

## **Commencement Bay Superfund Site — Project 3 (Thea Foss Waterway)**

### **Site Description**

The Thea Foss Waterway, the westernmost waterway in Commencement Bay, is part of the larger Commencement Bay Nearshore/Tideflats Superfund Site. The waterway extends north to south along approximately 1.5 miles of downtown shoreline (110 acres) in Tacoma, Washington. The Thea Foss Waterway site is approximately 1.2 miles in length by 600 feet in width, narrowing to approximately 400 feet in width. The Wheeler-Osgood Waterway, which runs east to west and is approximately 1,500 feet in length by 150 to 200 feet in width, enters the Thea Foss Waterway approximately halfway down the eastern shoreline. A portion of the width of the Thea Foss Waterway is a designated navigational channel. The waterway's submerged lands are largely state-owned aquatic lands, which are managed by the Washington State Department of Natural Resources.

### **Potential Responsible Parties**

In 2002, two groups agreed to take responsibility for cleaning up the Thea Foss Waterway: the City of Tacoma and the Utilities Group. The Utilities Group (the Utilities), which comprises three utility-related companies (Puget Sound Energy, PacifiCorp, and Advance Ross Sub-Company), agreed to take responsibility for finalizing the remedial design and conducting remedial action at the head of the Thea Foss Waterway (from just north of the SR 509 bridge to the southern end of the waterway); this area is now known as the Utilities' Work Area. The City of Tacoma (the City) took responsibility for completing the remedial design and conducting remedial action in the remainder of the Thea Foss Waterway, commonly referred to as the mouth (roughly from just north of the SR 509 bridge to the northern end of the waterway), and all of the Wheeler-Osgood Waterway. This area is referred to as the City's Work Area.

### **Threats and Contaminants**

The primary chemicals of concern (COCs) found throughout the waterways are cadmium, copper, lead, nickel, mercury, zinc, polycyclic aromatic hydrocarbons (PAHs), 2-methylphenol, 4-methylphenol, bis(2-ethylhexyl)phthalate (BEHP), butylbenzyl phthalate, and polychlorinated biphenyls (PCBs). In addition, nonaqueous-phase liquid (NAPL) seeps had been found at the head of the Thea Foss Waterway.

## **Cleanup Approach Update Since 2004**

### ***Remedial Action Areas***

The Thea Foss Waterway was divided into multiple Remedial Action (RA) areas, although not all areas were subject to active remediation; some were designated for no action, natural recovery, or enhanced natural recovery (City of Tacoma et al., 2006a). This discussion includes RA 19b, RA 20, RA 22, RA 23 and RA 24.

To delineate the City's Work Area from the Utilities' Work Area, the north-south waterway was divided by an east-west submarine sheetpile wall installed through RA 19b, RA 20 and RA 22; this wall forms a boundary between the two work areas. Included in the Utilities' Work Area were the southern portions of RA 19b, RA 20 and RA 22, and all of RA 23 and RA 24. The City was responsible for the northern portions of RA 19b, RA 20 and RA 22 and the rest of the waterway north of the sheetpile wall.

### ***Sediment Quality Objectives and Cleanup Objectives***

The Sediment Quality Objectives (SQOs) for the Commencement Bay Nearshore/Tideflats Superfund Site apply to the cleanup of surface sediment (0 to 10 centimeters [cm]) in the Thea Foss Waterway. The SQOs for the COCs in the Thea Foss Waterway (Dalton, Olmstead, and Fuglevand, Inc. [DOF], 2004) are:

- PCBs—300 micrograms per kilogram ( $\mu\text{g}/\text{kg}$ )
- BEHP—1,300  $\mu\text{g}/\text{kg}$
- Low-molecular-weight PAHs (LPAH)—5,200  $\mu\text{g}/\text{kg}$
- High-molecular-weight PAHs (HPAH)—17,000  $\mu\text{g}/\text{kg}$
- 2-methylphenol—63  $\mu\text{g}/\text{kg}$
- 4-methylphenol—670  $\mu\text{g}/\text{kg}$
- Cadmium—5.1 milligrams per kilogram ( $\text{mg}/\text{kg}$ )
- Copper—390  $\text{mg}/\text{kg}$

- Lead—450 mg/kg
- Mercury—0.59 mg/kg
- Nickel—140 mg/kg
- Zinc—410 mg/kg.

The first Explanation of Significant Differences (ESD) from the 1989 Record of Decision (ROD) was published in August 2000. In September 2004, the Environmental Protection Agency (EPA) issued a second ESD (EPA 2004a) to clarify the remedy. The discussion presented here is based on requirements of the 2004 ESD. Differences between the August 2000 and September 2004 ESDs addressed such issues as temporary storage areas for dredged sediments; sources of capping material; the estimated final volume of dredged sediments; habitat mitigation projects and the total acreage required; federal deauthorization of the navigation channel (representatives of the Utilities are working with Congressional staff to achieve deauthorization); institutional controls; the cleanup remedy for the NAPL seep area; and estimated project costs. The 2004 ESD (EPA, 2004a) established cleanup objectives for the Utilities' Work Area. A minimum 3-foot thick cap was required to:

- Isolate the sediment from the environment
- Prevent resuspension and transport of impacted sediments within the waterway
- Prevent sediments from being transported through groundwater
- Provide a surface for the recolonization of aquatic organisms.

The final remedial design for a cap over an area of NAPL seeps (DOF, 2004) was required to demonstrate that:

- Hydraulic control can prevent remobilization of NAPL within the waterway
- The cap can prevent recontamination from any source below the cap
- The cap will require minimal maintenance

- NAPL stabilization includes the removal of the source material.

***Remedial Action at the Head of the Thea Foss Waterway***

The EPA approved the Utilities' final remedial design for the head of the Thea Foss Waterway in November 2003. In the remedial design, the Utilities' Work Area was further divided into 11 subareas:

- Transition Zone
- North Waterway
- Central Waterway (deep and shallow zones)
- South Waterway
- SR-509 Seep Area
- East Bank Slopes
- West Bank Slopes
- South Bank Slopes
- Standard Chemical Remediation Area
- Slopes with Existing Riprap
- Foss Landing Marina.

In September 2003, the Utilities initiated in-water remedial activities in the Utilities' Work Area; construction of the Utilities' remedy was completed in February 2004. The Utilities received a Certificate of Completion of Remedial Action Construction from the EPA in September 2006 for the completion of remedial action construction activities in RA 23 and RA 24 as set forth in paragraph 50 of the May 2003 Consent Decree. As of September 2006, the Utilities had not received a Certificate of Completion for remedial action construction activities in RA 23 and RA 24 as set forth in paragraph 51.B of the 2003 Consent Decree (Tetra Tech, 2006).

Actions completed in the 11 subareas during the 2003-2004 construction season (DOF, 2004) are described below. Wilder Construction (the prime contractor) and Miller Contracting (subcontractor to Wilder Construction) completed the in-water remedial activities. Construction activities included the demolition of shoreline buildings and structures and the debris removal from the demolished structures such as covered wooden docks with floats, wooden piers, bulkheads and pilings, asphalt paving, and steel pipe piles. Costs incurred by the Utilities between 1999 and 2004 for remedial action in the Utilities' Work Area totaled \$11.5 million.

#### *Transition Zone*

The Transition Zone demarcates the Utilities' Work Area from the City's Work Area. A submerged sheetpile wall was installed by General Construction (a subcontractor to Wilder Construction), and a riprap buttress was placed on the north side of the sheetpile wall (the City was responsible for completing the placement of the rip rap and a 1 foot habitat layer on the north side). The purpose of the sheetpile wall was to provide stability between the two work areas, as well as to prevent sediments on the north side from eroding into the south side during remedial activities.

#### *North Waterway*

Debris was removed from this area, and a 3-foot-thick cap of waterway capping material was placed to contain the sediment. The waterway capping material was applied using a barge-mounted, fixed-arm excavator.

#### *Central Waterway—Shallow Zone*

Debris was removed from this area, and a 3-foot-thick cap of waterway capping material was placed to contain the sediment. The waterway capping material was applied using a barge-mounted, fixed-arm excavator. The toe of slope along the southwest bank was filled, and the contours along the north bank were reconfigured.

#### *Central Waterway—Deep Zone*

Debris was removed and a waterway cap was placed to an elevation of -9 feet mean lower low water using a barge-mounted, fixed-arm excavator, providing a turning basin for recreational vessels.

### *South Waterway*

Approximately 5,498 tons of sediment was dredged from the waterway near a pair of 96-inch outflows. The dredged sediments were temporarily stockpiled within the Upland Rehandling Facility in a lined containment cell and allowed to drain. Water that drained from the containment cell was collected and pumped to a wastewater holding tank for disposal. Sediments were hauled by truck and trailers, lined with polyethylene sheeting, to the Land Recovery, Inc. landfill in Pierce County, Washington, for proper disposal.

The areas surrounding the outfall scour protection were capped with waterway capping material, and the cap was provided with protection against erosion by the outfall discharges.

### *SR-509 Seep Area*

A 75-foot by 60-foot cap constructed of thick high-density polyethylene was placed over a localized area of underwater NAPL seeps and topped with an 18-inch-thick layer of sand. Wilder Construction installed the impermeable cap at low tide using barge-mounted and land-based winches.

### *East Bank, West Bank, and South Bank Slopes*

Outfalls 238, 239, and 240 to 243 were extended beyond the new cap. Scour protection was placed in front of Outfalls 235, 237a, 237b, and 243. Debris was removed and a toe berm was constructed using armor material. The slope was then capped, and a habitat layer was placed over the slope material. Slope cap and slope armor materials were placed using long-arm excavators.

### *Standard Chemical Remediation Area*

The Washington State Department of Ecology was responsible for cleanup in the uplands area at the head of the Thea Foss Waterway. The purpose was to remove NAPL sources before a cap was placed near the former Standard Chemical Company area. The slopes were capped with armor material using long-arm excavators and covered with a habitat layer.

#### *Slopes with Existing Riprap*

The littoral marine habitat zone was increased by constructing a slope toe berm and capping it with armor material and a habitat layer.

#### *Foss Landing Marina*

Propeller scour protection was provided under the marina by installing a 2.5-foot-thick cap in the waterway. A 0.5-foot-thick slope cap was placed over the waterway cap, and steel pilings were installed for the marina.

#### ***Remedial Action at the Mouth of the Thea Foss and Wheeler-Osgood Waterways***

The mouth of the Thea Foss and Wheeler-Osgood Waterways was remediated by the City, with contributions from other entities. Following completion of remedial action in the City's Work Area, the City received a Certificate of Completion of Remedial Action Construction from the EPA in September 2006.

Actions completed during the 2003-2004 construction season are described below, along with some related activities that occurred before and after the construction season. Capping operations were conducted by Manson Construction Company (MCC) and Brundage-Bone Concrete Pumping. The cost of cleanup work performed by the City between 1994 and 2006, as well as some follow-up monitoring, is estimated at \$90 million (City of Tacoma, 2007). The EPA fined the City \$358,000 for missing several cleanup deadlines, specifically for missing the completion of the confined disposal facility (CDF) berm in December 2004 at the head of the St. Paul Waterway.

#### *Related and Support Activities*

Before beginning the remedial action, the City identified potential sources of recontamination and implemented enhancements to its stormwater program (increased monitoring, inspections, and public education) to prevent recontamination.

In the fall of 2003, the City began construction of a CDF at the head of the St. Paul Waterway to contain sediment dredged from the Thea Foss Waterway. In July 2004, construction of a log haul-out facility in the Middle Waterway was initiated to replace an existing log haul-out at the head of the St. Paul Waterway that was displaced by the CDF. The CDF was subsequently capped and closed in early 2005. The City dredged

381,810 cubic yards (cy) of sediment from the St. Paul Waterway to create the disposal site. The top 35 percent of this material was sent to the Dredged Materials Management Plan (DMMP) site in Commencement Bay. The remaining 65 percent of clean sediment went to the Puyallup River to add to the new delta (thereby reducing the City's tipping fees for disposal at the DMMP site), a habitat for migrating salmonids.

In the fall of 2004, the City constructed a temporary marina in front of the Tacoma Glass Museum and Albers Mill for use while cleanup was conducted at four existing marinas on the waterway.

#### *Remedial Actions*

Dredging and capping activities were conducted on the west bank and shoreline in front of the Tacoma Glass Museum and Albers Mill (RA 19a and RA 19b). The area was hydraulically dredged and capped with sand and a grout mat (geotextile fabric with concrete pumped-in between two layers of fabric). The purpose of the cap and mat was to contain the remaining sediments and address potential future NAPL releases in this area. Approximately 31,065 cy of material was dredged from RA 19a and RA 19b. Sediments dredged from this location were placed in the St. Paul Waterway CDF. Final cap quantities included 12,813 tons of slope cap filter material; 13,309 tons of light loose riprap; 2,129 tons of habitat material; and 32,553 tons of imported channel sand cap placed by clamshell (31,869 tons) and Telebelt (684 tons) (City of Tacoma et al., 2006a).

The area north of the sheetpile wall within the City's Work Area (RA 20, RA 21 and RA 22) was dredged and capped between August 2004 and February 2006 by MCC. MCC initially used a standard open digging bucket, but switched to an environmental dredging bucket after uncovering significant amounts of wood debris and sawdust. A silt curtain and absorbent boom were employed in the dredge area to prevent material from migrating to the Utilities' Work Area. In November 2005, the City completed hydraulic dredging from the sheetpile wall northward. Final capping of the waterway was completed in February 2006. The final volumes for dredge and capping material are as follows (City of Tacoma et al., 2006a):

- **RA 20** - Approximately 12,289 cy of dredge material was removed by clamshell and transported by dump scow to the CDF for disposal. Final cap quantities included approximately 5,499 tons of slope cap filter material; 7,889 tons of light loose riprap; 1,930 tons of quarry spalls; 1,037 tons of habitat mix; and 15,247 tons of imported channel sand cap.



- RA 21 - Approximately 13,554 cy of material was dredged by clamshell and transported by dump scow to the CDF for disposal. RA 21 was capped concurrently with RAs 20 and 22. A total of 12,965 tons of imported channel sand was placed by Telebelt.
- RA 22 - Approximately 4,665 cy of material was dredged and disposed of in the CDF. Capping was accomplished in conjunction with RA 20 by clamshell placement. A total of 4,486 tons of imported channel sand capping was accomplished by Telebelt.

### **Habitat Mitigation**

To comply with Section 404 of the Clean Water Act, the City was required to mitigate for approximately 13 acres of habitat impacted by the St. Paul Waterway CDF and by remedial activities in the Thea Foss Waterway. All habitat mitigation projects were completed by August 2006.

The mitigation sites for this project included (City of Tacoma et al., 2006a):

- Shallow areas on the St. Paul Waterway berm where juvenile salmon could adjust to salt water
- Underwater bench areas and vegetation in the Middle Waterway corridor
- Nine acres of brackish marsh at the head of the Middle Waterway, including a 10- to 15-foot-wide vegetation buffer that allows fresh water to infuse the marsh, thereby decreasing salinity in the sediments to accommodate brackish intertidal plants
- The Puyallup River Side Channel, several pocket beaches throughout the Thea Foss Waterway and the Bunker mitigation site on Hylebos Creek.

### **Sampling for Verification and Monitoring**

#### *Pre-Dredge and Post-Dredge Verification Sampling*

In anticipation of the dredging and capping activities in the City's Work Area during the 2004 – 2005 construction season and to provide a baseline to evaluate the possible effects of dredging on sediment quality, "pre-dredge" and "post-dredge" samples were

obtained from both the City's and the Utilities' Work Areas (DOF and Tetra Tech, 2005).

- *August 2004* - Pre-dredge surface sediment samples were collected from the Utilities' waterway cap in the Utilities' Work Area south of the sheetpile wall (prior to the City dredging materials adjacent to the transitional sheetpile wall just north of the Utilities' Work Area). Samples were collected by Floyd-Snider and Parametrix (subcontractors for the City) and Tetra Tech-FW (a subcontractor for the Utilities). Floyd-Snider and Parametrix collected split samples for the City, the samples were divided between the City and the Utilities and then sent to two different labs for analysis.
- *September and November 2004* - Post-dredge surface sediment samples were collected in both the Utilities' Work Area and the City's Work Area (just after the initial dredging and capping in the City's Work Area was completed). Parametrix collected samples for the City and Tetra Tech-FW collected samples for the Utilities. Floyd-Snider collected split samples for both the City and Utilities.
- *November and December 2004* - Post-dredge core samples (by Parametrix and Tetra Tech-FW) and surface samples (by Tetra Tech-FW) were collected in both the Utilities' Work Area and the City's Work Area; Parametrix collected split samples. The post-dredge sampling indicated recontamination of the Utilities' cap had occurred during the City's dredging and capping activities.

The verification samples indicated two areas of recontamination:

- During the City's dredging and capping activities north of the sheetpile wall, a sediment release occurred in the northeast portion of the cleanup area adjacent to Foss Landing Marina, and "surface sediment quality had degraded to the point where SQOs for multiple constituents were exceeded" (DOF and Tetra Tech, 2005).
- At the head of the waterway, BEHP and PAH recontamination was associated with discharge from the City's stormwater outfalls (DOF and Tetra Tech 2005).

The City was responsible for placing a second cap on top of the northeast corner of the Utilities' cap to contain the recontamination. This occurred in December 2005 (City of Tacoma and Floyd|Snider, 2007).

*Year 0 Operations, Maintenance, and Monitoring Plan (OMMP) Sampling (2004)*

In April 2004, Year 0 sampling was conducted by the Utilities and the City. The Year 0 sampling had two purposes: (1) to provide data for assessing the chemical quality of in-place capping materials (i.e., cap verification) and (2) to provide baseline data for assessing contamination of capping materials, either from underlying contaminated materials (i.e., bottom-up contamination) or from sources such as stormwater discharge (i.e., top-down contamination). Sediment samples were collected by DOF (the on-site Utilities' Oversight Manager) and Tetra Tech-FW (a subcontractor for the Utilities) throughout the Utilities' Work Area from north of the SR 509 bridge to the southern end of the waterway (DOF and Tetra Tech 2005) and included waterway cap compliance samples, compliance samples were surface samples taken from the upper 0 to 10 cm of the installed cap; slope cap samples were taken from 0 to 10 cm; "early warning" samples were surface samples (taken from the upper 0 to 2 cm) and sediment core samples from the waterway.

The Year 0 sediment quality data indicated that stormwater constituents with potential to exceed SQOs in the future were accumulating on the cap. The samples collected were analyzed for BEHP, metals, PAHs, and PCBs. None of the constituents analyzed in the 0-10 cm samples exceeded SQOs, higher concentrations of constituents were found in the 0-2 cm samples as compared to the 0-10cm samples. BEHP exceeded the SQOs and PAHs were detected at higher percentages of the SQOs. COC concentrations in core samples collected throughout the Utilities' Work Area did not exceed SQOs and did not indicate bottom-up migration from underlying sediment (DOF and Tetra Tech, 2005).

*Year 1 OMMP Sampling (2005)*

The Year 1 OMMP sampling included the collection of early warning sediment samples and visual monitoring, including an underwater video survey, of the SR 509 seep area. The Utilities and the City also collected supplemental compliance samples, and the City collected additional sediment samples from its work area in RA 19b, RA 20, and RA 22 (DOF, 2005).

Physical observations of the Utilities' Work Area were made during low tide to detect any erosion of the cap during the first year of operation and maintenance. Observations indicated that the scour protection apron was functioning properly and there were no signs of erosion. Minor channels of erosion were observed in the waterway cap; they were local and did not appear to have adversely impacted the integrity of the cap. No NAPL sheens were observed in the SR 509 seep area (DOF, 2005).

OMMP sampling indicated approximately 1 to 11.5 cm of fine grained material accumulated over the capping materials within the Utilities' Work Area. Sampling indicated that sediment thicknesses had increased 3.5 to 4.5 cm from the Year 0 sampling event (DOF, 2005).

Sediment samples collected during the Year 1 OMMP sampling event were analyzed for PAH, lead, zinc, mercury, BEHP and PCBs. Due to the recontamination of the Utilities cap, the Utilities' samples were analyzed for additional constituents such as diesel and heavy-oil, arsenic, copper, nickel, dibenzofuran, and pesticides. The Utilities' samples were analyzed by Analytical Resources, Inc. (ARI); the City's samples were analyzed by Severn Trent Laboratories (STL). No semi-volatile organic compounds, pesticides, PCBs, arsenic or mercury were detected in the capping material. Copper lead, nickel and zinc were detected at concentrations below the criteria for the state of Washington (DOF, 2005).

SQOs for mercury, PAHs, BEHP, and total PCBs were exceeded in compliance and early warning sediment samples. The highest exceedances were detected in samples from stations near the sheetpile wall and the area between the sheetpile wall and the SR 509 Bridge (DOF, 2005).

#### *Year 2 OMMP Sampling (2006)*

Tetra Tech EC was contracted to perform the Year 2 OMMP sampling for the Utilities Work Area. The Year 2 OMMP activities consisted of physical observations, recolonization monitoring, and collection of sediment samples. Physical observations were consistent with Year 0 and Year 1, i.e., there were no signs of erosion excepting a small, shallow channel in the apron and no NAPL sheen was observed in the SR 509 seep area. A bathymetry survey conducted in 2006 was compared to the 2004 baseline bathymetry survey; both increases and decreases in elevation were observed throughout the waterway (Tetra Tech, 2006).

Waterway cap compliance samples were collected from the Utilities Work Area, with oily sheens and sheen spots being observed in the top silt layer at two locations, the thickness of fine-grained material ranged from 0.5 to 17 cm throughout the waterway cap area, greatest in the central area south of SR 509 seep and north of the scour protection. The compliance samples collected from within the northern section of the Utilities' Work Area, where the City's dredging activities caused recontamination of the cap, had accumulated 1 cm of material on top of the capping material placed in December 2005. Waterway cap compliance samples from south of the SR 509 bridge exceeded SQOs for PAHs, BEHP, and phenol. Most of the exceedances occurred in samples from the southeast corner of the head of the waterway, near the scour protection apron. COC concentrations in slope cap samples were below the SQOs with the exception of two samples in which BEHP was detected. All of the early warning samples, which were collected from north and south of the SR 509 bridge, contained BEHP above the SQOs. All of the core samples contained concentrations below the SQOs (Tetra Tech, 2006).

Recolonization monitoring was established to assess the success of the remediation at restoring a healthy benthic community in the waterway. During implementation of the remedy, dredging and capping eliminated non-mobile benthos over approximately 8.8 acres of the Utilities' Work Area. The bottom sediment created by the cap fill was expected to recolonize with infauna and epifauna. As part of the Utilities' OMMP, sediment profile imagery (SPI) was used to evaluate habitat recolonization. The secondary method involved the collection and analysis of benthic infauna samples. SPI confirmed that recolonization had occurred; it also indicated a substantial deposition of new sediment in the area surveyed since the capping operations were completed.

#### *Key Findings of Verification and Monitoring Sampling to Date*

Since installation of the Utilities' cap, sediment has accumulated on top of the cap and the thicker layers of fine-grained material contain concentrations of COCs that have increased since remedial activities were completed. COC concentrations are higher in the early warning samples than in the compliance samples in Year 1, and in Year 2, both early warning and compliance samples exhibited higher COC concentrations than in previous years (except for the area that was recapped by the City in 2005). In particular:

- The areal extent of BEHP in surface sediment has increased in size and concentration over the two-year period.

- Total HPAH concentrations showed a similar trend as BEHP, with exceedances increasing over the two-year period.
- Total LPAH concentration also increased over the two-year period, although no samples exceeded the SQOs for LPAH.
- PCB concentrations also increased over the two-year period. Concentrations in the early warning samples were consistently higher than in the compliance samples, although no samples exceeded the SQO of 300 µg/kg. The highest PCB concentrations occurred in samples collected under the SR 509 bridge (Tetra Tech, 2006).

#### **Future Activities**

The City is scheduled to perform operations, maintenance and monitoring of the waterway over the next 10 years. The City is planning to monitor the sediments, the benthic community, and the integrity of the cap installed in the City's Work Area; perform hydrographic surveys; monitor the sediment disposal site through qualitative observations and groundwater monitoring; and monitor the success of the habitat mitigation sites. The City is not monitoring the water column in the Thea Foss Waterway as part of this project (Mary Henley, City of Tacoma Project Manager, personal communication, September 26, 2007).

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