-----	-----	-----	-----	-----	-----
<b>Fine Grained Sediment</b>									
RC-01	0-2 cm	20 U	20 U	20 U	20 U	36 J	92 J	72	200 J
RC-02	0-2 cm	20 U	20 U	20 U	20 U	50 J	130 J	120	300 J
RC-03	0-2 cm	20 U	20 U	20 U	20 U	34 J	71 J	73 J	178 J
RC-04	0-2 cm	20 U	20 U	20 U	20 U	37	71 J	64	172 J
RC-05	0-2 cm	20 U	20 U	20 U	20 U	53 J	120 J	100 J	273 J
RC-06	0-2 cm	20 U	20 U	20 U	20 U	40 J	92 J	60	192 J
RC-07	0-2 cm	19 U	19 U	19 U	19 U	25	46 J	49	120 J
RC-08	0-2 cm	20 U	20 U	20 U	20 U	45	75 J	68	188 J
RC-09	0-2 cm	20 U	20 U	20 U	20 U	46	90 J	83	219 J
RC-10	0-2 cm	20 U	20 U	20 U	20 U	52	110 J	110	272 J
RC-11	0-2 cm	20 U	20 U	20 U	20 U	81 J	150 J	150	381 J
RC-12	0-2 cm	20 U	20 U	20 U	20 U	65 J	110 J	100	275 J
RC-13	0-2 cm	20 U	42 J	38	80 J				
RC-14	0-2 cm	20 U	57 J	53 J	110 J				
RC-14B	0 - 2 cm	20 U	19 J	19 J					
<b>Compliance Samples</b>									
WC-02	0 - 10 cm	20 U	20 U	20 U	20 U	25 J	57 J	43	125 J
WC-04	0 - 10 cm	20 U	20 U	20 U	20 U	21 J	39 J	29	89 J
WC-05	0 - 10 cm	20 U	47 J	37	84 J				
WC-07	0 - 10 cm	20 U	20 U						
WC-11	0 - 10 cm	20 U	20 U	20 U	20 U	61 J	110 J	96	267 J
S-15	0 - 10 cm	20 U	20 U	20 U	20 U	98	180 J	180	458 J
S-17	0 - 10 cm	20 U	30 J	29 J	59 J				
S-24	0 - 10 cm	20 U	20 U	20 U	20 U	24	52 J	56	132 J
<b>Duplicate Samples</b>									
RC-2A (Dup of RC-2)	0 -2 cm	59 U	59 U	59 U	59 U	61	180 J	110	351 J
<b>City Samples</b>									
WC-7	0 - 10 cm	6.5 U	26.2	28.9	55.1				
WC-8	0 - 10 cm	39.4 U	21.6 U	67.4 J	67.4 J				
WC-9	0 - 10 cm	37.9 U	20.8 U	107 J	107 J				
WC-11	0 - 10 cm	15.8 U	312	305	617				
S-15A	0 - 10 cm	9.5 U	295	243	538				
WC-12	0 - 10 cm	11.0 U	144	163	307				
S-15	0 - 10 cm	13.3 U	300	284	584				
S-16	0 - 10 cm	7.5 U	104	99.7	203.7				
S-19	0 - 10 cm	11.6 U	219	178	397				
S-20	0 - 10 cm	7.9 U	96.2	85.7	181.9				
S-29	0 - 10 cm	7.6 U	140	129	269				
S-30	0 - 10 cm	33.5 U	18.4 U	33.1 J	33.1 J				
CA-19B-03	0 - 10 cm	5.3 U	118	113	231				
CA-19B-06	0 - 10 cm	7.0 U	210	216	426				

**TABLE 2 - Summary of Surface Sediment Quality Data - Utilities' Work Area - May 2005**

PARAMETER		Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCBs
Units		(ug/kg)	(ug/kg)						
<b>Waterway Cap (a)</b>		19 U	31 U	19 U	----	19 U	19 U	19 U	19 U
<b>SQO</b>		----	----	----	----	----	----	----	<b>300</b>
Location	Depth Below Mudline	-----	-----	-----	-----	-----	-----	-----	-----
CA-20-01	0 - 10 cm	3.3 U	11.1 J	9.4 J	20.5 J				
CA-20-04	0 - 10 cm	3.3 U	21.3	19	40.3				
CA-22-02	0 - 10 cm	8.6 U	240	239	479				
CA-22-05	0 - 10 cm	4.3 U	24.1	25.6	49.7				

**Notes:** U - Not detected at indicated value

J - The numerical value is an estimated quantity.

B - The analyte was detected in the associated method blank.

nd - Not detected

----- - Not analyzed

(a) - Analysis of waterway capping material prior to placement (DOF 2004a)

**TABLE 3 - Highest Concentrations and SQO Exceedance Factors - Compliance Samples (0 to 10 cm) - May 2005**

Constituent	Highest Concentration (ug/kg)	SQO (a) (ug/kg)	Exceedance Factor (b)	Station
Mercury	700	590	1.2	WC-11/S-15
2-Methylnaphthalene	1300	670	1.9	S-15
Acenaphthene	4200	500	8.4	S-15
Anthracene	4100	960	4.3	S-15
Fluorene	1700	540	3.1	S-15
Naphthalene	3000	2100	1.4	S-15
Phenanthrene	7300	1500	4.9	S-15
Total LPAHs	22160	5200	4.3	S-15
Benzo(a)anthracene	4600	1600	2.9	S-15
Benzo(a)pyrene	4700	1600	2.9	S-15
Benzo(b)fluoranthene	5800	3600	1.6	S-15
Benzo(ghi)perylene	1500	720	2.1	S-15
Chrysene	4700	2800	1.7	S-15
Dibenzo(ah)anthracene	510	230	2.2	S-15
Fluoranthene	10000	2500	4.0	S-15
Indeno(123-cd)pyrene	1500	690	2.2	S-15
Pyrene	13000	3300	3.9	S-15
Total HPAHs	46310	17000	2.7	S-15
bis(2-ethylhexyl)phthalate	3500	1300	2.7	WC-11
4,4'-DDE	19.3	9	2.1	WC-11
4,4'-DDD	22	16	1.4	S-15
Total PCBs	617	300	2.1	WC-11

**Notes:** (a) - SQO = Sediment Quality Objective  
(b) - Exceedance factor - Concentration divided by SQO. Exceedance factors greater than 1.0 exceed SQO

**TABLE 4 - Highest Concentrations and SQO Exceedance Factors -  
Early Warning Samples (0 to 2 cm) - May 2005**

Constituent	Highest Concentration (ug/kg)	SQO (a) (ug/kg)	Exceedance Factor (b)	Station
Mercury	840	590	1.4	RC-11
2-Methylnaphthalene	1100	670	1.6	RC-12
Acenaphthene	2700	500	5.4	RC-12
Anthracene	3600	960	3.8	RC-12
Fluorene	1400	540	2.6	RC-12
Naphthalene	3000	2100	1.4	RC-12
Phenanthrene	6200	1500	4.1	RC-12
Total LPAHs	18510	5200	3.6	RC-12
Benzo(a)anthracene	3800	1600	2.4	RC-12
Benzo(a)pyrene	4200	1600	2.6	RC-12
Benzo(b)fluoranthene	5900	3600	1.6	RC-12
Benzo(ghi)perylene	990	720	1.4	RC-12
Chrysene	3500	2800	1.3	RC-12
Dibenzo(ah)anthracene	360	230	1.6	RC-12
Fluoranthene	8900	2500	3.6	RC-12
Indeno(123-cd)pyrene	1000	690	1.4	RC-12
Pyrene	11000	3300	3.3	RC-12
Total HPAHs	39650	17000	2.3	RC-12
Dimethylphthalate	350	160	2.2	RC-09
bis(2-ethylhexyl)phthalate	8200	1300	6.3	RC-1
4,4'-DDD	27	16	1.7	RC-11
Total PCBs	381	300	1.3	RC-11

**Notes:** (a) - SQO = Sediment Quality Objective  
(b) - Exceedance factor - Concentration divided by SQO. Exceedance factors greater than 1.0 exceed SQO

**TABLE 4 - Highest Concentrations and SQO Exceedance Factors -  
Early Warning Samples (0 to 2 cm) - May 2005**

Constituent	Highest Concentration (ug/kg)	SQO (a) (ug/kg)	Exceedance Factor (b)	Station
Mercury	840	590	1.4	RC-11
2-Methylnaphthalene	1100	670	1.6	RC-12
Acenaphthene	2700	500	5.4	RC-12
Anthracene	3600	960	3.8	RC-12
Fluorene	1400	540	2.6	RC-12
Naphthalene	3000	2100	1.4	RC-12
Phenanthrene	6200	1500	4.1	RC-12
Total LPAHs	18510	5200	3.6	RC-12
Benzo(a)anthracene	3800	1600	2.4	RC-12
Benzo(a)pyrene	4200	1600	2.6	RC-12
Benzo(a)fluoranthene	5900	3600	1.6	RC-12
Benzo(ghi)perylene	990	720	1.4	RC-12
Chrysene	3500	2800	1.3	RC-12
Dibenzo(ah)anthracene	360	230	1.6	RC-12
Fluoranthene	8900	2500	3.6	RC-12
Indeno(123-cd)pyrene	1000	690	1.4	RC-12
Pyrene	11000	3300	3.3	RC-12
Total HPAHs	39650	17000	2.3	RC-12
Dimethylphthalate	350	160	2.2	RC-09
bis(2-ethylhexyl)phthalate	8200	1300	6.3	RC-1
4,4'-DDD	27	16	1.7	RC-11
Total PCBs	381	300	1.3	RC-11

**Notes:** (a) - SQO = Sediment Quality Objective  
(b) - Exceedance factor - Concentration divided by SQO. Exceedance factors greater than 1.0 exceed SQO

**TABLE 5 - Sediment Trap Concentrations - 2002 to 2004**

Head of Thea Foss Waterway  
Tacoma, WA

	<b>Lead</b>	<b>Mercury</b>	<b>Zinc</b>	<b>Diesel</b>	<b>Heavy Oil</b>	<b>LPAH</b>	<b>HPAH</b>	<b>BEHP</b>	<b>4,4'-DDD</b>	<b>4,4'-DDE</b>	<b>4,4'-DDT</b>	<b>T-PCBs</b>
<b>Units</b>	<b>(mg/kg)</b>	<b>(mg/kg)</b>	<b>(mg/kg)</b>	<b>(mg/kg)</b>	<b>(mg/kg)</b>	<b>(ug/kg)</b>	<b>(ug/kg)</b>	<b>(ug/kg)</b>	<b>(ug/kg)</b>	<b>(ug/kg)</b>	<b>(ug/kg)</b>	<b>(ug/kg)</b>
<b>SQO</b>	450	0.59	410	None	None	5200	17000	1300	16	9	34	300
<b>237A-FD2</b>												
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
<b>237B-FD1</b>												
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
<b>235-FD6</b>												
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
<b>243-FD23</b>												
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

**Range (detections)**

Detections	11	11	11	13	15	15	15	15	1	1	8	8
Sample N	11	11	11	12	12	12	12	12	11	11	11	11

High	430	0.972	742	670	7200	5920	40020	41000	1.4 B	1.3 B	28.6 J	220
Low	56.7	0.04	185	37	1400	823	4193	3000	1.4 B	1.3 B	8.5	8
Average	166	0.21	359	164	3067	2982	16837	15233	----	----	12.7	89
Geomean	134	0.12	329	123	2745	2461	13216	12314	----	----	11.2	66

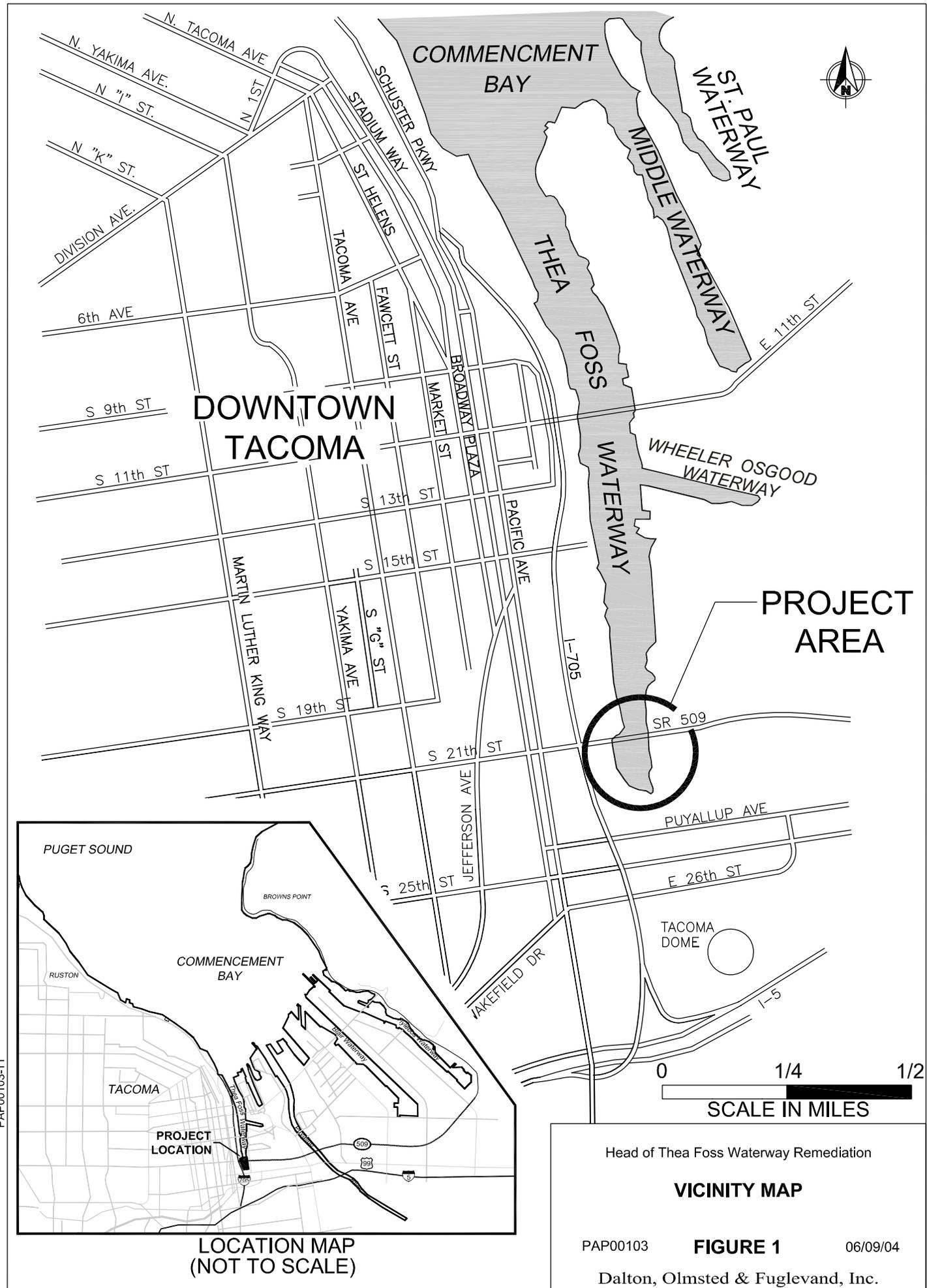
**Notes:** Source - Table E-15 in Stormwater Monitoring, August 2001-2004 Report, Thea Foss and Wheeler-Osgood Waterways, Prepared by City of Tacoma, November 2004.  
 U - Not detected at indicated value  
 J - Estimated concentration  
 C - Analyte detected in laboratory blank  
 ---- - Not reported  
 SQO - Commencement Bay Sediment Quality Objective

**TABLE 6 - Summary of Early Warning Sediment Quality Data - Utilities' Work Area - April 2004**

Head of Thea Foss Waterway  
Tacoma, Washington

PARAMETER				Pb	Hg	Zn	Diesel	Heavy Oil	LPAH	HPAH	BEHP	4,4'-DDE	4,4'-DDD	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)	(ug/kg)
<b>SQO</b>				<b>450</b>	<b>0.59</b>	<b>410</b>	<b>none</b>	<b>none</b>	<b>5200</b>	<b>17000</b>	<b>1300</b>	<b>9</b>	<b>16</b>	<b>34</b>	<b>300</b>	
<b>Cap Material</b>				<b>8.1(a)</b>	<b>0.06 U(a)</b>	<b>43.2 (a)</b>	na	na	nd	nd	nd	nd	nd	nd	nd	
Location	Sample Date	% solids	% TOC	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	
<b>Waterway Cap Samples</b>																
RC-01	4/8/2004	79.8	2.4	25	0.06 U	74.3	na	na	160	2667	1300	0.38 U	0.44	2.3 U	5.7	
RC-02	4/8/2004	50.7	5.3	20	0.1 U	71	na	na	197	1033	470	0.39 U	0.68	1.3 U	6.3	
RC-03	4/8/2004	37.8	6.7	44	0.1	115	na	na	586	2279	1100	1.1 U	0.78	1.4 U	7.2	
RC-04	4/8/2004	55.2	6.3	19	0.08	70	na	na	191	868	360	0.39 U	0.75	1.3 U	5.7	
RC-05	4/8/2004	46.2	5.3	19	0.09	70	na	na	74	259	110	0.39 U	0.66	0.39 U	4.3	
RC-06	4/8/2004	57.4	4.7	18	0.08 U	56	na	na	164	1050	500	0.39 U	0.65	1.7 U	9.2	
RC-07	4/8/2004	84.1	1.3	6	0.05 U	40.6	na	na	26	270	180	0.38 U	0.38 U	0.38 U	nd	
RC-08	4/8/2004	79.7	0.92	5	0.06 U	33.0	na	na	28	213	110	0.39 U	0.39 U	0.39 U	nd	
RC-09	4/8/2004	67.3	2.9	15	0.07 U	53.3	na	na	130	577	230	0.38 U	0.88	1.7 U	6.5	
RC-10	4/9/2004	68.1	3.2	11	0.06 U	43.7	na	na	159	392	80	0.39 U	0.55	0.39 U	nd	
RC-11	4/8/2004	67.6	3.0	35	0.13	82.8	na	na	338	881	280	1.6 U	1.7	2.4 U	11	
RC-12	4/9/2004	88.4	0.37	4	0.05 U	43.9	na	na	20 U	22	60	0.39 U	0.39 U	0.39 U	nd	
RC-13	4/8/2004	78.5	3.3	42	0.07	99.3	na	na	303	4180	1400	3.4 U	1.1	3.7 U	nd	
RC-14	4/8/2004	65.9	7.0	54	0.10	167	na	na	658	7360	3000	3.1 U	1.7	4.9 U	nd	

**Notes:** U = nondetected at the associated value      na - not analyzed  
 UJ = nondetect may be biased low due to low spike recoveries      (a) - Based on average of 0 to 10 cm samples obtained in April 2004  
 J = associated value is considered an estimate  
 nd - Not detected



**DOWNTOWN  
TACOMA**

**PROJECT  
AREA**

PUGET SOUND

COMMENCEMENT BAY

TACOMA

PROJECT LOCATION

**LOCATION MAP  
(NOT TO SCALE)**

Head of Thea Foss Waterway Remediation

**VICINITY MAP**

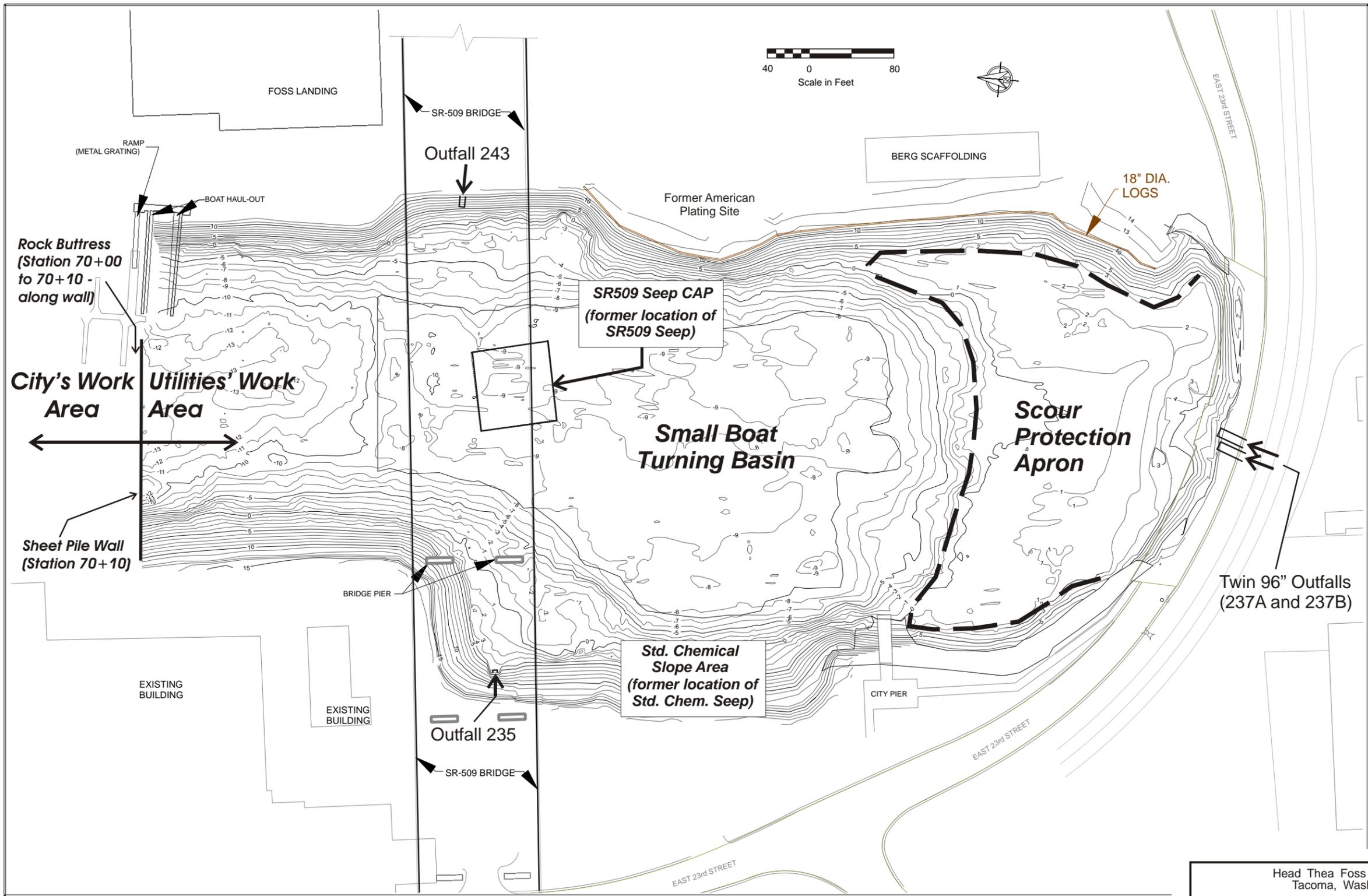
PAP00103

**FIGURE 1**

06/09/04

Dalton, Olmsted & Fuglevand, Inc.

PAP00103-11

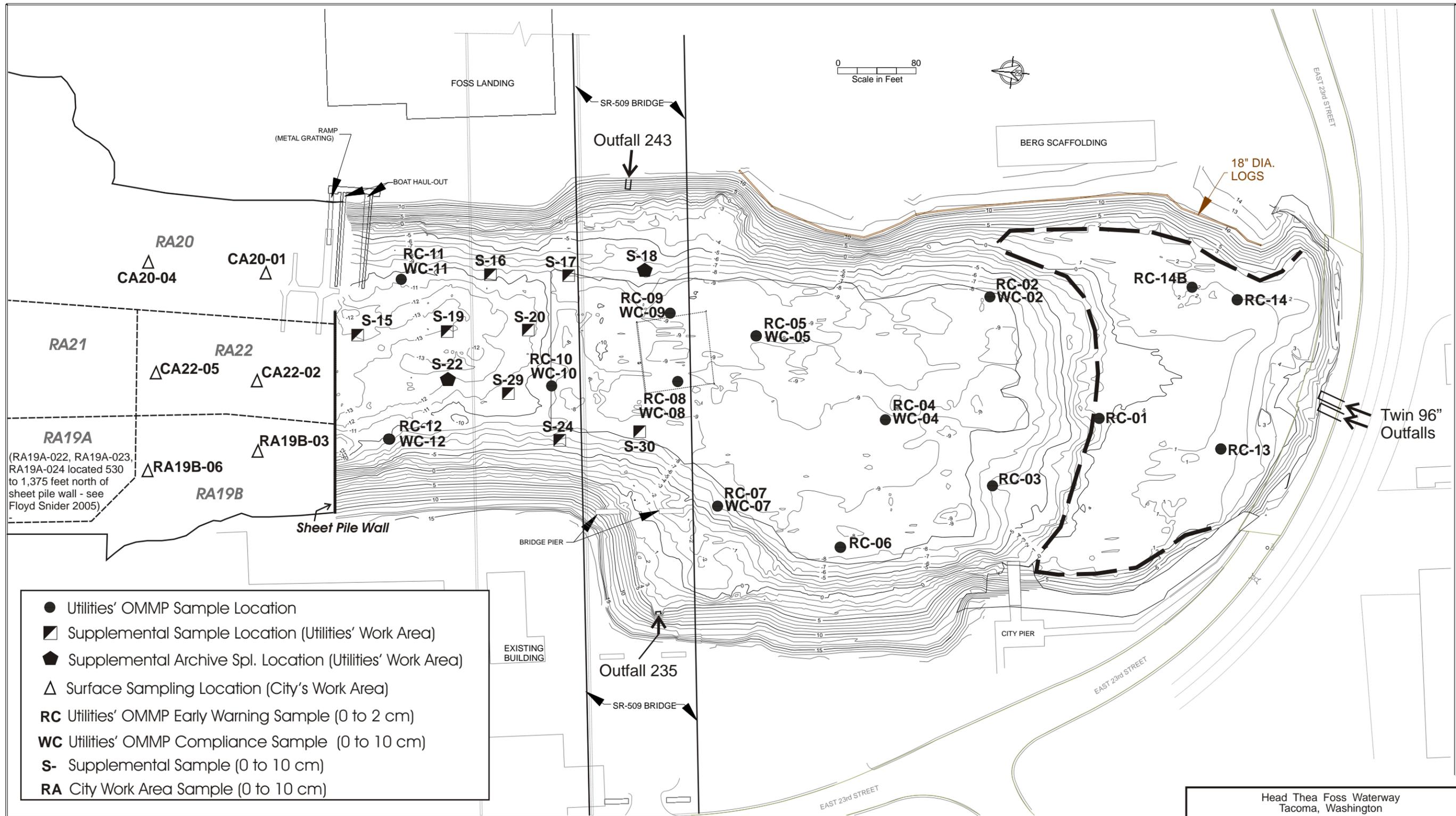


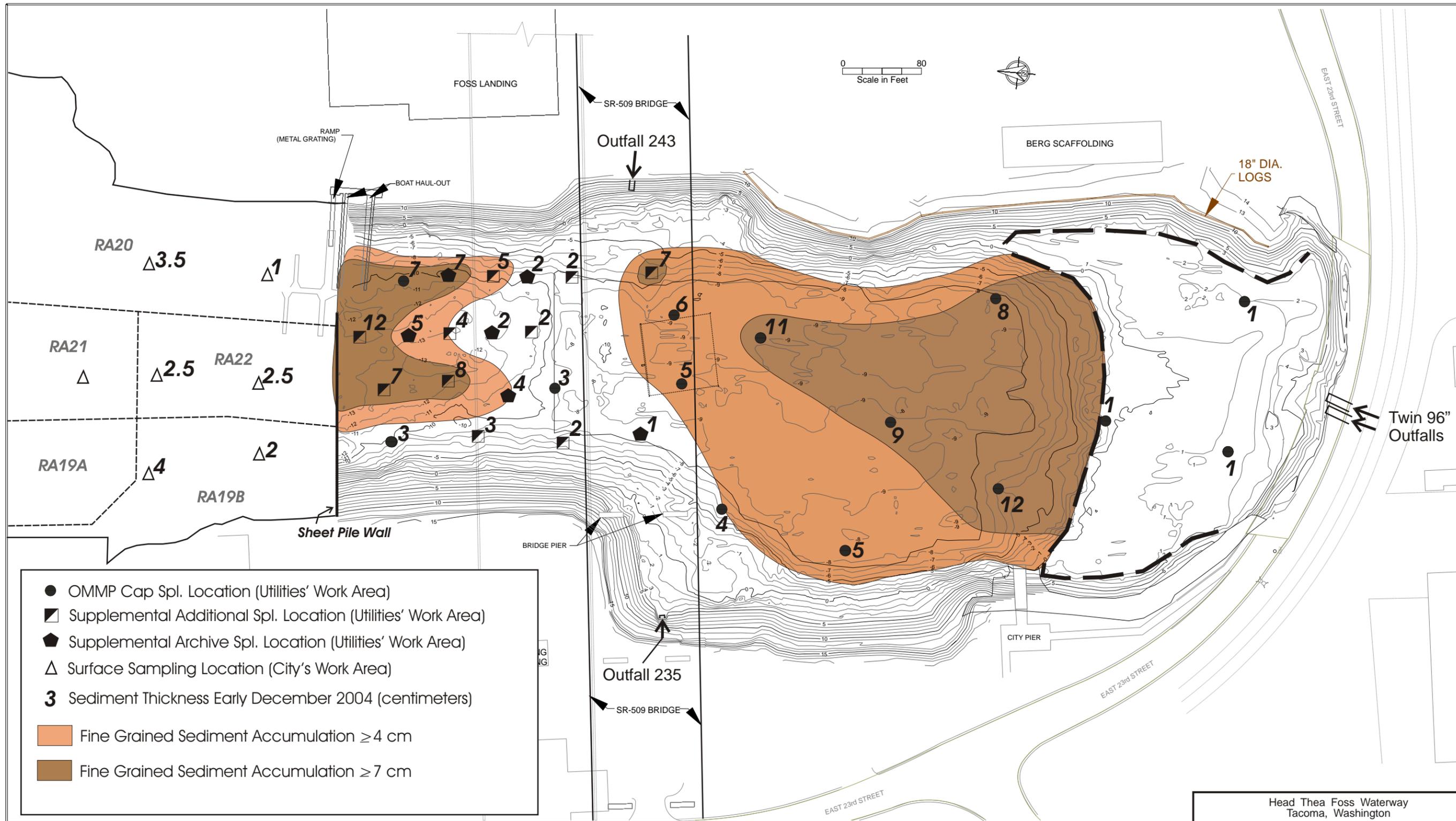
Head Thea Foss Waterway  
Tacoma, Washington

**Remedial Features  
Utilities' Work Area**

PAP-001-04 **FIGURE 2** May 2005  
Dalton, Olmsted & Fuglevand, Inc.

Ref: Head of waterway b.cdr





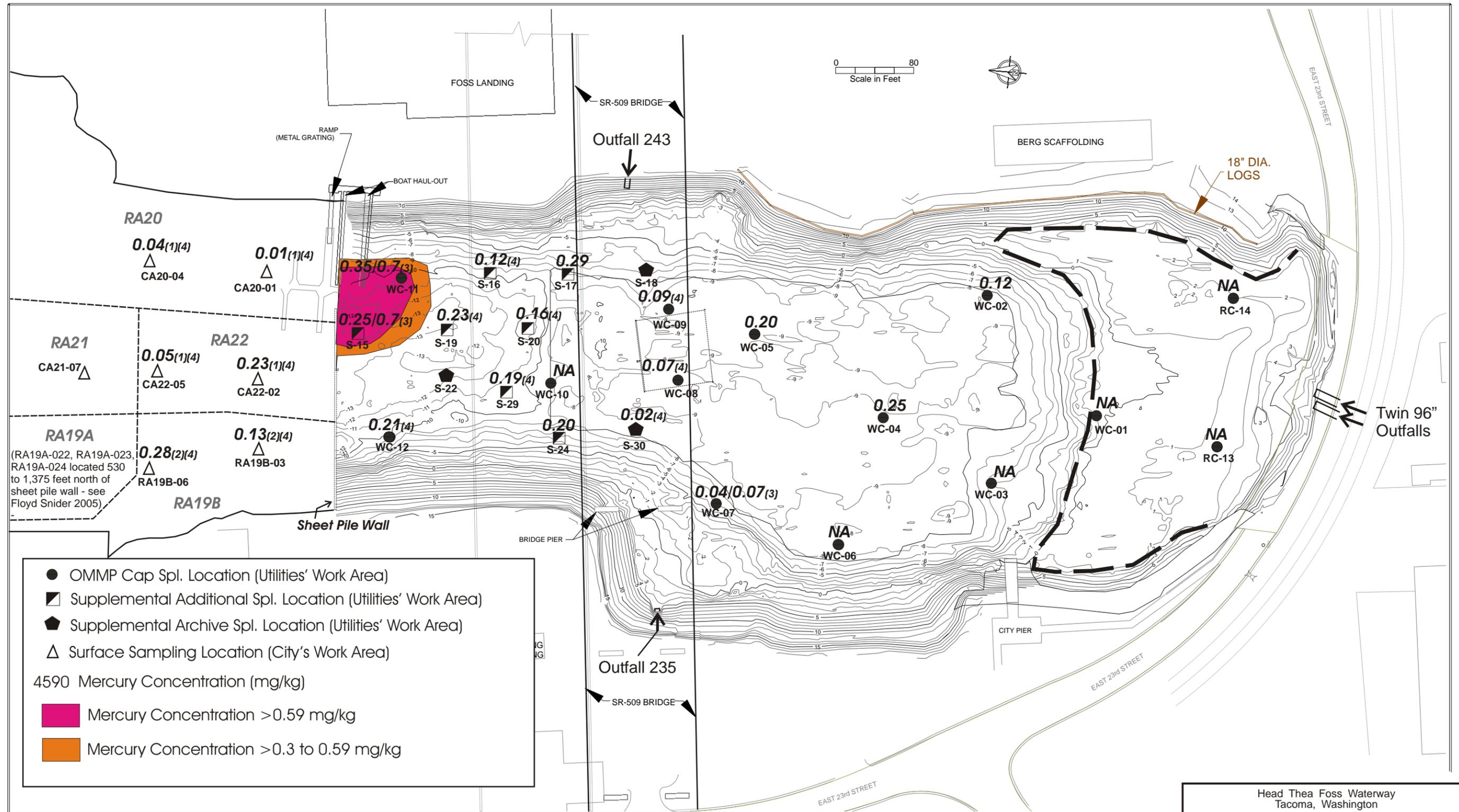
Head Thea Foss Waterway  
Tacoma, Washington

**Thickness of Fine Grained Sediment  
Early December 2004**

PAP-001-04 **FIGURE 4** May 2005  
Dalton, Olmsted & Fuglevand, Inc.

Ref: Fine Grained Thickness 12-04 a.cdr



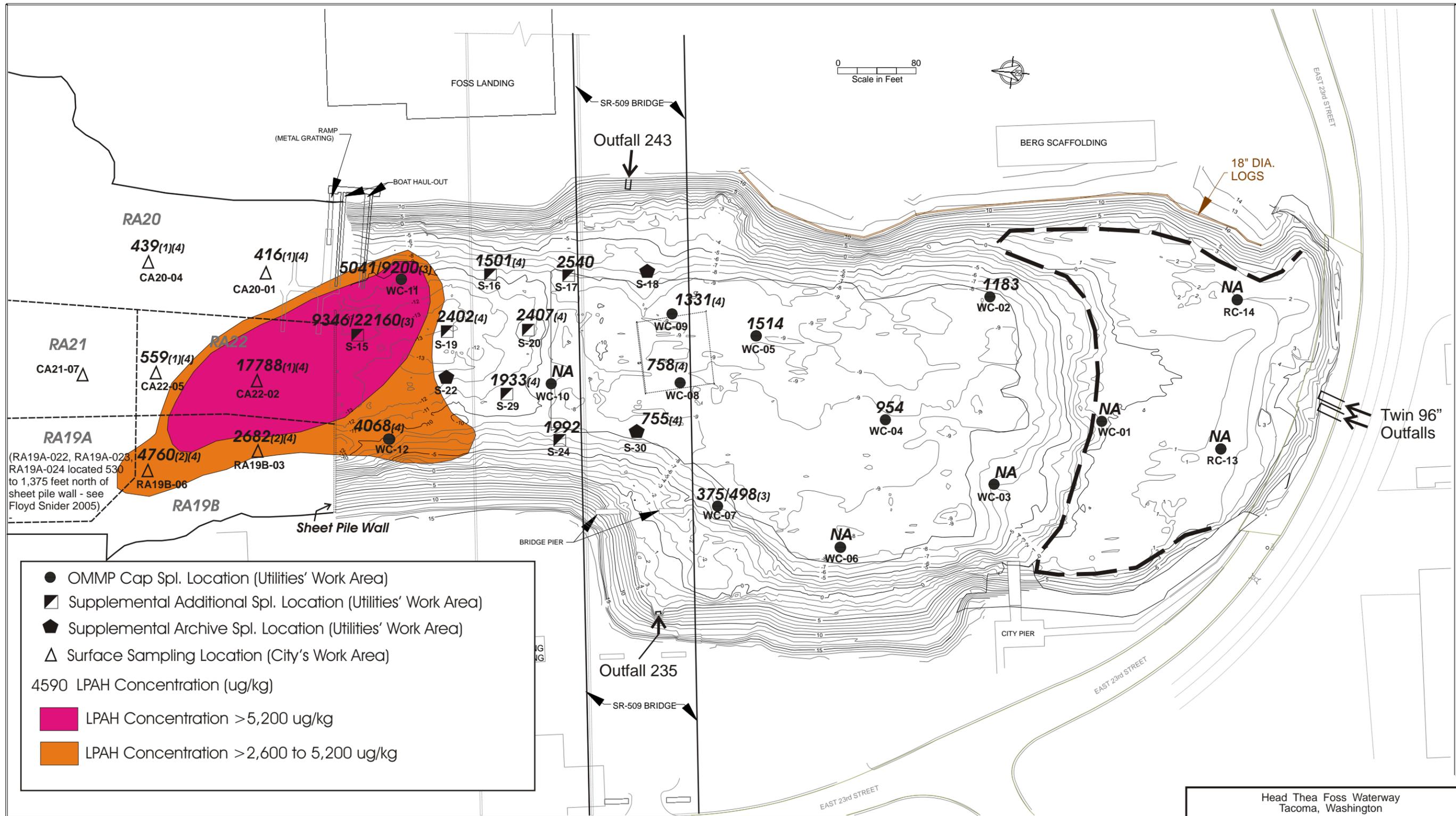


● OMMP Cap Spl. Location (Utilities' Work Area)  
 ▣ Supplemental Additional Spl. Location (Utilities' Work Area)  
 ⬢ Supplemental Archive Spl. Location (Utilities' Work Area)  
 △ Surface Sampling Location (City's Work Area)  
 4590 Mercury Concentration (mg/kg)  
 ■ Mercury Concentration >0.59 mg/kg  
 ■ Mercury Concentration >0.3 to 0.59 mg/kg

Notes: Hg SQO = 0.59 mg/kg  
NA - Not available

(1) First Cap Lift (3) City/Utilities Analyses  
(2) Top of final cap (4) City Analyses

Head Thea Foss Waterway  
 Tacoma, Washington  
**Mercury Concentrations in  
 0 to 10 cm Sediment  
 May 2005**  
 PAP-001-04 **FIGURE 6** July 2005  
 Dalton, Olmsted & Fuglevand, Inc.

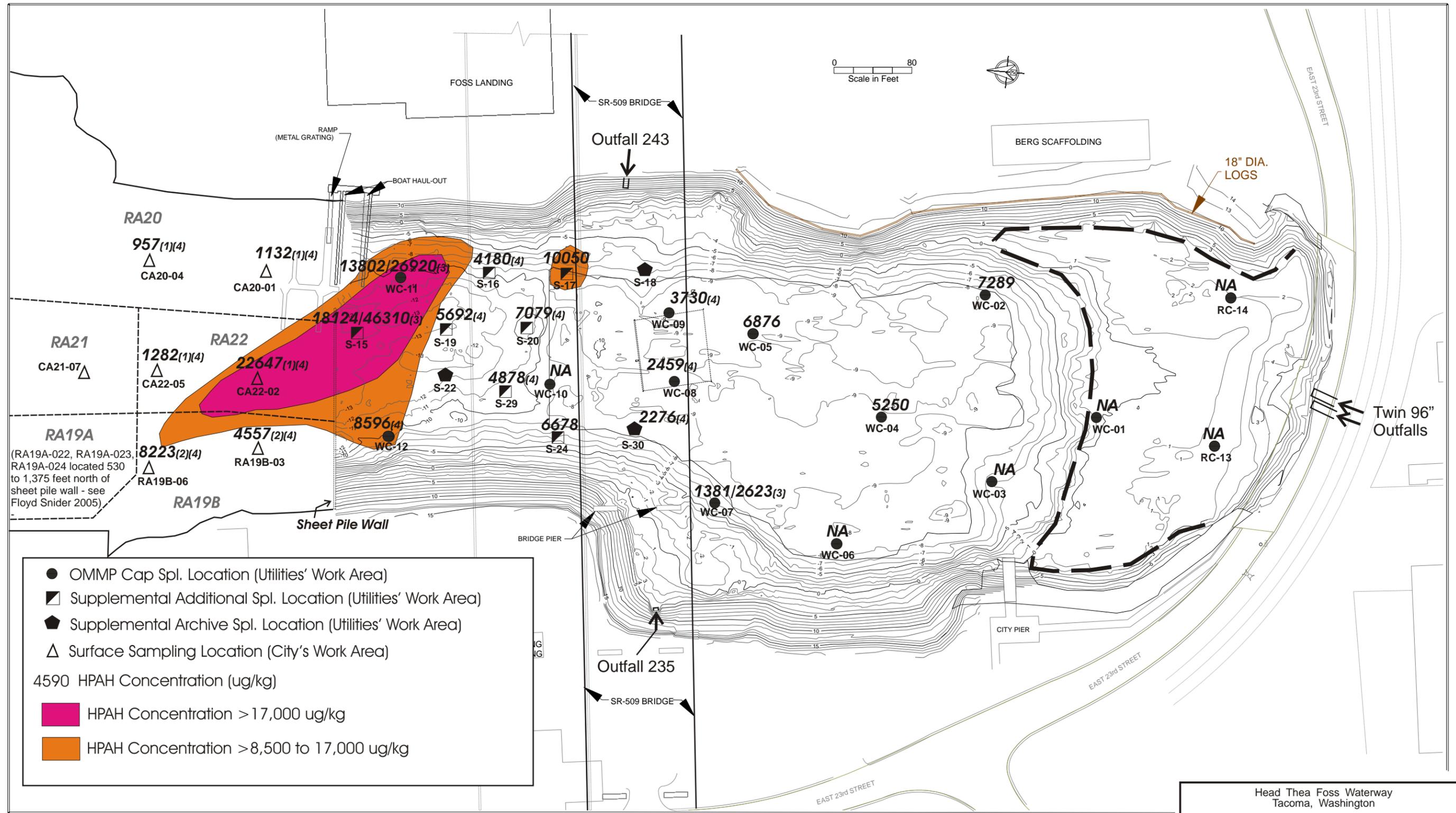


Notes: LPAH SQO = 5,200 ug/kg  
 NA - Not available

(1) First Cap Lift  
 (2) Top of final cap

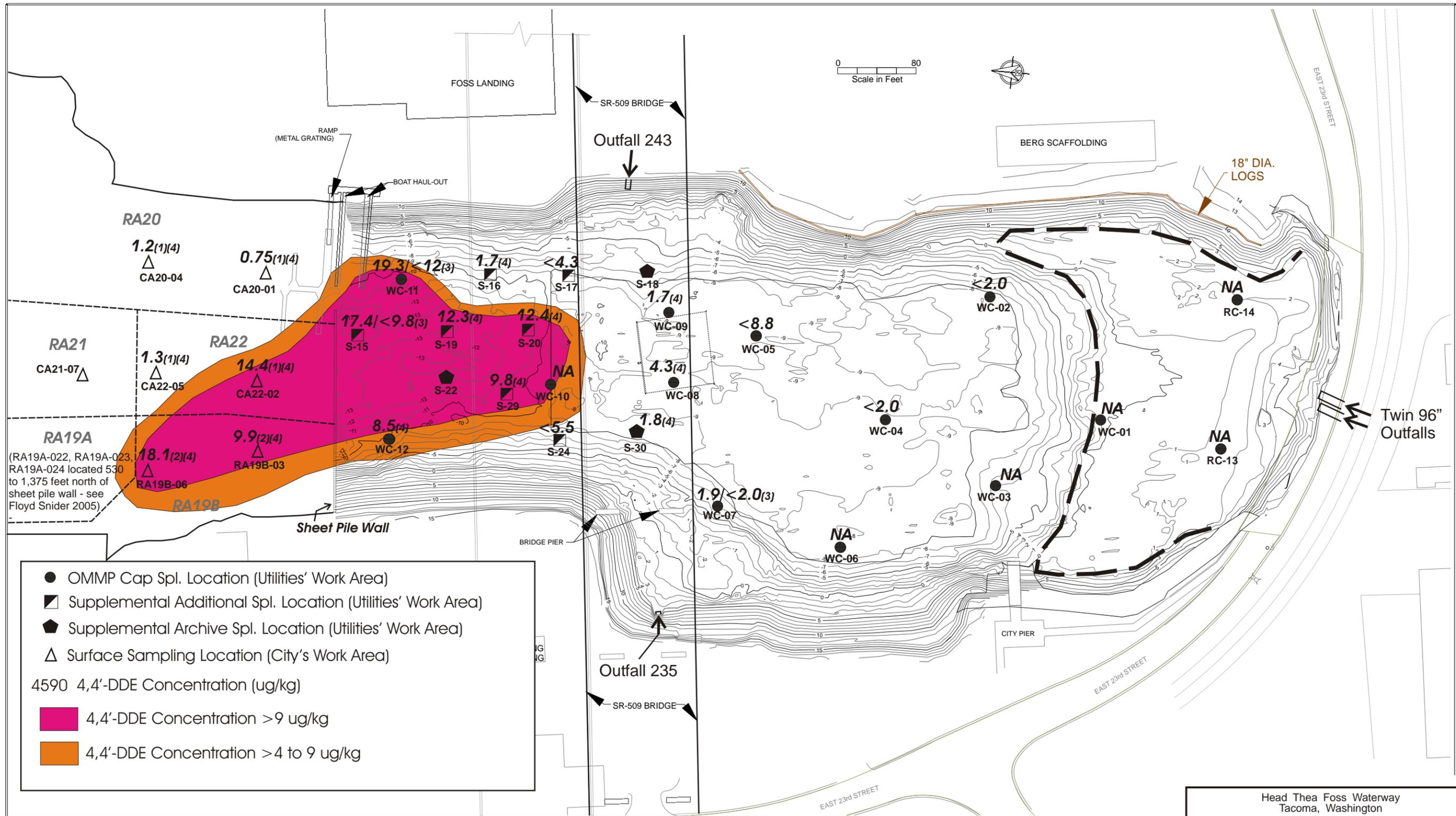
(3) City/Utilities Analyses  
 (4) City Analyses

Head Tea Foss Waterway  
 Tacoma, Washington  
**LPAH Concentrations in  
 0 to 10 cm Sediment  
 May 2005**  
 PAP-001-04 **FIGURE 7** July 2005  
 Dalton, Olmsted & Fuglevand, Inc.



Notes: HPAH SQO = 17,000 ug/kg  
 NA - Not available  
 (1) First Cap Lift  
 (2) Top of final cap  
 (3) City/Utilities Analyses  
 (4) City Analyses

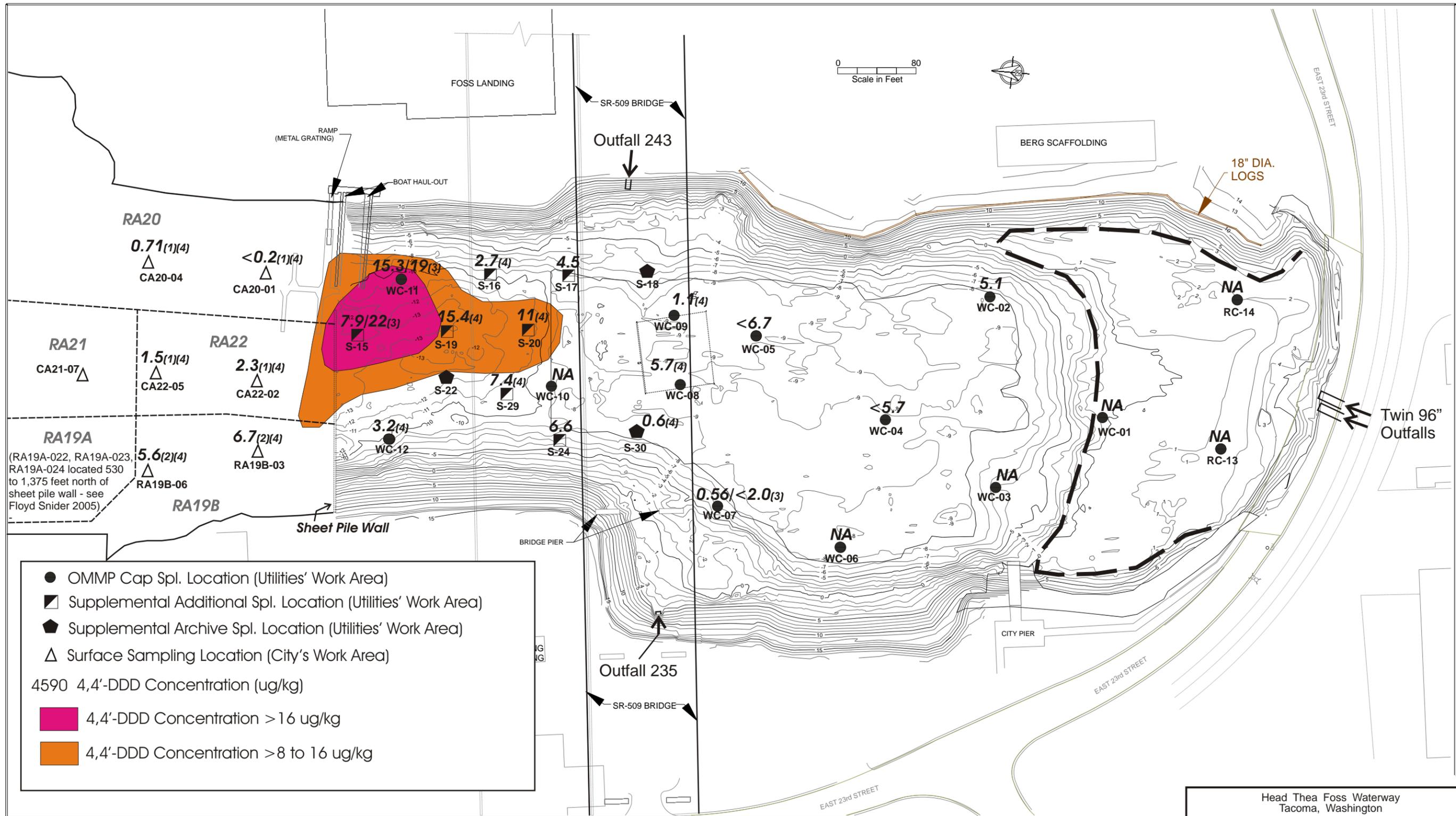
Head Tea Foss Waterway  
 Tacoma, Washington  
**HPAH Concentrations in  
 0 to 10 cm Sediment  
 May 2005**  
 PAP-001-04 **FIGURE 8** July 2005  
 Dalton, Olmsted & Fuglevand, Inc.



Notes: 4,4'-DDE SQO = 9 ug/kg  
 NA - Not available

(1) First Cap Lift  
 (2) Top of final cap  
 (3) City/Utilities Analyses  
 (4) City Analyses

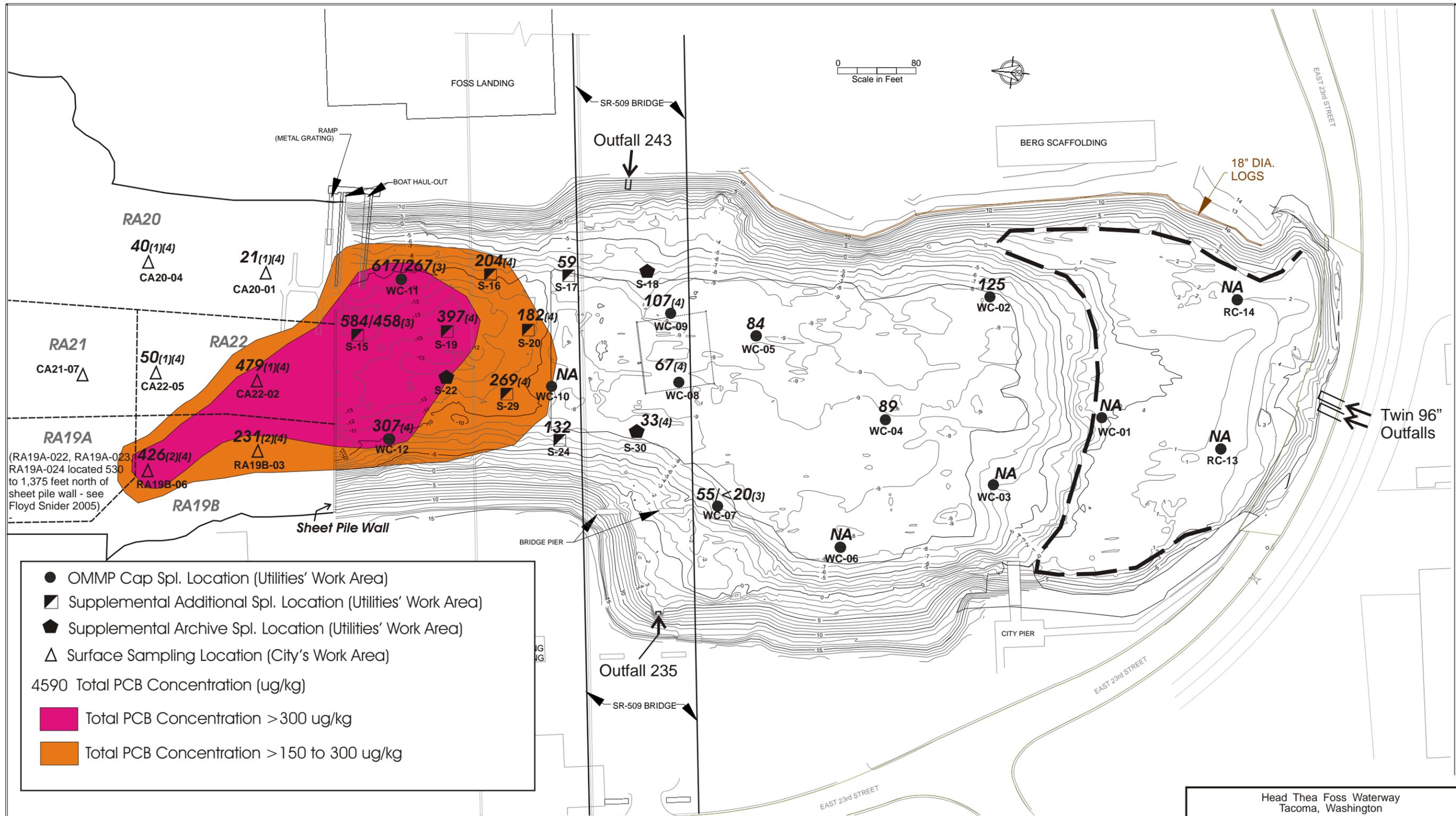
Head Tea Foss Waterway  
 Tacoma, Washington  
**4,4'-DDE Concentrations in  
 0 to 10 cm Sediment  
 May 2005**  
 PAP-001-04 **FIGURE 9** July 2005  
 Dalton, Olmsted & Fuglevand, Inc.



● OMMP Cap Spl. Location (Utilities' Work Area)  
 ▣ Supplemental Additional Spl. Location (Utilities' Work Area)  
 ⬢ Supplemental Archive Spl. Location (Utilities' Work Area)  
 △ Surface Sampling Location (City's Work Area)  
 4590 4,4'-DDD Concentration (ug/kg)  
 ■ 4,4'-DDD Concentration > 16 ug/kg  
 ■ 4,4'-DDD Concentration > 8 to 16 ug/kg

**Notes:** 4,4'-DDD SQO = 16 ug/kg  
 NA - Not available  
 (1) First Cap Lift  
 (2) Top of final cap  
 (3) City/Utilities Analyses  
 (4) City Analyses

Head Thea Foss Waterway  
 Tacoma, Washington  
**4,4'-DDD Concentrations in  
 0 to 10 cm Sediment  
 May 2005**  
 PAP-001-04 **FIGURE 10** July 2005  
 Dalton, Olmsted & Fuglevand, Inc.



● OMMP Cap Spl. Location (Utilities' Work Area)  
 ▣ Supplemental Additional Spl. Location (Utilities' Work Area)  
 ⬢ Supplemental Archive Spl. Location (Utilities' Work Area)  
 △ Surface Sampling Location (City's Work Area)

4590 Total PCB Concentration (ug/kg)  
 ■ Total PCB Concentration > 300 ug/kg  
 ■ Total PCB Concentration > 150 to 300 ug/kg

**Notes: Total PCB SQO = 300 ug/kg**  
 NA - Not available  
 (1) First Cap Lift  
 (2) Top of final cap  
 (3) City/Utilities Analyses  
 (4) City Analyses

Head Thea Foss Waterway  
 Tacoma, Washington  
**Total PCB Concentrations in  
 0 to 10 cm Sediment  
 May 2005**  
 PAP-001-04 **FIGURE 11** July 2005  
 Dalton, Olmsted & Fuglevand, Inc.



- OMMP Cap Spl. Location (Utilities' Work Area)
- ▣ Supplemental Additional Spl. Location (Utilities' Work Area)
- ◆ Supplemental Archive Spl. Location (Utilities' Work Area)
- △ Surface Sampling Location (City's Work Area)

1700 BEHP Concentration (ug/kg)

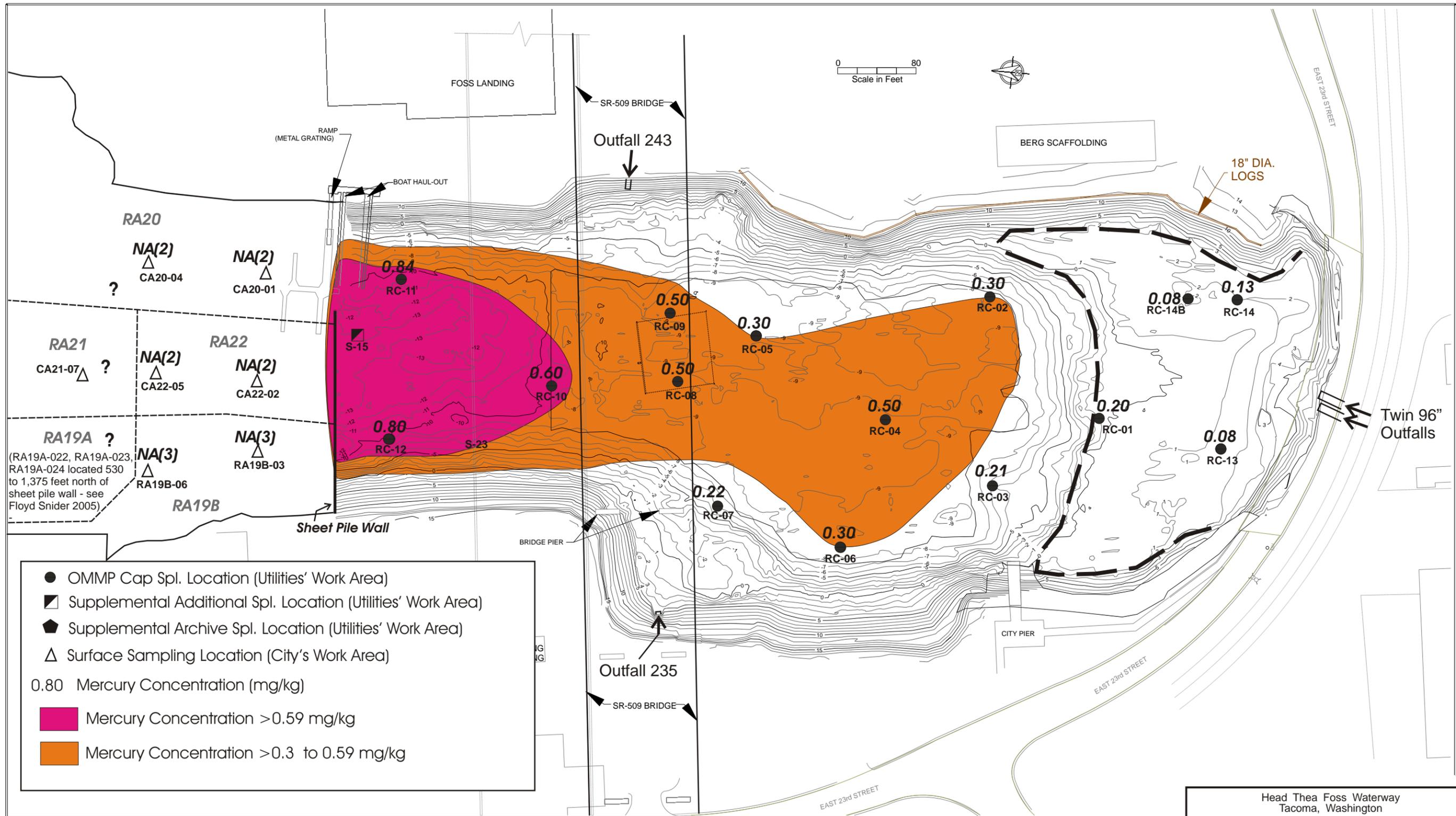
■ BEHP Concentration > 1,300 ug/kg

■ BEHP Concentration ≤ 1,300 ug/kg

Notes: BEHP SQO = 1,300 ug/kg  
 NA - Not available  
 (1) First Cap Lift  
 (2) Top of final cap  
 (3) City/Utilities Analyses  
 (4) City Analyses

Head Thea Foss Waterway  
 Tacoma, Washington  
**BEHP Concentrations in  
 0 to 10 cm Sediment  
 May 2005**  
 PAP-001-04 **FIGURE 12** July 2005  
 Dalton, Olmsted & Fuglevand, Inc.

Ref: BEHP 0 to 10 cm 05-05 rev.cdr



Head Thea Foss Waterway  
 Tacoma, Washington  
**Mercury Concentrations in  
 0 to 2 cm Sediment  
 May 2005**  
 PAP-001-04 **FIGURE 13** June 2005  
 Dalton, Olmsted & Fuglevand, Inc.



Notes: LPAH SQO = 5,200 ug/kg  
 (1) 0 to 10 cm sample  
 (2) 0 to 2 cm sample - first lift of cap  
 (3) 0 to 2 cm sample - top final cap

NA - Not analyzed

Head Thea Foss Waterway  
 Tacoma, Washington  
**LPAH Concentrations in  
 0 to 2 cm Sediment  
 May 2005**

PAP-001-04 **FIGURE 14** July 2005  
 Dalton, Olmsted & Fuglevand, Inc.

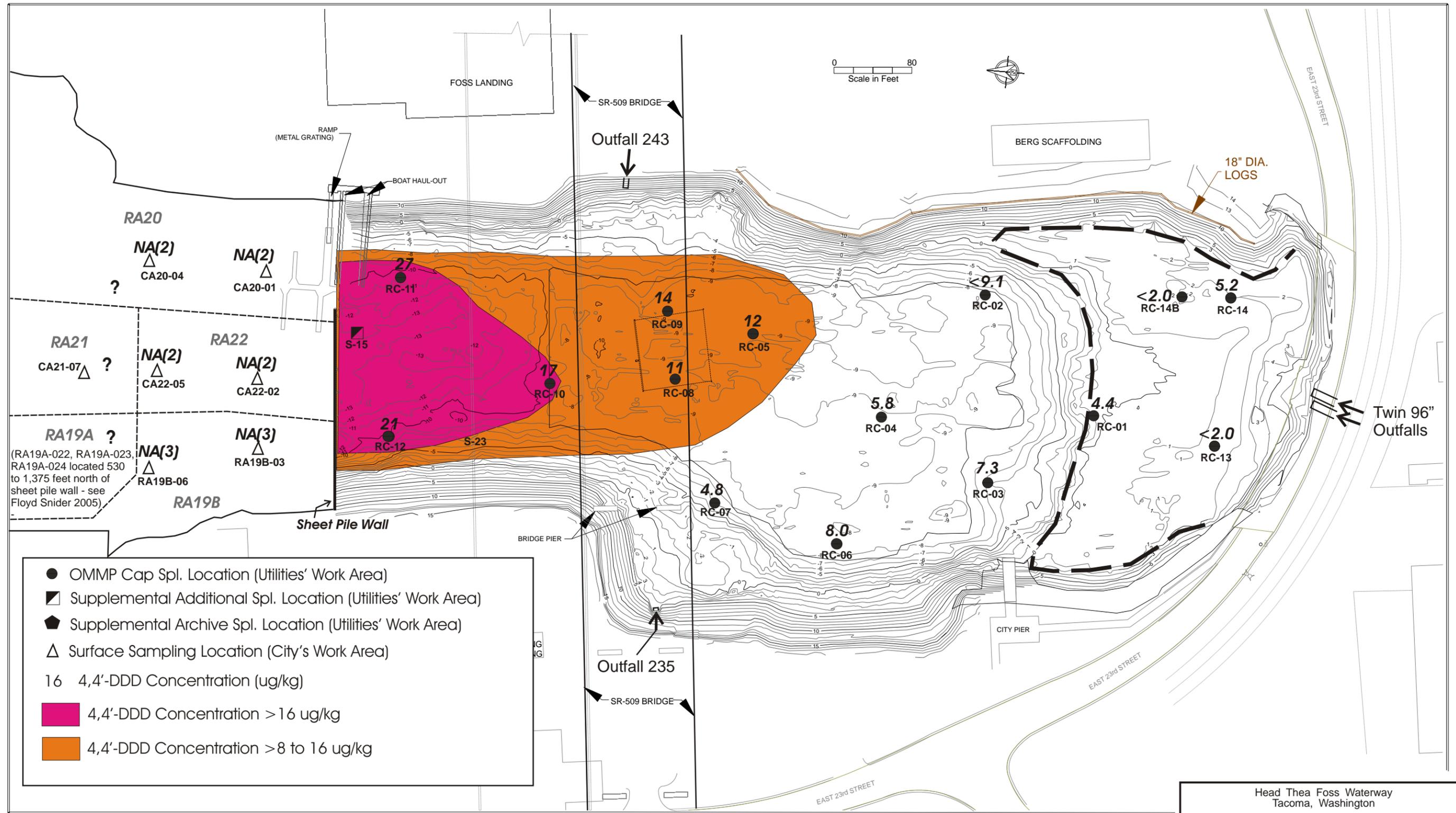


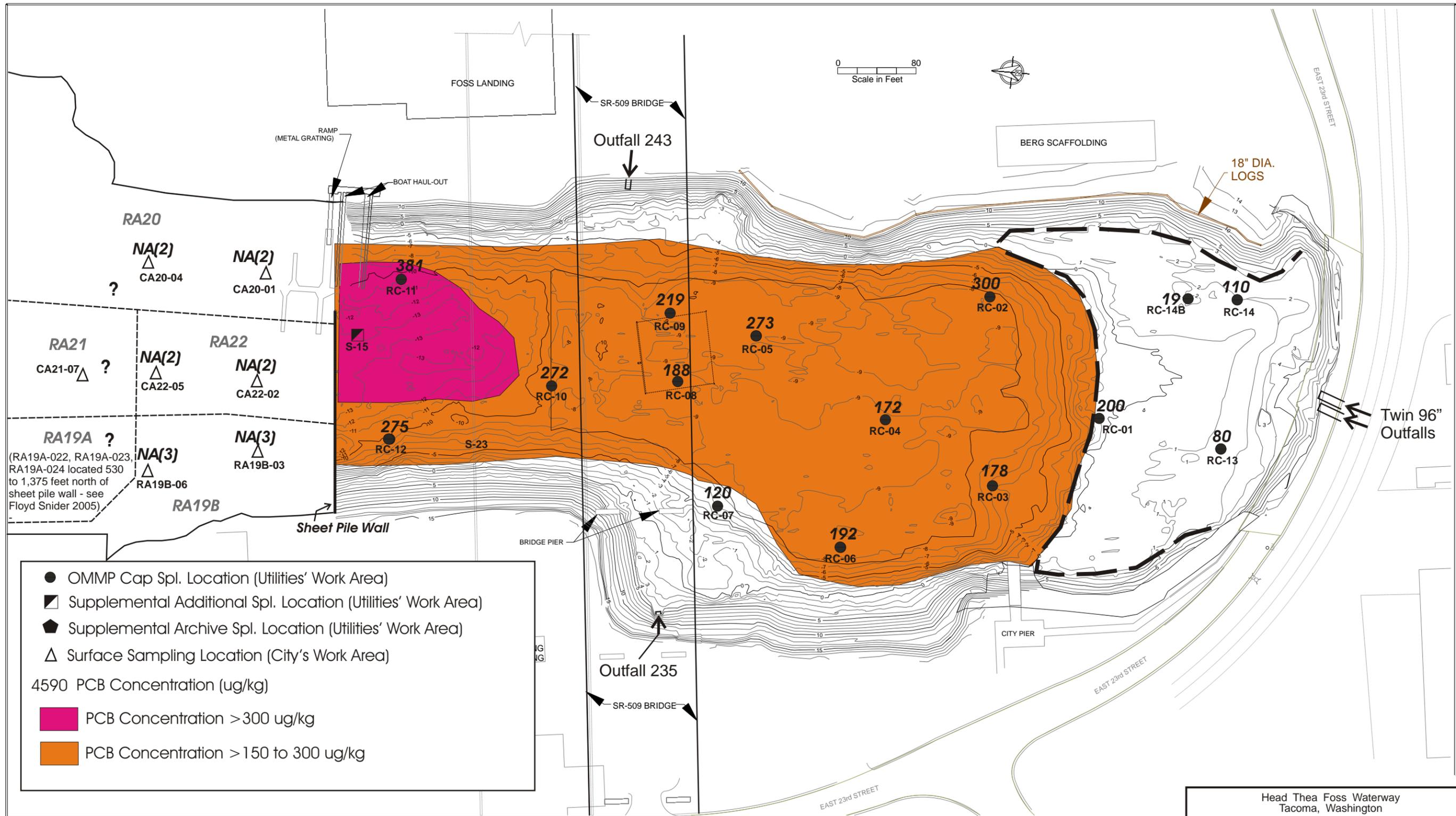
● OMMP Cap Spl. Location (Utilities' Work Area)  
 ▣ Supplemental Additional Spl. Location (Utilities' Work Area)  
 ▤ Supplemental Archive Spl. Location (Utilities' Work Area)  
 △ Surface Sampling Location (City's Work Area)  
 4590 HPAH Concentration (ug/kg)  
 ■ HPAH Concentration > 17,000 ug/kg  
 ■ HPAH Concentration > 8,500 to 17,000 ug/kg

Notes: HPAH SQO = 17,000 ug/kg  
 (1) 0 to 10 cm sample  
 (2) 0 to 2 cm sample - first lift of cap  
 (3) 0 to 2 cm sample - top final cap  
 NA - Not analyzed

Head Thea Foss Waterway  
 Tacoma, Washington  
**HPAH Concentrations in  
 0 to 2 cm Sediment  
 May 2005**  
 PAP-001-04 **FIGURE 15** July 2005  
 Dalton, Olmsted & Fuglevand, Inc.

Ref: HPAH 0 to 2 5-05.cdr





- OMMP Cap Spl. Location (Utilities' Work Area)
- ▣ Supplemental Additional Spl. Location (Utilities' Work Area)
- ◆ Supplemental Archive Spl. Location (Utilities' Work Area)
- △ Surface Sampling Location (City's Work Area)

4590 PCB Concentration (ug/kg)

- PCB Concentration > 300 ug/kg
- PCB Concentration > 150 to 300 ug/kg

Notes: PCB SQO = 300 ug/kg  
 (1) 0 to 10 cm sample

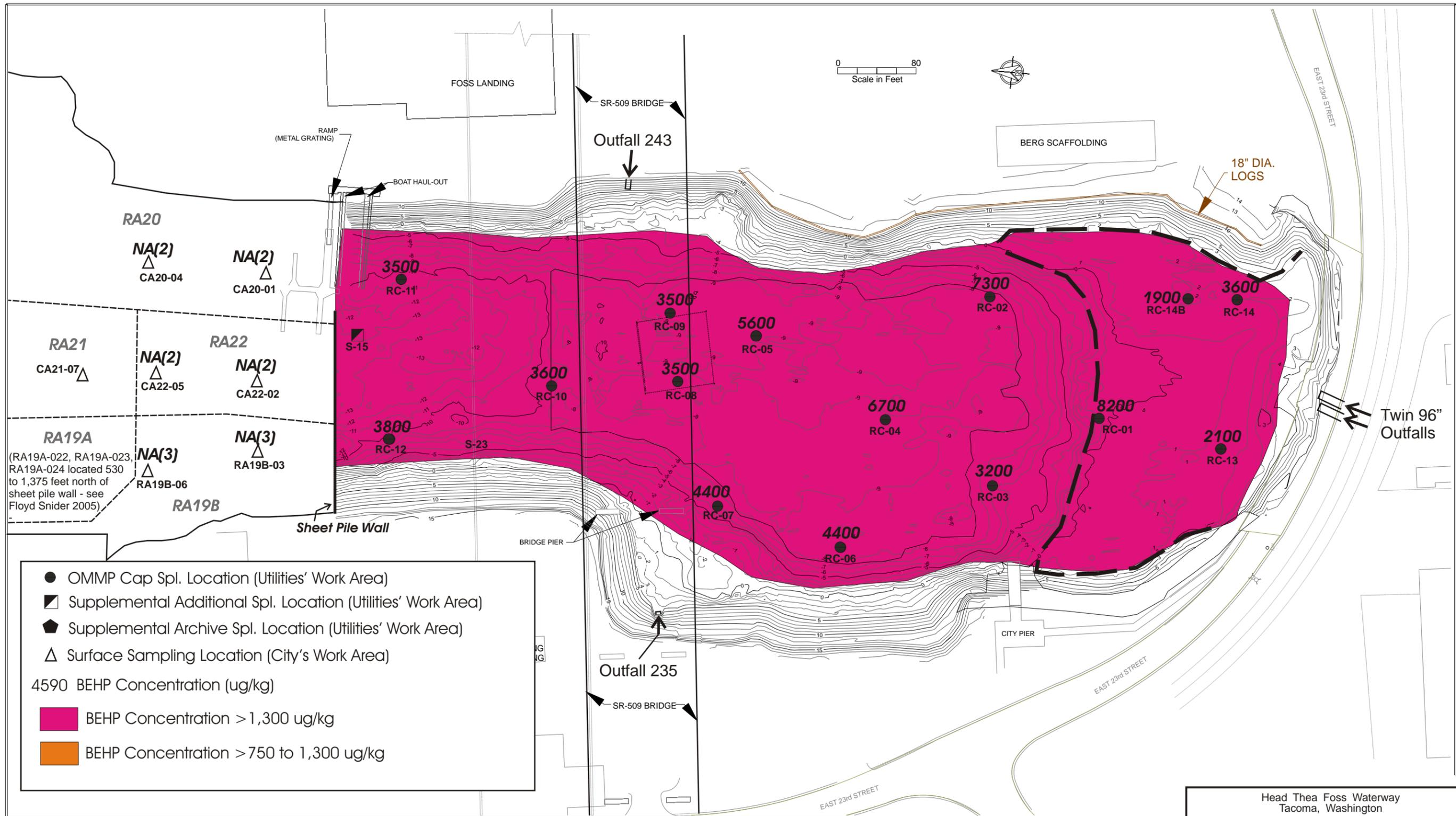
(2) 0 to 2 cm sample - first lift of cap  
 (3) 0 to 2 cm sample - top final cap

NA - Not analyzed

Head Thea Foss Waterway  
 Tacoma, Washington

**Total PCB Concentrations in  
 0 to 2 cm Sediment  
 May 2005**

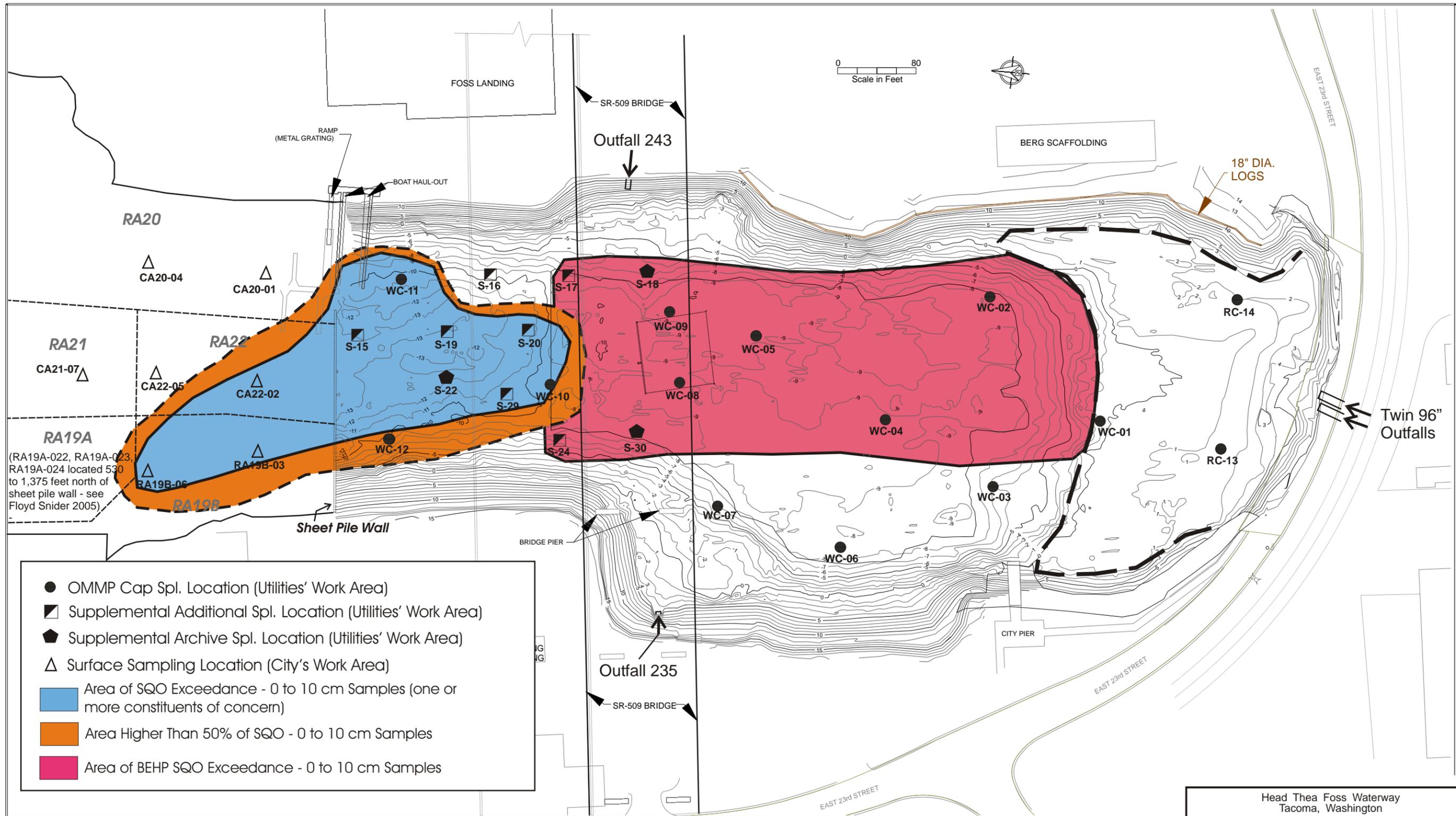
PAP-001-04 **FIGURE 17** July 2005  
 Dalton, Olmsted & Fuglevand, Inc.



Notes: BEHP SQO = 1,300 ug/kg  
 (1) 0 to 10 cm sample  
 (2) 0 to 2 cm sample - first lift of cap  
 (3) 0 to 2 cm sample - top final cap

NA - Not analyzed

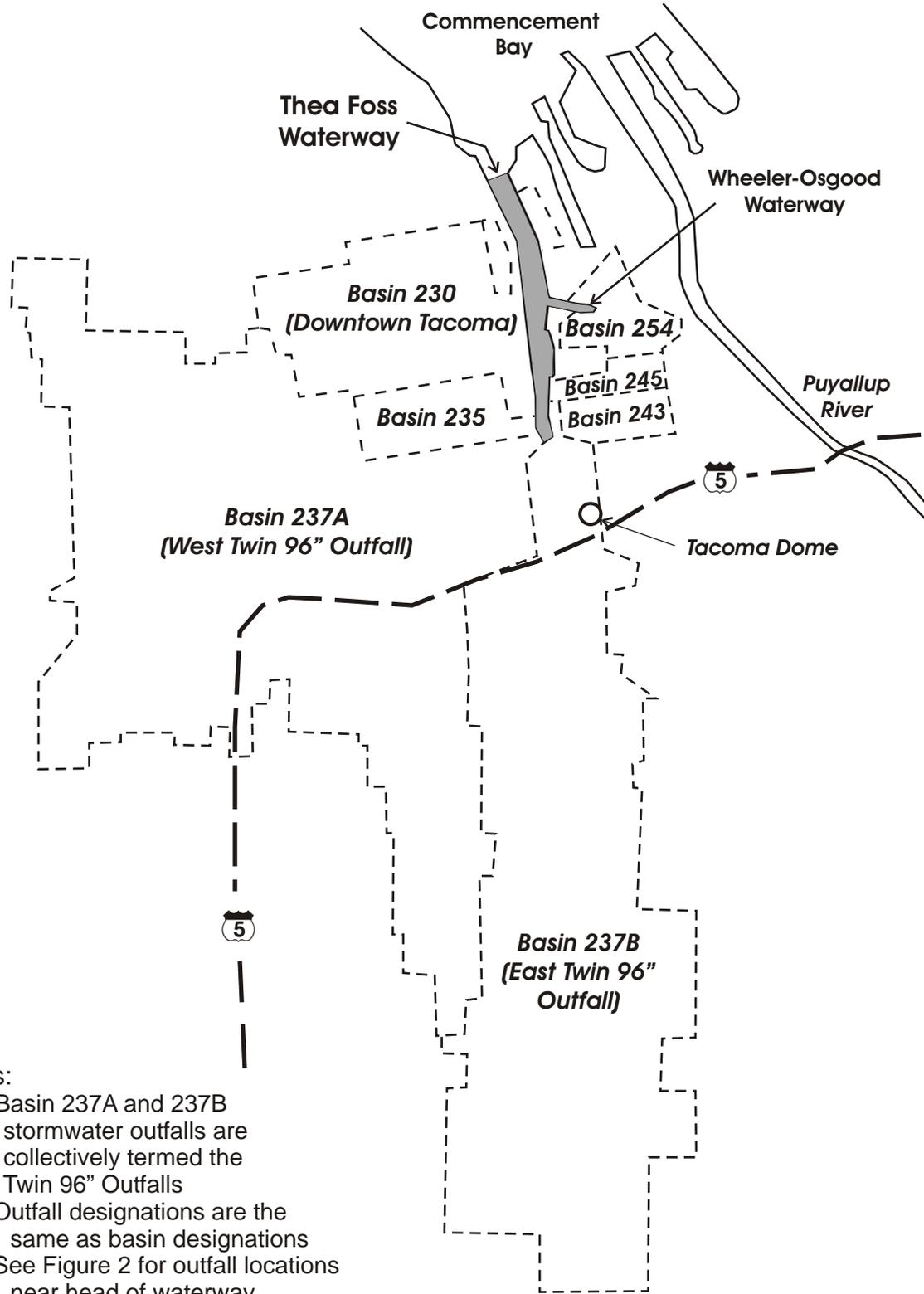
Head Thea Foss Waterway  
 Tacoma, Washington  
**BEHP Concentrations in  
 0 to 2 cm Sediment  
 May 2005**  
 PAP-001-04 **FIGURE 18** July 2005  
 Dalton, Olmsted & Fuglevand, Inc.



- OMMF Cap Spl. Location (Utilities' Work Area)
- ▣ Supplemental Additional Spl. Location (Utilities' Work Area)
- ◆ Supplemental Archive Spl. Location (Utilities' Work Area)
- △ Surface Sampling Location (City's Work Area)
- Area of SQO Exceedance - 0 to 10 cm Samples (one or more constituents of concern)
- Area Higher Than 50% of SQO - 0 to 10 cm Samples
- Area of BEHP SQO Exceedance - 0 to 10 cm Samples

Head Thea Foss Waterway  
Tacoma, Washington  
**Area of SQO Exceedance  
0 to 10 cm Sediment  
May 2005**  
PAP-001-04 **FIGURE 19** Sept. 2005  
Dalton, Olmsted & Fuglevand, Inc.

Ref: Exceed SQO 0 to 10 cm 05-05.cdr



**Notes:**

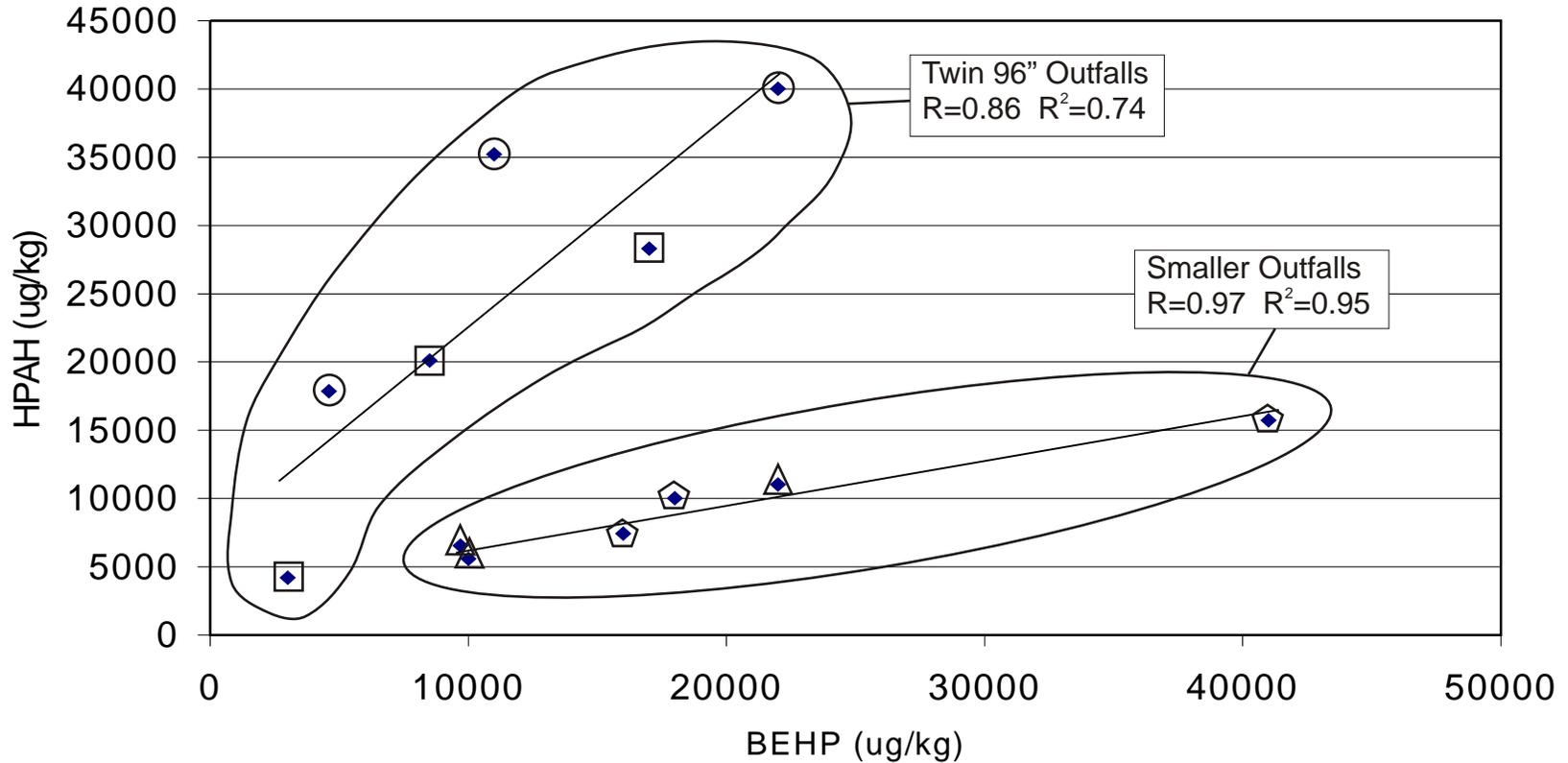
- (1) Basin 237A and 237B stormwater outfalls are collectively termed the Twin 96" Outfalls
- (2) Outfall designations are the same as basin designations
- (3) See Figure 2 for outfall locations near head of waterway

Head of Thea Foss Waterway Project  
Tacoma, Washington

**Thea Foss Drainage Basins**

PAP-004-01a,b      **FIGURE 20**      Sept. 2005  
Dalton, Olmsted & Fuglevand, Inc.

## BEHP vs. HPAH (Sediment Trap Data 2002 to 2004)



- Outfall 237A      ◐ Outfall 243
- ◻ Outfall 237B      ◕ Outfall 235

Head of Thea Foss Waterway  
Tacoma, Washington

**BEHP vs. HPAH in Sediment  
Trap Samples - 2002 to 2004**

PAP-001-01      **FIGURE 21**      Aug. 2005  
Dalton, Olmsted & Fuglevand, Inc.



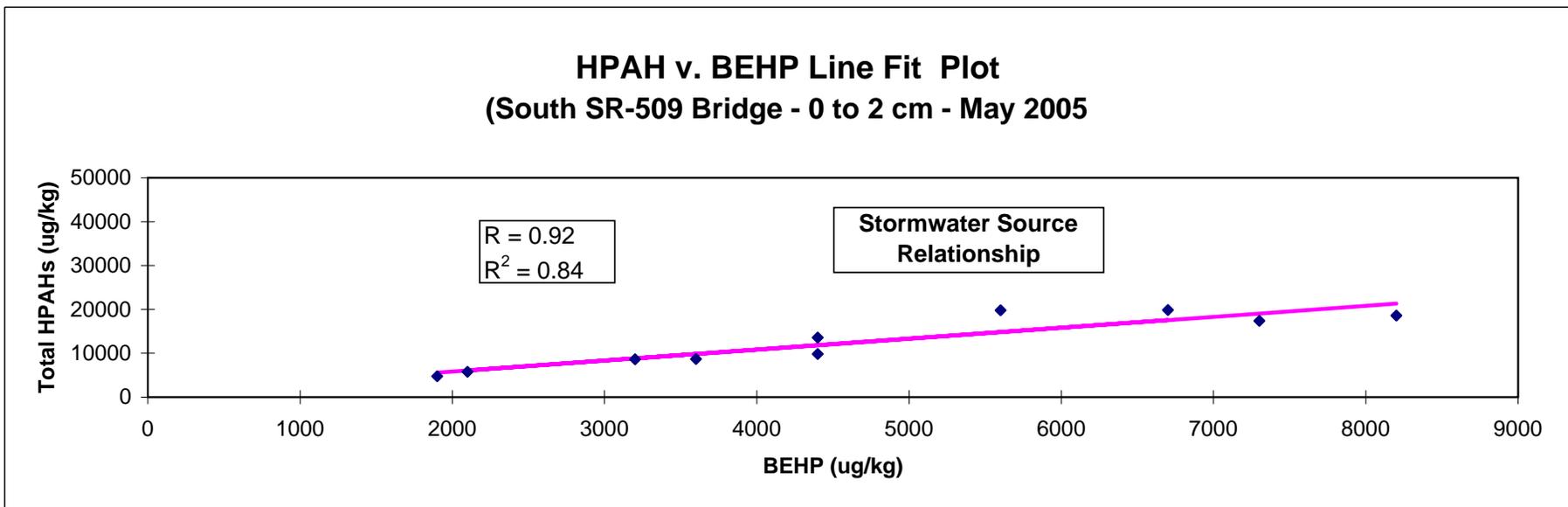
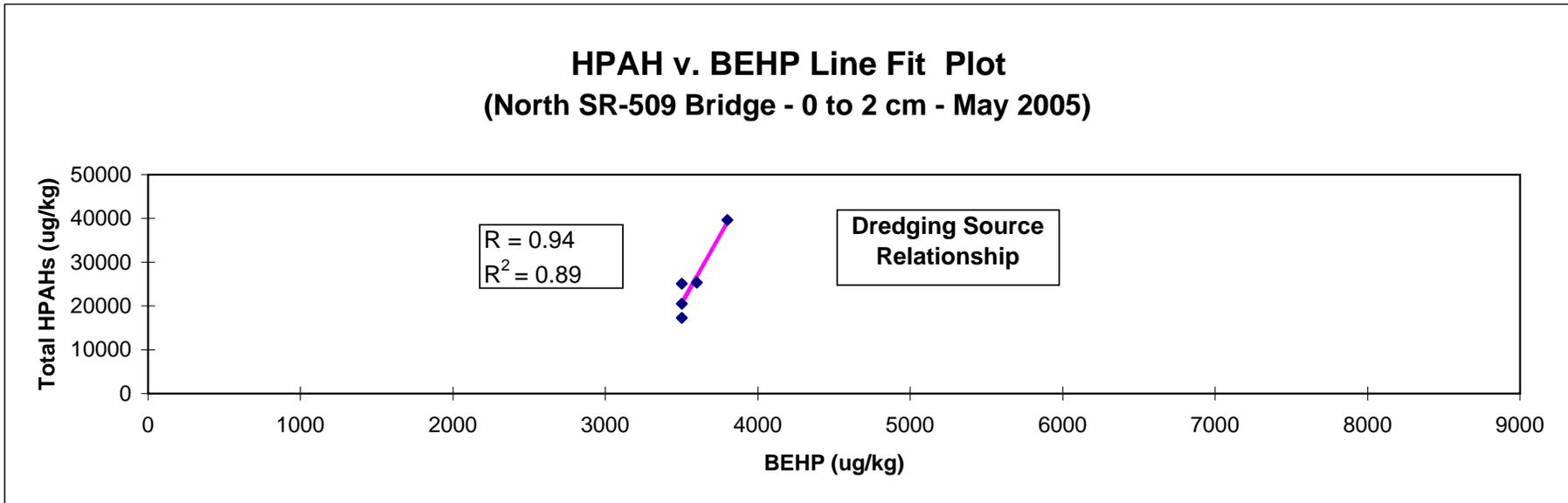
● OMMP Early Warning (0 to 2 cm) Sediment Sample Location

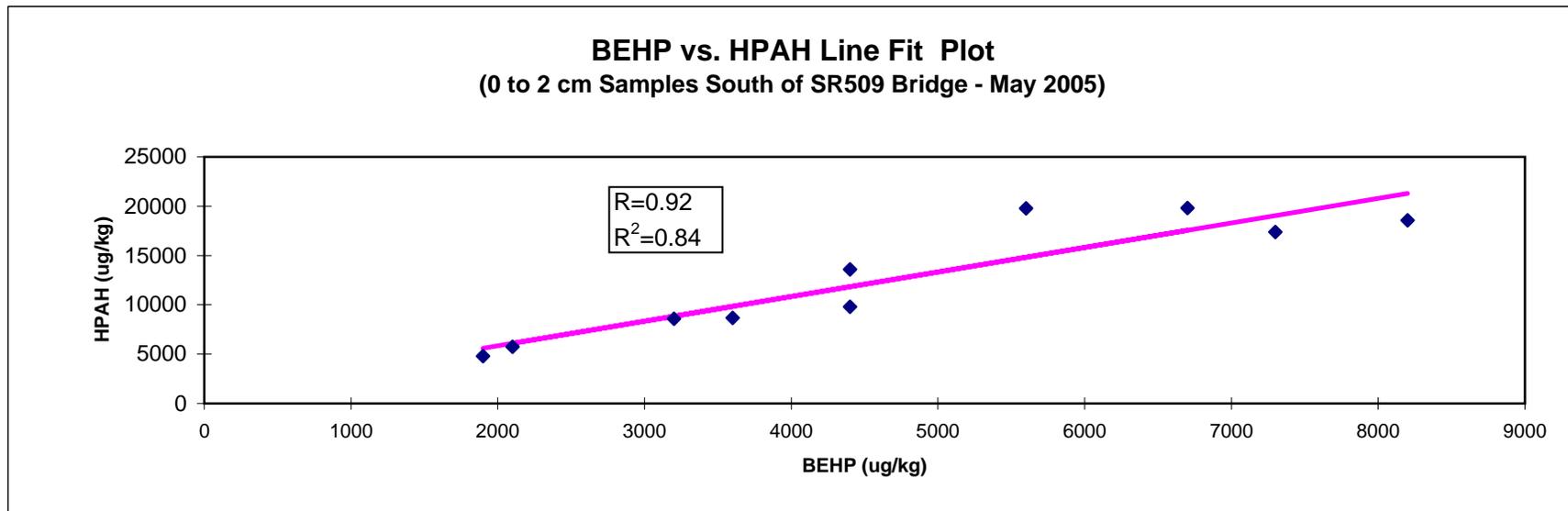
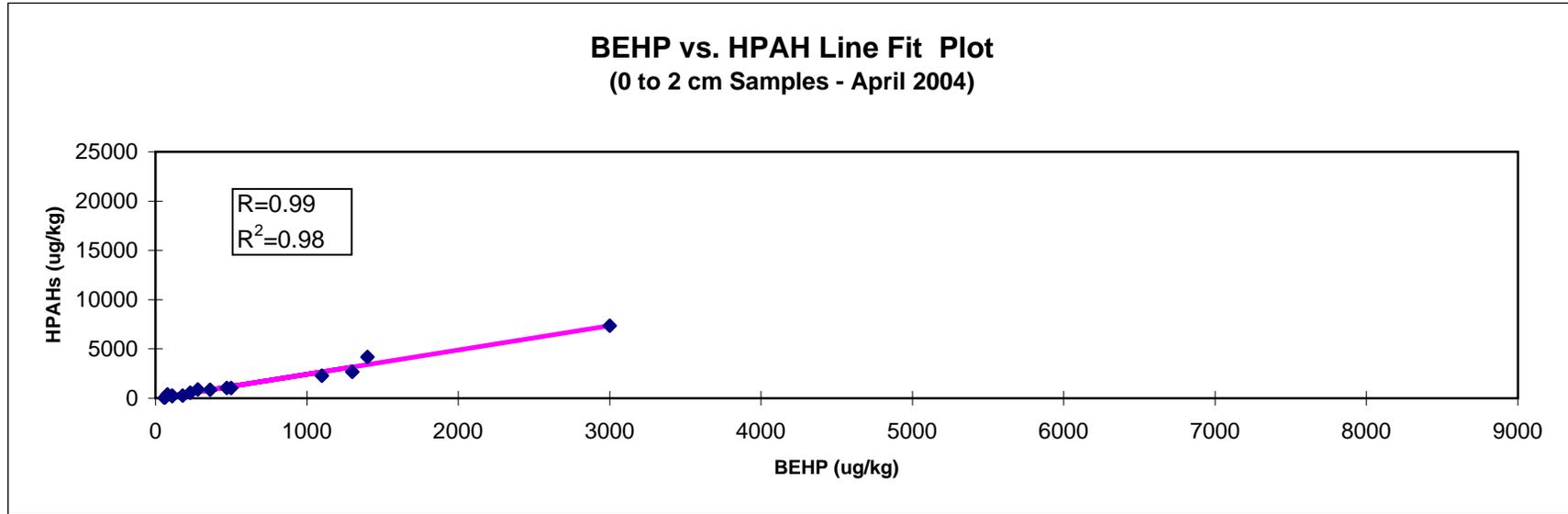
Head Thea Foss Waterway  
Tacoma, Washington

**Estimated Impact Areas Based on  
Early Warning Samples**

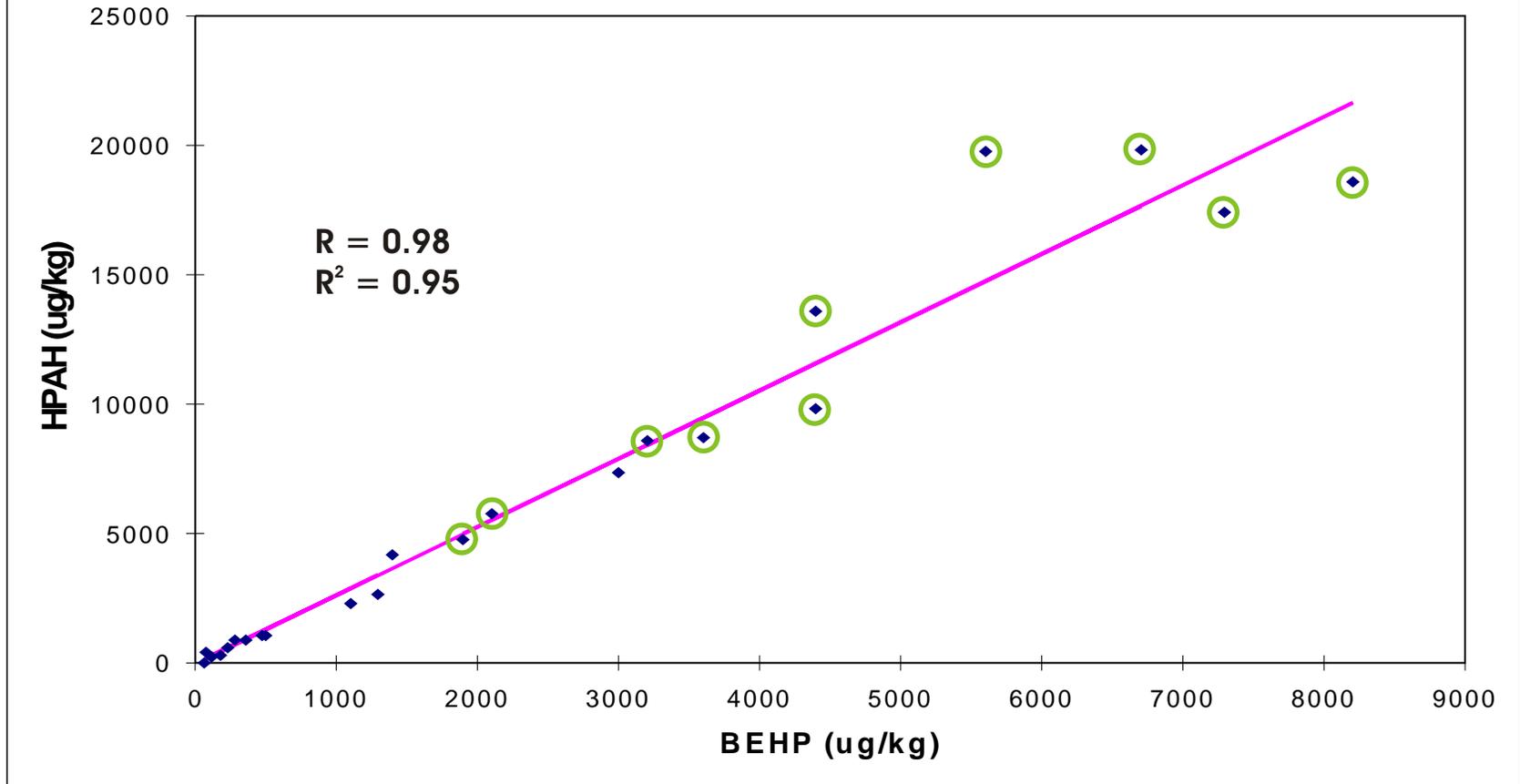
PAP-001-04 **FIGURE 22** Aug. 2005  
Dalton, Olmsted & Fuglevand, Inc.

Ref: Impact Areas a.cdr





**BEHP v. HPAH Line Fit Plot  
(early warning samples - combined)**



- ◆ April 04 - Early Warning Sample (0 to 2 cm)
- ◊ May 05 - Early Warning Sample (0 to 2 cm)

Head Thea Foss Waterway Project  
Tacoma, WA

**HPAH v. BEHP (combined)  
Early Warning Samples**

PAP-001-01      **FIGURE 25**      Aug. 2005  
Dalton, Olmsted & Fuglevand, Inc.

Ref: BEHP v HPAH comb a.cdr

**Appendix A**  
**Site Observation Report**  
**Dalton, Olmsted & Fuglevand, Inc.**  
**For:**  
**June 2005**

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

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Telephone (360) 380-0862 (FAX 360-380-0862)  
Cell (206) 498-6616 e-mail: [mdalton@dofnw.com](mailto:mdalton@dofnw.com)  
(Kirkland, WA Office – 425-827-4588)

**MEMORANDUM**

---

TO: Lotte Hass - PacifiCorp

FROM: Matt Dalton

DATE: August 2, 2005

SUBJECT: Site Observations  
June 21 and 22, 2005  
Head of Thea Foss Waterway Project

REF. NO: PAP-001-04

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This technical memorandum presents a summary of observed site conditions within the Head of the Thea Foss Waterway, Tacoma, Washington (Figure 1). The observations were made by Matthew Dalton, Sr. Consulting Hydrogeologist for Dalton, Olmsted & Fuglevand, Inc. (DOF). He visited the head of the waterway between approximately 12:30pm and 1:00 pm on June 21 as part of a waterway tour associated with Tacoma's stormwater working group. During this period, a low tide of -3.29 feet Mean Lower Low Water (MLLW) was predicted for 11:03 am (Figure 2).

He also visited the site on June 22 between approximately 10:30am and 1:00pm. During this period, a low tide of -3.85 feet MLLW was predicted for 11:48 am (Figure 2). On June 22 representatives of the Army Corps of Engineers (Kym Takasaki), Marv Coleman (Department of Ecology), Tim Goodman (Department of Natural Resources or DNR) and Lindie Schmidt (DNR) also visited the site.

## **OBSERVATIONS – June 22, 2005**

The primary objectives of the visit by DOF staff were to observe the following.

- **Condition of the scour protection apron installed at extreme head of the waterway, particularly related to discharges from the Twin 96” stormwater outfalls.**

The condition of the apron was similar to that observed during several visits by DOF staff in 2004 and April 2005. Digital photographs of the Twin 96” outfalls and scour protection apron are shown on Figures 3 to 6a. Water discharge from the Twin 96” outfalls during a rainfall event was spreading out over the apron (as intended) and migrating in a northward direction to the waterway channel. No erosional channels were observed on the apron and most of the water infiltrated into coarser materials near the north end of the apron.

In May 2004, a small, shallow erosional channel was observed on the north side of the apron near the southeast corner of the waterway (Figure 7a). This portion of the waterway bottom would only be exposed during the lowest tides (estimated to be less than -2 feet MLLW). The small channel was visually less pronounced as compared to the May 04 observations (Figure 7b). The bottom of the channel appeared to be “*self armoring*” in that coarser materials were observed in the bottom of the channel. The minor erosion is very local in nature and does not appear to have adversely impacted the overall integrity of the cap. No corrective action is warranted at this time other than to monitor this feature during other low tide events.

- **General condition of the waterway slopes exposed at low tide.**

Exposed waterway slopes are shown on the photographs presented in Figures 4 to 6 and Figures 8 to 13. During the site visits in June 2005, barnacles and algae covered the coarser capping materials. No visible evidence of slope erosion, sloughing etc. was observed.

Several small channels were observed at the toe of outfall scour protection material associated with Outfall 235 near the west side of the SR509 bridge (Figures 12 and 13). The bottom of the channel appeared to be “*self armoring*” in that coarser materials were observed in the bottom of the channel (Figure 12b). The minor erosion is local in nature and does not appear to have adversely impacted the overall integrity of the cap. No corrective action is warranted at this time other than to monitor this feature during other low tide events.

- **SR509 seep area for evidence of sheens.**

No sheens were observed in the area of the former SR509 seep (Figures 8, 9 and 10b) or elsewhere in the waterway, during our June 2005 site visits when the predicted low tides ranged between -3.29 feet and -3.85 feet MLLW. Naturally occurring gas bubbles were observed throughout the head of the waterway.

#### Attachments

Figure 1 – Thea Foss Waterway – South of Station 70+10 (Utility Work Area)

Figure 2 – Commencement Bay Tides – June 21 and 22, 2005

Figure 3 – Twin 96” Outfalls

Figure 4 – Scour Protection Apron – North View

Figure 5 – Scour Protection Apron – East View

Figure 6 – South End of Waterway

Figure 7 – Scour Protection Apron – Southwest View

Figure 8 – Standard Chemical Slope and SR509 Seep Areas

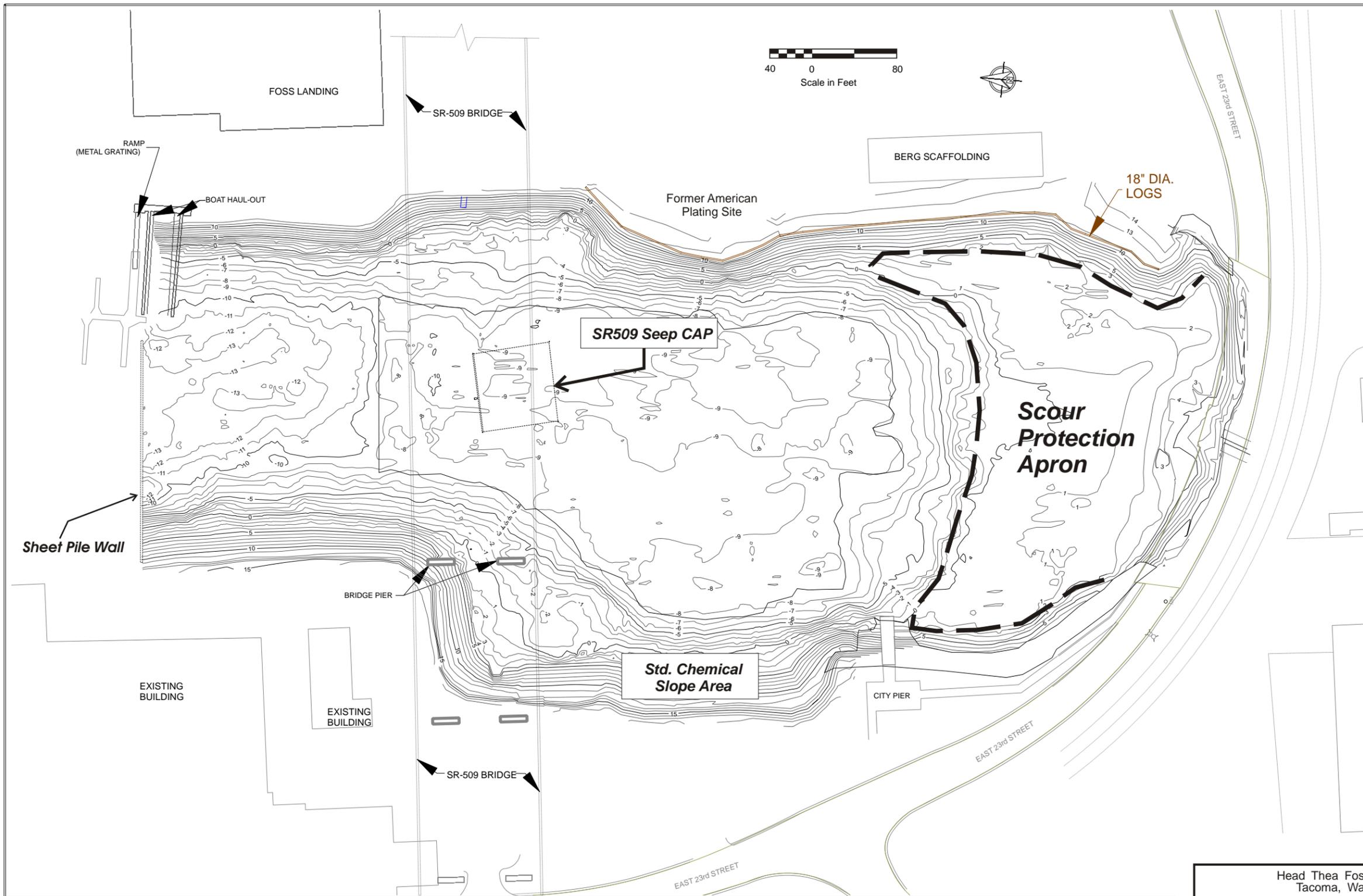
Figure 9 – SR509 Seep Area

Figure 10 – East Bank Slope and Foss Landing Marina

Figure 11 – Outfall 243 and 237a

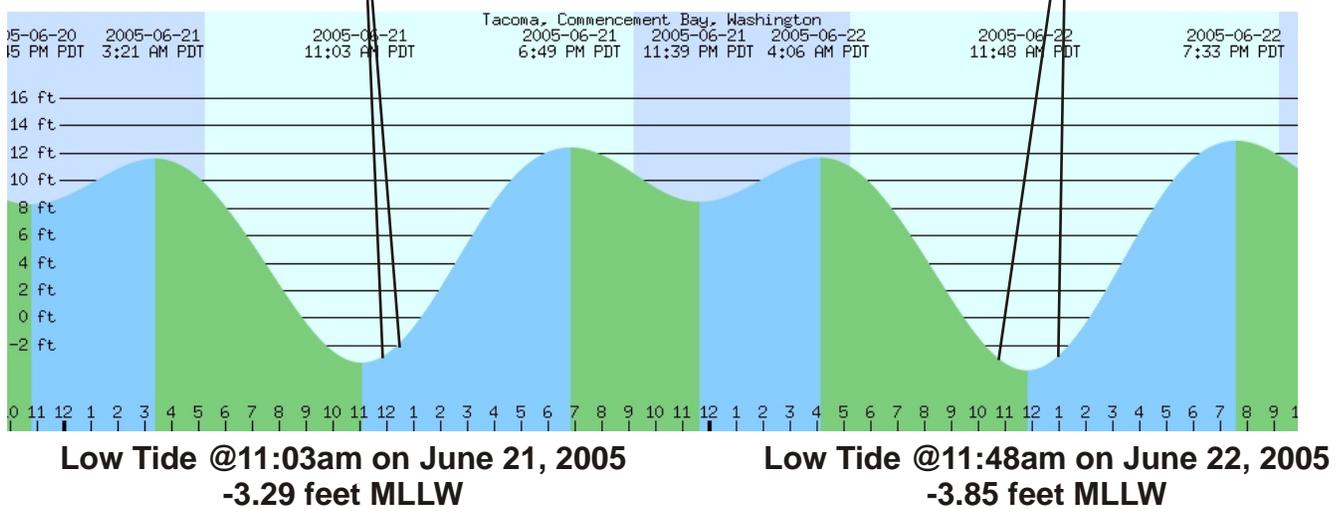
Figure 12 – Outfall 235

Figure 13 – Discharge Area Outfall 235



**Approximate Period  
of Site Observations  
by DOF**

**Approximate Period  
of Site Observations  
by PacifiCorp and Tacoma**



**Source:** XTide Prediction Server  
(<http://www.mobilegeographics.com:81/>)

Thea Foss Waterway  
Tacoma, Washington

**Commencement Bay Tides  
June 21 and 22, 2005**

PAP-001-01 **FIGURE 2** July 2005  
Dalton, Olmsted & Fuglevand, Inc.



*Figure 3a -  
Discharge From  
Outfalls 237a and  
237b - View  
to South*



*Figure 3b -  
Discharge from  
Outfalls 237a and  
237b - View  
to Southeast*

Thea Foss Waterway, Tacoma, Washington

**Twin 96" Outfalls**

PAP-001-01 **FIGURE 3** July 2005  
Dalton, Olmsted & Fuglevand, Inc.



*Figure 4a -  
Scour Protection  
Apron - View to  
North (towards  
Commencement  
Bay)*



*Former Std. Chemical Area*

*Figure 4b -  
Scour Protection  
Apron - View to  
Northwest (towards  
City Pier and former  
Std. Chemical Area)*

Thea Foss Waterway, Tacoma, Washington

**Scour Protection Apron - North View**

PAP-001-01b **FIGURE 4** July 2005  
Dalton, Olmsted & Fuglevand, Inc.



*Figure 5a -  
Scour Protection  
Apron - View to  
East (towards Berg  
Scaffolding)*



*Figure 5b -  
Scour Protection  
Apron - View to  
Northeast (towards  
Berg Scaffolding)*

Thea Foss Waterway, Tacoma, Washington

**Scour Protection Apron - East View**

PAP-001-01b **FIGURE 5** July 2005  
Dalton, Olmsted & Fuglevand, Inc.



*Figure 6a -  
South End of  
Waterway - View to  
Southwest*



*Figure 6b -  
South End of  
Waterway - View to  
Southwest*

Thea Foss Waterway, Tacoma, Washington

**South End of Waterway**

PAP-001-01 **FIGURE 6** July 2005  
Dalton, Olmsted & Fuglevand, Inc.



*Figure 7a -  
Scour Protection  
Apron - View to  
Southwest  
(May 04)*



*Figure 7b -  
Scour Protection  
Apron - View to  
Southwest  
(June 05)*

Thea Foss Waterway, Tacoma, Washington

**Scour Protection Apron - Southwest View**

PAP-001-01 **FIGURE 7** July 2005  
Dalton, Olmsted & Fuglevand, Inc.



*Figure 8a -  
West Bank Slope  
in Former Std.  
Chemical Co.  
Area - View to  
North*



*Figure 8b -  
Former SR509  
Seep Area -  
View to West  
Under SR509  
Bridge*

Thea Foss Waterway, Tacoma, Washington

**Standard Chemical Slope and SR509  
Seep Areas**

PAP-001-01 **FIGURE 8** July 2005  
Dalton, Olmsted & Fuglevand, Inc.



*Figure 9a -  
Sr509 Seep Area-  
View to Southwest*



*Figure 9b -  
SR509 Seep Area-  
View to Northwest  
(Foss Landing  
Marina)*

Thea Foss Waterway, Tacoma, Washington

**SR509 Seep Area**

PAP-001-01 **FIGURE 9** July 2004  
Dalton, Olmsted & Fuglevand, Inc.



*Figure 10a -  
East Bank Slope -  
View to North*



*Figure 10b -  
Foss Landing  
Marina - View  
to South*

Thea Foss Waterway, Tacoma, Washington

**East Bank Slope and  
Foss Landing Marina**

PAP-001-01 **FIGURE 10** July 2005  
Dalton, Olmsted & Fuglevand, Inc.



*Figure 11a - Outfall 243 Under SR509 Bridge - View to East*



*Figure 11b - Outfall 237A - During Rain Event*



**Figure 12a -  
Discharge From  
Outfalls 235 - View  
to Southwest**



**Figure 12b -  
Small Erosional  
Channel Outfall  
235 - View  
to Northeast**

Thea Foss Waterway, Tacoma, Washington

**Outfall 235**

PAP-001-01 **FIGURE 12** July 2005  
Dalton, Olmsted & Fuglevand, Inc.



*Figure 13a -  
Discharge From  
Outfall 235 - View  
to South*



*Figure 13b -  
Discharge from  
Outfall 235 - View  
to Southeast*

Thea Foss Waterway, Tacoma, Washington

**Discharge Area - Outfall 235**

PAP-001-01 **FIGURE 13** July 2005  
Dalton, Olmsted & Fuglevand, Inc.

**Appendix B**  
**OMMP Sampling Report**  
**TetraTech EC, Inc.**  
**For:**  
**May 2005**



TETRA TECH EC, INC.

## Memorandum

---

Date: June 1, 2005  
To: Lotte Hass, PacifiCorp  
Matt Dalton, Dalton, Olmsted and Fuglevand  
From: Gary Braun  
RE: Operation, Maintenance and Monitoring Plan Sampling and  
Evaluation of Contamination in Capped Areas Sampling

---

### Introduction

Tetra Tech EC was contracted by PacifiCorp and Puget Sound Energy (Utilities) to collect sediment samples in the Head of the Thea Foss Waterway following several post dredging sampling events conducted by the City of Tacoma and the Utilities. The waterway is part of the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site in Tacoma Washington. Dredging by the City's contractor (Manson) in the adjacent remediation areas (RA20 and RA22) was completed between August 31 and September 17, 2004. The construction of the remedy for the Utilities Work Area was completed in February 2004. The purpose of the sampling was twofold: 1) to provide data to assess potential changes in recontaminated surface sediment conditions in the Utilities Work Area since the last sampling event in Nov/Dec 2004, and 2) to fulfill the requirements of the Utilities Year 1 Operation, Maintenance, and Monitoring Plan (OMMP).

- The Year 1 OMMP sampling was performed simultaneously with post dredge monitoring for the City of Tacoma performed by Parametrix. Sediment samples were collected May 10 through 12, 2005.

The May 2005 surface sampling was proposed to meet the following objectives for the recontamination assessment:

- Within the Utilities Work Area, assess the current southward concentration gradient from the adjacent City Project Area due to dredging, and
- Determine the approximate area where SQOs are exceeded at the point of compliance (0 to 10 cm)
- Collect split samples from the City Project Area concurrently with samples collected by Parametrix.

The May 2005 surface sampling was proposed to meet the following objectives for Year 1 OMMP:

- To provide data to assess the chemical quality of in-place capping materials with respect to the Sediment Quality Objectives (SQOs) performance standards. Assess the overall change in contaminant concentrations in surface sediment since the baseline conditions were established in April 2004, and
- Provide additional data to assess possible recontamination of capping materials from underlying contaminated materials (bottom-up recontamination) and other sources such as storm water discharge (top-down recontamination) (i.e., a comparison between the fine-grained 0-2 cm surface sediments and the 0-10 cm compliance samples).

A representative from the Army Corps of Engineers (Emile Petrie) met the sampling crews on the docks to observe sample collection activities for approximately an hour on May 10, 2005 and a representative from the City of Tacoma (Terry Forslund –Floyd Snider) was on the boat for 50 minutes on May 12, 2005.

In all, 44 samples were obtained from 31 locations and hand delivered to Analytical Resources Inc. (ARI) for possible analysis. Samples were submitted for analysis or archived according to the Sampling and Analysis Plan (SAP; DOF 2004). Split samples were collected by Parametrix at several OMMP locations and split samples were collected by Tetra Tech EC at City Project Area locations sampled by Parametrix. Methods and procedures for collecting the samples are described below.

### **Sample Collection**

Surface sediment samples were collected by Tetra Tech EC from 15 OMMP stations (RC/WC-01 through RC/WC-12, RC-13, RC-14, and RC-14B) and 10 additional stations (S-15 through S-20, S-22, S-24, S-29, and S-30). During the Year 1 OMMP sampling, RC-14B was established as a new location, at approximately 50 yards south of RC-14. Within the City Project Area 6 locations were sampled (CA-19B-03, CA-19B-06, CA-20-01, CA-20-04, CA-22-02, CA-22-05). Sample locations are included in Figure 1.

Two samples were collected from 12 OMMP stations: a 0 – 10 cm sample for monitoring/SQO compliance purposes, and a 0 – 2 cm sample for OMMP monitoring. At 3 other OMMP stations (RC-13, RC-14, and RC-14B), only 0 – 2 cm fine-grained material was collected. For each of the City Project Area stations, one sample at 0 – 10 cm below the sediment/water interface was collected for monitoring/SQO compliance purposes.

One field duplicate was collected at RC-02 by Tetra Tech EC to measure precision in field and analytical methods. The field duplicate, RC-02A, was taken out of the same stainless steel bowl as the original sample.

Sampling was conducted from a vessel for 27 of the 31 stations using a 0.1 m<sup>2</sup> van Veen stainless steel grab sampler that was deployed from a davit. Additionally, an Eckman grab sampler was used to collect samples from RC-03 and RC-04 (while the van Veen sampler was used for WC-03 and WC-04). The van Veen and Eckman samplers retrieved relatively undisturbed sediment samples representative of *in situ* sediment conditions. The vessel was provided and operated by Parametrix.

Surface sediment was collected from the van Veen and Eckman samplers following PSEP/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, 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 Parametrix and was decontaminated in the laboratory. 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 Attachment 1. Sample collection data and sediment descriptions are included in Table 1. All samples are included on the Chain-of-custody (COC) forms included in Attachment 2.

**Table 1. Sample collection.**

Location	Eastings	Northing	Date	Time	Fines (cm)	Description
CA-19B-03	1160484.9	702826.4	05/10/05	15:10	5	5 cm olive to dark olive SILT over coarse SAND. A few radiating sheen spots.
CA-19B-06	1160456	702958	05/10/05	15:35	8	8 cm olive to dark olive black SILT over coarse SAND. SILT is mixed in SAND layer more than at other stations. Worm tubes, twigs, organic debris.
CA-20-01	1160658.5	702858.4	05/10/05	1305	0.5-1	0.5-1 cm light olive SILT over coarse olive SAND (cap material).
CA-20-04	1160664.8	702974.5	05/10/05	1335	1	1 cm light olive brown SILT over coarse SAND.
CA-22-02	1160556.0	702849.0	05/10/05	1410	7	7 cm dark olive black SILT over SAND. Oily sheen in grab and upon homogenizing. Slight odor.
CA-22-05	1160552.3	702953.9	05/10/05	1435	1.5	1.5 cm olive SILT over coarse sand.
RC/WC-01	1160545.6	701992.8	05/12/05	1320	1-2	1-2 mm light brown SILT over 1-2 cm black SILT over gray/brown SAND/cobble/scour protection. Twigs, shells, organic debris, green algae. Many 2-20 cm rocks on surface and below surface.
RC/WC-02	1160700	702125	05/12/05	0925	8.5	8.5 cm dark olive black SILT over gray/brown SAND. Layers of silt and sand, not clearly stratified. In some areas of grab, 4 cm silt over 1-2 cm sand over silt over sand. Sheen spots upon homogenizing. Slight H2S odor. Worm tubes, leaves, twig, candy wrapper.
RC/WC-02	1160702	702124	05/12/05	0950	9	9 cm dark olive black SILT over gray/brown SAND. Sheen spots upon homogenizing. Slight H2S odor. Leaves, organic material.
RC/WC-03	1160498	702096	05/12/05	1020	10	10 cm dark olive black SILT over gray/brown fine to medium SAND. One sheen spot upon homogenizing.
RC/WC-03	1160505	702100	05/12/05	1045	10	2-3 mm olive SAND and SILT over 10 cm darker black SILT. Trace sheen spots upon homogenizing.
RC/WC-04	1160559	702216	05/12/05	1105	13	~13 cm (variable) dark olive black SILT over gray/brown SAND. Multi-layered in some areas, with ~8 cm SILT over SAND over SILT over SAND. Sheen spots upon homogenizing.
RC/WC-04	1160560	702217	05/12/05	1130	9+	9 cm dark olive black SILT, gelatinous. Sheen spots upon homogenizing.
RC/WC-04	1160562	702215	05/12/05	1140	11+	11 cm dark olive black SILT, gelatinous. Fuzzy filamentous diatoms on surface. Organic debris. Sheen spots upon homogenizing.
RC/WC-05	1160637	702361	05/12/05	1230	10	10 cm dark olive black SILT (containing some SAND) over gray/brown SAND. Sheen spots upon homogenizing, with more sheen spots in bowl containing 0-2 cm than 0-10 cm material. Cable in jaw of van Veen. Organic material, twigs.
RC/WC-06	1160428	702258	05/12/05	1300	4.5	4.5 cm dark olive black SILT over gray/brown SAND. Sheen spots. Slight hydrocarbon and H2S odors. Wood debris on top (11 cm x 1.3 cm).
RC/WC-07	1160459	702381	05/11/05	1027	2	2 cm olive SILT over gray coarse SAND. Small sheen spots upon homogenizing. Crab (~7.5 cm), organic material, twigs.
RC/WC-07	1160459	702364	05/11/05	1045	3-4	1-2 mm light olive SILT over 3-4 cm dark olive black SILT over gray coarse SAND. Slight sheen spots. Crab (~2.5 cm), organic material, twigs, worm tubes.

RC/WC-08	1160568	702434	05/11/05	1400	4	4 cm dark olive SILT over gray/brown SAND. Slight sheen spots. Organic debris, worm tubes.
RC/WC-09	1160653.5*	702452.4*	05/11/05	1340	5.5	5.5 cm dark olive SILT over SAND. Sheen spots upon homogenizing, more in 0-2 cm portion than 0-10 cm portion. Organic material/debris, worm tubes.
RC/WC-10	1160567	702582	05/11/05	1105	5	5 cm dark olive SILT over gray SAND (cap material). Sheen spots. Crab (~7.5 cm), worm tubes, twigs.
RC/WC-11	1160665.4	702712.8	05/11/05	0930	10.5	10.5 cm dark olive black SILT over GRAVEL. Sheen spots on surface (0-2 cm) and upon homogenizing, more in 0-2 material than 0-10 cm material. Slight petroleum odor. Organic debris, twigs, worm tubes, algae.
RC/WC-12	1160525	702766	05/11/05	1000	5	~1 mm brown SILT over 5 cm dark olive gray/black SILT over coarse SAND (cap material). Sheen spots on surface and upon homogenizing 0-2 cm and 0-10 cm material. Petroleum odor. Worm tubes.
RC-13	1160539.3	701901.8	05/12/05	1340	1	1-2 mm olive SILT over 1 cm black SILT over SAND/GRAVEL. Green algae, shells. Many rocks, 2.5 cm-7.5 cm on surface and 2.5 cm-30.5 cm sub-surface.
RC-14	1160716.6	701873.1	05/12/05	1350	1-2	~1 mm olive SILT mottled over 1-2 cm black SILT over SAND/GRAVEL. Green algae, organic debris, leaves, twigs.
RC-14B	1160727.9	701824.2	05/12/05	1345	1-2	2 mm black SILT mottled over 1-2 cm black SILT over SAND/GRAVEL. Green algae, worm tubes, shells, organic debris.
S-15	1160596.5	702760.4	05/10/05	0952	11.5	~1 mm olive brown SILT over 11.5 cm black SILT over SAND. Prevalent oily sheen. Slight petroleum odor.
S-16	1160669.5	702640.5	05/10/05	1030	5	5 cm dark olive SILT over light gray GRAVEL. Slight sheen spots upon homogenizing. None to slight petroleum odor. Worm tubes, shells, leaves.
S-17	1160673.6*	702546.9*	05/11/05	1250	6	6+ cm dark olive black SILT over coarse gray SAND and GRAVEL. Slight sheen spots upon homogenizing. Twigs.
S-18	1160699.9*	702481.5*	05/11/05	1315	3	3+ cm dark olive black SILT over tan SAND. Sheen spots upon homogenizing. Slight petroleum odor. Worm tubes.
S-19	1160598.8	702671.0	05/10/05	1055	8	~1 cm light olive SILT over 7 cm dark olive SILT over GRAVEL cap material. Slight sheen. Worm tubes on surface, brown filamentous algae.
S-20	1160602.5*	702537.4*	05/10/05	1125	3.5	3.5 cm dark olive SILT over GRAVEL. Worm tubes, diatoms.
S-22	1160543	702648	05/11/05	1125	6.5	6.5 cm dark olive SILT over SAND (cap material). Sheen spots upon homogenizing.
S-24	1160509*	702551*	05/11/05	1145	6	6 cm dark olive black SILT over SAND. Slight sheen spots. Slight H2S odor. Twigs, organic debris, worm tubes.
S-29	1160549.0	702609.4	05/10/05	1155	4.5-5	~5 mm olive SILT over 4-4.5 cm black SILT/organic muck over medium-grained tan SAND. Slight sheen spots upon homogenizing.
S-30	1160510.9*	702470.9*	05/11/05	1425	3	3 cm dark olive SILT over gray/brown coarse SAND. 0.6-1.3 cm sheen spots. Organic debris, worm tubes.

<sup>1</sup>Datum: WA State Plane Zone South, NAD 83, US survey feet.

\* Planned coordinates; GPS not obtainable.

## Field Observations - Utilities Work Area

Visual inspection of surface samples indicates that fine-grained material has been deposited on top of the Utilities' cap since construction. Oily sheens and sheen spots were noted at most stations. Stations where sheen was not observed include three OMMP shore stations collected at low tide (WC/RC-01, RC-13, and RC-14), and one from the slope cap (S-20).

Depth of fine-grained material was documented on each of the log sheets included in Attachment 1. Previous data from November/December 2004 showed a deposition of dark gray-black silt over the Utilities cap during the City's dredging in remedial action areas RA20 and RA22. Table 2 includes a summary of the depth of fine-grained material deposited in the Utilities Work Area in spatial order from north to south in transects from west to east (see Figure 1) as observed during this previous sampling event. There is a clear decreasing southward gradient in the depth

of the overlying fine-grained silt layer from Site 15 (S-15) south to the 509 Bridge in all four transects.

**Table 2. Nov. – Dec. 2004 Sampling: Gradient of Fines At Utility’s Stations North of 509 Bridge\***

Location	Fines (cm)						
RC/WC-12	3	S-21	7	S-15	12	RC/WC-11	7
S-23	3	S-22	8	S-27	5	S-25	7
S-24	2	S-29	4	S-19	4	S-16	5
		RC/WC-10	3	S-28	2	S-26	2
				S-20	2	S-17	2

\*Stations are arranged in spatial order, North up.

The May 2005 sampling indicated the same general trend, as shown in Table 3.

**Table 3. May 2005 Sampling: Gradient of Fines At Utility’s Stations North of 509 Bridge\***

Location	Fines (cm)						
RC/WC-12	5	S-22	6.5	S-15	11.5	RC/WC-11	10.5
S-24	6	S-29	4.5-5	S-19	8	S-16	5
S-30	3	RC/WC-10	5	S-20	3.5	S-17	6
		RC/WC-08	4			S-18	3

\*Stations are arranged in spatial order, North up.

Under the 509 Bridge and south to the Twin 96” outfalls, accumulations of fine-grained material were also documented. However, in several of these samples (RC/WC-02, RC/WC-03, RC/WC-04, and RC/WC-05) the accumulated silts were stratified and formed several silt layers on top of the Utilities’ cap. This pattern of stratification indicates an apparent stormwater influence. One type of silt is dark olive black silt visually similar to the dark silt deposited north of the 509 Bridge. Lighter colored silt layers were also deposited at these locations. Representative photos are included in Attachment 3.

Three stations have been monitored several times since the completion of the remedial actions in the Utilities Work Area: RC/WC-11, RC/WC-12, and Site 15 (S-15). Accumulation of fine-grained material on top of cap material is evident from each sampling effort. Gradient of fines over time at RC-11, RC-12, and Site 15 are included in Table 4.

**Table 4. Depth of Fines Over Time at Three Monitoring Stations (West to East)**

Date Sampled	RC/WC-12	S-15	RC/WC-11
April 04	<1 cm silt over cap material	NS	~1 cm silt over cap material
8/20/04	0 cm silt	NS	Silt intermixed in top 5 cm of cap material
8/30/04	NS	1 cm silt over silty sand	1 cm silt over cap material
9/18/04	NS	3-7 cm silt over sand	3-4 cm silt over cap material
11/30/04 - 12/1/04	3 cm silt over cap material	12 cm silt over cap material	7 cm silt over cap material
05/10/04 - 12/05	5 cm silt over cap material	11.5 cm silt over cap material	10.5 cm silt over cap material

NS = No sample

### Field Observations - City Project Area

Observations of material within the City Project Area are included in Table 1. Four of the six stations in the City Project Area (CA-19B-06, CA-20-01, CA-20-04, and CA-22-05S-20) did not contain a sheen. Due to previous observations of fines in the City Project Area on November 9, 2004, an additional sand cap was placed in RA 20 and 22 in January 2005. The May 2005

sampling observed fine grained material on the surface of all six locations within the City Project Area. Table 5 compares the depth of fines in each sample collected May 2005 with the depth observed during the November 9, 2004 sampling event. There was an increase in silt on the surface in RA 19 and RA 22, with similar or less fines observed in RA 20.

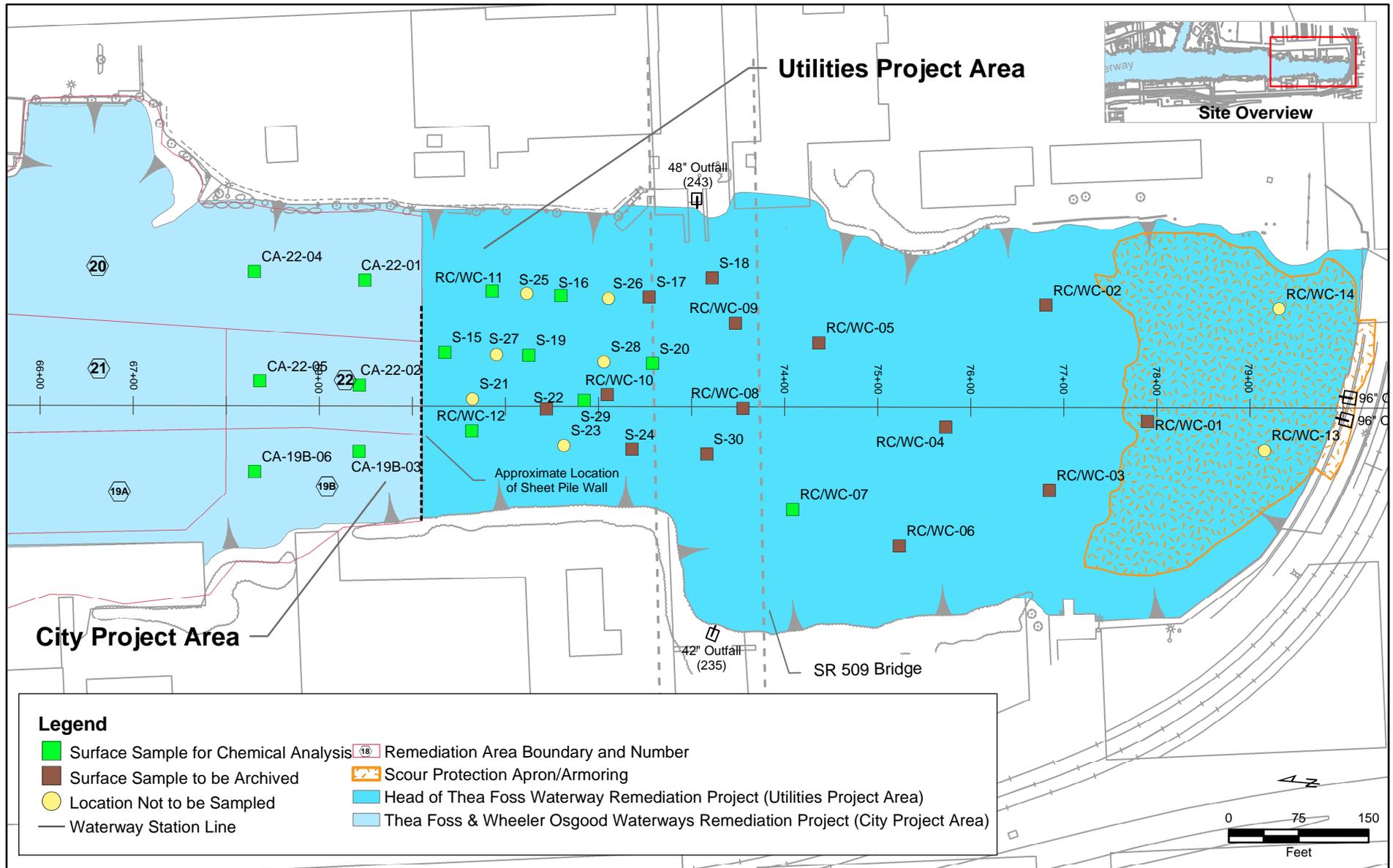
**Table 5. Depth of Fines November 2004 and May 2005 in the City Project Area**

Station	Sample	Date	Fines (cm)	Description
CA-19B-03	0-2 cm	11/9/04	1.5-4	1.5-4 cm brown SILT over coarse SAND cap material. Sheen spots observed.
	0-10 cm	11/9/04	3	3 cm brown SILT over coarse SAND cap material. Sheen spot. Leaf. Slight Petroleum odor.
	0-10 cm	05/10/05	5	5 cm olive to dark olive SILT over coarse SAND. A few radiating sheen spots.
CA-19B-06	0-2 cm	11/9/04	>17	Olive brown SILT over SAND cap material. Sheen spots. Slight creosote odor.
	0-10 cm	11/9/04	5	5 cm olive brown SILT over coarse SAND cap material. Small sheen spots. Several worm tubes.
	0-10 cm	05/10/05	8	8 cm olive to dark olive black SILT over coarse SAND. SILT is mixed in SAND layer more than at other stations. Worm tubes, twigs, organic debris.
CA-20-01	0-2 cm	11/9/04	1	1 cm brown SILT over coarse SAND cap material. Small sheen spots. Slight petroleum odor.
	0-10 cm	11/9/04	0.5	0.5 cm brown SILT over coarse SAND cap material. Small sheen spots.
	0-10 cm	05/10/05	0.5-1	0.5-1 cm light olive SILT over coarse olive SAND (cap material).
CA-20-04	0-2 cm	11/9/04	3-4	3-4 cm dark brown SILT over coarse SAND cap material. Sheen spots. Slight petroleum odor.
	0-10 cm	11/9/04	3	3 cm olive brown SILT over coarse SAND cap material. Sheen spots. Slight petroleum odor.
	0-10 cm	05/10/05	1	1 cm light olive brown SILT over coarse SAND.
CA-22-02	0-2 cm	11/9/04	2	2 cm brown SILT over coarse SAND cap material. Some sheen spots. Wood chips. Slight aged petroleum smell.
	0-10 cm	11/9/04	2-3	2-3 cm olive brown SILT with sand over coarse SAND cap material. Fine sand at 6 cm. Sheen spots. Slight petroleum odor.
	0-10 cm	05/10/05	7	7 cm dark olive black SILT over SAND. Oily sheen in grab and upon homogenizing. Slight odor.
CA-22-05	0-2 cm	11/9/04	0	Brown coarse SAND, some wood chips, several leaves and twigs on surface.
	0-10 cm	11/9/04	1.5	1.5 cm olive brown SILT over coarse SAND cap material. Sheen spots. Slight creosote odor.
CA-22-05B	0-2 cm	11/9/04	3	3 cm olive brown SILT over coarse SAND cap material. Sheen spots. Very slight petroleum odor. Collected because first 0-2 cm sample was anomaly without silt.
CA-22-05	0-10 cm	05/10/05	1.5	1.5 cm olive SILT over coarse sand.

## Summary

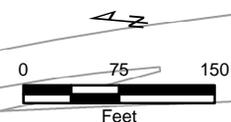
Field data from Year 1 OMMP sampling indicated the same trend as available data collected in April, August and September - December 2004. These data indicate that recontamination is occurring and is likely top-down in nature, caused by resuspension of contaminated sediments during dredging activities in RA20 and RA22 and to a lesser extent by stormwater discharges with evidence of a northward concentration gradient from the Twin 96" Outfalls. Existing data

indicates two opposing concentration gradients in surface sediment at the head of the Thea Foss Waterway. Available data (S-15 and RC-11) shows that a contaminant concentration gradient likely extends from the dredged area in a southward direction and data from the April 2004 OMMP and November/December 2004 sampling events shows a contaminant concentration gradient extending northward from the Twin 96" outfalls. May 2005 sampling chemistry data is pending.



**Legend**

- Surface Sample for Chemical Analysis
- Surface Sample to be Archived
- Location Not to be Sampled
- Waterway Station Line
- 18 Remediation Area Boundary and Number
- Scour Protection Apron/Armoring
- Head of Thea Foss Waterway Remediation Project (Utilities Project Area)
- Thea Foss & Wheeler Osgood Waterways Remediation Project (City Project Area)



**ATTACHMENT 1**  
**SAMPLE LOG FORMS**

<b>SURFACE SEDIMENT SAMPLE COLLECTION FORM</b>		Sample No. <u>CI CA-19B-03</u>
		Project Name: <u>Thea Foss Recontamination/OMMP Y1</u>
		Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/10/05</u> Time: <u>1505</u> Sampled by: <u>GB/SW - PM X</u> Checked by: _____		
Equipment: <u>0.1 m<sup>2</sup> van Veen</u>		
Location Description: <u>West side waterway near Sheetpile wall - City side</u>		
Deployment: <u>1</u> Time: <u>1510</u> Northing: <u>971940.070</u> Easting: <u>1222556.736</u>		
<input checked="" type="checkbox"/> Accepted / <input type="checkbox"/> Rejected            Bio / <input checked="" type="checkbox"/> Chem            Water Depth <u>17.7 ft</u> Penetration <u>17cm</u> RPD Depth <u>1-2cm</u>		
Sediment (density, color, type): <u>5cm silt layer - olive → dark olive over coarse sand</u>		
Sediment Odor (type and magnitude): <u>none noted</u>		
Biological (flora and fauna): <u>none noted</u>		
Sheen <u>a few sheen spots - road debris</u> Debris _____		
Comments: <u>5cm silt layer</u>		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected    Bio / Chem    Water Depth    Penetration    RPD Depth		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected    Bio / Chem    Water Depth    Penetration    RPD Depth		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected    Bio / Chem    Water Depth    Penetration    RPD Depth		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		

SURFACE SEDIMENT SAMPLE COLLECTION FORM		Sample No. <u>CA-19B-06</u>
		Project Name: <u>Thea Foss Recontamination/OMMP Y1</u>
		Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/10/05</u>	Time: <u>1530</u>	Sampled by: <u>GP/SW - PMX</u> Checked by: _____
Equipment: <u>0.1 m<sup>2</sup> Van Veen</u>		
Location Description: <u>Albers Mill dock inside 2<sup>nd</sup> slip from berth</u>		
Deployment: <u>1</u>	Time: <u>1535</u>	Northing: <u>702958</u> Easting: <u>1160456</u>
<input checked="" type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / <input checked="" type="checkbox"/> Chem	Water Depth <u>16.5</u> Penetration <u>18</u> RPD Depth _____
Sediment (density, color, type): <u>olive-dark olive silt over coarse sand @ ~8-10cm from</u>		
Sediment Odor (type and magnitude): <u>none noted</u> <sup>black</sup> -		
Biological (flora and fauna): <u>few worm tubes</u>		
Sheen <u>none noted</u>	Debris <u>twigs, organic debris</u>	
Comments: <u>8cm silt layer</u> <u>silt is mixed in sand layer more than other sites</u>		
Deployment: _____	Time: _____	Northing: _____ Easting: _____
Accepted / Rejected	Bio / Chem	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		
Deployment: _____	Time: _____	Northing: _____ Easting: _____
Accepted / Rejected	Bio / Chem	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		
Deployment: _____	Time: _____	Northing: _____ Easting: _____
Accepted / Rejected	Bio / Chem	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		

<b>SURFACE SEDIMENT SAMPLE COLLECTION FORM</b>		Sample No. <u>CA-20-01</u>
		Project Name: <u>Thea Foss Recontamination/OMMP Y1</u>
		Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/10</u> Time: <u>1:05 pm</u> Sampled by: <u>GSK-PMX</u> Checked by: _____		
Equipment: <u>0.1 m<sup>2</sup> van Veen</u>		
Location Description: <u>Between 2nd slip N of Boardwalk - middle of slip</u>		
Deployment : <u>1</u> Time: <u>1:05 pm</u> Northing: <u>702858.4</u> Easting: <u>1166658.5</u>		
<input checked="" type="checkbox"/> Accepted / <input type="checkbox"/> Rejected            Bio <input checked="" type="checkbox"/> Chem            Water Depth <u>12.0</u> Penetration <u>15</u> RPD Depth _____		
Sediment (density, color, type): <u>olive sand - coarse</u> <u>cap material</u>		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: <u>0.5-1 cm silt layer - thin &amp; light olive</u>		
Deployment : _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment : _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment : _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		

**SURFACE SEDIMENT SAMPLE  
COLLECTION FORM**

Sample No. CA-20-04  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/10/05 Time: 1:20 pm Sampled by: CA/SW-PMX Checked by: \_\_\_\_\_  
 Equipment: 0.1 m<sup>2</sup> Van Veen  
 Location Description: East side of Middle of 4<sup>th</sup> Slip Wayboat Lift  
 Deployment: 1 Time: 1325 Northing: 702974.5 Easting: 1160664.9  
 Accepted / ~~Rejected~~ Bio ~~Chem~~ Water Depth 10.4 Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): coarse sand - olive  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
 Comments: Rock in jaw - washed on surface

Deployment: 2 Time: 1330 Northing: 702974 Easting: \_\_\_\_\_  
 Accepted / ~~Rejected~~ Bio ~~Chem~~ Water Depth 10.4 Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): \_\_\_\_\_  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
 Comments: Washed out

Deployment: 3 Time: 1335 Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
~~Accepted~~ / Rejected Bio ~~Chem~~ Water Depth 10.4 Penetration 16cm RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): silt - light olive/brown over coarse sand (1-2mm)  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
 Comments: moved S/N 1cm silt layer

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
 Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): \_\_\_\_\_  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
 Comments: \_\_\_\_\_

**SURFACE SEDIMENT SAMPLE  
COLLECTION FORM**

Sample No. CA-22-02  
Project Name: Thea Foss Recontamination/OMMP Y1  
Project No.: 2562.0005.0001.00000

Date: 5/10/05 Time: 1355 Sampled by: GB/SW-PMR Checked by: \_\_\_\_\_

Equipment: 0.1 m<sup>2</sup> van Veen

Location Description: middle of waterway near sheet pile wall - city side

Deployment: \_\_\_\_\_ Time: 1358 Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration 18+ RPD Depth \_\_\_\_\_

Sediment (density, color, type): olive silt on surface

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: Over penetration 7cm silt over sand

Deployment: 2 Time: 14 Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth 21.5 ft Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): Silt - olive to black 2-4cm down - sand under

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen sheen noted Debris \_\_\_\_\_

Comments: Over penetration - 7cm silt layer

Deployment: 3 Time: 1410 Northing: 47°14'40.3105 Easting: 122°25'55.714

Accepted / Rejected Bio / Chem Water Depth 21.5 Penetration 16 RPD Depth \_\_\_\_\_

Sediment (density, color, type): olive-black silt layer (4cm down) over sand

Sediment Odor (type and magnitude): slight odor

Biological (flora and fauna): \_\_\_\_\_

Sheen only sheen in grab + bowl Debris \_\_\_\_\_

Comments: Silt layer = 7.0cm

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

# SURFACE SEDIMENT SAMPLE COLLECTION FORM

Sample No. CA-22-05  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/10/05 Time: 1437 Sampled by: CA/SW-PMX Checked by: \_\_\_\_\_  
 Equipment: 0.1 m<sup>3</sup> Van Veen  
 Location Description: center of waterway N of CA-22-02  
 Deployment: 1 Time: 1435 Northing: 4714' 41.344 Easting: 122° 25' 55.805  
 Accepted  Rejected  Bio / Chem Water Depth 22.10 @ 1457 Penetration 14 RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): 1.5cm silt - olive over coarse sand  
 Sediment Odor (type and magnitude): -  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
 Comments: 1.5cm silt layer

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
 Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): \_\_\_\_\_  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
 Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
 Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): \_\_\_\_\_  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
 Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
 Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): \_\_\_\_\_  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
 Comments: \_\_\_\_\_

# SURFACE SEDIMENT SAMPLE COLLECTION FORM

Sample No. WC-01/RC-01  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/12/05 Time: 1320 Sampled by: GB/SLW-PMX Checked by: \_\_\_\_\_  
 Equipment: by hand - spoons  
 Location Description: N end of scum protection

WC-01  
(0-10)

Deployment: by hand Time: 1320 Northing: 47°14.531 Easting: 122°25.926  
 Accepted /  Rejected Bio /  Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): light brown silt (1-2mm) over black silt (1-2cm) over sand/cobble  
 Sediment Odor (type and magnitude): none noted scum protection  
 Biological (flora and fauna): green algae  
 Sheen: none noted Debris: twigs, shells, org. debris  
 Comments: lots of rock (1-3") on surface w/ 6-8" picks

RC-01  
(0-2)

Deployment: by hand Time: 1320 Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
 Accepted /  Rejected Bio /  Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): same as WC-01  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen: \_\_\_\_\_ Debris: \_\_\_\_\_  
 Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
 Accepted /  Rejected Bio /  Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): \_\_\_\_\_  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen: \_\_\_\_\_ Debris: \_\_\_\_\_  
 Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
 Accepted /  Rejected Bio /  Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): \_\_\_\_\_  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen: \_\_\_\_\_ Debris: \_\_\_\_\_  
 Comments: \_\_\_\_\_

# SURFACE SEDIMENT SAMPLE COLLECTION FORM

Sample No. WC/RC-02  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/12/05 Time: 0925 Sampled by: GS/so - PMK Checked by: \_\_\_\_\_

Equipment: 0.1 m<sup>2</sup> Van Veen

Location Description: SE corner of turning Basin

Deployment: 1 Time: 0925 Northing: 702125 Easting: 1160700

Accepted /  Rejected Bio /  Chem Water Depth 16.6 Penetration 17cm RPD Depth \_\_\_\_\_

Sediment (density, color, type): Silt layer (dark olive/black) is 2.5 cm over sand

Sediment Odor (type and magnitude): 4.25 odor slight

Biological (flora and fauna): worm tubes

Sheen Yes (in bowl) - petroleum Debris leaves, twigs, sandy wrapper

Comments: 8.5 cm silt over sand - appears to have layers - 4cm silt, sand (0-2) then silt => sand

WC-02  
(0-10)

Deployment: 1 Time: 0925 Northing: 702125 Easting: 1160700

Accepted /  Rejected Bio /  Chem Water Depth 16.6 Penetration 17 RPD Depth \_\_\_\_\_

Sediment (density, color, type): Same as WC-02

Sediment Odor (type and magnitude): 1.1

Biological (flora and fauna): 1.1

Sheen \_\_\_\_\_ Debris lots of leaves + twigs

Comments: 8.5 cm silt

\* collected partial 0-2 sample

RC-02  
(0-2)

Deployment: 2 Time: 0950 Northing: 702124 Easting: 1160702

Accepted /  Rejected Bio /  Chem Water Depth 16.8 Penetration 17 RPD Depth \_\_\_\_\_

Sediment (density, color, type): silt layer (dark olive/black) is 9 cm over sand

Sediment Odor (type and magnitude): H<sub>2</sub>S odor (slight)

Biological (flora and fauna): leaves, organic material (more than grab at 09:25)

Sheen sheen spots observed while mixing in bowl Debris leaves, organic material

Comments: 9 cm silt

RC-02  
E  
RC-02A  
\* (field dup)

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted /  Rejected Bio /  Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

# SURFACE SEDIMENT SAMPLE COLLECTION FORM

Sample No. WC/RC-03  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/12/15 Time: 1015 Sampled by: GABW - PHAR Checked by: \_\_\_\_\_

Equipment: 0.1 m<sup>2</sup> van Veen / Eckman

Location Description: SW corner turning Basin near City Pier

Deployment: 1 Time: 1017 Northing: 702099 Easting: 1160502

Accepted / Rejected Bio / Chem Water Depth 12.4 Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_

Debris \_\_\_\_\_

Comments: Rejected - over penetration

Deployment: 2 Time: 1020 Northing: 702096 Easting: 1160498

Accepted / Rejected Bio / Chem Water Depth 12.4 Penetration 18+ RPD Depth \_\_\_\_\_

Sediment (density, color, type): 10 cm silt (dark olive/black) - sand (fine-med) below

Sediment Odor (type and magnitude): None noted

Biological (flora and fauna): None noted

Sheen \_\_\_\_\_

one sheen spot noted in bowl

Debris \_\_\_\_\_

None noted

Comments: Some over penetration but collect a 10cm sample

Deployment: 3 Time: 10:45 Northing: 702100 Easting: 1160505

Accepted / Rejected Bio / Chem Water Depth 10.9 ft Penetration \_\_\_\_\_ RPD Depth 2mm

Sediment (density, color, type): 10 cm silt (2-3mm olive, darker/black silt below)

Sediment Odor (type and magnitude): None noted

Biological (flora and fauna): None noted

Sheen \_\_\_\_\_

a little sheen - spots in bowl

Debris \_\_\_\_\_

None noted

Comments: 2-3 mm olive sands. silt with darker black silt underneath

Used Eckman grab for sample collection -

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_

Debris \_\_\_\_\_

Comments: \_\_\_\_\_

WC-03  
with  
van Veen

RC-03  
with  
Eckman

# SURFACE SEDIMENT SAMPLE COLLECTION FORM

Sample No. WC/RC-04  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/12/05 Time: 1105 Sampled by: GP/SW PWR Checked by: \_\_\_\_\_

Equipment: 0.1 m<sup>2</sup> Van Veen / Eckman

Location Description: Central Turning Basin

Deployment: 1 Time: 1105 Northing: 702216 Easting: 1160559

Accepted /  Rejected Bio /  Chem Water Depth 13.5 ft Penetration 18" RPD Depth \_\_\_\_\_

Sediment (density, color, type): dark olive/black silt with sand, multi layers, silt → sand → silt

Sediment Odor (type and magnitude): None noted

Biological (flora and fauna): None noted

Sheen Sheen spots in bowl Debris None noted

Comments: ~13 cm silt (variable) with sand in some areas of mean, layering w/ silt/sand slightly over-penetration, collect 0-10cm only

Deployment: 1 Time: 1130 Northing: 702217 Easting: 1160560

Accepted /  Rejected Bio /  Chem Water Depth 12.4 Penetration 9cm RPD Depth \_\_\_\_\_

Sediment (density, color, type): dark olive/black silt, gellatenuous

Sediment Odor (type and magnitude): None noted

Biological (flora and fauna): None noted

Sheen sheen spots in bowl Debris None fuzzy filamentous diatoms on top

Comments: gellatenuous silt

Eckman Grab

Deployment: 2 Time: 1140 Northing: 702215 Easting: 1160562

Accepted /  Rejected Bio /  Chem Water Depth 12.4 Penetration 11cm RPD Depth \_\_\_\_\_

Sediment (density, color, type): dark olive/black silt, gellatenuous

Sediment Odor (type and magnitude): None noted

Biological (flora and fauna): fuzzy filamentous diatoms on top

Sheen sheen spots in bowl Debris organic debris

Comments: gellatenuous, silty

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted /  Rejected Bio /  Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Went  
w/  
Van Veen

RC-04  
with  
Eckman  
Combined  
two  
Eckman  
grabs  
for  
sample

5/12/05

# SURFACE SEDIMENT SAMPLE COLLECTION FORM

Sample No. WC/RC-05  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/12/05 Time: 12:30 Sampled by: CBPW PINK Checked by: \_\_\_\_\_  
 Equipment: 0.1 m<sup>2</sup> van Veen

Location Description: just S of kayak dock in Turning Basin

Deployment: 1 Time: 12:30 Northing: 702361 Easting: 1160637

Accepted / Rejected Bio (Chem) Water Depth 10.3 Penetration 18 cm RPD Depth \_\_\_\_\_

Sediment (density, color, type): 10 cm silt (dark olive/black) over sand (grey)

Sediment Odor (type and magnitude): faint but notable H<sub>2</sub>S odor

Biological (flora and fauna): None noted

Sheen sheen in bowl Debris cable in jaw, organic material, H<sub>2</sub>S

Comments: 10 cm silt (dark olive/black) over grey sand  
Silt layer contains some sand

WC-05  
(0-10)

Deployment: 1 Time: 12:30 Northing: 702361 Easting: 1160637

(Accepted) / Rejected Bio (Chem) Water Depth 10.3 Penetration 18 cm RPD Depth \_\_\_\_\_

Sediment (density, color, type): 10 cm dark olive/black silt w/ some sand

Sediment Odor (type and magnitude): H<sub>2</sub>S odor faint

Biological (flora and fauna): None noted

Sheen sheen in bowl, more than 0-10 Debris cable in jaw org material twigs

Comments: 10 cm silt (dark olive/black) with some sand over sand  
collected from same grab as WC-05

RC-05  
(0-2)

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

# SURFACE SEDIMENT SAMPLE COLLECTION FORM

Sample No. WC/RC-06  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/12/05 Time: 1300 Sampled by: GB/KW - PMX Checked by: \_\_\_\_\_

Equipment: 0.1 m<sup>2</sup> Van Veen

Location Description: West edge of Turpin Basin

Deployment: 1 Time: 1300 Northing: 702253 Easting: 1160428

Accepted /  Rejected Bio /  Chem Water Depth 8.7 ft Penetration 14 RPD Depth \_\_\_\_\_

Sediment (density, color, type): 4.5 cm silt (dark olive/black) over sand (grey/brown)

Sediment Odor (type and magnitude): fast hydrocarbon smell, H<sub>2</sub>S odor also

Biological (flora and fauna): None noted

Sheen sheen spots Debris wood debris on top (4.5" x 5")

Comments: 4.5 cm silt (dark olive/black) over silt

WC-06

Deployment: 1 Time: 1300 Northing: 702253 Easting: 1160428

Accepted /  Rejected Bio /  Chem Water Depth 8.7 ft Penetration 14 RPD Depth \_\_\_\_\_

Sediment (density, color, type): 4.5 cm silt (dark olive/black)

Sediment Odor (type and magnitude): hydrocarbon (slight), H<sub>2</sub>S odor (slight)

Biological (flora and fauna): None noted

Sheen sheen spots Debris wood debris on top (4.5" x 5")

Comments: 4.5 cm silt  
collected from same grab as WC-06

RC-06

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

**SURFACE SEDIMENT SAMPLE  
COLLECTION FORM**

Sample No. WC/RC-07  
Project Name: Thea Foss Recontamination/OMMP Y1  
Project No.: 2562.0005.0001.00000

Date: 5/11/05 Time: 1025 Sampled by: CA/SU-PMK Checked by: \_\_\_\_\_

Equipment: 0.1m<sup>2</sup> van Veen

Location Description: South of Bridge on west side

Deployment: 1 Time: 1026 Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted /  Rejected Bio / Chem Water Depth 11.0 Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: Did not trigger

WC-07

Deployment: 2 Time: 1027 Northing: 702381 Easting: 1160459

Accepted / Rejected Bio / ~~chem~~ Water Depth 11.0 Penetration 13cm RPD Depth \_\_\_\_\_

Sediment (density, color, type): olive silt over coarse sand (grey)

Sediment Odor (type and magnitude): None noted

Biological (flora and fauna): crab (3 inches on surface took pic)

Sheen few sheen spots in haul Debris organic material/twigs

Comments: 2 cm silt over sand

0-10 cm collected

RC-07

Deployment: 3 Time: 1045 Northing: 702364 Easting: 1160459

Accepted / Rejected Bio / Chem Water Depth 11.0 Penetration 13 cm RPD Depth 2mm

Sediment (density, color, type): 3-4 cm silt (much) over coarse grey sand

Sediment Odor (type and magnitude): organic smell

Biological (flora and fauna): worm tubes, org/twigs, crab (1 inch)

Sheen few sheen spots Debris organic/twigs

Comments: 3-4 cm silt, 1-2 mm light to over black

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

**SURFACE SEDIMENT SAMPLE  
COLLECTION FORM**

Sample No. WC/RC-08  
Project Name: Thea Foss Recontamination/OMMP Y1  
Project No.: 2562.0005.0001.00000

Date: 5/6/05 Time: 1400 Sampled by: GR/SW/PUR Checked by: \_\_\_\_\_

Equipment: 0.1 m<sup>2</sup> van Veen

Location Description: Sedge of Bridge in West portion of U/W

Deployment: 1 Time: 1400 Northing: 702434 Easting: 1160568

Accepted /  Rejected Bio  Chem Water Depth 8.3 ft Penetration 16 cm RPD Depth \_\_\_\_\_

Sediment (density, color, type): 4 cm dark olive silt over sand (grey/brown)

Sediment Odor (type and magnitude): none noted

Biological (flora and fauna): Worm tubes

Sheen few small sheen spots Debris worm tubes, org debris

Comments: 4 cm dark olive silt over grey<sup>brown</sup> sand

WC-08

Deployment: \_\_\_\_\_ Time: 1400 Northing: same as above Easting: same as above

Accepted /  Rejected Bio  Chem Water Depth 8.3 ft Penetration 16 cm RPD Depth \_\_\_\_\_

Sediment (density, color, type): 4 cm dark olive silt

Sediment Odor (type and magnitude): none noted

Biological (flora and fauna): worm tubes

Sheen few small sheen spots Debris worm tubes, org debris

Comments: 4 cm dark olive silt over grey<sup>brown</sup> sand

RC-08

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

SURFACE SEDIMENT SAMPLE COLLECTION FORM		Sample No. <u>WC/RC-09</u>
		Project Name: <u>Thea Foss Recontamination/OMMP Y1</u>
		Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/11/05</u> Time: <u>1330</u> Sampled by: <u>GR/SW/PMX</u> Checked by: _____		
Equipment: <u>0.1 m<sup>3</sup> van beam</u>		
Location Description: <u>Under Bridge (southside) ~ mid way between fish docks &amp; 3rd pile line</u> <span style="float: right;"><u>from well end</u></span>		
Deployment: <u>1</u>	Time: <u>1340</u>	Northing: <u>702452.9 *</u> Easting: <u>1160653.5 *</u>
<input checked="" type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / <input checked="" type="checkbox"/> Chem	Water Depth <u>8 ft</u> Penetration <u>13 cm</u> RPD Depth _____
Sediment (density, color, type): <u>dark olive silt (5.5cm) over sand</u>		
Sediment Odor (type and magnitude): <u>None noted</u>		
Biological (flora and fauna): <u>worm tubes</u>		
Sheen <u>a little sheen (very little)</u> Debris <u>organic material/debris</u>		
Comments: <u>5.5 cm silt layer over sand</u>		
<u>* Planned - no GPS - visual locations</u>		
Deployment: <u>1</u>	Time: <u>1340</u>	Northing: <u>Same as above</u> Easting: <u>Same as above</u>
<input checked="" type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / Chem	Water Depth _____ Penetration <u>13 cm</u> RPD Depth _____
Sediment (density, color, type): <u>dark olive silt 5.5cm over sand</u>		
Sediment Odor (type and magnitude): <u>None noted</u>		
Biological (flora and fauna): <u>slw silt/lts worm tubes</u>		
Sheen <u>a little sheen spots</u> Debris <u>organic material/debris</u>		
Comments: <u>dark olive silt 5.5cm</u>		
<u>collected from same grab as WC-09</u>		
Deployment: _____	Time: _____	Northing: _____ Easting: _____
<input type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / Chem	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment: _____	Time: _____	Northing: _____ Easting: _____
<input type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / Chem	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		

WC-09  
(0-10)

RC-09  
(0-2)

**SURFACE SEDIMENT SAMPLE  
COLLECTION FORM**

Sample No. WC/RC-10  
Project Name: Thea Foss Recontamination/OMMP Y1  
Project No.: 2562.0005.0001.00000

Date: 5/14/05 Time: 1100 Sampled by: GB/scr - PWR Checked by: \_\_\_\_\_  
Equipment: 0.1 m<sup>2</sup> van Veen  
Location Description: Just N of Bridge ~ 50ft W of Foss Landing dock (near S-29)

Deployment: 1 Time: 1105 Northing: 702582 Easting: 1160567  
 Accepted /  Rejected Bio /  Chem Water Depth 12.3 Penetration 15cm RPD Depth \_\_\_\_\_  
(dive)  
Sediment (density, color, type): 5 cm silt / over sand (grey)  
Sediment Odor (type and magnitude): None noted  
Biological (flora and fauna): Crab (3 inches), worm tubes  
Sheen Sheen spot 2 Debris twigs  
Comments: 5 cm silt (dark olive) over sand (grey), cap material

(0-104) WC-10

Deployment: 1 Time: 1105 Northing: 702582 Easting: 1160567  
 Accepted /  Rejected Bio /  Chem Water Depth 12.3 Penetration 15cm RPD Depth 2cm  
Sediment (density, color, type): dark olive silt / layer over  
Sediment Odor (type and magnitude): none noted  
Biological (flora and fauna): Crab (3 inches) worm tubes  
Sheen Sheen spot 5 Debris twigs,  
Comments: 5 cm silt layer  
taken from same grab as WC-10 (opposite side)

(0-204) RC-10

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
Sediment (density, color, type): \_\_\_\_\_  
Sediment Odor (type and magnitude): \_\_\_\_\_  
Biological (flora and fauna): \_\_\_\_\_  
Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
Sediment (density, color, type): \_\_\_\_\_  
Sediment Odor (type and magnitude): \_\_\_\_\_  
Biological (flora and fauna): \_\_\_\_\_  
Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
Comments: \_\_\_\_\_

<b>SURFACE SEDIMENT SAMPLE COLLECTION FORM</b>		Sample No. <u>WC-11 (0-10 cm)</u>
		Project Name: <u>Thea Foss Recontamination/OMMP Y1</u>
		Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/11/05</u> Time: <u>0925</u> Sampled by: <u>GB/SW - PMX</u> Checked by: _____		
Equipment: <u>0.1 m<sup>2</sup> Van Veen</u>		
Location Description: <u>Fossil bed - inside E. fugate pion</u>		
Deployment: <u>1</u>	Time: <u>0930</u>	Northing: <u>4714 38.952</u> Easting: <u>122 25 54.081</u>
<input checked="" type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / <input checked="" type="checkbox"/> Chem	Water Depth <u>15.7</u> <sup>0825</sup> Penetration <u>18 cm</u> RPD Depth _____
Sediment (density, color, type): <u>dark olive silt layer over gravel</u>		
Sediment Odor (type and magnitude): <u>slight petroleum odor</u>		
Biological (flora and fauna): <u>a few twigs</u>		
Sheen <u>sheen spots to rt</u> Debris <u>small bit of sheen near</u> <u>2 cm portion</u> <u>few twigs, organic debris</u>		
Comments: <u>10.5 cm silt layer</u>		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		

<b>SURFACE SEDIMENT SAMPLE COLLECTION FORM</b>		Sample No. <u>RC-11 (0-2cm)</u>
		Project Name: <u>Thea Foss Recontamination/OMMP Y1</u>
		Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/11/05</u> Time: <u>0925</u> Sampled by: <u>CB/SW - PMX</u> Checked by: _____		
Equipment: <u>0.1m<sup>2</sup> van Veen</u>		
Location Description: _____		
Deployment: <u>1</u>	Time: <u>0930</u>	Northing: <u>47 14 38.993</u> Easting: <u>122 25 54.081</u>
<input checked="" type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / <input checked="" type="checkbox"/> Chem	Water Depth _____ Penetration <u>18</u> RPD Depth _____
Sediment (density, color, type): <u>dark-black olive silt layer over gravel</u>		
Sediment Odor (type and magnitude): <u>slight petroleum</u>		
Biological (flora and fauna): <u>invertebrates, algae</u>		
Sheen <u>lots of small spots</u>	Debris <u>frk twigs + organic debris</u>	
Comments: <u>10.5cm silt layer</u> <u>Same Grab as WC-11 - used opposite half of grab</u>		
Deployment: _____	Time: _____	Northing: _____ Easting: _____
<input type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / <input type="checkbox"/> Chem	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		
Deployment: _____	Time: _____	Northing: _____ Easting: _____
<input type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / <input type="checkbox"/> Chem	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		
Deployment: _____	Time: _____	Northing: _____ Easting: _____
<input type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / <input type="checkbox"/> Chem	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		

# SURFACE SEDIMENT SAMPLE COLLECTION FORM

Sample No. WC/RC-12  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/16/02 Time: 1000 Sampled by: CR/SCL/PMX Checked by: \_\_\_\_\_  
 Equipment: 0.1 m<sup>2</sup> Van Veen  
 Location Description: Central waterway W of Foss Landing

Deployment: 1 Time: 1000 Northing: 702766 Easting: 1160525  
 Accepted / Rejected Accepted Bio / Chem Chem Water Depth 15.6 Penetration 16 cm RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): 5 cm silt, sand below silt: 0.2 m surface (thin), over black and grey below  
 Sediment Odor (type and magnitude): petroleum like odor  
 Biological (flora and fauna): a few worm tubes  
 Sheen Green spots on surface (0-2) Debris None noted  
 Comments: 5 cm silt layer over sand (cop material)  
0-10 cm sample

WC-12

Deployment: 1 Time: 1000 Northing: 702766 Easting: 1160525  
 Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth 15.6 Penetration 16 cm RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): silt (olive-black on surface) over coarse sand  
 Sediment Odor (type and magnitude): petroleum odor  
 Biological (flora and fauna): worm tubes  
 Sheen lots of sheen spots Debris None noted  
 Comments: 0-2 cm sample  
- taken from same grab as WC-12

RC-12

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
 Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): \_\_\_\_\_  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
 Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
 Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
 Sediment (density, color, type): \_\_\_\_\_  
 Sediment Odor (type and magnitude): \_\_\_\_\_  
 Biological (flora and fauna): \_\_\_\_\_  
 Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
 Comments: \_\_\_\_\_

<b>SURFACE SEDIMENT SAMPLE COLLECTION FORM</b>		Sample No. <u>RC-13</u>
		Project Name: <u>Thea Foss Recontamination/OMMP Y1</u>
		Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/12/05</u>	Time: <u>1340</u>	Sampled by: <u>GB/SW</u> Checked by: _____
Equipment: <u>by hand spoons + bowl</u>		
Location Description: <u>West side of outfalls on scour protection</u>		
Deployment: <u>1</u>	Time: <u>1340</u>	Northing: <u>47° 14.576</u> Easting: <u>122° 25.927</u>
<input checked="" type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / <input checked="" type="checkbox"/> Chem	Water Depth <u>low tide</u> Penetration <u>0-2cm</u> RPD Depth _____
Sediment (density, color, type): <u>olive silt (1-2mm) over black silt (1cm) over sand/cobble</u>		
Sediment Odor (type and magnitude): <u>none noted</u>		
Biological (flora and fauna): <u>green algae</u>		
Sheen <u>none noted</u>	Debris <u>shells</u>	
Comments: <u>lots of rocks - surface 1-3"; sub surface 1-12"</u>		
Deployment: _____	Time: _____	Northing: _____      Easting: _____
Accepted / Rejected _____	Bio / Chem _____	Water Depth _____      Penetration _____      RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		
Deployment: _____	Time: _____	Northing: _____      Easting: _____
Accepted / Rejected _____	Bio / Chem _____	Water Depth _____      Penetration _____      RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		
Deployment: _____	Time: _____	Northing: _____      Easting: _____
Accepted / Rejected _____	Bio / Chem _____	Water Depth _____      Penetration _____      RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		

<b>SURFACE SEDIMENT SAMPLE COLLECTION FORM</b>		Sample No. <u>RC-14</u>
		Project Name: <u>Thea Foss Recontamination/OMMP Y1</u>
		Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/12/05</u> Time: <u>1350</u> Sampled by: <u>GB/SW</u> Checked by: _____		
Equipment: <u>by hand - spoons + barrels</u>		
Location Description: <u>at stake for RC-14 on E side of outfalls</u>		
Deployment: <u>1</u>	Time: <u>1350</u>	Northing: <u>47° 14.512</u> Easting: <u>122° 25.884</u>
<input checked="" type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / <input checked="" type="checkbox"/> Chem	Water Depth <u>low tide</u> Penetration <u>0-2</u> RPD Depth _____
Sediment (density, color, type): <u>Mottled surface layer - olive silt <sup>1cm</sup> mottled over black silt (more)</u>		
Sediment Odor (type and magnitude): <u>none noted</u> ( <u>black than RC14B</u> ) over sand/cobble		
Biological (flora and fauna): <u>green algae</u>		
Sheen <u>none noted</u> Debris <u>organic debris - leaves, twigs...</u>		
Comments: _____		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		

<b>SURFACE SEDIMENT SAMPLE COLLECTION FORM</b>		Sample No. <u>RC-14B *</u>
		Project Name: <u>Thea Foss Recontamination/OMMP Y1</u>
		Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/12/05</u> Time: <u>1345</u> Sampled by: <u>GB/SW</u> Checked by: _____		
Equipment: <u>by hand - spoons + bowl</u>		
Location Description: <u>*New location in backwater area SE corner of Head</u>		
Deployment: <u>1</u> Time: <u>1345</u> Northing: <u>47° 14.504</u> Easting: <u>122° 25.881</u>		
<input checked="" type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio <input checked="" type="checkbox"/> Chem	Water Depth <u>low tide</u> Penetration <u>0-2cm</u> RPD Depth _____
Sediment (density, color, type): <u>Thin Black layer (2mm) on surface, sand/gravel below</u>		
Sediment Odor (type and magnitude): <u>None noted</u>		
Biological (flora and fauna): <u>green algae - worm tubes</u>		
Sheen <u>None noted</u>	Debris <u>shells, org debris</u>	
Comments: <u>New location ~ 50' S of RC-14 SE of Outfalls</u> <u>same mottled 1-2cm layer as noted at other scour apron stations</u>		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
<input type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / Chem _____	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
<input type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / Chem _____	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		
Deployment: _____ Time: _____ Northing: _____ Easting: _____		
<input type="checkbox"/> Accepted / <input type="checkbox"/> Rejected	Bio / Chem _____	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____	Debris _____	
Comments: _____		

# SURFACE SEDIMENT SAMPLE COLLECTION FORM

Sample No. 3 S-15  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/10/05 Time: 0945 Sampled by: PMH-LB/SW Checked by: \_\_\_\_\_

Equipment: Van Veen

Location Description: Foss Marina dock #2

Deployment: 1 Time: 0952 Northing: 1160596.5 Easting: 702760.4

Accepted / Rejected Accepted Bio / Chem \_\_\_\_\_ Water Depth 18.0 Penetration 18 cm RPD Depth \_\_\_\_\_

Sediment (density, color, type): silty olive brown w/ black below surface over sand

Sediment Odor (type and magnitude): slight petroleum odor

Biological (flora and fauna): None noted

Sheen oily sheen note d Debris none noted

Comments: Silt layer 11.5 cm - sand layer below slight over penetration  
SW 5110105 - available sed on top center

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

# SURFACE SEDIMENT SAMPLE COLLECTION FORM

Sample No. S-16  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/10/05 Time: 10:25 Sampled by: PNX, GB, SW Checked by: \_\_\_\_\_

Equipment: Van Veen

Location Description: half-way down inside finger dock

Deployment: 1 Time: 10:30 Northing: 702640.5 Easting: 1160669.5

Accepted / Rejected Accepted Bio / Chem \_\_\_\_\_ Water Depth 13.4' Penetration 15cm RPD Depth \_\_\_\_\_

Sediment (density, color, type): Dark olive silt on top of gravel - light gray ~ 1cm gravel

Sediment Odor (type and magnitude): none to slight petroleum

Biological (flora and fauna): worm tubes

Sheen slight sheen spots Debris shells, leaves

Comments: Silt layer = 5cm

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

<b>SURFACE SEDIMENT SAMPLE COLLECTION FORM</b>		Sample No. <u>5-17</u>
		Project Name: <u>Thea Foss Recontamination/OMMP Y1</u>
		Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/11/05</u> Time: <u>1245</u> Sampled by: <u>GP/SW/PML</u> Checked by: _____		
Equipment: <u>Quinn Van Veen</u>		
Location Description: <u>off end of main finger pier - Trip to end of dock for sample</u>		
Deployment: <u>1</u>	Time: <u>1250</u>	Northing: <u>702546.9 *</u> Easting: <u>1160073.6 *</u>
Accepted / Rejected <u>Accepted</u>	Bio / Chem <u>Chem</u>	Water Depth <u>7.8 ft</u> Penetration <u>14 cm</u> RPD Depth _____
Sediment (density, color, type): <u>6+ cm silt (dark olive black) over sand (very coarse) + gravel</u>		
Sediment Odor (type and magnitude): <u>none noted</u>		
Biological (flora and fauna): <u>couple twigs</u>		
Sheen <u>None noted</u> Debris <u>couple of twigs</u>		
Comments: <u>6+ cm silt over coarse sand</u>		
<u>* = no GPS signal, planned locations</u>		
Deployment: _____	Time: _____	Northing: _____ Easting: _____
Accepted / Rejected _____	Bio / Chem _____	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment: _____	Time: _____	Northing: _____ Easting: _____
Accepted / Rejected _____	Bio / Chem _____	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment: _____	Time: _____	Northing: _____ Easting: _____
Accepted / Rejected _____	Bio / Chem _____	Water Depth _____ Penetration _____ RPD Depth _____
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		

<b>SURFACE SEDIMENT SAMPLE COLLECTION FORM</b>	Sample No. <u>S-18</u> Project Name: <u>Thea Foss Recontamination/OMMP Y1</u> Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/11/05</u> Time: <u>1315</u> Sampled by: <u>CP/SW - PIMX</u> Checked by: _____	
Equipment: <u>0.1m<sup>3</sup> Van Ness</u>	
Location Description: <u>Under middle of bridge off outfall 243 + end of finger pier</u>	
Deployment: _____ Time: <u>1315</u> Northing: <u>702491.5 #</u> Easting: <u>1160699.9 #</u>	
<input checked="" type="checkbox"/> Accepted / <input type="checkbox"/> Rejected            Bio <input checked="" type="checkbox"/> Chem            Water Depth <u>4.9</u> Penetration <u>12 cm</u> RPD Depth _____	
Sediment (density, color, type): <u>3<sup>rd</sup> cm silt over sand, dark olive/black</u>	
Sediment Odor (type and magnitude): <u>slight petroleum odor</u>	
Biological (flora and fauna): <u>worm tubes</u>	
Sheen <u>spots noted in bowl</u> Debris <u>None noted</u>	
Comments: <u>3<sup>rd</sup> cm silt over sand, dark olive/black</u>	
<u># Planned Pt - no GPS</u>	
Deployment: _____ Time: _____ Northing: _____ Easting: _____	
Accepted / Rejected    Bio / Chem    Water Depth _____ Penetration _____ RPD Depth _____	
Sediment (density, color, type): _____	
Sediment Odor (type and magnitude): _____	
Biological (flora and fauna): _____	
Sheen _____ Debris _____	
Comments: _____	
Deployment: _____ Time: _____ Northing: _____ Easting: _____	
Accepted / Rejected    Bio / Chem    Water Depth _____ Penetration _____ RPD Depth _____	
Sediment (density, color, type): _____	
Sediment Odor (type and magnitude): _____	
Biological (flora and fauna): _____	
Sheen _____ Debris _____	
Comments: _____	
Deployment: _____ Time: _____ Northing: _____ Easting: _____	
Accepted / Rejected    Bio / Chem    Water Depth _____ Penetration _____ RPD Depth _____	
Sediment (density, color, type): _____	
Sediment Odor (type and magnitude): _____	
Biological (flora and fauna): _____	
Sheen _____ Debris _____	
Comments: _____	

**SURFACE SEDIMENT SAMPLE  
COLLECTION FORM**

Sample No. S-19  
Project Name: Thea Foss Recontamination/OMMP Y1  
Project No.: 2562.0005.0001.00000

Date: 5/10/05 Time: \_\_\_\_\_ Sampled by: GB/SW-PMX Checked by: \_\_\_\_\_  
Equipment: Van Veen

Location Description: 1/2 down outer fender dock on West side

Deployment: 1 Time: 1055 Northing: 702671.0 Easting: 1160598.8

Accepted /  Rejected Bio / Chem Water Depth 136 Penetration 17cm RPD Depth 11cm

Sediment (density, color, type): light olive - 1cm dark olive silt over gravel cap material

Sediment Odor (type and magnitude): None Noted

Biological (flora and fauna): Worm tubes on surface; brown filamentous algae

Sheen Slight sheen Debris \_\_\_\_\_

Comments: Silt layer = 8cm

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

<b>SURFACE SEDIMENT SAMPLE COLLECTION FORM</b>		Sample No. <u>S-20</u>
		Project Name: <u>Thea Foss Recontamination/OMMP Y1</u>
		Project No.: <u>2562.0005.0001.00000</u>
Date: <u>5/10/05</u> Time: <u>1120</u> Sampled by: <u>GSW-PMT</u> Checked by: _____		
Equipment: <u>van Veen</u>		
Location Description: <u>end of outer finger pier at Foss Landing</u>		
Deployment : <u>1</u>	Time: <u>11:25</u>	Northing: <u>702537.4</u> Easting: <u>1160602.5</u> ← ext.
Accepted / Rejected	Bio <u>Chem</u>	Water Depth <u>9.7'</u> Penetration <u>11cm</u> RPD Depth _____
Sediment (density, color, type): <u>3.5cm silt dark olive silt, over gravels</u>		
Sediment Odor (type and magnitude): <u>no e</u>		
Biological (flora and fauna): <u>Worm tubes - distinct</u>		
Sheen <u>-</u>	Debris <u>-</u>	
Comments: <u>Silt layer 3.5cm</u>		
Deployment : _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment : _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		
Deployment : _____ Time: _____ Northing: _____ Easting: _____		
Accepted / Rejected _____ Bio / Chem _____ Water Depth _____ Penetration _____ RPD Depth _____		
Sediment (density, color, type): _____		
Sediment Odor (type and magnitude): _____		
Biological (flora and fauna): _____		
Sheen _____ Debris _____		
Comments: _____		

# SURFACE SEDIMENT SAMPLE COLLECTION FORM

Sample No. S-22  
 Project Name: Thea Foss Recontamination/OMMP Y1  
 Project No.: 2562.0005.0001.00000

Date: 5/11/05 Time: 1120 Sampled by: GBW - PMX Checked by: \_\_\_\_\_

Equipment: 0.1 m<sup>2</sup> Van Veen Grab

Location Description: W of Foss Landing dark midway ~ 50' west.

Deployment: 1 Time: 1125 Northing: 702648 Easting: 1160543

Accepted /  Rejected    Bio /  Chem    Water Depth 11.1    Penetration 15cm    RPD Depth \_\_\_\_\_

Sediment (density, color, type): 6.5 cm silt dark <sup>dark</sup> ACTIVE - sand below (exp material)

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): none noted

Sheen Sheen spots in bowl    Debris \_\_\_\_\_

Comments: 6.5 cm dark olive silt

Archive

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected    Bio / Chem    Water Depth \_\_\_\_\_    Penetration \_\_\_\_\_    RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_    Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected    Bio / Chem    Water Depth \_\_\_\_\_    Penetration \_\_\_\_\_    RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_    Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected    Bio / Chem    Water Depth \_\_\_\_\_    Penetration \_\_\_\_\_    RPD Depth \_\_\_\_\_

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_    Debris \_\_\_\_\_

Comments: \_\_\_\_\_

**SURFACE SEDIMENT SAMPLE  
COLLECTION FORM**

Sample No. S-24  
Project Name: Thea Foss Recontamination/OMMP Y1  
Project No.: 2562.0005.0001.00000

Date: 5/11/05 Time: 1140 Sampled by: GR/SW-PMX Checked by: \_\_\_\_\_  
Equipment: 0.1 m<sup>2</sup> Van Veen  
Location Description: om West side of W. W. Just N of Bridge  
Deployment: 1 Time: 11.45 Northing: 702551\* Easting: 1160507\*  
 Accepted /  Rejected Bio /  Chem Water Depth 5.7 Penetration 14 RPD Depth 2 mm  
Sediment (density, color, type): 6 cm dark olive silt over sand (silt with black)  
Sediment Odor (type and magnitude): H<sub>2</sub>S odor - slight  
Biological (flora and fauna): microtubers  
Sheen few sheen spots Debris twigs, organic debris  
Comments: 6 cm dark olive silt layer  
\* no location data collected - within 5' of planned pt.

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
Sediment (density, color, type): \_\_\_\_\_  
Sediment Odor (type and magnitude): \_\_\_\_\_  
Biological (flora and fauna): \_\_\_\_\_  
Sheen \_\_\_\_\_ Debris twigs  
Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
Sediment (density, color, type): \_\_\_\_\_  
Sediment Odor (type and magnitude): \_\_\_\_\_  
Biological (flora and fauna): \_\_\_\_\_  
Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_  
Accepted / Rejected \_\_\_\_\_ Bio / Chem \_\_\_\_\_ Water Depth \_\_\_\_\_ Penetration \_\_\_\_\_ RPD Depth \_\_\_\_\_  
Sediment (density, color, type): \_\_\_\_\_  
Sediment Odor (type and magnitude): \_\_\_\_\_  
Biological (flora and fauna): \_\_\_\_\_  
Sheen \_\_\_\_\_ Debris \_\_\_\_\_  
Comments: \_\_\_\_\_

SURFACE SEDIMENT SAMPLE COLLECTION FORM		Sample No.	S-29				
		Project Name:	Thea Foss Recontamination/OMMP Y1				
		Project No.:	2562.0005.0001.00000				
Date:	5/10/05	Time:	1150	Sampled by:	CB/KW-FHX	Checked by:	
Equipment:	0.1m <sup>2</sup> van Veen						
Location Description:	central part of waterway North of bridge, west of docks						
Deployment:	1	Time:	1155	Northing:	47° 14' 37.944	Easting:	120° 25' 59.731
Accepted / Rejected		Bio	Chem	Water Depth	9.1 @ 1229	Penetration	14cm
Sediment (density, color, type):		olive silt <sup>5cm</sup> over sand (medium-ton)					
Sediment Odor (type and magnitude):		black silt/organic muck over					
Biological (flora and fauna):		Worm tubes					
Sheen	slight sheen spots in bowl		Debris				
Comments:	Silt layer ~ 4.5 - 5cm						
Deployment:		Time:		Northing:		Easting:	
Accepted / Rejected		Bio / Chem		Water Depth		Penetration	
Sediment (density, color, type):							
Sediment Odor (type and magnitude):							
Biological (flora and fauna):							
Sheen			Debris				
Comments:							
Deployment:		Time:		Northing:		Easting:	
Accepted / Rejected		Bio / Chem		Water Depth		Penetration	
Sediment (density, color, type):							
Sediment Odor (type and magnitude):							
Biological (flora and fauna):							
Sheen			Debris				
Comments:							
Deployment:		Time:		Northing:		Easting:	
Accepted / Rejected		Bio / Chem		Water Depth		Penetration	
Sediment (density, color, type):							
Sediment Odor (type and magnitude):							
Biological (flora and fauna):							
Sheen			Debris				
Comments:							

**SURFACE SEDIMENT SAMPLE  
COLLECTION FORM**

Sample No. S-30  
Project Name: Thea Foss Recontamination/OMMP Y1  
Project No.: 2562.0005.0001.00000

Date: 5/4/05 Time: 1425 Sampled by: GS/SW - PMX Checked by: \_\_\_\_\_

Equipment: 0.1m<sup>2</sup> Van Veen

Location Description: under Bridge between W bridge piers

Deployment: 1 Time: 1425 Northing: 702470.9 Easting: 1160510.9

Accepted /  Rejected Bio  Chem Water Depth 60ft Penetration 13cm RPD Depth \_\_\_\_\_

Sediment (density, color, type): 3 cm dark olive silt over sand, coarse; than last one (WVS)

Sediment Odor (type and magnitude): None noted

Biological (flora and fauna): None

Sheen Sheen spots (1/4" x 1/2") Debris organic debris

Comments: 3 cm dark olive silt over sand (coarse) (grey/brown)

\*NO GPS; Planned pt.

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth Penetration RPD Depth

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth Penetration RPD Depth

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

Deployment: \_\_\_\_\_ Time: \_\_\_\_\_ Northing: \_\_\_\_\_ Easting: \_\_\_\_\_

Accepted / Rejected Bio / Chem Water Depth Penetration RPD Depth

Sediment (density, color, type): \_\_\_\_\_

Sediment Odor (type and magnitude): \_\_\_\_\_

Biological (flora and fauna): \_\_\_\_\_

Sheen \_\_\_\_\_ Debris \_\_\_\_\_

Comments: \_\_\_\_\_

**ATTACHMENT 2**  
**CHAIN OF CUSTODY FORMS**

# Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: \_\_\_\_\_ Turn-around Requested: \_\_\_\_\_  
 ARI Client Company: \_\_\_\_\_ Phone: \_\_\_\_\_  
 Client Contact: **DOE/TTEC**  
 Client Project #: **Mett Dalton**

Page: **1** of **1**  
 Date: **5/10/05** Ice Present?   
 No. of Coolers: \_\_\_\_\_ Cooler Temps: \_\_\_\_\_

Analytical Resources, Incorporated  
 Analytical Chemists and Consultants  
 4611 South 134th Place, Suite 700  
 Tukwila, WA 98168  
 206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested						Notes/Comments	
					Archive	TOC	Metals	SVOC (GAS)	PH	PCB		Grain Size
S-15	5/10/05	9:52 am	Seal	5	X	X	X	X	X	X		
S-16		10:30 am		1	X							
S-19		10:54 AM		1	X							
S-20		11:25 AM		1	X							
S-29		11:55 AM		1	X							
CA-20-01		1:05 pm		1	X							
CA-20-04		1:35		1	X							
CA-22-02		1:40		1	X							
CA-22-05		1:435		1	X							
CA-19B-03		15:10		1	X							
CA-19B-04		15:35		1	X							

Comments/Special Instructions  
 Coordinate with R. Farlow re target analytes.

Relinquished by: **Sherri Wunderlich**  
 Printed Name: **Sherri Wunderlich**  
 Company: **TTEC**  
 Date & Time: **5/10/05 10:55**

Received by: **Eric Brandon**  
 Printed Name: **Eric Brandon**  
 Company: **ARI**  
 Date & Time: **5/10/05 16:55**

Relinquished by: \_\_\_\_\_  
 Printed Name: \_\_\_\_\_  
 Company: \_\_\_\_\_  
 Date & Time: \_\_\_\_\_

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

# Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: \_\_\_\_\_ Turn-around Requested: \_\_\_\_\_

ARI Client Company: **DOF/TEC** Phone: \_\_\_\_\_

Client Contact: **Math Dalton**

Client Project Name: **Head of Iron Foss**

Page: **1** of **1**

Date: **5/11/05** Ice Present?

No. of Coolers: **1** Cooler Temps: **40**



Analytical Resources, Incorporated  
 Analytical Chemists and Consultants  
 4611 South 134th Place, Suite 100  
 Tukwila, WA 98168  
 206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested				Notes/Comments				
					Archive	TOX	Metals	Grain Size					
WC-11	5/11/05	9:30	Sed	4		X	X	X					
RC-11		9:30		4		X	X	X					
WC-12		10:00		1	X								
RC-12		10:00		4		X	X	X					
WC-07		10:07		4		X	X	X					
RC-07		10:05		4		X	X	X					
WC-10		11:05		4	X								
RC-10		11:05		4		X	X	X					
S-22		11:05		1	X								
S-24		11:05		4		X	X	X					
Comments/Special Instructions Coordinate with K. Forlow re. target analytes										Relinquished by: (Signature) _____ Printed Name: _____ Company: _____ Date & Time: _____		Received by: (Signature) _____ Printed Name: _____ Company: _____ Date & Time: _____	
Relinquished by: (Signature) _____ Printed Name: _____ Company: _____ Date & Time: _____										Received by: (Signature) _____ Printed Name: _____ Company: _____ Date & Time: _____		Relinquished by: (Signature) _____ Printed Name: _____ Company: _____ Date & Time: _____	

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

# Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: \_\_\_\_\_ Turn-around Requested: \_\_\_\_\_

ARI Client Company: \_\_\_\_\_ Phone: \_\_\_\_\_

Client Contact: **DIS/TEC**

Client Project Name: **Head of Trea Ess**

Client Project #: \_\_\_\_\_

Page: **2** of **2**

Date: **5/11/05** Ice Present? **Y**

No. of Coolers: **1** Cooler Temps: **4.0**

Analytical Resources, Incorporated  
 Analytical Chemists and Consultants  
 4611 South 134th Place, Suite 100  
 Tukwila, WA 98168  
 206-695-6200 206-695-6201 (fax)



Sample ID	Date	Time	Matrix	No Containers	Analysis Requested				Notes/Comments
					Archive	TOC	Metals	Grain Size	
S-17	5/11/05	13:50	Sed	4	X	X	X	X	
S-18		13:15		1	X				
WC-09		13:40		1	X				
RC-09		13:40		4	X	X	X	X	
WC-08		14:00		1	X				
RC-08		14:00		4	X	X	X	X	
S-30		14:25		1	X				

Relinquished by: **Sherril L. Wunderlich**  
 Printed Name: \_\_\_\_\_  
 Company: **Tetra Tech EC, Inc.**

Date & Time: **5/11/05 16:17**

Received by: **Michelle D'Estard**  
 Printed Name: \_\_\_\_\_  
 Company: **ARI**

Date & Time: **5/11/05 16:17**

Relinquished by: \_\_\_\_\_  
 Printed Name: \_\_\_\_\_  
 Company: \_\_\_\_\_

Date & Time: \_\_\_\_\_

Received by: \_\_\_\_\_  
 Printed Name: \_\_\_\_\_  
 Company: \_\_\_\_\_

Date & Time: \_\_\_\_\_

**Comments/Special Instructions:**  
 Coordinate with R. Farbo's re. target analytes

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

# Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: \_\_\_\_\_ Turn-around Requested: \_\_\_\_\_  
 ARI Client Company: \_\_\_\_\_ Phone: \_\_\_\_\_  
 Client Contact: **DOE IT&E**  
 Client Project Name: **Weld Dalton**  
 Head of **Three Foss**

Page: **1** of **2**  
 Date: **5/12/05** Ice Present? \_\_\_\_\_  
 No. of Coolers: \_\_\_\_\_ Cooler Temps: **3.5**



**Analytical Resources, Incorporated**  
 Analytical Chemists and Consultants  
 4611 South 134th Place, Suite 100  
 Tukwila, WA 98168  
 206-695-6200 206-695-6201 (fax)

Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested				Notes/Comments	
					Archive	TOC	Metals	SVC's, Pest, PCB, ABN, TPH		Grain Size
WC-φ2	5/12/05	09:25	Soil	4		X	X	X		
RC-φ2		09:25		4		X	X	X		Combined 2 grabs
RC-φ2A		09:25		4		X	X	X		" " "
WC-φ3		10:20		1	X					
RC-φ3		10:45		4		X	X	X		
WC-φ4		11:05		4		X	X	X		
RC-φ4		11:30		4		X	X	X		Combined 2 grabs
WC-φ5		12:30		4		X	X	X		
RC-φ5		12:30		4		X	X	X		
WC-φ6		13:00		1	X					
Comments/Special Instructions Coordinate with R. Carlson re target analytes 5/12/05 - last day of sampling round										
Relinquished by: <i>[Signature]</i> Printed Name: <b>Sherril E. Wunderlich</b> Company: <b>Tetra Tech, Inc.</b>					Received by: <i>[Signature]</i> Printed Name: <b>Eric Johnson</b> Company: <b>ARI</b>					
Date & Time: <b>5/12/05 16:10</b>					Date & Time: <b>5/12/05 16:10</b>					

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

# Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested:	Page:	2	of	2
ARI Client Company:	Phone:	Date:	5/11/05	Ice Present?	
Client Contact:	Matt Dalton	No. of Coolers:	3	Cooler Temps:	35
Client Project Name:	Head of Thea Foss	Analysis Requested			
Client Project #:	G. Braun Swunderlich Permethrin	Notes/Comments			

Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested				Notes/Comments
					Archive	TOC	Metals	Sinks Post, PCB, ABN, TPH	
RC-φ6	5/11/05	13:00	Sed	4	X	X	X	X	
WK-φ1		13:20		1	X	X	X	X	
RC-φ1		13:20		4	X	X	X	X	
RC-13		13:40		4	X	X	X	X	
RC-14B		13:45		4	X	X	X	X	
RC-14		13:50		4	X	X	X	X	

**Comments/Special Instructions**  
 Coordinate with R. Earlson re. target analytes  
 SINKS was the last day of sampling round

**Relinquished by (Signature):** [Signature] (W-AL)  
**Printed Name:** Special Swunderlich  
**Company:** Tetra Tech EC, Inc.  
**Date & Time:** 5/11/05 16:10

**Received by (Signature):** [Signature]  
**Printed Name:** Eric [Signature]  
**Company:** ARI  
**Date & Time:** 5/11/05 16:18

**Relinquished by (Signature):**  
**Printed Name:**  
**Company:**  
**Date & Time:**

**Received by (Signature):**  
**Printed Name:**  
**Company:**  
**Date & Time:**

**Limits of Liability:** ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

**Sample Retention Policy:** All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.



Analytical Resources, Incorporated  
 Analytical Chemists and Consultants  
 4611 South 134th Place, Suite 100  
 Tukwila, WA 98168  
 206-695-6200 206-695-6201 (fax)

**ATTACHMENT 3**  
**REPRESENTATIVE PHOTOS**



Collecting a Van Veen grab at S-19.



Van Veen grab at S-20.



Van Veen grab at CA-22-05 with 0-10 cm cut.



CA-19-06 on back of boat after sampling. Silt is mixed in sand layer more than other samples from the City Project Area.



Van Veen grab at RC/WC-12.



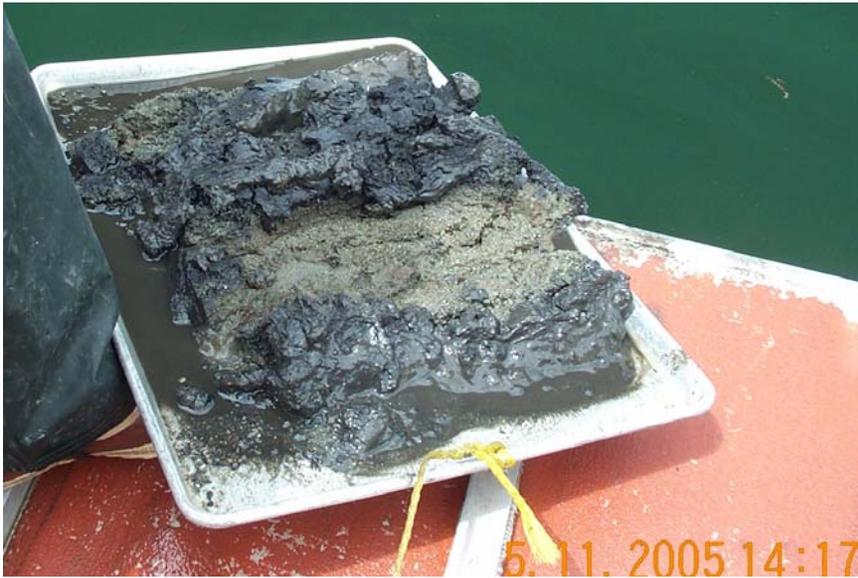
WC-07 (0 – 10 cm) in bowl, showing sheen spots.



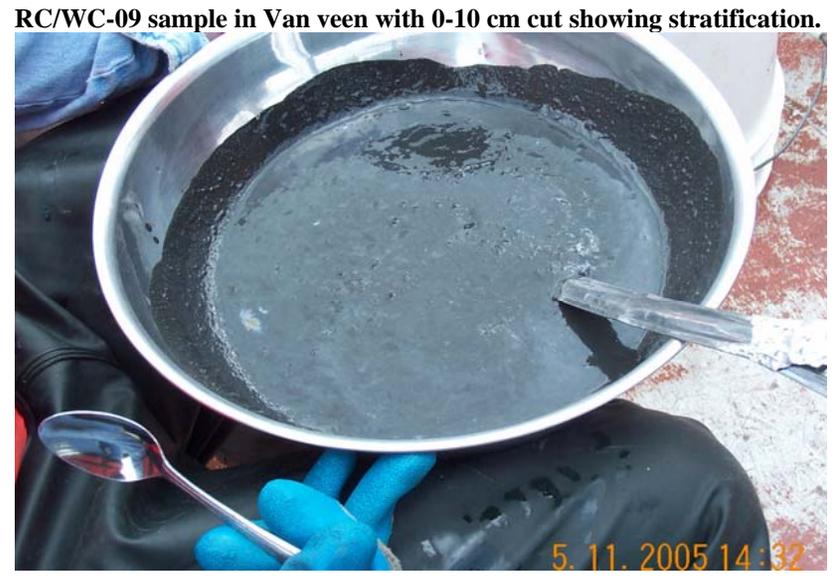
Van Veen grab at RC/WC-09.



Van Veen grab of WC-08 with 0-10 cm cut.



RC/WC-08 in tray after sampling.



RC/WC-09 sample in Van veen with 0-10 cm cut showing stratification.

S-30 in bowl showing sheen spots..



Eckman sampler in foreground on left, Van veen sampler in background.



Eckman sampler with RC-03.



Stratification of RC-03 in tray.



Stratification of RC-04 in tray.



Stratification of RC/WC-06 in tray.



Preparing to collect RC-01.

**Appendix C**  
**Data Validation Report**  
**May 2005 Sampling Event**  
**DMD, Inc.**

DATA VALIDATION REPORT  
MAY 2005 SAMPLING EVENT  
HEAD OF THEA FOSS REMEDIATION PROJECT

MAY 2005

## **SEMIVOLATILE ORGANIC COMPOUND ANALYSES - U.S. EPA SW-846 Method 8270.**

Semivolatile organic compound (SVOC) analyses were performed by Analytical Resources, Inc. (ARI) of Tukwila, Washington, in accordance with the requirements of the *Quality Assurance Project Plan (QAPP), Utilities Work Area Remediation*, prepared by DOF, DMD & Tetra Tech-FW, July 24, 2003, and referenced SOP's. Analyses were performed on extracts by SW-846 Method 8270. Twenty-four sediment samples were submitted for analyses, of which one sediment pair is a field duplicate. Target analyte results are presented in the attached Table, entitled "Head of Thea Foss Waterway, Post-Construction Monitoring, May 2005", with associated data qualifiers.

The analytical data were evaluated using those procedures identified in the U.S. EPA guidance *Laboratory Data Validation: Functional Guidelines for Evaluating Organics Analyses* (U.S. EPA, 1994 [EPA-540/R-94/012]), as applicable to the QAPP. Quality control measurements are evaluated against the performance criteria presented in the QAPP.

**DELIVERABLES:** Complete.

The laboratory provided U.S. EPA CLP-type, or comparable, deliverables for all sample submittals. Documentation provided by the laboratory was sufficient to allow evaluation and validation of the associated results.

**SAMPLE HANDLING / HOLDING TIMES:** Within specification.

All samples were hand-couriered and delivered to the project laboratory the same day of collection in cooler containers with ice present. Samples were received at 3.5 - 4.6 °C. The QAPP specifies a  $4 \pm 2$  °C sample holding temperature from collection to receipt at the project laboratory.

Samples were extracted and analyzed within the conditions and holding times allowed in the QAPP. The QAPP specifies a maximum sample holding time of 14 days from sample collection, and an additional extract holding time of 40 days. All analyses were performed within the specified and maximum recommended holding times.

**GC/MS TUNE CHECK:** Within specification.

Decafluorotriphenylphosphine (25 ng/ $\mu$ L DFTPP) was analyzed at the beginning of each twelve-hour calibration period as required for instrument NT6 (an HP linear quadrupole). Four checks (04/19/05 [initial cali period], 05/20/05, 05/21/05 & 05/23/05) were performed. All ion abundances and relative ion abundances are within the acceptance range. Mass spectral plots and listings were compared, and transcription of mass data to the GC/MS tuning and mass calibration summaries were checked. No errors were found.

All criteria were met and all sample analyses and calibrations were performed within the twelve-hour instrument tune check period.

**INITIAL CALIBRATION:** Within specification.

Initial multi-point calibrations were established for all target analytes at concentrations of 1, 5, 10,

25, 40 and 80 ng/μL, and for surrogate compounds at 5, 10, 25, 40 and 80 ng/μL on 04/19/05. The minimum RRF (relative response factor) requirement of 0.05 was met for all calibrations, and the RSD specification for linearity of  $\leq 30\%$  was also met for all calibrations. Initial calibration performance is within specified limits.

An initial calibration verification (ICV 04/19/05 @ 25 ng/μL) using a separate/independent source standard (Ultra [PAH]US-106N, Lot# U-0297) was reported with recoveries between 94% and 116%. No data requires qualification.

An independent check on the integrity of the initial calibration standard solutions was performed on a separate instrument (NT4) on 06/28/05 with use of an alternate source reference solution (Supelco 46853-U, lot# LB23812). The initial calibration standard solutions were the same on instruments NT4 and NT6 (as performed on 04/19/05). Accuracies for target analytes on the alternate reference material showed comparabilities of 75-95%.

**CONTINUING CALIBRATION:** Acceptable.

Continuing calibration verifications (CCV) at 25 ng/μL were analyzed prior to the analysis of sample extracts (on 05/20/05, 05/21/05 & 05/23/05), as required. All relative response factors were greater than 0.05, as specified; and all %D were less than 30% for all target analytes.

**BLANKS:** Acceptable.

One method (preparation) blank was analyzed with the group of project samples, which was extracted as a single group. The method blank showed di-n-butylphthalate at 28 μg/kg. Di-n-butylphthalate was sufficiently greater in project sediment samples than the level reported for the method blank to have no expected adverse effect on project sample results. No project sample results required qualification.

**SURROGATE COMPOUND RECOVERIES:** Within specification.

Twenty-five μg. of surrogate compounds (2-fluorobiphenyl [FBP] and d<sub>14</sub>-p-terphenyl [TPH]) were added to all samples, including method blanks. The QAPP specifies an acceptance range of 30% - 115% recovery for FBP and 18% - 137% recovery for TPH. All recoveries are reported in the range of 49% - 104%, all within the specified ranges. None of the reported data required qualification based on surrogate performance.

**MATRIX SPIKE / MATRIX SPIKE DUPLICATE (MS / MSD) ANALYSES:**

Acceptable.

One MS/MSD analysis was performed, as requested. Matrix spike compounds are selected analytes (naphthalene, dimethylphthalate, diethylphthalate, di-n-butylphthalate, fluoranthene, butylbenzylphthalate, bis(2-ethylhexyl)phthalate, di-n-octylphthalate and benzo(g,h,i)perylene) spiked at 25 μg (925 μg/kg dry) into RC-11. Recoveries ranged from 25% to 151%, with RPDs in the range of 0.5 - 21%. Observed recoveries were 72% - 127% for analytes with small to nondetectable native concentrations (showing low native level variabilities). All MS/MSD recoveries and associated RPD's were within acceptable limits.

One laboratory control sample (spiked blank; LCS) was analyzed for selected target analytes

(same as above) at an equivalent spike concentration of 500 µg/kg. The LCS source is different from the initial calibration standards source. Analyte recoveries ranged from 78% to 151%.

**INTERNAL STANDARDS PERFORMANCE:** Acceptable.

Seven internal standards (IS) were added to all sample extracts at a concentration of 20 ng/µL. Retention times (RT) for all internal standards in all analyses are within the specified window of ± 30 seconds of the continuing calibration internal standard RT. All internal standard (IS) areas for all sample extracts were verified for accuracy and determined to be correct. The specified acceptance limit for internal standard areas in sample extracts is 0.5 to 2 times the area of the 12-hour continuing calibration standard. Four extracts initially (05/20/05) exhibited an internal standard (for d<sub>12</sub>-perylene) area outside the acceptance range (low). Reanalyses of extract dilutions brought the deviations into compliance. Dibenz(a,h)anthracene in RC-07 was reported from the initial analysis showing low IS response and required qualification of the value as an estimate (with the "J" qualifier code) at 88 µg/kg (the dilution showed a nondetect at 130 µg/kg). With this one exception, internal standards performances were all within specification for the reported data. The IS for pyrene is normally specified as d<sub>12</sub>-chrysene, however, for this work the IS was changed [by the reviewer] to d<sub>10</sub>-phenanthrene to match that for fluoranthene. Thus, pyrene concentrations were appropriately adjusted. This was accomplished to maintain consistent isomer ratioing for enhanced precision in data use. One data point only required qualification due to internal standards performance.

**TARGET COMPOUND IDENTIFICATION:** Acceptable.

All compound identifications were reviewed and are acceptable. The relative retention times (RRT) for all target compounds are within acceptable limits ( ± 0.06 relative retention time units of the standard). Ion relative abundances on mass spectra for reported compounds were checked against library reference spectra and were found to be acceptable.

**COMPOUND QUANTITATION and REPORTED QUANTITATION LEVELS**

Target compound lower limits of quantitation are based on on-column amounts of 1 ng/µL. The algorithm for calculation of target analyte concentrations was checked and found to be correct. Target analyte concentrations (principally PAHs) are considered to be relatively high and numerous dilutions were required to bring extract concentrations within linear range of the instrument. The concentrations reported for benzo(b)fluoranthene and benzo(k)fluoranthene, relative to each other, may be in error due to imprecision in the separation of the two overlapping chromatographic peaks; however, the summation of the two isomers for reporting of benzo(b+k)fluoranthenes concentration is expected to be considerably more accurate. Specified internal standards, quantitation ions, and RRF's were checked for all sample results and determined to be correct. All target analyte responses were generally determined by an automated/computerized routine, however, some manual reintegrations were required in samples with high analyte chromatographic loadings that displayed distorted peak shapes and/or chromatographic interferences. All sample volume and concentration calculations were checked for each sample and determined to be correct.

**SYSTEM PERFORMANCE**

No signs of degraded system performance were observed, with the exception of some slight

chromatographic overloadings that required dilutions and reanalyses. All QC measures were either within specification or acceptable limits. RIC's were examined for abrupt retention time shifts, elevated baselines, or high background levels. The analytical system appeared to be stable and within control during the course of these analyses.

## OTHER PERFORMANCE DATA

Field Generated Quality Control Samples: One field duplicate pair was submitted for analysis (duplicate pair = RC-02 / RC-02A). Analytical results for the duplicate analysis are presented in the results Table. RPDs ranged up to approximately 57%, in the case of *bis*(2-ethylhexyl)phthalate, but generally averaged 20%. This variability for an environmental [field] split is not considered unusual for a polluted heterogeneous sample matrix.

Independent Reference Sediment: An independent reference material (sediment SQ-1) was analyzed on NT6 (04/20/05 [HX24]) with the same initial calibration curve and response factors as applied for these analyses. Analytical performance is as follows:

<u>Target analyte</u>	<u>Ref. value</u>	<u>04/20/05 Recov.</u>
Naphthalene	76 µg/kg	82 %
2-Methylnaphthalene	89 µg/kg	98 %
Acenaphthylene	50 µg/kg	70 %
Acenaphthene	95 µg/kg	88 %
Fluorene	98 µg/kg	91 %
Phenanthrene	156 µg/kg	72 %
Anthracene	111 µg/kg	72 %
Fluoranthene	143 µg/kg	89 %
Pyrene	132 µg/kg	84 %
Benzo(a)anthracene	115 µg/kg	77 %
Chrysene	128 µg/kg	79 %
<i>bis</i> (2-Ethylhexyl)phthalate	180 µg/kg	36 %
Benzo(b)fluoranthene	132 µg/kg	80 %
Benzo(a)pyrene	120 µg/kg	77 %
Dibenzo(a,h)anthracene	101 µg/kg	97 %
Benzo(g,h,i)perylene	91 µg/kg	120 %

All reported/measured values are within the reference range established by EPA Region 10 ( $\pm$  1sd of the mean reference value).

## OVERALL ASSESSMENT

All deliverables required by the project are present and the data package is complete. All performance indicators for reported data were either within specification or within acceptable limits. The data quality is sufficient for its intended purposes.

## **CHLORINATED PESTICIDES and PCB's ANALYSES - U.S. EPA SW-846 Method 8081/8082.**

Chlorinated pesticides and PCB's (as Aroclors) analyses were performed by Analytical Resources, Inc. (ARI) of Tukwila, Washington, in accordance with the requirements of the *Quality Assurance Project Plan (QAPP), Utilities Work Area Remediation*, prepared by DOF, DMD & Tetra Tech-FW, July 24, 2003, and referenced SOP's. Extracts for chlorinated pesticides were subjected to silica gel chromatography cleanup as well as Hg treatment for removal of elemental sulfur ( $S_x$ ). Extracts for PCBs determination were further treated with concentrated sulfuric acid to minimize chemical interference. All analytical runs were performed on two GC columns, and all evaluations performed here are for dual-column runs (for pesticides and PCBs). Twenty-four sediment samples were submitted for analyses, of which one sediment pair is a field duplicate. Target analyte results are presented in the attached Table, entitled "Head of Thea Foss Waterway, Post-Construction Monitoring, May 2005", with associated data qualifiers.

The analytical data were evaluated using those procedures identified in the U.S. EPA guidance *Laboratory Data Validation: Functional Guidelines for Evaluating Organics Analyses* (U.S. EPA, 1994 [EPA-540/R-94/012]), as applicable to the QAPP. Quality control measurements are evaluated against the performance criteria presented in the QAPP.

**DELIVERABLES:** Complete.

The laboratory provided U.S. EPA CLP-type, or comparable, deliverables for all sample submittals. Documentation provided by the laboratory was sufficient to allow evaluation and validation of the associated results.

**SAMPLE HANDLING / HOLDING TIMES:** Acceptable.

All samples were hand-couriered and delivered to the project laboratory the same day of collection in cooler containers with ice present. Samples were received at 3.5 - 4.6 °C. The QAPP specifies a  $4 \pm 2$  °C sample holding temperature from collection to receipt at the project laboratory.

Samples were extracted and analyzed within the conditions and holding times allowed in the QAPP. The QAPP specifies a maximum sample holding time of 14 days from sample collection, and an additional extract holding time of 40 days. Two samples required reextraction after 25 and 29 days (RC-04 and WC-05), however, the reextractions were performed on aliquots taken from frozen (-18 °C) archives. Regional guidance allows storage/holding of samples at -18 °C prior to analysis for up to 1 year. All analyses were performed within the specified and maximum recommended holding times.

### **INITIAL & CONTINUING CALIBRATIONS**

Initial five-point calibrations were established for all pesticide target analytes on 04/29/05, 05/19/05 and 05/29/05. Calibration standard concentrations are 0.005, 0.01, 0.02, 0.04 and 0.08 µg/mL. Linear calibration %RSDs for both columns ranged from 1.5 to 9.6, all within the  $\leq 20\%$  specification. Aroclors 1016 and 1260 were calibrated on 05/17/05, 05/23/05 and 05/26/05 using

five concentrations (0.02, 0.1, 0.25, 0.5 and 1.0 ng/μL). Variability, in terms of %RSDs, for each Aroclor on both columns (using 4-5 representative peaks for each Aroclor) was within the ≤ 20% specification. Single-point calibrations were run for Aroclors 1221, 1232, 1242, 1248 and 1254 at 1.0 ng/μL. Aroclors were quantified using 3-5 representative peaks for each mixture. Initial calibration performance is within specification.

DDT breakdown/degradation was evaluated on both columns, as required, and determined to be 4%/3%, 5%/5%, 12%/13%, 2%/4%, 2%/4%, 3%/4%, 10%/10%, 5%/9%, 4%/7%, 31%/32% (05/29), 52%/55% (05/30), 4%/4%, 9%/11%, 2%/4% and 4%/6%. Project specifications are < 20% for DDT. All sample with the exception of S-15, RC-04 and WC-05 are potentially effected.

The MS/MSD analysis was also performed within the pertinent period, and recoveries were both 44% at 19 μg/kg. With the exception of WC-07, WC-02 and RC-14B, the reported nondetects for DDT are due to presence of chemical interferences and not method lower reporting limits.

The level of chemical interferences are greater than the detectability of DDT, assuming a mean recovery of 40%; thus, for all samples with elevated reporting limits due to chemical interferences and greater than 2.5 times the normal lower reporting limits for DDT are "U" qualified as nondetected at the associated value. For samples WC-07, WC-02 and RC-14B, the lower reporting limit is raised by a factor of 2.5x and "U" qualified to account for lower recoveries (40% recov.). The nondetection for DDT in S-17 was raised from 4.5 Y (interference limited) to 5.0 U to account for potential bias associated with DDT degradation. All detections of DDT, DDD and DDE in affected samples are "J" qualified as estimates due to potential artifact effects from DDT degradation during analysis.

Initial and continuing calibration verifications (ICVs & CCVs) were analyzed at the specified frequencies for target pesticides and Aroclors. All target analyte RPDs were ≤ 25% for pesticides and ≤ 15% [mean] for Aroclor mixtures, as specified; with the exception of the pesticide CCV on 5/21 (30-45 RPD), 5/29 (35-70 RPD) and 5/30 (33-82 RPD); and the Aroclor CCV on 5/20 (A1016 @ 18) and 5/24 (A1248 @ 18). This affects reported results for S-15, which require qualification as estimates with the "J" qualifier code for DDD and DDT, and Aroclor 1248 in samples WC04, WC-02, RC-01, RC-02, RC-03, RC-05 and RC-06.

**BLANKS:** Within specification.

One method (preparation) blank was analyzed with each extraction group, as required (five blanks for pesticides and three for Aroclors analyses). No analytes were detected above the lower quantitation limits. No results required qualification.

### **SURROGATE COMPOUND RECOVERIES**

Tetrachloro-*m*-xylene (TCMX) and decachlorobiphenyl (DCBP) were employed as surrogate compounds for all samples, including method blanks. Two hundred nanograms of each surrogate were added to samples prior to extraction. The QAPP identifies acceptable performance at 60%-150% recovery. All recoveries are within specification, with the exception of TCMX (48%) in the pesticides analysis for S-17; and for Aroclors analyses, TCMX in WC-11 (59%), S-17 (36%), WC-02 (50%), RC-02 (49%), RC-04 (56%), WC-05 (58%), RC-05 (52%) and RC-14B (43%); and DCBP in S-17 (58%). No further qualification of pesticide results for S-17 is required.

Regarding Aroclors analyses, with the exception of S-17, all TCMX deviations are associated with DCBP recoveries well within acceptable range. DCBP is considered a more representative surrogate for the PCB mixtures reported here. Aroclor 1260 results in sample S-17 were qualified as an estimate with the "J" qualifier code to identify potential negative bias in quantitation. No additional data required qualification based on surrogate performance.

#### **MATRIX SPIKE / MATRIX SPIKE DUPLICATE (MS / MSD) ANALYSES:**

Within specification.

One MS/MSD analysis was performed for each parameter group, as required. Matrix spike compounds, DDT (@ 19 µg/kg), Aroclor 1016 (@ 97 µg/kg) and Aroclor 1260 (@ 97 µg/kg) were spiked into WC-07. DDT recoveries were both 44%, and Aroclor 1016 and 1260 recoveries were 67% & 69% and 104% & 105%, respectively. All MS/MSD recoveries and associated RPD's were within the specifications of the QAPP. No data required qualification due to MS / MSD measurement performance.

Laboratory control samples (LCSs or spiked blanks) were analyzed for the same target analytes as for the MS/MSDs at an equivalent spike concentration of 8.0 µg/kg for DDT and 100 µg/kg for Aroclors. DDT recoveries are reported at 93%, 85% and 93%, and Aroclor (A1016 & A1260) recoveries are reported in the range of 87% to 104%.

#### **TARGET COMPOUND IDENTIFICATION**

All compound identifications were reviewed and are acceptable. The retention times (RTs) for all target compounds are within acceptable limits on both columns ( $\pm 0.10$  minutes of the initial calibration standard RTs).

#### **COMPOUND QUANTITATION and REPORTED QUANTITATION LEVELS:**

Acceptable.

Target compound lower limits of quantitation are generally based on on-column amounts of the lowest calibration standard. The algorithm for calculation of target analyte concentrations and reporting limits was checked and found to be correct. Reported quantitation limits are elevated compared to the requested limits due to chemical interferences associated with relatively high levels of contamination. Pesticide lower reporting limits are variable and reflect the level of chemical interference for each sample. Chemical interference found in the analyses for Aroclors tended to manifest itself in a variable response between the two gas chromatographic columns for each Aroclor reported. Between column RPDs > 40% resulted in qualification of Aroclor results as estimated with the "J" qualifier code; as for Aroclor 1248 in WC-11, RC-11, RC-12, RC-03, RC-05 and RC-06; for Aroclor 1254 in all project sediment samples; and for Aroclor 1260 in RC-03, RC-05 and RC-14.

#### **SYSTEM PERFORMANCE**

Project samples tended to accelerate a deterioration in analytical system performance beyond what typical sediment samples exhibit. This was manifested in elevated baselines, elevated chemical background interference levels, out-of-range CCVs, and high DDT degradation rates. The analytical system appeared to be stable prior to and during initial analyses, however, a trend

towards degraded performance consistently occurred following the analyses of a group of project samples. The analytical system would bounce back to acceptable performance levels following conditioning. High levels of background interference and contamination unique to the site resulted in a consistent and increasing analytical system degradation.

#### **OTHER PERFORMANCE DATA**

Field Generated Quality Control Samples: One field duplicate pair was submitted for analysis (duplicate pair = RC-02 / RC-02A). Analytical results for the duplicate analysis are presented in the results Table. RPDs ranged up to approximately 33%. This variability is considered remarkably good (tight) for a polluted heterogeneous sample matrix.

#### **OVERALL ASSESSMENT**

All deliverables required by the project are present and the data package is complete. Performance indicators were consistent in indicating that sample extracts had an unusually detrimental effect on the analytical system. Numerous reruns and reextractions were made in attempts to bring the analytical system back into control. The degree of success was variable. The lower quantitation levels achieved were somewhat elevated and attributed to chemical interferences associated with high levels of sample contamination; probably PAH (based on the SVOC analyses). Some limitations in data quality have been identified, resulting in some data qualification.

## **METALS ANALYSES - U.S. EPA SW-846 Method 6010B / 7000.**

Metals analyses were performed by Analytical Resources, Inc. (ARI) of Tukwila, Washington, in accordance with the requirements of the *Quality Assurance Project Plan (QAPP), Utilities Work Area Remediation*, prepared by DOF, DMD & Tetra Tech-FW, July 24, 2003, and referenced SOP's. The analytical SOP's are identified as U.S. EPA SW-846 Methods 6010B / 7000 (all metals analyzed by 6010B (ICP-AES); with the exception of Hg, which was analyzed by 7471A (CVAA)). Twenty-four sediment samples were submitted for analyses, of which one sediment pair is a field duplicate. Target analyte results are presented in the attached Table, entitled "Head of Thea Foss Waterway, Post-Construction Monitoring, May 2005", with associated data qualifiers.

The analytical data were evaluated using those procedures identified in the U.S. EPA guidance *Laboratory Data Validation: Functional Guidelines for Evaluating Inorganics Analyses* (U.S. EPA, 1994 [EPA-540/R-94/013]), as applicable to the QAPP. Quality control measurements are evaluated against the performance criteria presented in the QAPP.

**DELIVERABLES:** Complete.

The laboratory provided U.S. EPA CLP-type, or comparable, deliverables for all sample submittals. Documentation provided by the laboratory was sufficient to allow evaluation and validation of the associated metals results.

**SAMPLE HANDLING / HOLDING TIMES:** Within specification.

All samples were hand-couriered and delivered to the project laboratory the same day of collection in cooler containers with ice present. Samples were received at 3.5 - 4.6 °C. The QAPP specifies a  $4 \pm 2$  °C sample holding temperature from collection to receipt at the project laboratory.

Samples were digested and analyzed within the conditions and holding times allowed in the QAPP. The QAPP specifies a maximum sample holding time of 6 months, 28 days for mercury, from sample collection. All analyses were performed within the specified and maximum recommended holding times.

**CALIBRATION:** Within specification.

Initial Calibration. Initial instrumental calibrations were performed daily using at least the minimum required number of data points to establish the analytical curve for each method: a blank and one standard for ICP analyses, and a blank and six standards for mercury (CVAA) analyses. Correlation coefficient for the CVAA initial calibration is  $\geq 0.995$ , as required.

Initial Calibration Verification. Initial calibration verification checks (ICV's) were performed immediately after initial instrumental calibrations during all ICP and AA (atomic absorption; CVAA) analytical runs, as required. All ICV recoveries are within acceptance limits (90-110% for ICP and 80-120% for mercury).

Continuing Calibration Verification. Continuing calibration verification standards (CCV's)

were analyzed at the required frequency for all ICP and CVAA analytical runs (at the beginning and end of each run; at a frequency of  $\geq 10\%$  or every two hours, whichever is more frequent). All CCV recoveries are within acceptance limits (90-110% for ICP and 80-120% for CVAA).

**CALIBRATION and PREPARATION BLANKS:** Within specification.

Initial/Continuing Calibration Blanks. Initial calibration blanks (ICB's) were analyzed immediately after ICV's, and continuing calibration blanks (CCB's) were analyzed immediately after CCV's during all ICP-AES and CVAA analytical runs, as required.

All ICB's and CCB's were less than the lower reporting/quantitation limits.

Preparation / Method Blanks. One preparation blank was analyzed for all target analytes at the required frequency (once per preparation batch). No analytes were reported above the project lower quantitation limits.

**INTERFERENCE CHECK SAMPLE:** Within specification.

ICP interference check solutions (ICSs) were analyzed for interferents and target analytes at the beginning of the analytical run. Recoveries for the target analytes of concern were within acceptance limits (80-120%).

**LABORATORY CONTROL SAMPLE:** Within specification.

An independent solid reference material (ERA D044540) was analyzed as the LCS, and all target analytes are within published advisory limits (all within 10% of the certified values).

**DUPLICATE SAMPLE ANALYSES:** Within specification.

A laboratory duplicate sample (WC-11) was analyzed for the target analytes at the required frequency (at least one sample per matrix per preparation batch). Results of all duplicate analyses greater than the IDL are (all  $< 15\%$  RPD) within project acceptance limits ( $\pm 35\%$  RPD). No results required qualification.

**MATRIX SPIKE SAMPLE ANALYSES:** Within specification.

A matrix spike sample was analyzed for the target analytes in sediment (WC-11) at the required frequency (at least one sample per preparation batch). Project-specified acceptance limits for matrix spike recovery are 75-125% and are applicable only to those samples in which the sample concentration does not exceed 4 times the spike concentration. All recoveries are acceptable (83 - 107%) for all reported analytes. No results required qualification based on matrix spike recoveries.

## **SAMPLE RESULT VERIFICATION**

Sample quantitation and transcription to the reporting form (Form I) was verified for at least 10% of the analytes for each sample, including QC samples. No errors were detected.

Results for all target analytes are within the linear range of the instrument. No significant anomalies were noted in the raw data. All raw data are legible and complete.

### **OTHER PERFORMANCE DATA**

Field Quality Control Sample Analyses. One field split pair (RC-02 / RC-02A) was submitted for analysis. Results are presented in the attached Table. RPD's were less than or equal to 2%.

### **OVERALL ASSESSMENT OF THE DATA**

All deliverables required by the project are present and data packages are complete. Recommended sample holding times were met for all analytes in all samples. Initial calibration and continuing calibration requirements were met for all analytes in all analytical runs. No problems were encountered and the data meet the project's data quality objectives.

## **PETROLEUM HYDROCARBON ANALYSES - WDOE NWTPH-D<sub>x</sub>.**

Total petroleum hydrocarbons analyses were performed by Analytical Resources, Inc. (ARI) of Tukwila, Washington, in accordance with the general requirements of the *Quality Assurance Project Plan (QAPP), Utilities Work Area Remediation*, prepared by DOF, DMD & Tetra Tech-FW, July 24, 2003, and referenced SOP's. The analytical SOP is identified as NWTPH-D<sub>x</sub>. Twenty-four sediment samples were submitted for analyses. Two of the samples submitted for TPH-D<sub>x</sub> analyses represent a field duplicate pair. Sample results are presented in the attached Table, entitled "Head of Thea Foss Waterway, Post-Construction Monitoring, May 2005".

The analytical data were evaluated using those procedures identified in the U.S. EPA guidance *Laboratory Data Validation: Functional Guidelines for Evaluating Organics Analyses* (U.S. EPA, 1994 [EPA-540/R-94/012]), as applicable to the QAPP. Quality control measurements are evaluated against a generally acceptable level of performance and any applicable performance criteria presented in the QAPP for extractable organic target parameters.

**DELIVERABLES:** Complete.

The laboratory provided U.S. EPA CLP-type, or comparable, deliverables for all sample submittals. Documentation provided by the laboratory was sufficient to allow evaluation and validation of the associated results.

**SAMPLE HANDLING / HOLDING TIMES:** Within specification.

All samples were hand-couriered and delivered to the project laboratory the same day of collection in cooler containers with ice present. Samples were received at 3.5 - 4.6 °C. The QAPP specifies a  $4 \pm 2$  °C sample holding temperature from collection to receipt at the project laboratory.

Samples were extracted and analyzed within the conditions and holding times allowed in the QAPP for extractable organic parameters. The QAPP specifies a maximum sample holding time of 14 days from sample collection, and an additional extract holding time of 40 days for TPH-D<sub>x</sub>. All analyses were performed within the specified and maximum recommended holding times.

**INITIAL & CONTINUING CALIBRATIONS:** Acceptable.

Initial multi-point calibrations were established for diesel fuel #2 at concentrations of 50, 100, 250, 500, 1000 and 2500 ng/μL. Lubricant/motor oil calibration was established at concentrations of 100, 250, 500, 1000 and 2500 ng/μL. All curve fits were linear with individual curve %RSDs  $\leq 16.5\%$  (diesel<sub>[4/29/05]</sub> @ 8.8% and lube oil<sub>[5/10/05]</sub> @ 16.5%).

Continuing calibration verifications (CCVs) for diesel (at 250 ng/μL) and lube (at 500 ng/μL) were 2.1-11 RPD and 2.9-15 RPD, respectively.

**BLANKS:** Within specification.

One method (preparation) blank was analyzed with each group of project samples for each parameter group, as required. No analytes were detected above the reported lower quantitation

limits. No results required qualification.

**SURROGATE COMPOUND RECOVERIES:** Acceptable.

A surrogate compound (*o*-terphenyl) was added to all samples, including QC samples to assess recoveries. Surrogate compound recoveries were reported at 66-122% when measurable; two samples (WC-11 and RC-11) reported sufficiently high contaminant levels to obscure the surrogate compound response. No data required qualification based on surrogate performance.

**MATRIX SPIKE / MATRIX SPIKE DUPLICATE (MS / MSD) ANALYSES:** Acceptable.

One MS/MSD analysis was performed for WTPH-D<sub>x</sub>, as requested. The matrix spike (diesel fuel #2) was added at 140 mg/kg into WC-07. Recoveries are reported at 78% and 92% with an 8.1% RPD. No data required qualification due to MS / MSD measurement performance.

A laboratory control samples (spiked blank; LCS) was analyzed for diesel fuel #2 at an equivalent spike concentration of 150 µg/kg. Recovery was reported at 91%.

**TARGET COMPOUND IDENTIFICATION:** Acceptable.

Diesel and lubricant range hydrocarbons were correctly reported. Characteristic patterns for, principally, petroleum-based lubricants were apparent for all project/site sediment samples. While the principal chromatographic profile is most characteristic of petroleum-based lubricant hydrocarbons (n-C<sub>24</sub> - n-C<sub>38</sub>) with a predominant unresolved complex mixture (UCM) and centroid at approximately n-C<sub>28</sub>, there is some overlap into the diesel-range (n-C<sub>12</sub> - n-C<sub>24</sub>). This profile is typical for urban-derived contamination. Sufficient amount of resolved peaks are present (on top of the UCM) to account for additional contamination [other than refined petroleum products], such as PAH and phthalate esters (see SVOC analytical results). The hydrocarbon profiles were relatively uniform and consistent for all samples analyzed.

**COMPOUND QUANTITATION and REPORTED QUANTITATION LEVELS**

Target analyte concentrations were checked and found to be correct. All sediment samples showed hydrocarbons in both the diesel and lubricant ranges, but principally lubricant-range. Lubricant-range hydrocarbon values are highlighted in the attached results Table due to the predominant characteristic profiles observed.

**SYSTEM PERFORMANCE:** Acceptable.

No signs of degraded system performance were observed. RIC's were examined for abrupt retention time shifts, elevated baselines, or high background levels. The analytical system appeared to be stable and within control during the course of these analyses.

**OTHER PERFORMANCE DATA**

Field Generated Quality Control Samples: Two blind sample split pairs were submitted for TPH-D<sub>x</sub> analyses (duplicate/split pair = RC-02 / RC-02A). Analytical results for the sample splits are presented in the results Table. Duplicate analyses reported a 46% RPD, within the normal range for organic contamination in similar environments.

## **OVERALL ASSESSMENT**

All deliverables required by the project are present and the data package is complete. All performance indicators were either within acceptable limits. Both diesel-range and petroleum lubricant-range hydrocarbons were reported in project samples. The characteristic hydrocarbon profile observed in all site sediment samples is very similar to that observed for urban-derived contamination with a lubricant-type UCM and centroid at approximately n-C<sub>28</sub>. Analytical performance is within acceptable limits, and the data quality is sufficient for its intended purposes.

**CONVENTIONALS ANALYSES - TOC by PSEP/Plumb 1981, &  
Grain size analysis by PSEP methodology.**

Total organic carbon (TOC) and grain size analyses were performed by Analytical Resources, Inc. (ARI) of Tukwila, Washington, in accordance with the requirements of the *Quality Assurance Project Plan (QAPP), Utilities Work Area Remediation*, prepared by DOF, DMD & Tetra Tech-FW, July 24, 2003, and referenced SOP's. Twenty-four sediment samples were submitted for analyses. Two of the samples submitted represent a field duplicate pair (RC-02 / RC-02A). Sample results are presented in the attached Table, entitled "Head of Thea Foss Waterway, Post-Construction Monitoring, May 2005".

The analytical data were evaluated using those procedures identified in the U.S. EPA guidance *Laboratory Data Validation: Functional Guidelines for Evaluating Inorganics Analyses* (U.S. EPA, 1994 [EPA-540/R-94/013]), as applicable to the QAPP. Quality control measurements are evaluated for all target analytes against the performance criteria, as applicable, presented in the QAPP.

**DELIVERABLES:** Complete.

The laboratory provided U.S. EPA CLP-type, or comparable, deliverables for all sample submittals. Documentation provided by the laboratory was sufficient to allow evaluation and validation of the associated results.

**SAMPLE HANDLING / HOLDING TIMES:** Within specification.

All samples were hand-couriered and delivered to the project laboratory the same day of collection in cooler containers with ice present. Samples were received at 3.5 - 4.6 °C. The QAPP specifies a  $4 \pm 2$  °C sample holding temperature from collection to receipt at the project laboratory.

Technical requirements for maximum sample holding time prior to analysis are established in the QAPP as 28 days for TOC and 6 months for grain size determinations. All analyses were performed well within the specified and maximum recommended holding times.

**CALIBRATION:** Acceptable.

Initial Calibration. Initial instrumental calibration for TOC was performed daily using a blank and one standard (@ 2000 ppm) for TOC analyses. The TOC calibration consisted of taking an average from three burns for a 2000 ppm standard.

Initial Calibration Verification. An initial calibration verification check (ICVs) was performed immediately after initial instrumental calibration, as required. ICV recoveries are reported at 97 - 106%.

Continuing Calibration Verification. Continuing calibration verification standards (CCV's) were analyzed at the required frequency for all TOC analytical runs (at the beginning and end of each run; at a frequency of  $\geq 10\%$ ). All CCV recoveries are within acceptable limits (reported @

102 - 106%).

**CALIBRATION and PREPARATION BLANKS:** Within specification.

Initial/Continuing Calibration Blanks. Initial calibration blanks (ICB's) were analyzed immediately after ICB's, and continuing calibration blanks (CCB's) were analyzed immediately after or just prior to CCV's during all TOC analytical runs, as required. All ICB's and CCB's are less than the lower quantitation limit. All ICB's and CCB's were within specification.

Preparation / Method Blanks. Two preparation blanks were analyzed for TOC. No TOC was reported above 0.02% in either blank.

**LABORATORY CONTROL SAMPLE:** Acceptable.

An independent reference material was analyzed three times as a laboratory control sample (LCS) for TOC. TOC was evaluated with NIST 8704 showing a recovery of 78 - 96%.

**REPLICATE SAMPLE ANALYSES:** Acceptable.

A laboratory triplicate sample was analyzed for TOC on S-15 and RC-11 showing RSDs of 12% and 7.3%, respectively. A triplicate analysis was performed twice for grain size on non-project samples with similar grain size profiles, which showed < 7% RSD for major class size fractions.

**MATRIX SPIKE SAMPLE ANALYSES:** Acceptable.

Matrix spike sample analysis was performed for TOC on S-15 and RC-11. Matrix spike recoveries are 87% and 103%, respectively. No results required qualification based on matrix spike recoveries.

### **SAMPLE RESULT VERIFICATION**

Sample quantitation and transcription to the reporting form (Form I) was verified for at least 10% of the analytes for each sample, including QC samples. No errors were detected, and no significant anomalies were noted in the raw data. All raw data are legible and complete.

### **OTHER PERFORMANCE DATA**

Field Quality Control Sample Analyses. A field split pair (RC-02 / RC-02A) was taken and submitted for analyses. Results are presented in the attached Table. TOC showed an 8.8% RPD. Grain size results for the field replicate show very good agreement. No results are qualified based on field replicate variabilities.

### **OVERALL ASSESSMENT OF THE DATA**

All deliverables required by the project are present and data packages are complete. Recommended sample holding times were met for all parameters in all samples. Initial calibration and continuing calibration requirements were met for TOC in all analytical runs. No data required qualification due to noncompliance with QAPP specifications or laboratory SOP requirements. Data quality is sufficient for the intended purposes of the data.

**Head of Thea Foss Waterway  
Post-Construction Monitoring  
May 2005**

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

Field I.D.	Comments	Sample Date	Lab I.D.	% solids	% TOC	TPH-Dx (mg/kg)		As 7440-38-2	Cu 7440-50-8	Pb 7439-92-1	Hg 7439-97-6	Ni 7440-02-0	Zn 7440-66-6
						Diesel-range	Lube-range						
<b>S-15 (0-10)</b>	0-10 cm surficial	5/10/2005	058135-IA87A	49.0	4.2	1600	<b>4300</b>	<b>10</b>	<b>106</b>	<b>162</b>	<b>0.7</b>	<b>37</b>	<b>200</b>
<b>WC-11 (0-10)</b>	0-10 cm surficial	5/11/2005	058185-IA97A	42.1	5.0	2100	<b>5300</b>	<b>20</b>	<b>145</b>	<b>212</b>	<b>0.7</b>	<b>35</b>	<b>257</b>
<b>RC-11 (0-2)</b>	0-2 cm surficial	5/11/2005	058186-IA97B	41.8	4.5	2200	<b>5700</b>	<b>20</b>	<b>132</b>	<b>178</b>	<b>0.84</b>	<b>35</b>	<b>231</b>
<b>RC-12 (0-2)</b>	0-2 cm surficial	5/11/2005	058188-IA97D	43.8	4.8	1600	<b>4400</b>	<b>20</b>	<b>121</b>	<b>186</b>	<b>0.8</b>	<b>31</b>	<b>217</b>
<b>WC-07 (0-10)</b>	0-10 cm surficial	5/11/2005	058189-IA97E	80.2	2.5	140	<b>600</b>	<b>7</b>	<b>45.3</b>	<b>23</b>	<b>0.07</b>	<b>20</b>	<b>62.2</b>
<b>RC-07 (0-2)</b>	0-2 cm surficial	5/11/2005	058190-IA97F	56.8	5.5	480	<b>2100</b>	<b>10</b>	<b>73.9</b>	<b>70</b>	<b>0.22</b>	<b>25</b>	<b>141</b>
<b>RC-10 (0-2)</b>	0-2 cm surficial	5/11/2005	058192-IA97H	44.5	4.7	1200	<b>3800</b>	<b>20</b>	<b>115</b>	<b>159</b>	<b>0.6</b>	<b>32</b>	<b>203</b>
<b>S-24 (0-10)</b>	0-10 cm surficial	5/11/2005	058194-IA97J	60.1	4.4	430	<b>1700</b>	9 U	<b>66.0</b>	<b>59</b>	<b>0.20</b>	<b>22</b>	<b>105</b>
<b>S-17 (0-10)</b>	0-10 cm surficial	5/11/2005	058195-IA97K	55.1	4.1	680	<b>2700</b>	<b>13</b>	<b>92.2</b>	<b>87</b>	<b>0.29</b>	<b>26</b>	<b>134</b>
<b>RC-09 (0-2)</b>	0-2 cm surficial	5/11/2005	058198-IA97N	40.9	4.7	1100	<b>3700</b>	<b>20</b>	<b>117</b>	<b>144</b>	<b>0.5</b>	<b>32</b>	<b>211</b>
<b>RC-08 (0-2)</b>	0-2 cm surficial	5/11/2005	058200-IA97P	41.3	4.7	1000	<b>3200</b>	<b>20</b>	<b>111</b>	<b>145</b>	<b>0.5</b>	<b>31</b>	<b>215</b>
<b>WC-02 (0-10)</b>	0-10 cm surficial	5/12/2005	058331-IB17A	65.3	4.9	440	<b>2100</b>	<b>10</b>	<b>72.5</b>	<b>54</b>	<b>0.12</b>	<b>26</b>	<b>127</b>
<b>RC-02 (0-2)</b>	0-2 cm surficial	5/12/2005	058332-IB17B	41.7	7.1	1300	<b>5900</b>	<b>10</b>	<b>107</b>	<b>122</b>	<b>0.3</b>	<b>34</b>	<b>261</b>
<b>RC-02A (0-2)</b>	field dup. of RC-02	5/12/2005	058333-IB17C	40.8	6.5	880	<b>3700</b>	<b>10</b>	<b>106</b>	<b>123</b>	<b>0.3</b>	<b>34</b>	<b>267</b>
<b>RC-03 (0-2)</b>	0-2 cm surficial	5/12/2005	058335-IB17E	50.4	5.4	400	<b>1600</b>	10 U	<b>69.3</b>	<b>55</b>	<b>0.21</b>	<b>25</b>	<b>123.0</b>
<b>WC-04 (0-10)</b>	0-10 cm surficial	5/12/2005	058336-IB17F	52.5	6.3	350	<b>1400</b>	<b>10</b>	<b>80.9</b>	<b>50</b>	<b>0.25</b>	<b>26</b>	<b>113</b>
<b>RC-04 (0-2)</b>	0-2 cm surficial	5/12/2005	058337-IB17G	35.4	6.3	1000	<b>3500</b>	<b>20</b>	<b>119</b>	<b>140</b>	<b>0.5</b>	<b>37</b>	<b>254</b>
<b>WC-05 (0-10)</b>	0-10 cm surficial	5/12/2005	058338-IB17H	49.4	4.9	390	<b>1400</b>	<b>10</b>	<b>80.3</b>	<b>54</b>	<b>0.2</b>	<b>27</b>	<b>111</b>
<b>RC-05 (0-2)</b>	0-2 cm surficial	5/12/2005	058339-IB17I	41.6	5.2	880	<b>3000</b>	<b>10</b>	<b>100</b>	<b>108</b>	<b>0.3</b>	<b>31</b>	<b>187</b>
<b>RC-06 (0-2)</b>	0-2 cm surficial	5/12/2005	058341-IB17K	42.2	5.6	580	<b>1800</b>	10 U	<b>100.0</b>	<b>114</b>	<b>0.3</b>	<b>32</b>	<b>216</b>
<b>RC-01 (0-2)</b>	0-2 cm surficial	5/12/2005	058343-IB17M	45.2	6.9	1200	<b>4800</b>	<b>10</b>	<b>81.7</b>	<b>104</b>	<b>0.2</b>	<b>37</b>	<b>289</b>
<b>RC-13 (0-2)</b>	0-2 cm surficial	5/12/2005	058344-IB17N	70.7	12	210	<b>910</b>	8 U	<b>53.3</b>	<b>38</b>	<b>0.08</b>	<b>26</b>	<b>118</b>
<b>RC-14B (0-2)</b>	0-2 cm surficial	5/12/2005	058345-IB17O	66.9	4.4	250	<b>1200</b>	<b>7</b>	<b>44.6</b>	<b>37</b>	<b>0.08</b>	<b>26</b>	<b>117</b>
<b>RC-14 (0-2)</b>	0-2 cm surficial	5/12/2005	058346-IB17P	61.3	7.4	390	<b>1800</b>	<b>9</b>	<b>56.2</b>	<b>58</b>	<b>0.13</b>	<b>30</b>	<b>203</b>

*U = nondetected at the associated value*

*J = associated value is considered an estimate due to a variety of factors - see report narrative*

**Head of Thea Foss Waterway  
Post-Construction Monitoring  
May 2005**

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

Field ID.	% v. coarse sand		% coarse sand		% med. sand		% v. fine sand			Naphthalene 91-20-3	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
	> 2000 µm	1000-2000 µm	500-1000 µm	250-500 µm	125-250 µm	62-125 µm	3.9-62.5 µm	< 3.9 µm	< 62.5 µm						
S-15 (0-10)	2.9	3.9	9.3	10.8	9.1	6.3	39.7	18.0	57.7	3000	1300	140 U	560	4200	380
WC-11 (0-10)	1.0	0.8	2.2	4.4	6.8	7.8	52.5	24.4	76.9	1700	690	38 U	400	1100	180
RC-11 (0-2)	0.2	0.8	2.0	3.5	6.2	8.1	54.6	24.6	79.2	1800	700	37 U	360	1400	190
RC-12 (0-2)	2.0	2.4	4.0	5.4	6.6	7.6	45.9	26.1	72.0	3000	1100	49 U	510	2700	340
WC-07 (0-10)	40.4	8.5	10.5	21.3	10.4	1.7	4.3	2.9	7.2	120	36	25 U	25 U	46	25 U
RC-07 (0-2)	11.5	5.3	9.6	23.0	16.6	7.8	17.3	8.9	26.2	490	160	42 U	72	220	69
RC-10 (0-2)	2.2	2.7	3.0	9.2	11.1	6.6	44.9	20.1	65.0	2000	720	150 U	310	1000	180
S-24 (0-10)	4.4	4.5	7.8	25.4	26.3	6.5	16.5	8.6	25.1	390	140	28 U	72	190	42
S-17 (0-10)	7.0	2.7	5.4	14.7	18.8	8.6	29	13.7	42.7	590	190	86 U	86 U	240	86 U
RC-09 (0-2)	0.2	0.5	4.6	11.5	12.3	7.2	43.6	20.2	63.8	1200	380	350	130	460	120 U
RC-08 (0-2)	2.7	3.6	7.6	9.9	8.0	5.9	42.5	19.6	62.1	960	310	120 U	150	430	120 U
WC-02 (0-10)	1.3	0.7	5.4	22.0	25.8	8.0	26.1	10.7	36.8	140	51	29 U	29 U	82	39
RC-02 (0-2)	0.4	1.0	6.4	15.0	17.2	9.0	34.7	16.2	50.9	420	150	67 U	74	220	78
RC-02A (0-2)	0.2	0.9	6.6	14.7	16.6	9.0	37.2	14.8	52.0	530	230 U	230 U	230 U	250	230 U
RC-03 (0-2)	0.1	1.0	6.4	18.4	23.3	12.3	26.2	12.3	38.5	320	100	44 U	50	160	51
WC-04 (0-10)	9.3	5.8	10.4	17.1	12.9	7.0	24.6	12.8	37.4	170	57	36 U	36 U	86	36 U
RC-04 (0-2)	0.2	0.6	5.7	8.7	9.5	7.5	49.7	18.1	67.8	980	320	72 U	140	480	120
WC-05 (0-10)	2.6	3.4	5.4	11.3	16.3	13.2	32.6	15.2	47.8	280	95	41 U	49	140	41 U
RC-05 (0-2)	0.1	0.6	3.6	9.9	16.0	9.9	45.4	14.6	60.0	1000	350	75 U	170	530	130
RC-06 (0-2)	0.3	1.1	5.4	15.0	15.7	8.0	39.2	15.3	54.5	650	220	67 U	100	260	76
RC-01 (0-2)	21.3	8.6	15.0	10.1	7.3	7.9	18.1	11.7	29.8	260	220 U	220 U	220 U	220 U	220 U
RC-13 (0-2)	32.3	12.6	19.7	12.3	5.0	2.8	9.6	5.7	15.3	73	28 U	28 U	28 U	32	28 U
RC-14B (0-2)	25.5	13.2	21.8	13.3	4.6	3.3	11.4	6.8	18.2	86 U	86 U	86 U	86 U	86 U	86 U
RC-14 (0-2)	18.1	9.8	19.5	15.0	9.6	7.8	12.8	7.4	20.2	70	40 U	40 U	40 U	48	40 U

*U = nondetected at the associated value*

*J = associated value is considered an estimate due to a variety of factors - see report narrative*

**Head of Thea Foss Waterway  
Post-Construction Monitoring  
May 2005**

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

<b>Field ID.</b>	Diethyl- phthalate	Fluorene	Phenanthrene	Anthracene	Di-n-butyl- phthalate	Fluoranthene	Pyrene	Butylbenzyl- phthalate	Benzo(a)- anthracene	bis(2-Ethylhexyl)- phthalate	Chrysene	Di-n-octyl- phthalate	Benzo(b)- fluoranthene	Benzo(k)- fluoranthene
	<u>84-66-2</u>	<u>86-73-7</u>	<u>85-01-8</u>	<u>120-12-7</u>	<u>84-74-2</u>	<u>206-44-0</u>	<u>129-00-0</u>	<u>85-68-7</u>	<u>56-55-3</u>	<u>117-81-7</u>	<u>218-01-9</u>	<u>117-84-0</u>	<u>205-99-2</u>	<u>207-08-9</u>
S-15 (0-10)	140 U	<b>1700</b>	<b>7300</b>	<b>4100</b>	<b>210</b>	<b>10,000</b>	<b>13,000</b>	<b>260</b>	<b>4600</b>	<b>3000</b>	<b>4700</b>	140 U	<b>2900</b>	<b>2900</b>
WC-11 (0-10)	38 U	<b>710</b>	<b>2800</b>	<b>1800</b>	<b>160</b>	<b>5500</b>	<b>7500</b>	<b>520</b>	<b>2600</b>	<b>3500</b>	<b>2800</b>	<b>80</b>	<b>2000</b>	<b>2000</b>
RC-11 (0-2)	37 U	<b>800</b>	<b>2900</b>	<b>1900</b>	<b>110</b>	<b>5400</b>	<b>6700</b>	<b>480</b>	<b>2400</b>	<b>3500</b>	<b>2600</b>	<b>99</b>	<b>1900</b>	<b>1900</b>
RC-12 (0-2)	49 U	<b>1400</b>	<b>6200</b>	<b>3600</b>	<b>180</b>	<b>8900</b>	<b>11,000</b>	<b>500</b>	<b>3800</b>	<b>3800</b>	<b>3500</b>	<b>63</b>	<b>2400</b>	<b>3500</b>
WC-07 (0-10)	25 U	<b>29</b>	<b>180</b>	<b>87</b>	<b>62</b>	<b>700</b>	<b>660</b>	<b>150</b>	<b>200</b>	<b>730</b>	<b>250</b>	<b>30</b>	<b>220</b>	<b>280</b>
RC-07 (0-2)	42 U	<b>160</b>	<b>880</b>	<b>400</b>	<b>200</b>	<b>2400</b>	<b>2400</b>	<b>270</b>	<b>810</b>	<b>4400</b>	<b>1000</b>	<b>120</b>	<b>840</b>	<b>810</b>
RC-10 (0-2)	150 U	<b>640</b>	<b>3000</b>	<b>1900</b>	<b>250</b>	<b>5300</b>	<b>6500</b>	<b>390</b>	<b>2500</b>	<b>3600</b>	<b>2600</b>	150 U	<b>2300</b>	<b>1800</b>
S-24 (0-10)	28 U	<b>130</b>	<b>680</b>	<b>390</b>	<b>110</b>	<b>1400</b>	<b>1600</b>	<b>200</b>	<b>600</b>	<b>2000</b>	<b>730</b>	<b>43</b>	<b>640</b>	<b>640</b>
S-17 (0-10)	86 U	<b>140</b>	<b>870</b>	<b>510</b>	<b>98</b>	<b>2100</b>	<b>2700</b>	<b>190</b>	<b>900</b>	<b>2000</b>	<b>980</b>	86 U	<b>760</b>	<b>750</b>
RC-09 (0-2)	120 U	<b>320</b>	<b>1600</b>	<b>940</b>	<b>180</b>	<b>3900</b>	<b>4700</b>	<b>360</b>	<b>1700</b>	<b>3500</b>	<b>1800</b>	<b>170</b>	<b>2600</b>	<b>2600</b>
RC-08 (0-2)	120 U	<b>300</b>	<b>1600</b>	<b>890</b>	<b>160</b>	<b>3800</b>	<b>4600</b>	<b>370</b>	<b>1600</b>	<b>3500</b>	<b>1700</b>	<b>130</b>	<b>1700</b>	<b>1000</b>
WC-02 (0-10)	29 U	<b>70</b>	<b>650</b>	<b>190</b>	<b>130</b>	<b>1700</b>	<b>1600</b>	<b>200</b>	<b>540</b>	<b>2700</b>	<b>780</b>	<b>70</b>	<b>710</b>	<b>710</b>
RC-02 (0-2)	67 U	<b>190</b>	<b>1300</b>	<b>490</b>	<b>320</b>	<b>3900</b>	<b>3800</b>	<b>540</b>	<b>1300</b>	<b>7300</b>	<b>2000</b>	<b>230</b>	<b>1700</b>	<b>1700</b>
RC-02A (0-2)	230 U	230 U	<b>1600</b>	<b>570</b>	<b>470</b>	<b>4600</b>	<b>4600</b>	<b>580</b>	<b>1600</b>	<b>13,000</b>	<b>2300</b>	<b>320</b>	<b>2300</b>	<b>1900</b>
RC-03 (0-2)	44 U	<b>120</b>	<b>700</b>	<b>290</b>	<b>150</b>	<b>2000</b>	<b>2000</b>	<b>240</b>	<b>650</b>	<b>3200</b>	<b>920</b>	<b>130</b>	<b>830</b>	<b>830</b>
WC-04 (0-10)	36 U	<b>61</b>	<b>400</b>	<b>180</b>	<b>92</b>	<b>1200</b>	<b>1200</b>	<b>160</b>	<b>390</b>	<b>1700</b>	<b>540</b>	<b>70</b>	<b>580</b>	<b>510</b>
RC-04 (0-2)	72 U	<b>350</b>	<b>1600</b>	<b>860</b>	<b>250</b>	<b>4500</b>	<b>4600</b>	<b>520</b>	<b>1600</b>	<b>6700</b>	<b>2100</b>	<b>250</b>	<b>1900</b>	<b>1900</b>
WC-05 (0-10)	41 U	<b>100</b>	<b>550</b>	<b>300</b>	<b>92</b>	<b>1600</b>	<b>1700</b>	<b>170</b>	<b>550</b>	<b>2200</b>	<b>690</b>	<b>92</b>	<b>640</b>	<b>640</b>
RC-05 (0-2)	75 U	<b>360</b>	<b>1700</b>	<b>1000</b>	<b>220</b>	<b>4500</b>	<b>4900</b>	<b>480</b>	<b>1700</b>	<b>5600</b>	<b>2000</b>	<b>240</b>	<b>1800</b>	<b>1800</b>
RC-06 (0-2)	67 U	<b>200</b>	<b>1100</b>	<b>540</b>	<b>210</b>	<b>3100</b>	<b>3300</b>	<b>350</b>	<b>1100</b>	<b>4400</b>	<b>1400</b>	<b>150</b>	<b>1300</b>	<b>1300</b>
RC-01 (0-2)	220 U	220 U	<b>1700</b>	<b>380</b>	<b>410</b>	<b>4300</b>	<b>4000</b>	<b>520</b>	<b>1200</b>	<b>8200</b>	<b>2000</b>	<b>330</b>	<b>2400</b>	<b>2000</b>
RC-13 (0-2)	28 U	<b>33</b>	<b>460</b>	<b>88</b>	<b>120</b>	<b>1300</b>	<b>1200</b>	<b>170</b>	<b>380</b>	<b>2100</b>	<b>590</b>	<b>81</b>	<b>800</b>	<b>570</b>
RC-14B (0-2)	86 U	86 U	<b>380</b>	86 U	<b>100</b>	<b>1100</b>	<b>1000</b>	<b>140</b>	<b>320</b>	<b>1900</b>	<b>520</b>	86 U	<b>580</b>	<b>550</b>
RC-14 (0-2)	40 U	<b>48</b>	<b>710</b>	<b>120</b>	<b>320</b>	<b>2100</b>	<b>1900</b>	<b>190</b>	<b>580</b>	<b>3600</b>	<b>880</b>	<b>93</b>	<b>930</b>	<b>930</b>

*U = nondetected at the associated value*

*J = associated value is considered an estimate due to a variety of factors - see report narrative*

**Head of Thea Foss Waterway  
Post-Construction Monitoring  
May 2005**

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

<b>Field I.D.</b>	Benzo(a)- pyrene	Indeno(1,2,3- cd)pyrene	Dibenz(a,h)- anthracene	Benzo(g,h,i)- perylene	4,4'-DDE	4,4'-DDD	4,4'-DDT	Aroclor 1016	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1221	Aroclor 1232
	<u>50-32-8</u>	<u>193-39-5</u>	<u>53-70-3</u>	<u>191-24-2</u>	<u>72-55-9</u>	<u>72-54-8</u>	<u>50-29-3</u>	<u>12674-11-2</u>	<u>53469-21-9</u>	<u>12672-29-6</u>	<u>11097-69-1</u>	<u>11096-82-5</u>	<u>11104-28-2</u>	<u>11141-16-5</u>
S-15 (0-10)	4700	1500	510	1500	9.8 U	22 J	34 J	20 U	20 U	98	180 J	180	20 U	20 U
WC-11 (0-10)	2800	760	280	680	12 U	19 J	23 U	20 U	20 U	61 J	110 J	96	20 U	20 U
RC-11 (0-2)	2600	700	240	650	18 U	27 J	33 U	20 U	20 U	81 J	150 J	150	20 U	20 U
RC-12 (0-2)	4200	1000	360	990	14 U	21 J	21 J	20 U	20 U	65 J	110 J	100	20 U	20 U
WC-07 (0-10)	210	52	25 U	51	2.0 U	2.0 U	5.0 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
RC-07 (0-2)	880	290	88 J	300	5.8 U	4.8 J	7.4 U	19 U	19 U	25	46 J	49	19 U	19 U
RC-10 (0-2)	2800	670	240	620	12 U	17 J	20 U	20 U	20 U	52	110 J	110	20 U	20 U
S-24 (0-10)	690	160	58	160	5.5 U	6.6 J	8.9 J	20 U	20 U	24	52 J	56	20 U	20 U
S-17 (0-10)	960	380	120	400	4.3 U	4.5 J	5.0 U	20 U	20 U	20 U	30 J	29 J	20 U	20 U
RC-09 (0-2)	1800	600	190	600	11 U	14 J	18 U	20 U	20 U	46	90 J	83	20 U	20 U
RC-08 (0-2)	1700	530	170	510	9.0 U	11 J	14 U	20 U	20 U	45	75 J	68	20 U	20 U
WC-02 (0-10)	670	250	89	240	2.0 U	5.1 J	5.0 U	20 U	20 U	25 J	57 J	43	20 U	20 U
RC-02 (0-2)	1600	600	190	600	4.5 J	9.1 U	18 U	20 U	20 U	50 J	130 J	120	20 U	20 U
RC-02A (0-2)	1900	660	230 U	640	15 U	10 J	27 J	59 U	59 U	61	180 J	110	59 U	59 U
RC-03 (0-2)	810	240	83	240	8.4 U	7.3 J	18 U	20 U	20 U	34 J	71 J	73 J	20 U	20 U
WC-04 (0-10)	490	150	50	140	2.0 U	5.7 U	11 J	20 U	20 U	21 J	39 J	29	20 U	20 U
RC-04 (0-2)	1900	550	200	580	8.1 U	5.8	11	20 U	20 U	37	71 J	64	20 U	20 U
WC-05 (0-10)	650	180	56	170	8.8 U	6.7 U	12	20 U	20 U	20 U	47 J	37	20 U	20 U
RC-05 (0-2)	1900	490	180	510	10 U	12 J	19 J	20 U	20 U	53 J	120 J	100 J	20 U	20 U
RC-06 (0-2)	1300	340	120	350	7.3 U	8.0 J	12 J	20 U	20 U	40 J	92 J	60	20 U	20 U
RC-01 (0-2)	1600	540	220 U	530	9.4 U	4.4 J	15 J	20 U	20 U	36 J	92 J	72	20 U	20 U
RC-13 (0-2)	510	180	60	170	2.0 U	2.0 U	12 U	20 U	20 U	20 U	42 J	38	20 U	20 U
RC-14B (0-2)	430	150	86 U	140	2.0 U	2.0 U	5.0 U	20 U	20 U	20 U	20 U	19 J	20 U	20 U
RC-14 (0-2)	760	260	86	260	7.2 U	5.2 J	11 J	20 U	20 U	20 U	57 J	53 J	20 U	20 U

*U = nondetected at the associated value*

*J = associated value is considered an estimate due to a variety of factors - see report narrative*

**Appendix D**  
**Review of City of Tacoma's Data Quality Assessment**  
**May 2005 Sampling Event**  
**DMD, Inc.**



**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 2, 2005

**SUBJECT:** City of Tacoma's Data Quality Assessment for May 2005 Sediment Monitoring in Thea Foss Waterway

Per your request, a review of the City's (City of Tacoma) data quality assessment report ("Quality Assurance/Quality Control Review of Laboratory Data for the May 2005 RFC-205 Utility Area Sediment Samples", May 25, 2005, generated by Parametrix and submitted to Manson Construction Co.) was performed. The report/memorandum attempts to document data quality for 15 samples submitted to and analyzed by Severn Trent Laboratories (STL) of Tacoma, Washington. Without the page of introduction, the report consists of 3.5 pages of narrative review for PAHs, two pesticides, PCBs, mercury and TOC. The review presents an evaluation of holding times, method blanks, LCS's, lab replicate analyses, MS/MSD's, and surrogate compound recoveries for organic analytes.

The Parametrix evaluation involved a minimal level of effort and may be considered a QA-1 type of assessment. The reviewer simply compared the lab's report of selected QC measures to applicable QC criteria. The review did not include a review of lab raw data or bench sheets for verification of reported results, calculations, calibration and internal standard reviews, selected parameter degradation checks, authentication of calibrant standard sources, or evaluation of independent/alternative source standards. The review was not consistent with reviews normally required by Regional regulatory authorities for evaluation of data supporting remedial activities.

The Parametrix evaluation is not sufficient to allow a comparison of STL data quality to the Utilities' data set. A considerably greater level of effort was exercised to evaluate and document the Utilities' effort (see D.M.D., Inc. *Head of Thea Foss, Utilities' Post-construction Sediment Investigation, May 2005*). Based on the Parametrix review, the City's data quality remains unknown. A comprehensive review, consistent with the level of effort exhibited by the Utilities, of the City's data is required before any comparison of data sets can be performed.

No information regarding the model, manufacturer and type of instrument used by STL for SVOC analyses was provided to the Utilities (see 6/16/05 request from L. Hass Edgel to M. Henley). A cursory review of the instrument calibration data suggests that an Ion Trap (IT) mass spectrometer was used for the SVOC analyses. The U.S. Army Corps of Engineers Center of Expertise (CX) has determined that IT instrumentation is unreliable for the analyses of highly contaminated samples, and should not be allowed for the analyses of contaminated soils/sediments under ACOE contracts. Consequently, the STL SVOC data is suspect until

demonstrated otherwise. This would require a comprehensive review of laboratory instrument electronic raw data files.

I recommend a thorough and comprehensive review of the City's (STL) data commensurate with the Utilities' review of ARI data and the level of data quality review required for Federal-oversight and litigation support projects. Based on the technical position of the ACOE-CX, a comprehensive review of the GC/(IT)MS data may be necessary to determine SVOC data reliability.

**Appendix E**  
**Underwater Video Survey**  
**August 19, 2005**  
**By:**  
**TetraTech EC, Inc.**

**Note: A DVD with the video survey is included on the CD in Appendix F**



## Memorandum

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Date: September 21, 2005  
To: Lotte Edgel and Jackie Wetzsteon, PacifiCorp  
Matt Dalton, Dalton, Olmsted and Fuglevand  
From: Gary Braun and Robert Feldpausch  
RE: August 19, 2005 OMMP Underwater Video Survey

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### Introduction

Tetra Tech EC, Inc (TtECI) was contracted by PacifiCorp and Puget Sound Energy (Utilities) to perform an underwater video survey in the Thea Foss Waterway on August 19, 2005. Video survey operations were conducted by TtECI personnel. The video survey was conducted within the Utilities Work Area at the Head of the Thea Foss Waterway between 70+10 and 74+00 and over the "SR509 Seep" HDPE cap area. For the purposes of this memorandum, the Utilities' remedial area is termed herein as the "Utilities Work Area". This site is part of the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site in Tacoma Washington.

### Video Survey Objectives and Activities

The objective of this video survey was to observe and document, at or near a low tide, the current condition of the Utilities cap in the vicinity of the former SR509 seep area as a part of the Utilities ongoing OMMP monitoring. The survey included observations of the HDPE cap perimeter and any gas bubbles rising from the sand cap on the Utilities Work Area. A low tide of -2.71 feet at 10:00 occurred on the day of the survey (Figure 1). Emphasis, during visual observations and the video survey, was placed on the SR509 HDPE cap and its borders.

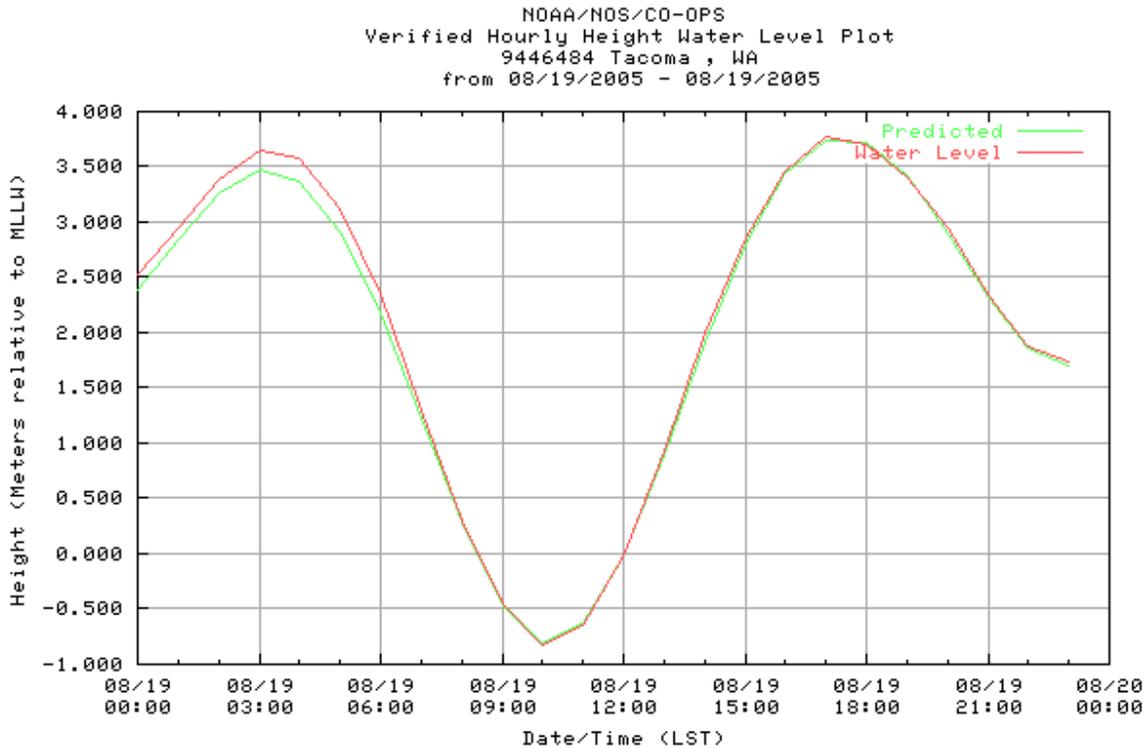


Figure 1. August 19, 2005 Tidal Chart Commencement Bay.

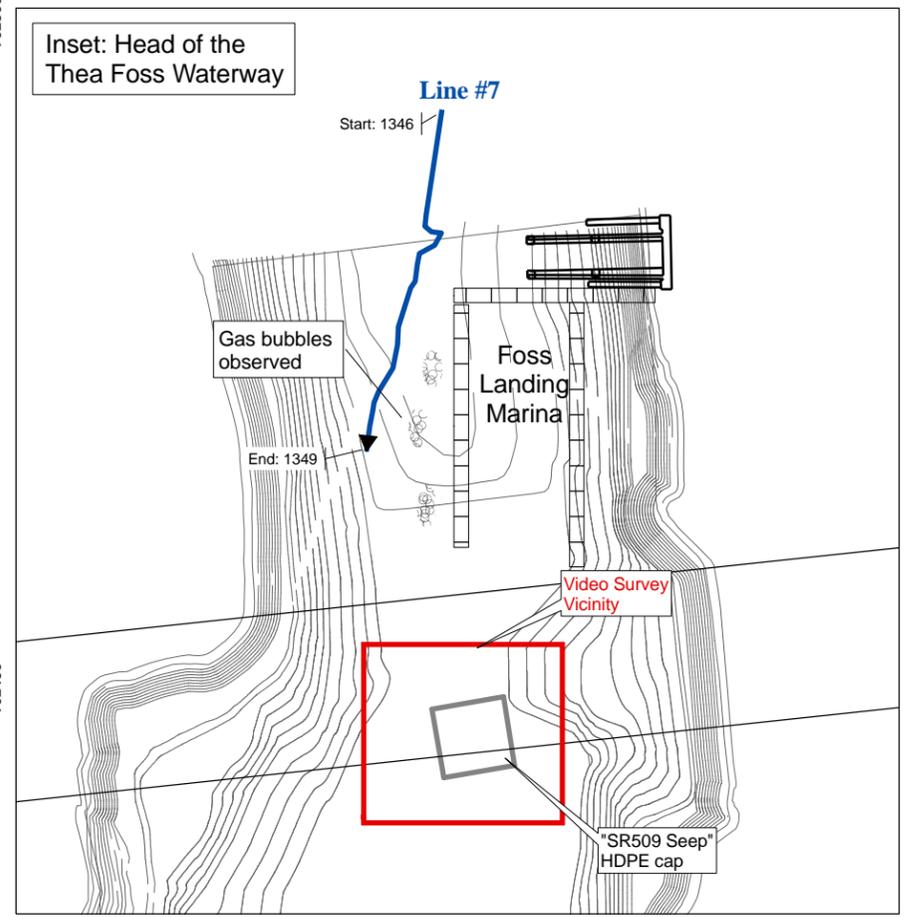
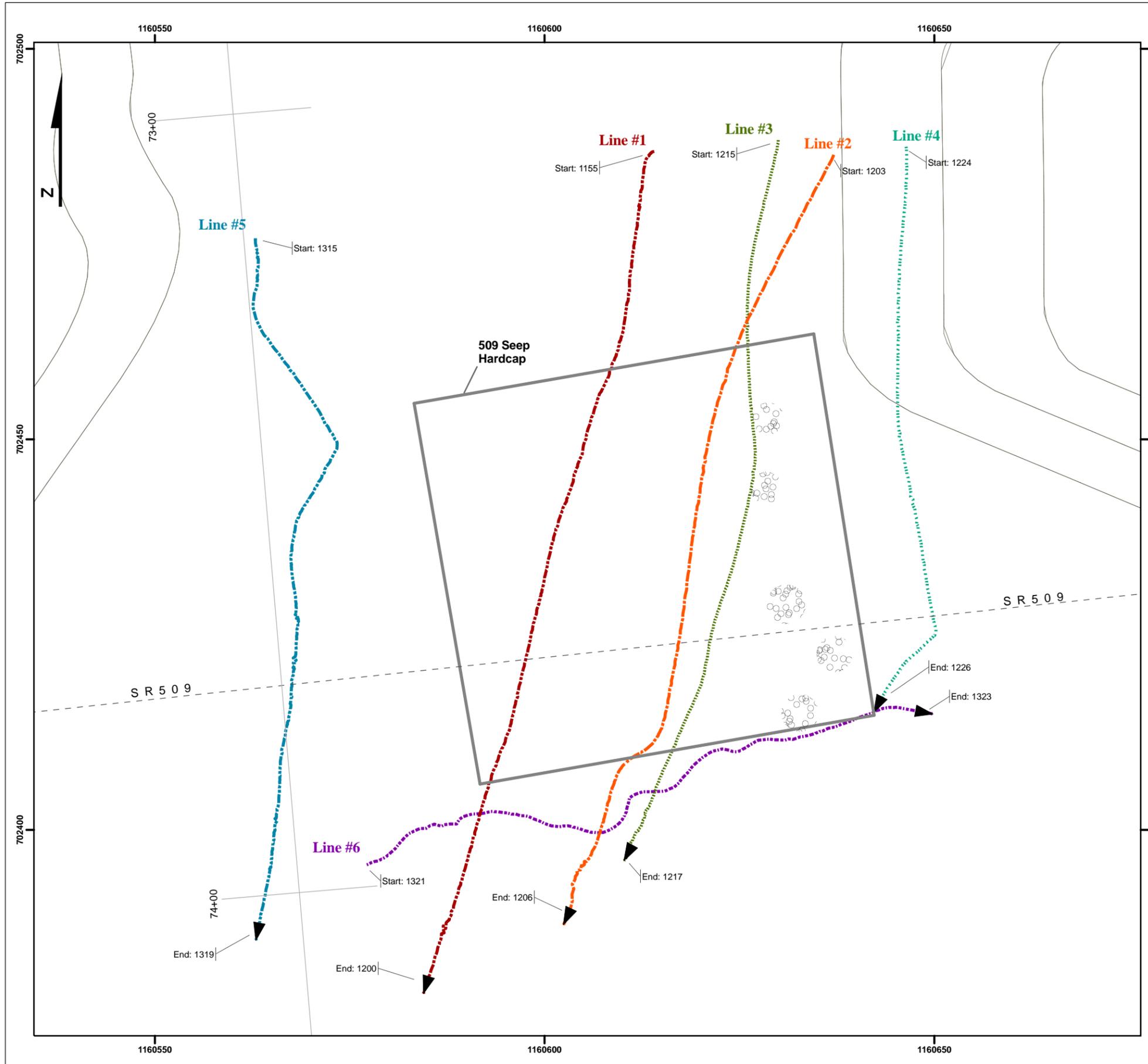
A TtECI jet boat was used to tow and position an underwater camera at the targeted locations and along transects. The vessel maintained an average speed of approximately 1- 2 knots while moving along transects and recording video. To achieve perspective of the observations, 2 lasers spaced 10 cm apart and aimed forward were attached to the underwater camera. These lasers can be seen in the recorded footage and can be used for scaling. Included, as Attachment 1, with this memo is a DVD that is a copy of the compiled digital video.

Due to the SR 509 overpass, DGPS could not be used for navigation. Therefore, an upland based Robotic Total Station (RTS) was used to log survey coordinates over the HDPE cap. Outside the SR509 overpass shadow, Differential GPS was used to record survey positions. All coordinates were logged in NAD83, Washington State plane, South Zone, US survey feet, and referenced to Washington Department of Transportation Monument #IS27119.

Survey personnel completed 6 transect lines over the HDPE cap with the camera in the water and recording. Three transects ran along the borders and 3 transects ran from North to South over the middle of the cap (Figure 2). Additional video was recorded along the waterway between 70+10 and 74+00 where rising bubbles were observed and above the water surface to document the location of active gas release. Locations where rising gas bubbles were observed were noted in the field logbook. If the bubbles persisted and if the vessel and camera could be positioned over the bubbles, video was recorded to document the bottom surface conditions. The video survey began at approximately 11:00 and ended at approximately 1400. No surface sheens or evidence of NAPL were observed during survey activities. A review of the video indicated that the sediment present at the sediment/water interface is silt and that the sand cap material can no longer be seen on the sediment surface. A summary of the observations made during a review of

the video survey is included below. Based on the observations made during the video survey, the SR509 Seep cap appears to be functioning as intended.

<b>Table 1. Summary of Thea Foss OMMP Video Survey</b>					
<b>Video File Name</b>	<b>Line #</b>	<b>Sediment Type</b>	<b>Active Bubbling</b>	<b>Marine Life</b>	<b>Observations</b>
050819-002	n/a	n/a	No	n/a	Area overview
050819-004	n/a	n/a	YES(surface)	n/a	Active bubbling on surface
050819-007	n/a	Silt	YES(surface)	n/a	Active bubbling on surface
050819-008	1	Silt	No	Vegetation, burrow holes	Bubbles attached to vegetation
050819-009	2	Silt	No	Vegetation, burrow holes	Bubbles attached to vegetation
050819-010	n/a	Silt	YES(surface)	n/a	Active bubbling on surface
050819-011	3	Silt	No	Vegetation, Crabs	Bubbles attached to vegetation
050819-012	4	Silt	No	Crabs	
050819-018	5	Silt	No	Vegetation, Crabs, Fish	Crab on camera
050819-019	6	Silt	No	Crabs	
050819-020	7	Large rocks, Silt	No	Vegetation, burrow holes	Large rocks for sheetpile wall buttress



Note: Survey conducted in Washington Stateplane, South Zone, NAD 83.

**Legend:**

- Video Survey Track Path with Start and End Time (Arrow Indicates Direction Traveled)
- Approximate Location of Observed Rising Gas Bubbles

0 25 50  
Feet

Video Survey Track Lines  
Thea Foss Waterway  
Tacoma, WA  
August 19, 2005

**TETRA TECH EC, INC.**

**Attachment 1 to Appendix E (on CD)  
Underwater Video Survey  
August 19, 2005**

**Appendix F (on CD)  
ARI Laboratory Data Sheets  
For:  
May 2005 Sampling Event**