THEA FOSS AND WHEELER-OSGOOD WATERWAYS REMEDIATION PROJECT

REMEDIAL ACTION CONSTRUCTION REPORT

SEPTEMBER 2006





Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY

Prepared by:

CITY OF TACOMA
KPFF CONSULTING ENGINEERS
FLOYD|SNIDER

THEA FOSS AND WHEELER-OSGOOD WATERWAYS REMEDIATION PROJECT

REMEDIAL ACTION CONSTRUCTION REPORT

SEPTEMBER 2006

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY

Prepared by:

CITY OF TACOMA
KPFF CONSULTING ENGINEERS
FLOYD|SNIDER

Table of Contents

List of Tables, Figures and Appendices

TABLES

FIGURES

Appendices

Acronyms and Abbreviations

2LAET	2nd Lowest Apparent Effects Threshold
AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
ARI	Analytical Resources, Inc.
Army EOD	U.S. Army Explosives Ordnance Disposal
BMP	Best Management Practices
CAD	Confined Aquatic Disposal
CB/NT	Commencement Bay Nearshore/Tideflats
CDF	Confined Disposal Facility (i.e., St. Paul Waterway CDF)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHB	Citizens for a Healthy Bay
City	City of Tacoma
CM Team	Construction Management Team
CMU	Concrete Masonry Unit
COC	Chemicals of Concern
Corps	U.S. Army Corps of Engineers
CPAH	Carcinogenic Polycyclic Aromatic Hydrocarbons
CQAP	Construction Quality Assurance Plan
CQC	Construction Quality Control
CWM Landfill	Chemical Waste Management Landfill in Arlington, OR
CY	Cubic Yard
DEA	David Evans and Associates
DO	Dissolved Oxygen
DRET	Dredging Elutriate Test
Ecology	Washington State Department of Ecology
EDMS	Electronic Document Management System
EODT	EOD Technology
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESD	Explanation of Significant Differences
FSP	Field Sampling Plan
FWDA	Foss Waterway Development Authority
Golder	Golder and Associates
HPAH	High Molecular Weight Polycyclic Aromatic Hydrocarbons
LHOF	Log Haul Out Facility
LPAH	Low Molecular Weight Polycyclic Aromatic Hydrocarbons
LWD	Large Woody Debris
Manson	Manson Construction Company
MDL	Method Detection Limits
MET	Modified Elutriate Testing
MHHW	Mean Higher High Water
MLLW	Mean Lower Low Water
MOA	Memorandum of Agreement
MS	Matrix Spike
MSD	Matrix Spike Duplicate

MWTF	Middle Waterway Tideflat Habitat
NPL	National Priorities List
NTU	Nephelometric Turbidity Unit
O&M	Operation and Maintenance
OMMP	Operation, Maintenance and Monitoring Plan
OVRA	Olympic View Resource Area
PAH	Polycyclic Aromatic Hydrocarbon
PAS	Performance Abatement Services
PCB	Polychlorinated Biphenyl
PEC	Pacific Erosion Control
PQL	Practical Quantitation Limit
PRP	Potentially Responsible Party
PRSC	Puyallup River Side Channel
PSDDA	Puget Sound Dredged Disposal Analysis
QAPP	Quality Assurance Project Plan
RA	Remedial Area or Remediation Area
Rabanco Landfill	Rabanco's Roosevelt Regional Landfill
RACR	Remedial Action Construction Report
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RFC	Request for Change
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
ROW	Right of Way
SARA	Superfund Amendments and Reauthorization Act
Scarsella	Scarsella Brothers
SF	Square Foot
SQO	Sediment Quality Objective
SR 509	State Route 509
STL	Severn Trent Laboratories
SVOC	Semivolatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
TCU	Temporary Containment Unit
TPCHD	Tacoma-Pierce County Health Department
TSS	Total Suspended Solids
UAO	Unilateral Administrative Order
USM	Uniform Section Mat
UST	Underground Storage Tank
UXO	Unexploded Military Ordnance
WQC	Water Quality Certification

Bibliography

City of Tacoma. 1989. Draft Surface Water Quality Study. Public Works Department Sewer Utility. April 1989.

City of Tacoma. 1995a. Compilation of Existing Data, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington. January 12, 1995.

City of Tacoma. 1995b. Remedial Design Work Plan, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington. March 31, 1995.

City of Tacoma. 1995c. Round 1 Data Evaluation Report, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington. May 30,1995.

City of Tacoma. 1996. Screening of Remedial Options Report, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington. November 15, 1996.

City of Tacoma. 1997a. Round 2 Data Evaluation Report, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington. January 17, 1997.

City of Tacoma. 1997b. Technical Memorandum, Remedial Acton Alternative, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington. December 10, 1997.

City of Tacoma. 1999. Final Round 3 Data Evaluation and Pre-Remedial Design Evaluation Report, Thea Foss and Wheeler-Osgood Waterways, Tacoma, Washington. September 30, 1999.

City of Tacoma. 2002a. Memorandum of Understanding (MOU) for the Thea Foss Master Lease Agreement between the City of Tacoma, the Foss Waterway Development Authority and the Washington State Department of Natural Resources (DNR). August 2002.

City of Tacoma. 2002b. Settlement and Escrow Agreement for the Thea Foss and Wheeler-Osgood Waterways Problem Areas. August 30, 2002.

City of Tacoma. 2003a. Final Design, Design Analysis Report, Thea Foss and Wheeler-Osgood Waterways Remediation/St. Paul Confined Disposal Project, Tacoma, Washington. January 31, 2003.

City of Tacoma. 2003b. Memorandum of Understanding for Allocation of Total Response Costs at the Thea Foss Waterway Project. March 6, 2003.

City of Tacoma. 2003c. Remedial Action Documents, Thea Foss and Wheeler-Osgood Waterways Remediation Project, Tacoma, Washington. December 18, 2003.

City of Tacoma. 2003d. Settlement Agreement. August 21, 2003 (DNR).

City of Tacoma. 2003e. St. Paul Waterway, Confined Disposal Facility and Habitat Restoration Project Memorandum of Agreement (CDF MOA) between the City of Tacoma and Simpson. July 28, 2003.

Ecology. 1993a. Milestone 1 Source Control Status Report for the Head and Mouth of Thea Foss Waterway Problem Areas in the Commencement Bay Nearshore/Tideflats Superfund Site. July 1, 1993.

Ecology. 1993b. Milestone 2 Source Control Status Report for the Mouth of the Thea Foss Waterway Problem Area, Commencement Bay Nearshore/Tideflats Superfund Site. June 30, 1993.

Ecology. 1994. Addendum to the Milestone 1 Source Control Status Report for the Head and Mouth of Thea Foss Waterway Problem Areas in the Commencement Bay Nearshore/Tideflats Superfund Site. April 7, 1994.

Ecology. 1995. Milestone 2 Source Control Status Report for the Head of the Thea Foss Waterway Problem Area, Commencement Bay Nearshore/Tideflats Superfund Site. July 19, 1995.

Ecology. 2003a. Milestone 3 Source Control Status Report for Head of Thea Foss Waterway Problem Area, Commencement Bay Nearshore/Tideflats Superfund Site. March 28, 2003.

Ecology. 2003b. Milestone 4 Source Control Status Report for Head of Thea Foss Waterway Problem Area, Commencement Bay Nearshore/Tideflats Superfund Site. March 13, 2003.

Ecology. 2003c. Milestone 5 Source Control Status Report for Head of Thea Foss Waterway Problem Area, Commencement Bay Nearshore/Tideflats Superfund Site. March 28, 2003.

EPA. 1989. Commencement Bay Nearshore/Tideflats Record of Decision. USEPA, Region 10, Seattle, Washington. September 30, 1989.

EPA. 1994a. Administrative Order on Consent (AOC) for Remedial Design Study Between the City of Tacoma and U.S. EPA, Region 10.

EPA. 1994b. Contaminated Sediment Management Strategy. USEPA 823-R-94-001.

EPA. 1997. Explanation of Significant Difference-PCB, Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, Washington. July 1997.

EPA. 2000a. Explanation of Significant Differences, Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, Washington. August 2000.

EPA. 2000b. Substantive Compliance with Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, Washington. Prepared by EPA, Region 10, Seattle, Washington.

EPA. 2002a. United States Environmental Protection Agency Region 10, Unilateral Administrative Order for Remedial Design and Remedial Action, Commencement Bay Nearshore/Tideflats Superfund Site, Thea Foss and Wheeler-Osgood Waterways. September 30, 2002.

EPA. 2002b. Statement of Work. Remedial Action and Long-Term Monitoring. Thea Foss and Wheeler-Osgood Waterways. Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, Washington.

EPA. 2003. RD/RA Consent Decree. Thea Foss and Wheeler/Osgood Waterways Problem Areas. Commencement Bay Nearshore/Tideflats Superfund Site. United States of America, Plaintiffs, v. Atlantic Richfield Company et al., May 9, 2003. Civil Action No. C03-5117RJB.

EPA. 2004. Explanation of Significant Differences, Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, Washington. September 2004.

EPA, USACE, Department of Natural Resources and Ecology. 1994. Interagency Agreement-Contaminated Sediment Strategy.

NOAA. 2004. Biological Opinion and Essential Fish Habitat Consultation for the Thea Foss and Wheeler-Osgood Waterways Superfund Remediation Action, Commencement Bay Nearshore/Tideflats Superfund Site, Tacoma, Washington (HUC 17110019, Puget Sound).

PacifiCorp. 2003. Head of the Thea Foss Waterway Remediation Project, Tacoma, Washington, Operations, Maintenance and Monitoring Plan. August 27, 2003.

PacifiCorp. 2004. Head of the Thea Foss Waterway Remediation Project, Tacoma, Washington, Remedial Action Construction Report. June 9, 2004.

Tetra Tech. 1985. Commencement Bay Nearshore/Tideflats Remedial Investigation. Prepared by Tetra Tech, Inc., Bellevue, Washington, for Washington Department of Ecology and U.S. Environmental Protection Agency. August 1985.

Tetra Tech. 1988. Commencement Bay Nearshore/Tideflats Feasibility Study. Volume 1. Prepared by Tetra Tech, Inc, Bellevue, Washington, for Washington Department of Ecology and U.S. Environmental Protection Agency. December 1988.

Washington State Department of Natural Resources. 2003. Aquatic Land Use Authorization No. 22-074977. September 8, 2003.

1.0 INTRODUCTION

This Remedial Action Construction Report (RACR) presents the remedial actions and construction activities performed as part of the Thea Foss and Wheeler-Osgood Waterways Remediation Project. The remedial actions and construction activities described in this report were performed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act (SARA) otherwise known as Superfund. The Thea Foss and Wheeler-Osgood Waterways Remediation Project area is part of one of the six operable units (Operable Unit 01 – CB/NT Sediments) within the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund site. Three of the nine problem areas identified in Operable Unit 01 are addressed.

The CB/NT Superfund site is located in Tacoma, Washington, at the southern end of Puget Sound. The site includes 10-12 square miles of shallow water, shoreline, and adjacent land, most of which is highly developed and industrialized. The tideflats portion of the site includes the Thea Foss and Wheeler-Osgood Waterways, along with portions of several other waterways (Figure 1).

The Wheeler-Osgood Waterway was historically a branch of the Puyallup River, and is currently a shallow, privately-owned channel connected to the east side of the Thea Foss Waterway at approximately its midpoint. The shoreline area surrounding the Wheeler-Osgood Waterway is primarily in industrial use or properties are vacant at this time.

The Thea Foss Waterway is 8,000 feet long and is the southernmost waterway within Commencement Bay. The Thea Foss Waterway is adjacent to downtown Tacoma, and the shoreline areas surrounding the waterway were historically used for various industrial activities. The majority of the western shoreline, however, has been vacant for over 20 years. The City of Tacoma (City) acquired these Brownfield properties in 1991 for cleanup and redevelopment. To date, a museum, numerous commercial businesses, as well as residential units have been or are in the process of being developed on some of these properties. Property uses on the eastern shoreline include commercial activities such as marinas and restaurants, as well as industrial activities such as shipbuilding and petroleum storage.

Remediation of the Thea Foss and Wheeler-Osgood Waterways began in November 2002, when the City voluntarily entered into a Unilateral Administrative Order (UAO) issued by the U.S. Environmental Protection Agency (EPA) on September 30, 2002. Work was performed in the following six areas (Figure 2) and is documented in the UAO Remedial Action Construction Report for 2002 Construction Activities dated April 2003:

- Remedial Area 1 – Thea's Park, Slope Capping
- Remedial Area 3– Totem Marine Services, Slope Capping
- Remedial Area 8 – Johnny's Seafood, Sheet Pile Wall
- Remedial Areas 10, 11, and 13 – Wheeler-Osgood Waterway, Slope Capping, and Bank Rehabilitation

- Remedial Area 14 – Martinac Shipbuilding, Debris Removal and Slope Capping
- St. Paul/Middle Waterway Peninsula, Piling Removal

This RACR documents remedial construction activities performed by the City, which occurred during the 2003-2004, 2004-2005, and 2005-2006 in-water construction seasons. This work was performed in accordance with the Remedial Action Consent Decree lodged by the EPA on March 3, 2003, and entered by U.S. District Court on May 9, 2003.

Work on the project began in stages as the City continued to work with EPA and others for final approval of the design for the project. Interim Water Quality Certifications (WQC) were issued allowing specific in-water activities to begin (Appendix A). The following are the Water Quality Certificates issued for the project:

- Interim Water Quality Certification dated July 28, 2003, for CERCLA Remedial Action – Mobilization, Piling Removal, Pile Driving – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways;
- Interim No. 2 Water Quality Certification dated August 22, 2003, for CERCLA Remedial Action – RA 19 Piling Removal, Log Haul Out Facility Dredging – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways;
- Interim No. 3 Water Quality Certification dated September 30, 2003, for CERCLA Remedial Action – Selected Elements of 2003 In-Water Work – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways;
- Interim No. 4 Water Quality Certification dated November 10, 2003 – Remaining Elements of 2003-2005 In-Water Work – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways; and
- Interim No. 5 Water Quality Certification dated July 5, 2005 – CERCLA Remedial Action – Remaining Elements of 2005-2006 In-Water Work – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways.

Work activities required under the Consent Decree and those included under the Thea Foss and Wheeler-Osgood Waterways Remediation Project during the 2003-2004, 2004-2005, and 2005-2006 in-water construction seasons are identified as follows (Figure 2):

- Remedial Area 2 Dredging and Backfilling
- Remedial Area 4 Dredging and Backfilling
- Remedial Area 5 Dredging and Slope Capping
- Remedial Area 6 Dredging and Slope Capping
- Remedial Areas 7 and 7A Dredging and Capping
- Remedial Area 8 Dredging and Capping
- Remedial Area 9 Dredging and Backfilling
- Remedial Area 12 Dredging and Backfilling
- Remedial Area 14 Dredging and Capping
- Remedial Area 15 Dredging and Capping
- Remedial Area 16 Dredging
- Remedial Area 17 Dredging
- Remedial Area 18 Dredging and Capping
- Remedial Areas 19A and 19B Dredging and Capping

- Remedial Area 20 Dredging, Capping, and Sheetpile Walls
- Remedial Area 21 Dredging and Capping
- Remedial Area 22 Dredging and Capping
- Dock Street Marina (aka Alber's, City View, and 17th Street Marinas)
- Middle Waterway Corridor Habitat
- Middle Waterway Tideflat Habitat (MWTH)
- North Beach Habitat – Peninsula and St. Paul Beach Habitats
- Puyallup River Side Channel (PRSC)
- Simpson Fuel Dock
- Simpson Log Haul Out Facility (LHOF)
- St. Paul Waterway Confined Disposal Facility (CDF)

There are several areas within the waterway that are included in the remedial action area but where active remediation did not occur. These areas are designated for natural recovery and are expected to meet the performance standards within ten years as allowed by the Record of Decision (ROD). These areas are shown on Figure 3, but are not discussed herein, as construction activities did not occur. Monitoring of these areas to gauge progress toward meeting the performance standards is covered in the Operations, Maintenance, and Monitoring Plan (OMMP) for the site which is expected to be finalized in September 2006.

This RACR is prepared as required in Section XIV, Paragraph 50.c, of the Remedial Design/Remedial Action (RD/RA) Consent Decree (CD) for the Thea Foss and Wheeler-Osgood Waterways Problem Areas of the Commencement Bay Nearshore/Tideflats (CB/NT) Superfund Site (Civil Action No. C03-5117RJB) and Sections IV and V of the Statement of Work (SOW). This construction report documents the completion of the construction phase of the remedial action set forth in the ROD for the CB/NT Superfund Site, Tacoma, Washington and in the associated Explanation of Significant Differences (ESD).

The SOW and EPA's Office of Emergency and Remedial Response guidance document "Closeout Procedures for National Priorities List Sites" (EPA 540-R-98-016 – Office of Solid Waste and Emergency Response (OSWER) Directive 9320.2-09A-P – PB98-963223 – January 2000), were followed in preparing this report.

All construction related documentation is maintained by the City in the project record. Documents will be retained by the City in accordance with Section XXVI of the Consent Decree for the site. In the event that copies or review of the records are needed, the City's Project Coordinator identified in the Consent Decree should be notified.

2.0 OPERABLE UNIT BACKGROUND

2.1 OPERABLE UNIT HISTORY

The Commencement Bay Nearshore/Tideflats (CB/NT) site was placed on the National Priorities List (NPL) of sites requiring investigation and cleanup under the U.S. Environmental Protection Agency's (EPA) Superfund Program on September 8, 1983. A remedial investigation/feasibility study (RI/FS) was completed by the Washington State Department of Ecology (Ecology) in 1988. The RI/FS found elevated concentrations of numerous metals, Polycyclic Aromatic Hydrocarbons (PAH), Polychlorinated Biphenyls (PCB), and phthalates in the sediments of the Thea Foss and Wheeler-Osgood Waterways.

EPA issued its Record of Decision (ROD) in 1989, which outlined the alternatives for cleanup of sediments at the various operable units within the Commencement Bay site, including the Thea Foss and Wheeler-Osgood Waterways. For marginally contaminated areas expected to recover naturally to the sediment quality objectives (SQO) within 10 years after sediment remedial action, the ROD allowed for natural recovery. For areas that were not expected to recover within a 10-year time frame, the ROD specified that active remediation of problem sediments would be accomplished by utilizing a limited range of four confinement methods. These methods were: in-place capping; and dredging with upland, nearshore, or confined aquatic disposal (CAD). Habitat mitigation is also a component of all remedies.

Long-term monitoring of the remediated areas, the disposal site, and the habitat mitigation areas, is another component of the remedy required by the ROD. Monitoring is to be conducted following remediation to evaluate the effectiveness of the remedy in achieving SQOs and in achieving the habitat functions that are called for in the mitigation plans. Details of the monitoring program can be found in the Operations, Maintenance and Monitoring Plan (OMMP) which is expected to be finalized in September 2006.

In 1994, the City entered into an Administrative Order on Consent (AOC) with EPA to perform pre-remedial design study and remedial design for the Thea Foss and Wheeler-Osgood Waterways. Three rounds of sediment sampling and analysis were performed, including both chemical and biological analysis. Based upon this study, the City of Tacoma (City) determined that the majority of sediments in the waterway south of the 11th Street Bridge were contaminated at levels requiring active remediation. In addition, some hotspots requiring removal were present in the mouth of the waterway. Key contaminants throughout the waterway included PAHs, phthalates, mercury, PCBs and pesticide residuals. Based upon this pre-remedial design study, the City recommended a cleanup plan to EPA, taking into account the nature and extent of sediment contamination as well as the current and anticipated uses of the waterway.

As described above, the CB/NT ROD set forth a general cleanup approach for the waterways that comprise the CB/NT site and identified, based on RI/FS sampling data, problem areas requiring response action. The pre-remedial design study of the Thea Foss and Wheeler-Osgood Waterways better defined the area and volume of sediment

exceeding the SQOs and identified specific areas to be dredged or capped, as well as areas where natural recovery would be appropriate. Based upon this information, EPA issued an Explanation of Significant Differences (ESD), which documents several modifications to the ROD, including:

- The size of the problem areas and the volume of sediments to be dredged;
- Institutional controls related to contaminated sediments contained on-site;
- Addition of an option to use a thin layer of clean material to allow marginally contaminated sediments to naturally recover (i.e., enhanced natural recovery);
- Additional specificity of remedial actions for the various waterways, including the Thea Foss and Wheeler-Osgood Waterways;
- Elaboration of performance criteria for the cleanup plans;
- Inclusion of the Endangered Species Act (ESA) as an applicable or relevant and appropriate requirement (ARAR) for remedial actions under the ROD; and
- The cost of the remedial action.

Upon finalization of the ESD by EPA in August 2000, the City continued work toward completing the design for the cleanup of the sediments in the Thea Foss and Wheeler-Osgood Waterways. While completing the study and design for the waterway, the City worked with other Potentially Responsible Parties (PRP) to allocate the liability for cleanup and determine the performing parties for the work. While negotiations were being finalized, the City worked with EPA on a plan to allow some components of the remediation to begin in 2002. Work on six project activities began in November 2002 under a Unilateral Administrative Order (UAO) issued by EPA on September 30, 2002.

Based upon the final negotiated settlement, the City entered into a Consent Decree with EPA to perform cleanup activities in approximately 80% of the waterway, supported in part by funding from 70 other PRPs. The Consent Decree was signed by the City and funding parties on September 30, 2002, and was lodged by EPA on March 3, 2003. The effective date of the Consent Decree was May 9, 2003. Remediation work for the main construction project began in the summer of 2003 and was completed in March 2006 as detailed in Section 3.0.

A private group of Utilities signed a separate Consent Decree with EPA to perform cleanup activities in the remaining 20% of the waterway. The work area covered by the Utilities' Consent Decree is located in the head of the Thea Foss Waterway. Construction of the remedy in this area was completed in February 2004. Upon completion of construction, a Remedial Action Construction Report dated June 9, 2004, was prepared by the Utilities. In addition, an Operations, Maintenance and Monitoring Plan dated August 27, 2003, has been prepared for use in this portion of the waterway.

The State of Washington (State), acting through the Department of Natural Resources (DNR), is the owner of the aquatic lands in the Thea Foss Waterway between the pierhead/bulkhead lines. The State and the City entered into an Aquatic Land Use Authorization to allow the City to implement remedial actions, including placement of confining caps, at the site. In addition, harbor areas, as shown on Figure 1, are established in the shoreline areas of the waterway. These harbor areas are subject to leases between the property owner and DNR.

Congress authorized a federal navigation channel within the waterway in 1902. The federal project extends between harbor lines (pierhead/bulkhead lines) for a total distance of about 8,000 feet from the landward end to deep water at the mouth in Commencement Bay. The mudline elevations (MLLW) designated for navigation ranged from -29 feet MLLW (north of the 11th Street Bridge), to -22 feet MLLW (between the 11th and 14th Street Bridges), to -19 feet MLLW (from the 14th Street Bridge to the head of the Thea Foss Waterway).

The Utilities are currently working to deauthorize the channel from Station 70+10 to the head of the waterway. They have entered into a Memorandum of Agreement with the Army Corps of Engineers (Corps) to address the presence of their cap over contaminated sediments in the area until the deauthorization is completed. Under a separate action, the City has entered into a Memorandum of Agreement with the Corps to address other pre-existing encroachments along the shoreline areas where the placement of capping materials as part of the remediation process increased the area of these encroachments (see Appendix F). Under this agreement, the City has agreed to initiate an informal process to deauthorize these encroachment areas.

2.2 CLEANUP GOALS AND PERFORMANCE STANDARDS

Cleanup goals and performance standards for the Thea Foss and Wheeler-Osgood Waterways Remediation Project were provided in the following documents:

- Record of Decision;
- Explanation of Significant Differences (2000 and 2004);
- Statement of Work; and
- Design Analysis Report.

The cleanup goals and performance standards provided in these documents are summarized in Table 1. Additionally, this table provides the specific reference for each goal and standard and provides a description of how the goal or standard was achieved and or addressed as part of remediation. The remedial actions performed to meet the cleanup goals and performance standards are described in detail in Sections 3.0, 5.0 and 6.0.

3.0 CONSTRUCTION ACTIVITIES

This section provides a description of the activities undertaken by the City of Tacoma (City) to construct and implement remedial actions as part of the Thea Foss and Wheeler-Osgood Waterways Remediation Project during the 2003-2004, 2004-2005, and 2005-2006 in-water construction seasons. The descriptions are provided in the following sections by remedial action sites, habitat/mitigation sites, Puyallup River Delta/Borrow Area, Dock Street Marina, and construction activities for Simpson necessary to allow the St. Paul Waterway to be used as a confined disposal facility (CDF).

Work in Remedial Areas (RA) 1, 3, 10, 11, and 13 was completed in 2002-2003 under a Unilateral Administrative Order (UAO) issued by the U.S. Environmental Protection Agency (EPA) on September 30, 2002. Construction activities for these areas are documented in the Remedial Action Construction Report (RACR) for 2002 Construction Activities dated April 2003. In addition, the initial work began in RAs 8 and 14 and at the Peninsula Habitat Area under the UAO is also documented in the April 2003 report. The completion of work in these areas that was performed under the Consent Decree during the 2003-2004, 2004-2005, and 2005-2006 in-water construction seasons is presented in this report. Table 2 presents a summary of construction quantities for work performed during the course of the project.

In order to manage the overall project schedule, it was at times necessary to request that work be allowed outside of the fish window. Where in-water work extensions were pursued, the City submitted their request for extension to EPA with copies of the request transmitted to the U.S. Army Corps of Engineers (Corps), National Oceanic and Atmospheric Association (NOAA), Citizens for a Health Bay (CHB), and the Washington Department of Fish and Wildlife (WDFW). For extensions occurring after issuance of the Biological Opinion (BO) on March 11, 2004, NOAA issued Amendments to the BO to address these work extensions. Written authorization of these extensions was generally provided by EPA.

The Construction Management Team (CM Team) was comprised of numerous entities that had various roles in the project. Numerous City personnel were on the team and regularly participated in project activities, communications, and coordination with regulatory staff to ensure compliance with the Consent Decree. In addition, KPFF Consulting Engineers was hired through a Request for Qualifications process to perform construction management services on the City's behalf. Floyd|Snider worked with KPFF as their sub-consultant to oversee environmental compliance for the project. Hart Crowser, the design engineering firm for the remediation project, was also retained during the construction phase of the project to coordinate any necessary design revisions. The General Contractor hired by the City to perform the work was Manson Construction Company (Manson), and they oversaw a large team of specialty contractors to perform various aspects of the work. Regulatory oversight was provided during the course of the project primarily by EPA, and the Corps, and is discussed in more detail in Section 5.4. Other regular participants in project meetings and construction coordination included CHB and Simpson.

3.1 REMEDIAL ACTION SITES

Remedial actions and associated construction activities (i.e., marina construction, log haul out modifications, fuel pier reconfiguration, etc.) were performed as part of the Thea Foss and Wheeler-Osgood Waterways Remediation Project during the 2003-2004, 2004-2005, and 2005-2006 in-water construction seasons in the following remedial action sites: RAs 2, 4, 5, 6, 7 and 7A, 8, 9, 12, 14, 15, 16, 17, 18, 19A and 19B, 20, 21, and 22.

Remedial actions at these sites included dredging, dredging followed by backfilling or capping, or capping. See Table 3 for a summary of activities completed in each RA and the date these activities were completed. Figure 3 provides an overview of the remedial actions performed in each RA, while Figures 4 through 7 present the post-construction conditions for each RA.

Overall Cleanup Process

Before beginning the various phases of remedial actions and construction activities, pre-construction meetings were held to discuss the approach to work, health and safety considerations, best management practices (BMP) for environmental protection, monitoring requirements, and other issues as further described below. Pre-construction meetings were typically discussed and scheduled during the weekly construction meetings. Attendees at pre-construction meetings included representatives from the City's CM Team, the contractor and their sub-contractors associated with the work, and, at times, representatives from the Corps.

Prior to the start of construction, David Evans and Associates (DEA) conducted hydrographic and topographic surveys of all areas of project work with the exception of the Puyallup River Delta and the Hylebos Creek Mitigation Site.

During construction, Manson used their hydrographic survey boats for surveying from approximate elevation +5 feet Mean Lower Low Water (MLLW) and below, and provided topographic surveys for elevations above +5 feet MLLW.

Pre and post-dredge surveys were performed at 25-foot intervals through the length of the work area in each RA. Post dredge surveys, overlain with the theoretical dredge templates, were reviewed and approved by the City prior to the placement of any cap materials. Areas requiring correction were so noted and resurveyed for approval following corrective measures.

For slope capping, three additional hydrographic surveys were performed following placement of the toe berm riprap, slope cap filter material, and either quarry spall or thick slope riprap cap layers. For the latter two surveys, a line was generated by the survey program that depicted an 18-inch depth following the dredged surface. This procedure provided an easily assessed graphic display for review to ensure the full cap design depth was achieved. This procedure was repeated for the placement of the 18-inch layer of riprap with another computer generated line 36 inches above the post-dredge surface. In areas of thick channel sand capping, hydrographic surveys followed

the same procedure for each lift of material placed. All surveys were performed on 25-foot intervals and reviewed and approved prior to the placement of the next lift of cap material.

A combination of topographic surveys and onsite continuous inspections were used to confirm placement of cap material above elevation +5 feet MLLW. Inspectors confirmed the placement of the 18-inch layer of slope cap filter material through visual observations of marked stakes and computation tonnage on material placed over a known area. Topographic surveys were performed following placement of riprap or quarry spalls and compared with the post-dredge slope to verify a minimum three-foot final cap thickness.

No surveys were performed following the placement of the habitat mix as the criteria was based upon a unit weight per area rather than thickness. For slopes with a thick slope cap (light loose riprap), the habitat mix application rate was 25 tons per 1,000 SF of surface area. For slopes with a quarry spall cap, the habitat mix application rate was 15 tons per 1,000 SF of surface. Quantities were verified by calculating the area of the slope and application rate with the actual quantities placed from the barge.

Following construction of each of the work areas, Pre-Final Inspections were conducted to confirm that the construction was completed in accordance with the approved plans. Surveys for each of the RAs were reviewed by the CM Team and representatives of the Corps. Wherever possible, low-tide field inspections were conducted to observe the visible portions of the completed work areas. In addition, data collected during the course of construction was reviewed to confirm compliance with the performance standards. Pre-Final and Final Inspection Reports were prepared following the inspections. Quantities included in the Final Inspection Reports were estimated based upon the available surveys (Appendix D).

At the completion of dredging and capping, DEA provided final hydrographic and topographic surveys for the completed surfaces in all remedial action areas. The dredge quantities included in this report are based on these post-dredge surveys for each RA and in some cases differ slightly from the quantities reported in the Final Inspection Reports. The quantities reported in the Final Inspection Reports were derived from survey information submitted for monthly pay estimates by Manson. In some cases the quantity reported for a single RA actually included dredging or capping in a portion of an adjacent RA. For example, dredging in RA 20 and a portion of the adjacent RA 22 was accomplished concurrently but attributed to only RA 20. At the conclusion of all work, Manson recalculated the quantities with greater attention to RA boundaries. This recalculation resulted in no change to the total quantities, but a more accurate distribution of quantities to the appropriate RA.

These procedures, as a minimum, were generally followed for each RA. Any additional surveys or deviation from the procedures is noted in the survey sections below for each remedial action area. Approved surveys are bound in record for future reference.

Water quality monitoring was performed during remedial actions to monitor and control impacts from in-water construction activities. Visual and in-situ water quality monitoring was performed during remedial actions in accordance with the EPA approved CQAP, Water Quality Field Sampling Plan (FSP), project plans and

specifications, and the project Water Quality Certifications (WQC). The WQCs administered by EPA for the project included:

- Interim Water Quality Certification dated July 28, 2003, for CERCLA Remedial Action – Mobilization, Piling Removal, Pile Driving – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways;
- Interim No. 2 Water Quality Certification dated August 22, 2003, for CERCLA Remedial Action – RA 19 Piling Removal, Log Haul Out Facility Dredging – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways;
- Interim No. 3 Water Quality Certification dated September 30, 2003, for CERCLA Remedial Action – Selected Elements of 2003 In-Water Work – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways;
- Interim No. 4 Water Quality Certification dated November 10, 2003 – Remaining Elements of 2003-2005 In-Water Work – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways; and
- Interim No. 5 Water Quality Certification dated July 5, 2005 – CERCLA Remedial Action – Remaining Elements of 2005-2006 In-Water Work – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways.

The specific elements of water quality monitoring performed for the Thea Foss and Wheeler-Osgood Waterways Remediation Project consisted of the following:

- Pre-construction ambient water quality monitoring;
- Construction ambient water quality monitoring;
- Construction water quality monitoring; and
- Chemicals of Concern (COC) sampling and analysis.

In-situ water quality monitoring was performed during remedial actions to measure water quality parameters and collect samples for water quality analysis. Water quality parameters measured and recorded during ambient and construction water quality monitoring included the following:

- Real time measurement of DO;
- Real time measurement of temperature;
- Real time measurement of turbidity;
- Real time measurement of salinity;
- Sample collection and analysis for Total Suspended Solids (TSS);
- Sample collection and analysis for target metals (i.e., copper and silver); and
- Sample collection and analysis for DO.

DO, temperature, and turbidity monitoring and TSS and DO sample collection and analysis were required by the CQAP, Water Quality FSP, project plans and specifications, and WQCs. Salinity monitoring was performed by the contractor to provide additional information about water sources (i.e., marine, storm, or Puyallup River) and stratification. The CQAP, Water Quality FSP, and project plans and specifications required weekly sample collection and analysis for copper and silver in the vicinity of remedial actions and to provide ambient copper and silver concentrations. Additionally, the WQCs required the following sample collection and analysis for COCs:

- Interim No. 3 WQC (and subsequent WQCs) required sample collection and analysis for COCs during the beginning of contaminated sediment clamshell dredging (which occurred in RA 19);
- Interim No. 3 WQC (and subsequent WQCs) required sample collection and analysis for COCs during grout mat placement (which occurred in RA 19); and
- Interim No. 4 WQC (and subsequent Interim No. 5 WQC) required sample collection and analysis for COCs during discharge from the CDF.

COC sampling and analysis was performed in conjunction with construction water quality monitoring. Monitoring for COCs consisted of sample collection and analysis for the following total and dissolved parameters:

- Polycyclic aromatic hydrocarbons (PAH);
- Phthalates;
- Lead, mercury, and zinc;
- Polychlorinated Biphenyls (PCB);
- DDT, DDE, and DDD; and
- Total organic carbon.

Additionally, Best Management Practices (BMP) (i.e., control of dredging and material placement speed, containment of debris with debris booms, use of oil absorbent booms, etc.) were employed during remedial actions to minimize resuspension and transport of sediment, capture debris, and capture and contain sheen generated by remedial actions. Visual monitoring was performed to monitor contractor compliance with the BMPs.

The results of water quality monitoring were reported in daily and monthly water quality monitoring reports. Daily water quality monitoring reports were faxed or emailed to EPA and the Corps (EPA's oversight personnel). Monthly water quality monitoring reports that consisted of a compilation of water quality monitoring data collected each month (including daily reports) were also prepared and submitted to EPA and the Corps.

The results of water quality monitoring are discussed with respect to each individual site in the following sections.

The following sections provide additional information on the remedial/construction activities which were performed in each area.

3.1.1 REMEDIAL AREA 2

Remedial Area 2 (RA 2) is an isolated area north of the 11th Street Bridge that required dredging and backfilling to address a "hot spot" area identified during the design analysis (Figure 2). RA 2 is approximately 44,000 square feet (SF). The area required dredging to a depth of four feet and backfilling with channel sand cap material to match the adjacent channel bottom.

3.1.1.1 SUMMARY OF CONSTRUCTION

Construction activities performed in RA 2 includes:

- Dredging;
- Backfilling with channel sand cap material;
- Surveying;
- Sediment verification sampling; and
- Water quality monitoring.

3.1.1.2 PREPARATION FOR CONSTRUCTION

Preparation for dredging was accomplished primarily through a pre-construction meeting conducted on July 14, 2004. Representatives of the City, KPFF, Floyd|Snider, and Manson were in attendance.

Topics discussed included:

- Health and safety requirements;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;
- Water quality monitoring requirements; and
- Containment boom deployment at the site of dredging and other environmental BMPs.

Pre-dredge hydrographic surveys were also performed in preparation for construction.

3.1.1.3 DREDGING

Dredging in RA 2 started on October 13, 2004, utilizing the derrick Andrew. The material was loaded into a dump scow and transported to the CDF for disposal. Approximately 7,825 cubic yards (CY) of material was dredged from RA 2 when dredging activities were completed on October 21, 2004.

3.1.1.4 CAPPING / BACKFILLING

As RA 2 was a dredge to clean surface, backfilling was considered a lower priority activity and was therefore reserved as a "go to" area. This provided Manson with a location to rapidly move equipment and material to when circumstances prevented work in other higher priority areas. Backfilling with available imported channel sand cap material was conducted intermittently from November 2, 2004 through December

11, 2004. After initial hydrographic surveys were reviewed it was determined additional backfilling was required to meet project criteria. Manson continued backfilling activities as material became available for placement on January 20, 2005 and February 7, 2005, but ceased this activity when other higher priority work was needed before closure of the fish window. A total of 12,385 tons of channel sand cap material was placed in RA 2 during the 2004-2005 in-water construction season. Surveys conducted on March 7, 2005, after the construction season ended, indicated that there were still some depressions up to two feet deep in the surface of the backfill relative to adjacent elevations. Since the construction window had ended, remaining backfilling was deferred until the following season. Backfilling resumed on August 8, 2005, and was completed 10 days later on August 18, 2005. The total backfill placed in RA 2 was approximately 15,800 tons

3.1.1.5 SURVEYING

Hydrographic surveys were conducted to confirm dredge depths and limits as well as backfill depth. Prior to commencing backfill operations, dredge surveys were reviewed by the CM Team and the Corps with no issues noted. Final backfill surveys were reviewed by the CM Team and the Corps as part of the Pre-Final Inspection process, also with no issues noted. Figure 4 presents the post-construction conditions in RA 2.

3.1.1.6 SEDIMENT VERIFICATION SAMPLING AND ANALYSIS

Sediment verification sampling and analysis were performed as specific components of the remedial action were completed in RA 2. Sediment verification sampling was performed in RA 2 during the 2004-2005 construction season. A summary of the results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment verification samples were analyzed for the chemicals of concern (COC) identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the Sediment Quality Objectives (SQO). The COCs and SQOs are presented in Table B-2.

3.1.1.6.1 Post-Dredge, Prior-to-Backfill

Samples were collected from three stations in RA 2 once dredging was completed and prior to backfilling the area (Figure B-1). The post-dredge surface samples (RA-02-001-041022-G, RA-02-002-041022-G, and RA-02-003-041022-G) were collected on October 22, 2004 (Table B-1). The detected chemical concentrations and detection limits in the post-dredge samples were less than the SQOs for all but one compound at one station (Table B-3). The sample collected from the east portion of RA 2 (RA-02-002-041022-G) had a detected p,p'-DDE concentration (12 ug/kg) that exceeded the SQO (9 ug/kg).

Although the detected p,p'-DDE concentration was 1.3 times the SQO, the average p,p'-DDE concentration for the three post-dredge, prior-to-backfill samples was 4.9 ug/kg,

which is below the SQO. The Final Design Construction Quality Assurance Plan (CQAP) states that the average (arithmetic mean) concentration of the three post-dredge, prior-to-backfill samples will be compared to the SQOs. Because the average concentration is below the SQO, placement of channel sand cap material in RA 2 constitutes a backfill rather than a cap and long-term monitoring for the purposes of cap placement integrity monitoring is not required as part of the City's future Operation, Maintenance and Monitoring (OMMP) activities (Figure 3).

3.1.1.6.2 Dredge Boundary Verification

Dredge boundary verification samples were collected from surface sediments located on each side of the boundary of RA 2 following the completion of dredging. The four dredge boundary samples (RA-02-006-041022-G, RA-02-007-041022-G, RA-02-008-041022-G, and RA-02-009-041022-G) were collected on October 22, 2004. A field duplicate sample (RA-02-004-041022-G) was also collected for quality control. Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the dredge boundary samples (Table B-4). Therefore, no response action or additional sampling was required.

3.1.1.7 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during dredging and backfilling activities in RA 2 in accordance with the EPA approved CQAP, Water Quality Field Sampling Plan (FSP), project plans and specifications, and Interim No. 4 and Interim No. 5 Water Quality Certifications (WQC). Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs) (i.e., dredge speed, containment by debris boom, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and dissolved oxygen (DO). Samples were also collected for DO, total suspended solids (TSS), and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature and DO consistently met water quality standards specified in the project WQCs. Turbidity exceeded the criteria once during the 2004-2005 construction season, when backfilling with channel sand cap material was performed in RA 2. The maximum turbidity measured was 48.4 nephelometric turbidity units (NTU), which is approximately twice the standard. EPA was notified of the turbidity exceedence. To lower turbidity, the contractor reduced the rate at which material was being placed.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples were consistently comparable to concentrations at the up-current ambient monitoring locations. Copper concentrations in construction area samples ranged between 11.5 and 17.8 µg/L. Ambient concentrations were 18.5 and 18.9 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations were the result of ambient conditions and that remedial construction activities did not cause further increases in the copper concentration.

3.1.2 REMEDIAL AREA 4

Remedial Area 4 (RA 4) is an isolated area north of the 11th Street Bridge that required dredging and backfilling to address a "hot spot" identified during the design analysis (Figure 2). RA 4 is approximately 20,700 SF. The area required dredging to a depth of four feet and backfilling with channel sand cap material to match the adjacent channel bottom.

3.1.2.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 4 included:

- Dredging;
- Backfilling with channel sand cap material;
- Surveying;
- Sediment verification sampling; and
- Water quality monitoring.

3.1.2.2 PREPARATION FOR CONSTRUCTION

Preparation for dredging was accomplished primarily through a pre-construction meeting conducted on July 14, 2004. Representatives of the City, KPFF, Floyd|Snider, and Manson were in attendance.

Topics discussed included:

- Health and safety requirements;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;
- Water quality monitoring requirements; and
- Containment boom deployment at the site of dredging and other environmental BMPs.

Pre-dredge hydrographic surveys were also performed in preparation for construction.

3.1.2.3 DREDGING

RA 4 was dredged from November 8-11, 2004, with the derrick Andrew. Dredged material was loaded into a dump scow and transported to the CDF for disposal. Approximately 3,771 CY of material was dredged and disposed of in the CDF.

3.1.2.4 CAPPING / BACKFILLING

RA 4 was not immediately backfilled because all available equipment was working on other prioritized areas requiring completion prior to closure of the work window for the 2004-2005 in-water construction season. RA 4 backfilling commenced on August 3, 2005, and was completed eight days later on August 11, 2005. A total of approximately 7,030 tons of imported channel sand cap material was placed as backfill in RA 4.

3.1.2.5 SURVEYING

Hydrographic surveys were conducted to confirm dredge depths and limits as well as backfill depth. Prior to commencing backfill operations, dredge surveys were reviewed by the CM Team and the Corps with no issues noted. Backfill surveys were reviewed by the CM Team and the Corps as part of the Pre-Final Inspection process, also with no issues noted. Figure 4 presents the post-construction conditions in RA 4.

3.1.2.6 SEDIMENT VERIFICATION SAMPLING AND ANALYSIS

Sediment verification sampling and analysis were performed as specific components of the remedial action were completed in RA 4. Sediment verification sampling was performed in RA 4 in November and December 2004. A summary of results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to the EPA and Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

3.1.2.6.1 Post-Dredge, Prior-to-Backfill

Samples were collected from three stations in RA 4 once dredging had been completed and prior to backfilling the area (Figure B-1). The post-dredge surface samples (RA-04-001-041115-G, RA-04-002-041115-G, and RA-04-003-041115-G) were collected on November 15, 2004 (Table B-1). A field duplicate sample (RA-04-004-041115-G) was also collected for quality control. Neither the detected concentrations nor analytical detection limits exceeded SQOs in the post-dredge samples (Table B-5). Because the chemical concentrations are below the SQOs, placement of channel sand cap material in RA 4 constitutes a backfill rather than a cap and therefore long-term monitoring for the purposes of cap placement integrity monitoring is not required as part of the City's future OMMP activities (Figure 3).

3.1.2.6.2 Dredge Boundary Verification

Dredge boundary verification samples were collected from surface sediment located on each side of the boundary of RA 4 following the completion of dredging. The four dredge boundary samples (RA-04-005-041115-G, RA-04-006-041115-G, RA-04-007-041115-G, and RA-04-008-041115-G) were collected on November 15, 2004. The detected concentrations and analytical detection limits in the dredge boundary samples were less than the SQOs for all but one parameter at one station. The sample collected from the dredge boundary location east of RA 4 (RA-04-006-041115-G) had a detected concentration of zinc (2,870 mg/kg) that exceeded the SQO (410 ug/kg) (Table B-6).

The zinc concentration detected in the sample from east of RA 4 (RA-04-006-041115-G) appeared to be anomalous when compared to other metals concentrations in the same sample and the other dredge boundary and post-dredge samples collected from RA 4. The concentrations of other metals (i.e., arsenic, copper, lead, and mercury) in the same sample were well below the SQOs and were equivalent to concentrations for metals detected in all other dredge boundary and post-dredge samples collected. The zinc detected in this sample may have been from a localized particle or fragment of metal captured in the sample as the detection was not confirmed as discussed in Section 3.1.2.6.3.

3.1.2.6.3 Dredge Boundary Verification, Offset Confirmation

In accordance with the CQAP, additional surface sampling was performed at RA 4 in response to the elevated zinc concentration detected east of RA 4. Two offset boundary surface samples (RA-04-009-041229-G and RA-04-011-041229-G) were collected 50 feet north and south of Station RA4-006 on December 29, 2004. Additionally, Station RA4-006 was re-sampled (RA-04-010-041229-G) on December 29, 2004. This co-located sample station is identified as Station RA4-010 in the offset confirmation sampling results. A field duplicate sample (RA-02-012-041229-G) was also collected for quality control.

The offset confirmation surface samples and additional co-located sample were analyzed for the parameter that exceeded the SQO (zinc) in accordance with the CQAP and project plans and specifications. Zinc was detected in all four samples but at concentrations less than 1/3 the zinc SQO (Table B-7). The results for offset samples and the additional sample at the original sample location verify that the original sample with the zinc concentration greater than the SQO was an anomaly and is not representative of zinc concentrations in or adjacent to RA 4. Therefore, the dredge boundary area east of RA 4 meets the SQOs and further response actions or sediment verification sampling, including collection of an offset core, are not required.

The CQAP states that if a verification sample exceeds an SQO then an offset core will be collected to evaluate the depth of contamination. However, the results for the additional, co-located surface sample collected at the original sample location and offset surface samples verify that surface sediment east of RA 4 meets the SQOs. Therefore, the offset core was not warranted to evaluate subsurface sediment concentrations. EPA provided approval of the results for RA 4 in an email dated October 4, 2005.

3.1.2.7 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring were performed during dredging and backfilling activities in RA 4 in accordance with the EPA approved CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris boom, etc.). In-situ water quality monitoring was performed to measure temperature,

turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature, turbidity, and DO consistently met water quality standards specified in the project WQCs. Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper concentrations in samples collected in the Thea Foss Waterway ranged between 8.2 and 9.04 µg/L during dredging in RA 4 and between 25.8 and 28.1 µg/L during capping. The ambient concentrations were 7.9 and 8.26 µg/L during dredging and 26.1 µg/L during capping. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.3 REMEDIAL AREA 5

Remedial Area 5 (RA 5) is located on the eastern side of the channel between Station 34+91 (approximately the centerline of the 11th Street Bridge) on the north and Station 52+34 on the south (Figure 2). It is bounded on the west by RA 6 and on the east by the channel/pierhead line.

The dredge design elevation through most of RA 5 was elevation -28 feet MLLW, however, on the northern portion of RA 5, adjacent to the Petrich Marine Dock, there was an area where dredging was followed by placement of a thick slope cap, or where quarry spalls were placed for erosion protection (Figure 3).

The project remediation dredging significantly improved the depth conditions in this area and brought much of it into compliance with the authorized channel depth, however, there remains approximately 26,000 SF of encroachment into the authorized channel in front of Petrich Marine Dock and approximately 15,500 SF in front of Martinac. In these areas, although the dredge design depth was -28 feet MLLW, the pierhead/bulkhead/channel lines overlay each other and the presence of pre-existing pile supported structures at these locations prohibited dredging to the design depth as undermining of the structures and slope instability would have resulted. This encroachment existed prior to the City's work on the project. Therefore, the City and the Corps are negotiating a Memorandum of Agreement (MOA) formalizing the limits of the City's responsibility for these areas of encroachment (Appendix F).

3.1.3.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 5 included:

- Relocation of vessels and floats from Petrich Marine Dock, Martinac, and the Woodworth Company dock;
- Debris removal;
- Slope dredging and capping;
- Surveying;
- Sediment verification sampling; and
- Water quality monitoring.

3.1.3.2 DESIGN MODIFICATIONS

The Thea Foss and Wheeler-Osgood Waterways Remediation Project plans identified a submerged, buried utility (i.e., cable) crossing south of the 11th Street Bridge. During the design phase of the project and again in 2003, the City contacted Qwest with a request for drawings showing the as-built alignment and depth of the utility crossing to gather the data necessary to insure the cables would not be damaged by dredging in the area. Qwest had no records of the crossing. The City also requested that the Corps review their records for the Thea Foss Waterway Federal Navigation Channel to provide any information with respect to the utility crossing. The Corps reviewed its construction and navigation drawings and the crossing did not appear on any of their drawings.

As no records were available for the utility crossing, the City retained Golder and Associates (Golder) of Redmond, WA to conduct marine geophysical investigations. Golder's investigations identified multiple locations where utilities cross the Thea Foss Waterway between approximately 20 and 120 feet south of the 11th Street Bridge (Figure 1). Their report is included in the project record. The remedial actions that were to be performed in the northern portion of RAs 5, 6, and 7 had the potential to damage the utilities crossing the waterway. These utilities included fiber optics for military bases in Pierce County.

Additional sediment sampling and analysis was performed to characterize sediment in the northern portions of RAs 5, 6, and 7, to evaluate the potential for modification of remedial actions in the area of the utility crossings. The detected chemical concentrations were below the SQOs in the three samples collected from the northern portion of RA 5 (Section 3.1.3.7.1).

Based on the location of the utility crossings and the results of sediment sampling and analysis, the remedial actions in the northern portion of RA 5 were modified. In the area north of Station 37+10, the remedial actions were modified from dredging and placement of a thick slope cap in the area adjacent to the Petrich Marine Dock to natural recovery and placement of six inches of quarry spalls for prop wash scour protection. The remedial actions were not modified in the area south of Station 37+10 except that three feet of channel sand cap material was placed on the transitional slope that was cut from the existing sediment surface in the natural recovery area north of Station 37+10 to the design dredge elevation of -28 feet MLLW south of Station 37+10. Additionally, the dredge boundary verification sample was relocated from a position 50 feet north of the original dredge boundary in RA 5 to 50 feet north of Station 37+10.

The results of the geophysical investigations performed by Golder, results of the additional sampling and analysis, and remedial design modifications were reported in two memorandums submitted to EPA on August 11, 2005 and September 12, 2005. The modifications to dredge boundary verification sampling in RA 5 were submitted to EPA on September 16, 2005. The modifications to the remedial action and dredge boundary verification sampling in RA 5 were approved by EPA in emails dated October 6, 2005 and January 3, 2006, respectively.

3.1.3.3 PREPARATION FOR CONSTRUCTION

Preparation for dredging was accomplished primarily through pre-construction meetings. Representatives of the City, KPFF, Floyd|Snider, and Manson attended a pre-construction meeting for the initial clamshell dredging on July 14, 2004. A second pre-construction meeting was held for hydraulic dredging on August 2, 2005.

Topics discussed during the two meetings included:

- Health and safety requirements including working around the hydraulic dredge and pipeline;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;

- Water quality monitoring requirements;
- Containment boom deployment at the site of dredging and other environmental BMPs;
- Spill response; and,
- Simpson safety rules for work in and near the CDF during disposal operations.

Pre-dredge hydrographic surveys were also performed in preparation for construction.

Additionally, in August 2004, the City retained the diving company Sunchasers Inc. to perform an underwater inspection of the debris fields identified on the plans. The purpose of the investigation was to attempt to define the limits of the debris fields and the nature of the material in them. The investigation was accomplished through a combination of visual observation by a diver and the use of a water jet to probe below the surface in an attempt to locate buried material and to define its size.

In a report dated August 29, 2004, Sunchasers Inc. characterized the debris as timber and concrete consisting of small to large blocks and slabs. In two locations, large monolithic concrete foundations were identified and the approximate depths were noted. Through consultation with the Corps and EPA, it was determined that these pre-existing monolithic structures would not be removed as part of the remedial action even though their depth encroached into the area of the Federally authorized channel minimum finished elevation. It was agreed that the locations would be noted for navigation purposes and future reference, and the encroachment would be documented in an MOA between the City and the Corps (Appendix F).

The final Sunchasers Inc. report/investigation was provided to Manson prior to the onset of dredging in these areas.

3.1.3.4 DREDGING

Dredging in RA 5 during the 2004-2005 construction season consisted only of work in and around the debris fields associated with the historic bridge abutments at approximate Stations 47+50 and 52+00. As described in Section 3.1.4, the dredging moved back and forth across the boundary between RAs 5 and 6 to remove debris in preparation for planned hydraulic dredging to be performed during the 2005-2006 construction season. As most of the work was accomplished in RA 6, the full description is provided under that section.

Dredging in RA 5 resumed on August 23, 2005, using the hydraulic dredge Lofgren. Dredging was performed concurrently with the adjacent portion of RA 6 and dredging to design elevations was completed on October 4, 2005.

On October 7, 2005, post-dredge samples were collected from the remaining northern stations in RA 5 after the remainder of the dredging was completed. At each of these northern stations, sample results indicated that one or more pesticides exceeded SQOs. In response to the SQO exceedences, the City directed Manson to overdredge the cut in RA 5 from Stations 39+00 to 45+00 an additional three feet in accordance with the contract contingency requirements in order to meet the SQOs for the project. Overdredging in RA 5 commenced on October 21, 2005, and was completed on

October 23, 2005. Post dredge samples were collected from the overdredged surfaces on October 24, 2005 (Section 3.1.3.7.2). The detected pesticide concentrations were below the SQOs.

In all, approximately 50,664 CY of dredge material was removed and disposed of in the CDF. This quantity included approximately 4,213 CY of overdredging.

3.1.3.5 CAPPING / BACKFILLING

Slope capping in the area fronting Petrich Marine Dock was conducted intermittently from September 7, 2005 to October 31, 2005. Thick slope capping including toe berm construction from Stations 38+25 to 40+35 was conducted from October 24-27, 2005. Capping in RA 5 included approximately 502 tons of riprap, 372 tons of slope cap filter material, and 3,533 tons of quarry spalls for prop wash protection.

3.1.3.6 SURVEYING

The dredging in the debris fields was only for the purpose of removing obstructions to future hydraulic dredging. Therefore, hydrographic surveys were conducted solely for the purpose of determining dredge quantities for payment rather than confirmation of dredge elevations.

During the 2005-2006 construction season, hydrographic surveys were conducted to confirm dredge depths and limits, as well as for all capping activities. Dredging and capping surveys were reviewed by the CM Team and the Corps at the time of the Pre-Final Inspection with no issues noted. Figure 5 presents the post-construction conditions in RA 5.

3.1.3.7 SEDIMENT VERIFICATION SAMPLING AND ANALYSIS

Sediment verification sampling and analysis were performed as specific components of the remedial action were completed in RA 5. Sediment verification sampling was performed in RA 5 between June 2005 and January 2006. A summary of the results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

3.1.3.7.1 Remedial Design Modification Evaluation

Multiple utility crossings were identified approximately 20 to 120 feet south of the 11th Street Bridge in the northern portion of RAs 5, 6, and 7. As a result, sampling was performed to characterize sediment in the northern portion of RAs 5, 6, and 7, in order

to evaluate the potential for modification of the remedial actions in the area of the utility crossings.

Samples were collected from three stations located in the northern portion of RA 5 in the area of the utility crossings (Figure B-2). The surface sediment samples (RA-05-001-050629-G, RA-05-002-050629-G, and RA-05-003-050629-G) were collected on June 29, 2005 (Table B-1). A field duplicate sample (RA-05-004-050629-G) was also collected for quality control. Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the samples collected from the northern portion of RA 5 (Table B-8). Because the chemical concentrations were below the SQOs, the remedial actions in the northern portion of RA 5 were modified as discussed in Section 3.1.3.2.

3.1.3.7.2 Post-Dredge, No Cap or Backfill

Samples were collected from eight stations in RA 5 once dredging had been completed to the design dredge elevation. Three post dredge surface samples (RA-05-001-050923-G, RA-05-002-050923-G, and RA-05-003-050923-G) were collected from the southern portion of RA 5 on September 23, 2005. Five post dredge surface samples (RA-05-004-051007-G, RA-05-005-051007-G, RA-05-006-051007-G, RA-05-007-051007-G, and RA-05-008-051007-G) were collected from the northern portion of RA 5 on October 7, 2005. A field duplicate sample (RA-05-011-051007-G) was also collected for quality control.

Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the post dredge samples and field duplicate sample collected from the four sample stations in the southern portion of RA 5 (RA-05-001-050923-G, RA-05-002-050923-G, and RA-05-003-050923-G, RA-05-004-051007-G, and RA-05-011-051007-G) or the sample collected from the northern-most station (RA-05-008-051007-G) (Table B-9). The detected concentrations and detection limits in samples collected from the remaining three post-dredge sample stations (RA-05-005-051007-G, RA-05-006-051007-G, and RA-05-007-051007-G) were less than the SQOs for all chemicals except the pesticides p,p'-DDD and p,p'-DDE.

In response to the SQO exceedences in Samples RA-05-005-051007-G, RA-05-006-051007-G, and RA-05-007-051007-G, the grid areas represented by these samples were overdredged from October 21-23, 2005. The grid areas were overdredged three feet (i.e., the final dredge elevation was three feet deeper than the design elevation). Three post-dredge samples were collected from the overdredge surface (RA-05-020-051024-G, RA-05-021-051024-G, and RA-05-022-051024-G) on October 24, 2005. No detected concentrations or analytical detection limits exceeded SQOs in the post-dredge samples collected from the overdredge surface (Table B-10). No further response actions were required in RA 5 as the detected concentrations and analytical detection limits were less than the SQOs in all post-dredge samples.

3.1.3.7.3 Dredge Boundary Verification

A dredge boundary verification sample was collected from surface sediments located 50 feet from the northern boundary of dredging performed in RA 5 following the completion of dredging. The dredge boundary sample (RA-05-009-051215-G) was

collected on December 15, 2005. A field duplicate sample (RA-05-010-051215-G) was also collected for quality control. The detected chemical concentrations and detection limits in the dredge boundary samples were less than the SQOs for all but one compound (Table B-11). Bis(2-Ethylhexyl)phthalate was detected at concentrations (1,400 ug/kg and 1,500 ug/kg) that slightly exceeded the SQO (1,300 ug/kg) in the dredge boundary and field duplicate samples. The dredge boundary sample station is within the area that was designated for natural recovery as part of the design modification and will be monitored as part of the City's future OMMP activities.

3.1.3.7.4 Cap Boundary Verification

Cap boundary verification samples were collected from surface sediments in RA 5, 50 feet west of the slope cap placed in RA 14 following the completion of capping in RA 14. The two cap boundary samples (RA-14-001-060109-G and RA-14-002-060109-G) were collected on January 9, 2006. A field duplicate sample (RA-14-003-060109-G) was also collected for quality control. Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the cap boundary samples (Table B-12). Therefore, no response action or additional sampling was required.

3.1.3.8 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during dredging and slope capping activities in RA 5 in accordance with the EPA approved CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris boom, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

Sheen was intermittently observed as a result of dredging in RA 5. Debris and absorbent booms were deployed to contain sheen during remedial activities in RA 5 in accordance with project BMPs.

The results of in-situ monitoring for temperature and DO consistently met water quality standards specified in the project WQCs. Turbidity exceeded the criteria once during the 2005-2006 construction season during hydraulic dredging in RA 5. The maximum turbidity that was measured was 14.6 NTU, which slightly exceeded the water quality standard (i.e., 10 NTUs above background turbidity). The Lofgren had only been intermittently dredging when the water quality measurements were taken. Therefore, dredging was discontinued multiple times allowing turbidity to decrease. EPA was notified of the turbidity exceedence and observance of sheen during construction in RA 5.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently

comparable to concentrations at the up-current ambient monitoring locations. Copper concentrations ranged from 17.9 to 18.6 µg/L. Ambient concentrations were 18.3 and 19.9 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further decreases in the copper concentration.

3.1.4 REMEDIAL AREA 6

Remedial Area 6 (RA 6) is comprised of the channel area between Station 52+34 on the south and Station 34+91 (approximately the center of the 11th Street Bridge) on the north. It is bounded on the east by RA 5 through its entire length. It is bounded on the northwest by RA 7 and on the southwest by RA 8 with the west channel line defining the RA boundaries (Figure 2).

The remedial design for RA 6 was to remove sediment with chemical concentrations greater than the SQOs. The dredge design elevation throughout RA 6 was -31 feet MLLW. Transitions to the more shallow elevations in the adjacent RAs occurred with 2H:1V upward slopes from the channel line to the finished surfaces of RAs 7 and 8 on the west side and from the RA boundary line up to the finished surface of RA 5 on the east side.

Within RA 6, a large area on the west side of the waterway from Stations 42+50 to 52+50 was already above the federally authorized channel elevation of -22 feet MLLW in the navigation channel. This area is along the western edge of the waterway as the slope rises up the shoreline, and is in close proximity to upland structures that are susceptible to damage from construction work along the shoreline. The project remediation dredging aimed to preserve the existing bottom elevation conditions in this area and to bring some of it within the authorized channel elevation, however, there remains approximately 41,200 SF of channel encroachment in front Johnny's Seafood and Colonial Fruit.

As previously stated, the City and the Corps are negotiating a MOA that formalizes the City's limited responsibility for these areas of encroachment (Appendix F).

The project plans identified debris fields related to the remnants of the piers from two former bridges which crossed the Thea Foss. The plans and specifications called for the debris and foundation structures to be removed to the design elevation of -31 feet MLLW.

3.1.4.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 6 includes:

- Debris removal;
- Dredge to clean to a depth of -31 feet MLLW;
- Slope capping between the toe of slope and the lower cap limit of RA 8 between RAs 7 and 19A;
- Surveying;
- Sediment and cap verification sampling; and
- Water quality monitoring.

3.1.4.2 DESIGN MODIFICATIONS

As stated in Section 3.1.3.2, the Thea Foss and Wheeler-Osgood Waterways Remediation project plans identified a submerged, buried utility crossing south of the 11th Street Bridge (Figure 1). However, no records of the crossing were identified by

Qwest or the Corps. As no records were available for the utility crossing, the City retained Golder to conduct marine geophysical investigations. Golder's investigations identified multiple locations where utilities cross the Thea Foss Waterway between approximately 20 and 120 feet south of the 11th Street Bridge. Their report is included in the project record. As the remedial actions that were to be performed in the northern portion of RAs 5, 6, and 7 had the potential to damage the utilities crossing the waterway, additional sediment sampling and analysis was performed to characterize sediment in the northern portions of RAs 5, 6, and 7 to evaluate the potential for modification of remedial actions in the area of the utility crossings. These utilities included fiber optics for military bases in Pierce County.

The detected chemical concentrations were below the SQOs in the two samples collected from the northern portion of RA 6 (Section 3.1.4.7.1). Based on the location of the utility crossings and the results of sediment sampling and analysis, the remedial actions in the northern portion of RA 6 were modified. In the area north of Station 37+10, the remedial actions were modified from dredging to natural recovery. The remedial actions were not modified in the area south of Station 37+10 except that three feet of channel sand cap material was placed on the transitional slope that was cut from the existing sediment surface in the natural recovery area north of Station 37+10 to the design dredge elevation of -31 feet MLLW south of Station 37+10.

Additionally, sediment verification sampling was also modified in response to modifications to the remedial actions. A post-dredge sample from the transitional slope and a sample from the surface of the cap material placed on the transitional slope were included in sediment verification to be performed in RA 6. The dredge boundary verification sample was also relocated from a position 50 feet north of the original dredge boundary in RA 6 to 50 feet north of Station 37+10 and the transitional slope.

The results of the geophysical investigations performed by Golder, results of the additional sampling and analysis, and remedial design modifications were reported in two memorandums submitted to EPA on August 11, 2005 and September 12, 2005. The modifications to sediment verification sampling in RA 6 were submitted to EPA on September 16, 2005. The modification to the remedial actions and sediment verification sampling in RA 6 were approved by EPA in emails dated October 6, 2005 and January 3, 2006, respectively.

Additionally, as stated in Section 3.1.4, the remedial design for RA 6 was to remove sediment with chemical concentrations greater than the SQOs. However, a cap was placed in the southwestern portion of RA 6 in response to the presence of chemical concentrations greater than the SQOs in a post-dredge sample (Figure 3). The cap placed in RA 6 is comprised of three feet of channel sand cap material. Additional detail concerning capping performed in RA 6 is presented in Section 3.1.4.7.2.

3.1.4.3 Preparation for Construction

Preparation for dredging was accomplished primarily through pre-construction meetings. Representatives of the City, KPFF, Floyd|Snider and Manson attended a pre-construction meeting for the initial clamshell dredging on July 14, 2004. A second pre-construction meeting was held for hydraulic dredging on August 2, 2005.

Topics discussed during the two meetings included:

- Health and safety requirements including working around the hydraulic dredge and pipeline;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;
- Water quality monitoring requirements;
- Containment booms at the site of clamshell dredging and other environmental BMPs.
- Spill response; and,
- Simpson safety rules for work in and near the CDF during dredge disposal operations.

Pre-dredge hydrographic surveys were also performed in preparation for dredging.

As stated in Section 3.1.3.3, the City retained the diving company Sunchasers Inc. to perform an underwater inspection of the debris fields identified on the plans. The purpose of the investigation was to attempt to define the limits of the debris fields and the nature of the material in them.

In a report dated August 29, 2004, Sunchasers characterized the debris as timber and concrete consisting of small to large blocks and slabs. In two locations, large monolithic concrete foundations were identified and the approximate depths were noted. Through consultation with the Corps and EPA, it was determined that it would not be necessary to attempt to remove these monolithic structures as part of the remedial cleanup action even though their depth encroached into the area of the Federally authorized channel minimum finished elevation. It was agreed that the locations would be noted for navigation purposes and future reference.

The final Sunchasers' report/investigation was provided to Manson prior to the onset of dredging in these areas.

3.1.4.4 DREDGING

Construction in RA 6 during the 2004-2005 construction season consisted solely of clamshell dredging between approximate Stations 46+00 and 52+34, to remove concrete and wood debris in preparation for hydraulic dredging during the 2005-2006 construction season. Dredging in the debris fields in RA 6 commenced on February 8, 2005, using a 14 CY bucket. Debris field dredging extended across the border between RAs 6 and 5 in the vicinity of Station 47+00 and into the northern end of RA 17 to approximate Station 55+00. The Vulcan dredged continuously 24 hours per day for 10 days within the debris fields of RAs 5, 6 and 17. The Vulcan loaded the material into dump scows for transport and disposal in the CDF. As the purpose of this dredging was to remove surficial and near surface debris, the dredge depth was generally five feet or less below the sediment surface.

Dredging along the western boundary of RA 6 consisted of slope dredging adjacent to the boundary of RA 8 between approximate Stations 42+50 and 52+34. Dredging was

accomplished with the clamshell dredge Andrew with material transported by dump scow to the CDF for disposal. Dredging extended approximately 25 feet eastward of the toe of slope to provide separation from the slope cap rock toe berm and the future hydraulic dredging.

Dredging in RA 6 along with dredging in the adjacent portion of RA 5 resumed on August 22, 2005, using the hydraulic dredge Lofgren. During the dredging in RA 6, approximately 300 CY of material was removed in the corner at the boundary of RAs 6, 7, and 8 that could not be reached with the Lofgren. With EPA approval, this material was initially dredged by clamshell dredge and moved to an adjacent area in RA 6 where it could be removed with the Lofgren. The hydraulic removal occurred within 24 hours of the initial clamshell dredging as stipulated in the WQC.

On October 7, 2005, post-dredge samples were collected from the northernmost stations in RA 6. Sample results indicated exceedences for mercury and pesticides (DDD and DDE) (Section 3.1.4.7.2). In response to the SQO exceedences, the City directed Manson to overdredge RA 6 an additional three feet in the grids represented by these samples with SQO exceedences. Overdredging in RA 6 commenced on October 21, 2005, and was completed on October 23, 2005. Post-dredge samples were collected from the overdredge surfaces on October 24, 2005. No detected concentrations or analytical detection limits exceeded the SQOs in these post-dredge samples.

All dredging in RA 6 was completed on October 23, 2005. In all, a total of 162,575 CY were removed.

3.1.4.5 CAPPING / BACKFILLING

Slope capping in RA 6 began on February 1, 2005, in support of the capping on the higher slope in RA 8 above. Generally, slope capping in RA 6 was between the channel elevation of -31 feet MLLW and the boundary of RA 8 at approximate elevation +5 feet MLLW. Toe berms were constructed first, followed by 18 inches of slope cap filter material, and then 18 inches of light loose riprap. Habitat mix was applied to the slope at a rate of 25 tons per 1,000 SF from -10 feet MLLW up the slope.

RAs 6 and 8 slope capping was completed between approximate Station 50+50 at Outfall 230 to approximate Station 47+00 at the north end of Johnny's Seafood. The Andrew continued placing rock toe berm to approximate Station 44+00 before ending the capping work for the season.

On September 23, 2005, post-dredge samples were collected from the southernmost stations in RA 6. Semivolatile organic compound (SVOC) data was rejected in one sample because the surrogate recoveries for all six surrogate compounds were below quality control criteria. In response to the rejected data, a new sample was collected at the same location for analysis of SVOCs on November 10, 2005. Detected concentrations of several polycyclic aromatic hydrocarbons (PAH) and dibenzofuran exceeded the SQOs in this sample. Overdredging could not be performed as the contractor had already demobilized their dredging equipment. In response to the SQO exceedences in the new sample, on January 21, 2006, three feet of channel sand cap material was placed over the grid, located on the west side of the channel baseline to

the toe of the slope between approximate Stations 48+75 and 50+80 (Figure 3). A cap verification sample was collected from the cap surface to verify compliance with SQOs on January 23, 2006. No detected concentrations or detection limits for chemicals were greater than the SQOs in the cap verification sample. Approximately 6,943 tons of imported channel sand cap was placed in RA 6.

3.1.4.6 SURVEYING

Dredging the debris fields was for the purpose of removing obstructions to subsequent hydraulic dredging. Therefore, hydrographic surveys conducted after this dredging was completed were done solely for the purpose of determining dredge quantities for payment rather than confirmation of dredge elevations.

Pre and post-dredge hydrographic surveys were performed for the slope in RAs 6 and 8. Cap placement surveys were performed for toe berm, slope cap filter material, and light loose riprap placement. Surveys were reviewed and approved by the CM Team prior to approving the placement of the subsequent lift of cap material. Final capping surveys were reviewed by the CM Team and the Corps at the time of the Pre-Final Inspection with no issues noted. Figure 5 presents the post-construction conditions in RA 6.

3.1.4.7 SEDIMENT / CAP VERIFICATION SAMPLING AND ANALYSIS

Sediment and cap verification sampling and analysis were performed as specific components of the remedial action were completed in RA 6. Sediment and cap verification sampling was performed in RA 6 between June 2005 and January 2006. A summary of the results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment and cap verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

The thickness of the channel sand cap placed in RA 6 was verified by hydrographic survey as the cap was placed as a response action. As stated in Section 3.1.4.6, cap surveys were reviewed as part of the Pre-Final Inspection and no issues were noted. Therefore, no cap verification coring was performed for the channel sand cap placed in RA 6.

3.1.4.7.1 Remedial Design Modification Evaluation

Multiple utility crossings were identified approximately 20 to 120 feet south of the 11th Street Bridge in the northern portion of RAs 5, 6, and 7. As a result, sediment sampling was performed to characterize sediment in the northern portion of RAs 5, 6, and 7 to evaluate the potential for modification of the remedial actions in the area of the utility crossings.

Samples were collected from two stations located in the northern portion of RA 6 in the area of the utility crossings (Figure B-2). The surface sediment samples (RA-06-001-050629-G and RA-06-002-050629-G) were collected on June 29, 2005 (Table B-1). Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the samples collected from the northern portion of RA 6 (Table B-13). Because the chemical concentrations were below the SQOs, the remedial actions in the northern portion of RA 6 were modified as discussed in Section 3.1.3.2.

3.1.4.7.2 Post-Dredge, No Cap or Backfill

Samples were collected from 13 stations in RA 6 once dredging had been completed to design dredge elevation. Six post-dredge surface samples (RA-06-001-050926-G, RA-06-002-050926-G, RA-06-003-050926-G, RA-06-004-050926-G, RA-06-005-050926-G, and RA-06-006-050926-G) were collected from the southern portion of RA 6 on September 23, 2005. Seven post-dredge surface samples (RA-06-007-051007-G, RA-06-008-051007-G, RA-06-009-051007-G, RA-06-010-051007-G, RA-06-011-051007-G, RA-06-012-051007-G, and RA-06-013-051007-G) were collected from the northern portion of RA 6 on October 7, 2005.

Neither the detected concentrations nor analytical detection limits exceeded the SQOs in 10 of 13 post dredge samples collected from RA 6 (RA-06-001-050926-G, RA-06-002-050926-G, RA-06-003-050926-G, RA-06-004-050926-G, RA-06-005-050926-G, RA-06-006-050926-G, RA-06-008-051007-G, RA-06-009-051007-G, RA-06-011-051007-G, and RA-06-012-051007-G) (Table B-14).

The detected concentrations and detection limits in samples collected from the remaining three post-dredge sample stations (RA-06-007-051007-G, RA-06-010-051007-G, and RA-06-013-051007-G) were less than the SQOs for all analyzed chemicals except mercury and pesticides p,p'-DDD and p,p'-DDE.

In response to the SQO exceedences in Samples RA-06-007-051007-G, RA-06-010-051007-G, and RA-06-013-051007-G, the grid areas represented by these samples were overdredged from October 21-23, 2005. The grid areas were overdredged three feet (i.e., the final dredge elevation was three feet deeper than the design elevation). Three post-dredge samples were collected from the overdredge surface (RA-06-020-051024-G, RA-06-21-051024-G, and RA-06-22-051024-G) on October 24, 2005. No detected concentrations or analytical detection limits exceeded SQOs in the post dredge samples collected from the overdredge surface (Table B-15). No further response actions were required in the grid areas of RA 6 that were overdredged as the detected concentrations and analytical detection limits were less than the SQOs in the post-dredge samples.

Additionally, the data quality review identified that the recoveries were low for all six surrogate compounds in the SVOC analysis of Sample RA-06-004-050926-G. Therefore, the non-detected analytes were rejected (qualified "UR") in Sample RA-06-004-050926-G and detected SVOCs were considered estimates (qualified "J") based on the Data Quality Review. In response to the rejected data in Sample RA-06-004-050926-G, another sample (RA-06-31-051110-G) was collected from the grid area represented by this sample on November 10, 2005, and analyzed for SVOCs. A field

duplicate (RA-06-32-051110-G) was also collected for quality control. Detected concentrations of several PAHs and dibenzofuran exceeded the SQOs in Sample RA-06-031-051110-G and duplicate sample RA-06-032-051110-G (Table B-16). As the contractor had demobilized the dredging equipment, the grid area represented by Samples RA-06-031-051110-G and RA-06-032-051110-G was capped with three feet of channel sand cap material (Figure 3).

A cap verification sample (RA-06-041-060123-G) was collected from the surface of the channel sand cap placed in the grid area represented by Samples RA-06-004-050926-G, RA-06-031-051110-G, and RA-06-032-051110-G on January 23, 2006, to verify compliance with SQOs. A field duplicate sample (RA-06-042-060123-G) was also collected for quality control. No further response actions were required in the grid area that was capped in RA 6 as the detected concentrations and analytical detection limits were less than the SQOs in the cap verification samples (Table B-17).

3.1.4.7.3 Transition Slope

As discussed in Section 3.1.4.2, sediment verification sampling was revised in response to design modifications. Verification sampling was revised to include a post-dredge sample from the transitional slope and a sample from the surface of the material placed on the transitional slope in RA 6. A post-dredge sample was collected from the surface of the transitional slope once dredging had been completed and prior to placing channel sand cap material on the area. The post-dredge sample (RA-06-016-051007-G) was collected on October 7, 2005. The detected chemical concentrations and detection limits in the post-dredge sample were less than the SQOs (Table B-18).

A verification sample (RA-06-026-051215-G) was collected on December 12, 2005, from the surface of the channel sand cap material placed on the transitional slope. No detected concentrations or analytical detection limits exceeded SQOs in the verification sample. Because the concentrations in the post-dredge sample were below the SQOs, placement of the channel sand cap material on the transitional slope constitutes a backfill and no monitoring for the purposes of cap placement integrity monitoring is required as part of the City's future OMMP activities (Figure 3).

3.1.4.7.4 Dredge Boundary Verification

Two dredge boundary verification samples were collected from surface sediments located 50 feet from the northern boundary of dredging performed in RA 6 following the completion of dredging. The dredge boundary samples (RA-06-014-051215-G and RA-06-015-051215-G) were collected on December 15, 2005. The detected chemical concentrations and detection limits in the dredge boundary samples were less than the SQOs (Table B-19). The dredge boundary sample stations are within the area that was designated for natural recovery as part of the design modification and will be monitored as part of the City's future OMMP activities.

3.1.4.8 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during debris removal, dredging, and capping activities in RA 6 in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4

and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature and DO consistently met water quality standards specified in the project WQCs. Turbidity exceeded the water quality criteria once in the 2004-2005 construction season during debris removal and dredging in RA 6. At the time, remediation construction activities were occurring simultaneously in RA 8, to the west of RA 6. The measured turbidity was roughly 10 NTUs above the water quality criteria. The rate of dredging was slowed in an effort to reduce the turbidity. Subsequent monitoring identified that turbidity met the water quality standard. EPA was notified of the turbidity exceedence and the contractor's response actions to reduce turbidity.

Sheen was intermittently observed as a result of debris removal in RA 6. Debris and absorbent booms were deployed to contain sheen during remedial activities in RA 6 in accordance with project BMPs.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper concentrations in construction area samples ranged from 13.5 to 18.6 µg/L. The ambient concentration ranged from 16.8 to 19.9 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.4.9 FISH MONITORING ACTIVITIES

An extension to the in-water work period was requested beyond February 14, 2005, to continue removal of concrete and wood debris in preparation for hydraulic dredging in RA 6. The intent of continuing this construction activity was to complete clamshell dredging activities so that the CDF berm could be completed in preparation for hydraulic dredging work to be performed during the 2005-2006 construction season. EPA granted a work extension to March 15, 2005, and the City continued until work was completed on March 3, 2005. During the work extension period, specified BMPs and monitoring were required for in-water construction activities.

Fish monitoring consisted of visual observations within and adjacent to work areas and seining at designated locations to evaluate fish presence. Visual monitoring was performed at each in-water construction location. Seining for fish was performed at the following locations during the work extension period:

- Mouth of the Wheeler-Osgood Waterway;
- Volleyball Court in RA 19A;

- Simpson Peninsula;
- OVRA Site; and
- North Beach Habitat.

Seining was performed at specific locations depending upon the location of in-water construction activities occurring at that time.

BMPs and monitoring required and performed for debris removal in RA 6 during the work extension period included:

- Enclosing the debris removal area within a fish exclusion barrier / containment boom with a six-foot deep silt curtain;
- Performing intensive water quality monitoring;
- Biologist observations for the presence of fish; and
- Seining to evaluate for the presence of fish.

The seining sites associated with debris removal in RA 6 were the Volleyball Court site and mouth of the Wheeler-Osgood Waterway. During the work extension period when debris removal was performed in RA 6 (February 15-17, 2005), no salmonids were captured in two seine sets at the Volleyball Court site and two salmonids (both Chinook) were captured and released in two seine sets performed at the mouth of the Wheeler-Osgood Waterway.

3.1.5 REMEDIAL AREAS 7 AND 7A

Remedial Areas 7 and 7A (RAs 7 and 7A) are located below the Foss Waterway Marina in the harbor area on the west side of the Thea Foss Waterway between Station 34+91 on the north and approximately Station 42+50 on the south. RAs 7 and 7A are bounded on the west by RA 8 and the pierhead/bulkhead line, and on the east by RA 6 and the channel line (Figure 2).

The remedial design for RA 7 consisted of placement of a thin layer cap (i.e., enhanced natural recovery) under the marina floats, and dredging along the eastern and southern boundaries of RA 7 to transition to the channel dredging in RA 6. RA 7A is an area of approximately 4,000 SF within RA 7. The remedial design for RA 7A consisted of dredging three feet and placement of a thick channel sand cap.

3.1.5.1 SUMMARY OF CONSTRUCTION

Construction performed in RAs 7 and 7A includes:

- Relocation of boats from Foss Waterway Marina;
- Timber piling and float removal;
- Thin channel sand cap placement (RA 7) (Enhanced Natural Recovery);
- Dredging (RA 7A);
- Thick channel sand cap placement (RA 7A);
- Surveying;
- Marina float reinstallation using steel piling; and
- Water quality monitoring.

3.1.5.2 DESIGN MODIFICATIONS

As stated in Section 3.1.3.2, the Thea Foss and Wheeler-Osgood Waterways Remediation Project plans identified a submerged, buried utility crossing south of the 11th Street Bridge. However, no records of the crossing indicating the alignment and depth of the utility were identified by Qwest or the Corps. As no records were available for the utility crossing, the City retained Golder to conduct marine geophysical investigations. Golder's investigations identified multiple locations where utilities cross the Thea Foss Waterway between approximately 20 and 120 feet south of the 11th Street Bridge (Figure 1). Their report is included in the project record. As the remedial actions that were to be performed in the northern portion of RAs 5, 6, and 7 had the potential to damage the utilities crossing the waterway, additional sediment sampling and analysis was performed to characterize sediment in the northern portions of RAs 5, 6, and 7, to evaluate the potential for modification of remedial actions in the area of the utility crossings. These utilities included fiber optics for military bases in Pierce County.

The detected chemical concentrations were less than the SQOs in the sample collected from the northernmost portion of RA 7 between Stations 35+00 and 36+30. The detected concentration of a pesticide (p,p'-DDE) was greater than the SQO but less than the 2nd Lowest Apparent Effects Threshold (2LAET) criteria (Section 3.1.5.8.1) in the sample collected between Stations 36+30 to 37+10. Based on the location of the utility crossings and the results of sediment sampling and analysis, the remedial

actions in the northern portion of RA 7 were modified. In the area north of Station 36+30, the remedial action was modified from enhanced natural recovery to natural recovery. The remedial actions were not modified in the area south of Station 36+30.

The results of the geophysical investigations performed by Golder, results of the additional sampling and analysis, and remedial design modifications were reported in two memorandums submitted to EPA on August 11, 2005 and September 12, 2005. The modifications to sediment verification sampling in RA 7 were submitted to EPA on September 16, 2005. The modifications to the remedial action in RA 7 were approved by EPA in an email dated October 6, 2005. The portion of RA 7 that was changed from enhanced natural recovery to natural recovery will be monitored during the OMMP.

Following float removal, at the marina owner's option, the floats at Foss Waterway Marina were reconfigured by their own designers and reinstalled by Manson in the 2005-2006 construction season. The new configuration did not increase the overwater coverage and, therefore, no additional permit was required for installation as part of this project. The plans were submitted to EPA by the owner and were approved.

3.1.5.3 PREPARATION FOR CONSTRUCTION

To facilitate the dredging and capping in RAs 7 and 7A, the portion of the Foss Waterway Marina overlying the work area, with the exception of the covered moorage, was removed during the first week of November 2005. All timber piling were removed and disposed of. Following cap placement, the marina was reconfigured with the approval of EPA and the Corps and reinstalled from December 8-22, 2005.

The preparation for dredging and rehandling material upland for truck transport to the CDF was accomplished in a pre-construction meeting on November 9, 2005. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance.

Topics discussed included:

- Health and safety requirements;
- Dredging and placement in a dump scow;
- Transfer of dredge material from dump scow to trucks;
- Protection of slope and upland transfer area with visqueen;
- Dewatering dump scow;
- Minimizing spillage during transfer of material;
- Disposal of material below +9 feet MLLW in the CDF; and
- Containment booms at the site of dredging and other environmental BMPs.

A pre-capping meeting was held on November 30, 2005, prior to placement of the six-inch layer of channel sand cap within the covered moorage area with a barge mounted Telebelt. The City retained divers to monitor the placement of cap material, provide information with respect to the distribution of the sand across the bottom as it passed through the water column, and to provide feedback to the operator as to the rate of accumulation on the bottom.

Pre-dredge hydrographic surveys were also performed for RA 7A in preparation for construction.

3.1.5.4 DREDGING

Dredging was required in RA 7A and was accomplished on November 10, 2005, using a clamshell dredge. As the CDF containment berm was already closed, the dredge material was placed in a dump scow and then transferred by clamshell to lined dump trucks on shore at a location just north of Colonial Fruit. The trucks transported the dredge material to the CDF for disposal. The entire transfer area, both upland where trucks were loaded and the slope over which the clamshell swung, were covered with heavy visqueen during the operation. The visqueen remained intact throughout the transfer operation and was disposed of in the CDF below elevation 9 feet MLLW.

Post-dredge hydrographic surveys confirmed the three-foot dredge depth had been achieved prior to capping. Approximately 559 CY of material was dredged and transported to the CDF for disposal.

3.1.5.5 CAPPING / BACKFILLING

Thin layer capping in RA 7 commenced on November 30, 2005, with a Telebelt conveyor used to cap under the covered moorage in the Foss Waterway Marina. Divers were used in this initial Telebelt capping to assist in determining placement rates and dispersion of the material as it passed through the water column. The divers confirmed that material flowed freely and evenly under the marina floats to complete the required capping and also that the calculated volume for a known area and the placement pattern used by the Telebelt operator produced the desired six-inch cap thickness. Telebelt capping of the covered moorage portion of RA 7 was completed on December 1, 2005. The remainder of RA 7 was capped with a derrick and clamshell on December 6-7, 2005.

Capping of RA 7A was performed on November 11, 2005.

Capping quantities included approximately 1,288 tons in RA 7A, 3,885 tons in RA 7, and 260 CY placed by Telebelt under the covered moorage area in RA 7.

3.1.5.6 SURVEYING

Hydrographic surveys were conducted in RA 7A to confirm dredge depths and limits as well as capping depth. Dredge surveys were reviewed and approved by the CM Team prior to commencing capping operations. Capping surveys were reviewed by the Corps at the time of the Pre-Final Inspection with no issues noted.

There were no hydrographic surveys performed in the thin channel sand cap area of RA 7 as the six-inch layer is within the allowable accuracy of the survey equipment. In lieu of a survey, the cap thickness was verified by quantifying the amount of material placed over RA 7.

Surveys and quantity calculations were reviewed by the Corps at the time of the Pre-Final Inspection with no issues noted. Figure 5 presents the post-construction conditions in RAs 7 and 7A.

3.1.5.7 DEMOLITION AND DISPOSAL

Removal and disposal of timber piling and floats was performed at the Foss Waterway Marina in preparation for remediation in RAs 7 and 7A. Piling removal consisted of placing containment and absorbent booms around the work areas to contain floating debris and any possible petroleum sheen, using a derrick to extract approximately 48 individual piling; placing the piling onto plastic lined barges; and transferring the piling (approximately 97 tons) from the barge into containers at the Middle Waterway Peninsula for transport and disposal at Rabanco's Roosevelt Regional Landfill (Rabanco Landfill) (Table C-1).

Removal of the existing piling was performed by Manson from November 3-7, 2005. Transfer, transport, and disposal of the debris were performed for Manson by Rhine between November 3, 2005 and January 17, 2006.

Floats were removed concurrently with piling. The floats were rafted in the head of the Thea Foss Waterway adjacent to the State Route 509 (SR 509) Bridge and removed from the water with a shore-based Manitowoc crane. The floats were transported by Rhine to the Rabanco Landfill on January 17, 2006, for disposal. Approximately 7 tons of floats were disposed of at the landfill.

3.1.5.8 SEDIMENT VERIFICATION SAMPLING AND ANALYSIS

Sediment verification sampling and analysis were performed prior to initiation of remedial actions in RA 7. Sediment verification sampling was performed in RA 7 in June 2005. A summary of the results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

3.1.5.8.1 Remedial Design Modification Evaluation

Multiple utility crossings were identified approximately 20 to 120 feet south of the 11th Street Bridge in the northern portion of RAs 5, 6, and 7. As a result, sediment sampling was performed to characterize sediment in the northern portion of RAs 5, 6, and 7 to support modification of the remedial actions in the area of the utility crossings.

Samples were collected from two stations located in the northern portion of RA 7 in the area of the utility crossings. The surface sediment samples (RA-07-001-050629-G and RA-07-002-050629-G) were collected on June 29, 2005 (Table B-1) (Figure B-2). Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the sample collected from the northernmost portion of RA 7 (RA-07-001-050629-G) between Stations 35+00 and 36+30 (Table B-20). The detected chemical

concentrations and detection limits in the sample collected between Stations 36+30 and 37+10 were less than the SQOs for all but one compound. The pesticide p,p'-DDE was detected at a concentration (12.8 ug/kg) greater than the SQO (9 ug/kg) but less than the 2LAET criteria (15 ug/kg). Based on the results of samples collected in the northern portion of RA 7, the remedial actions in the northern portion of RA 7 were modified as discussed in Section 3.1.5.2.

3.1.5.9 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring were performed during piling removal, dredging, and capping activities in RAs 7 and 7A in accordance with the EPA approved CQAP, Water Quality FSP, project plans and specifications, and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris boom, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO and TSS analyses in accordance with the project plans and WQC.

The results of in-situ monitoring for turbidity, temperature, and DO consistently met water quality standards specified in the project WQC.

Dissolved silver was detected in water quality samples at concentrations below the water quality standard. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper concentrations in samples collected during construction in RAs 7 and 7A ranged from 9.8 to 15.08 µg/L. Ambient copper concentrations were between 11 and 14 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.6 REMEDIAL AREA 8

Remedial Area 8 (RA 8) is comprised of the western bank of the Thea Foss Waterway from Station 52+34 on its southern boundary to Station 34+91 on the north (Figure 2). The area extends from elevation +13 feet MLLW on the shoreline slope to the pierhead/bulkhead line along the west side of the Thea Foss Waterway.

The remedial design for RA 8 consisted of slope dredging to support slope capping. Slope dredging was performed to achieve a 2H:1V slope. Capping consisted of constructing a thick slope cap. Facilities in or adjacent to RA 8 include: Johnny's Seafood and the seaplane float, Colonial Fruit, Foss Waterway Marina, and a pile supported esplanade.

3.1.6.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 8 includes:

- Debris and piling removal;
- Removal and replacement of the seaplane float;
- Dredging and thick slope cap placement;
- Habitat enhancement;
- Surveying; and
- Water quality monitoring.

3.1.6.2 DESIGN MODIFICATIONS

Several design modifications were made following or in conjunction with agency approval of the Remedial Design on November 10, 2003, and prior to the beginning of work in RA 8. These changes were incorporated into revised drawings and submitted to EPA for approval. The changes listed below were approved by EPA:

- The top elevation of the slope cap in front of the sheetpile wall at Johnny's Seafood was revised from +12 feet MLLW to +10 feet MLLW. This change was necessary to prevent the reinstalled seaplane float from future grounding on the slope cap. Additionally, the two-foot bench at the top of the slope was eliminated to resolve the grounding issue. The slope was maintained at 2H:1V, and the capping requirements were not changed.
- More large woody debris (LWD) was added to the habitat bench between Stations 52+24 and 50+90.
- An abandoned concrete vault at the north side of Colonial Fruit was identified to be demolished and a log step habitat area constructed in its place.
- The piling used for reinstallation of the seaplane float was changed from treated timber to galvanized steel pipe.

The following minor change was transmitted to and approved by EPA via email:

- The cap material for a small area under Colonial Fruit was changed from quarry spalls to habitat mix to be consistent with the adjacent area under the warehouse and to facilitate placement of the cap material.

One additional minor change was made to fit field conditions:

- The quarry spall and habitat mix slope cap in the vicinity of Outfall 230 was extended above the elevation shown on the plans to provide erosion protection in an area of existing trees on the upper bank. Had the bank been left in its existing condition, the City felt the trees could be lost. As this change was an addition to prevent bank erosion and loss of vegetation and did not change the remedial design, a field modification was made in this area.

3.1.6.3 PREPARATION FOR CONSTRUCTION

Several meetings were held on-site to discuss various aspects of the work such as the method for grading the slopes at the sheetpile wall at Johnny's Seafood; method of constructing the splash pad at Outfall 230; construction of the habitat bench at the south end of the RA; removal of creosote piling located within the dredge prism in proximity of the sheetpile wall; and placement of cap and habitat material under the pile supported portions of the Esplanade.

Additionally, the preparation for dredging was accomplished in a pre-construction meeting on July 14, 2004. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance.

Topics discussed included:

- Health and safety requirements;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;
- Water quality monitoring requirements; and
- Containment booms at the site of dredge and other environmental BMPs.

3.1.6.4 SEAPLANE FLOAT

The seaplane float was removed to allow for the dredging and slope capping to be completed in front of the sheetpile wall at Johnny's Seafood. Derrick 3 initially removed and stored the gangway and then used a vibratory hammer to extract six timber guide piles along the float. When the dredging and capping were completed, the float was reinstalled using 12-inch diameter galvanized steel piling at the same locations where the pre-existing timber piling had been removed.

3.1.6.5 DREDGING

Dredging in RA 8 commenced on December 28, 2004, with the derrick Andrew loading dredge material into the dump scows for transport and disposal of the material into the CDF. The initial dredging between approximate Stations 52+34 to 44+50 proceeded continuously until January 31, 2005, with one additional day of dredging on February 11, 2005. The dredging and capping to elevation -31 feet MLLW in a portion of this area actually crosses the line between RA 8 and RA 6.

On three separate occasions, a backhoe on a flat deck barge was used at night during low tides to excavate the upper slope along the sheetpile wall at Johnny's Seafood, for the excavation at the base of Outfall 230, and under the walkway access for the seaplane float where it was impracticable to try to use the clamshell dredge.

Dredging in RA 8 resumed on November 14, 2005, with the derrick Andrew cutting the slope riprap keyway between Stations 38+75 to 37+25. This dredging was completed on November 15, 2005, and was the final dredging in RA 8. This material was loaded into a dump scow and then transferred to lined trucks for haul and disposal into the CDF.

Approximately 43,434 CY of material was dredged from the slopes of RA 8 between Stations 52+34 and 37+25. Although some of the material from the lower portions of the slope and the toe trench was actually within the boundaries of RA 6, it is included in the dredging volumes for RA 8 as it was done in support of the slope capping in RA 8.

3.1.6.6 CAPPING / BACKFILLING

The emphasis for slope capping during the 2004-2005 construction season was to complete the slope in the area of the seaplane float and sheetpile wall at Johnny's Seafood to allow for reinstallation of the float and to restore the stability of the slope at the sheetpile wall. Following dredging of the slope, the work proceeded first with the placement of the riprap toe berm, then placement of an 18-inch lift of slope cap filter material. This was followed by placement of an 18-inch lift of riprap, and finally a covering of habitat mix at a rate of 25 tons per 1,000 SF. The Andrew placed the filter material and riprap while Derrick 3 was used to place habitat mix. A backhoe on a flat deck barge was used to place cap material around Outfall 230 and under the seaplane float approach pier.

Slope capping began January 26, 2005, and proceeded through February 15, 2005. During that period of time, the activity switched back and forth between toe berm construction and the placement of thick slope cap materials. Slope capping was completed from Outfall 230 through the northern end of the seaplane float. The riprap toe berm was completed from that point north to approximate Station 44+50. In all, approximately 3,925 tons of slope cap filter material, 5,600 tons of riprap, and 115 tons of habitat mix were placed on the RA 8 slopes during the 2004-2005 construction season.

Capping resumed on July 18, 2005, at approximate Station 47+00 following agency approval of an early start of the in-water construction season for the placement of clean cap material. On July 21-22, 2005, a conveyor belt was used to place habitat mix under Colonial Fruit at a rate of 25 tons per 1,000 SF. Capping continued intermittently in various areas of RA 8 through August 19, 2005, when capping was completed to the southern end of the Foss Waterway Marina.

Capping resumed in the area of the Foss Waterway Marina on November 17, 2005. At the south end of the marina, in the area under the pile supported concrete section of the Esplanade, an extendable boom bucket loader was used to place slope cap filter

material and riprap during night time low tides. Approximately 150 feet of thick slope cap between the pile supported timber portion of the Esplanade and the pile supported concrete portion of the Esplanade was steepened from 2V:1H to approximately 1.5V:1H to prevent grounding of the adjacent marina marginal walkway float. A derrick with a clamshell bucket was used to place slope cap material in the open areas of the slope.

At the north end of RA 8, a combination of Telebelt and bucket loader placement through the deck was used to cap under the timber pile supported portion of the Esplanade. The derrick was used where possible to complete capping on this slope.

Final capping in RA 8 was completed on December 7, 2005. Approximate material quantities for capping included 13,588 tons of slope cap filter material, 26,616 tons of light loose riprap, 2,690 tons of quarry spalls, and 1,362 tons of habitat mix.

3.1.6.7 STORMWATER OUTFALLS

Riprap splash pads were constructed for Stormwater Outfalls 225 and 230 to prevent erosion. Neither pipe required extension.

3.1.6.8 HABITAT ENHANCEMENTS

Two habitat enhancement areas were created in RA 8. At the south end of RA 8 between approximate Stations 52+24 and 50+90 a bench was created at the top of the shoreline slope at elevation +13 feet MLLW and six pieces of LWD were placed (Figure 3). At approximate Station 44+00, a log step with a benched planting area was installed in the slope at elevation +11 feet MLLW to +13 feet MLLW.

3.1.6.9 SURVEYING

Hydrographic surveys were conducted in RA 8 after dredging to confirm dredge depths and limits. Hydrographic surveys were also performed following placement of the toe berm riprap, slope cap filter material, and thick slope riprap layer. Surveys were reviewed and approved by the CM Team prior to the placement of the next lift of cap material.

A combination of topographic surveys and onsite continuous inspection were used to confirm placement of cap material above elevation +5 feet MLLW. Inspectors confirmed the placement of the 18-inch layer of slope cap filter material through visual observation and computation of tonnage of material placed over a known area. Topographic surveys were performed following placement of riprap and compared with the post-dredge slope to verify a minimum three-foot final cap thickness.

Dredging and capping surveys were reviewed by the CM Team and the Corps at the time of the Pre-Final Inspection with no issues noted. Figure 5 presents the post-construction conditions in RA 8.

3.1.6.10 DEMOLITION AND DISPOSAL

3.1.6.10.1 Johnny's Seafood

Removal and disposal of treated timber piling associated with the seaplane float was performed adjacent to Johnny's Seafood in preparation for dredging in RA 8. Piling removal consisted of placing containment and absorbent booms around the work areas to contain floating debris and any possible petroleum sheen, using a derrick and vibratory hammer to fully extract six individual treated timber piling; placing the piling onto a plastic lined barge; and transferring the piling (approximately 15 tons) from the barge into containers at the Middle Waterway Peninsula for transport and disposal at the Rabanco Landfill. These piling removed from the seaplane float were combined with piling removed from other portions of the Thea Foss Waterway and disposed of (Table C-2).

Removal of the seaplane float piling was performed by Manson from January 3-5, 2005. Transfer, transport, and disposal of the debris were performed by Rhine on March 14, 2005.

Additionally, during dredging of the slope at Johnny's Seafood on January 21, 2005 (approximate Stations 47+50 to 50+00), a row of non-treated piling was discovered below the mudline at approximate elevation +7 feet MLLW. Piling removal consisted of breaking the piling off at the mudline with an excavator, placing the piling onto a barge, and transferring the piling from the barge into containers at the Middle Waterway Peninsula for transport to the Rabanco Landfill for disposal (Table C-2). Transfer, transport and disposal were performed by Rhine on March 14, 2005.

3.1.6.10.2 Colonial Fruit

Removal and disposal of timber piling was performed adjacent to Colonial Fruit in preparation for remediation in RA 8. Piling removal consisted of placing debris and absorbent booms around the work areas to contain floating debris and any possible petroleum sheen; using a derrick to extract approximately 30 individual treated timber piling; placing the piling onto plastic lined barges; and transferring the piling (approximately 68 tons) from the barge into containers at the Middle Waterway Peninsula for transport to the Rabanco Landfill for disposal (Table C-3).

Removal of the piling was performed by Manson from July 7-13, 2005. All piling were extracted using a vibratory hammer. Transfer, transport, and disposal of the piling were performed by Rhine from July 11-15, 2005.

3.1.6.10.3 Log Step

Just north of Colonial Fruit a concrete vault was demolished on August 1-2, 2005, in preparation for the creation of a log step habitat enhancement area. The concrete vault was demolished using small tools and a trackhoe with a breaker operating from the upland. The demolished concrete vault and surrounding sediment was excavated by the trackhoe and loaded into lined trucks and transported to the CDF for disposal. Approximately 200 tons of concrete and sediment were transported to the CDF for disposal from the log step habitat area.

3.1.6.10.4 Foss Waterway Marina

Several debris piles were removed from beneath the Esplanade at the Foss Waterway Marina on August 30-31, 2005 and October 13-14, 2005. The debris piles were excavated by hand and placed into steel containers. The steel containers were lifted with a crane and the debris within the containers was transferred into lined trucks. Approximately 14 cubic yards of debris was transported by truck to the CDF for disposal.

3.1.6.11 CAP VERIFICATION SAMPLING AND ANALYSIS

The CQAP identified the collection of cap boundary verification samples at four locations in RA 6 following completion of slope capping in RA 8. The intent of the samples was to monitor potential impacts of cap placement in RA 8 on dredged surfaces in RA 6.

The cap boundary verification samples were not collected as the components of capping in RA 8 (i.e., dredging, placement of key rock, filter material, and riprap) occurred prior to completion of dredging in the adjacent portion of RA 6. This modification to the CQAP for cap verification sampling was transmitted to EPA in a letter dated September 16, 2005. The approval for the CQAP modification was received in an email from EPA dated October 4, 2005.

3.1.6.12 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during piling and marina float removal, dredging, capping, and pile driving and float installation activities in RA 8. Water quality monitoring was performed in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature and DO consistently met water quality standards specified in the project WQCs. Turbidity infrequently exceeded the criteria (i.e., ambient turbidity plus 10 NTUs) during dredging activities. Turbidity exceedences were generally less than 10 NTUs above the criteria.

Turbidity exceedences occurred on three occasions in the 2004-2005 construction season when dredging first began in RA 8. The elevated turbidity was predominantly measured at one monitoring station located at the boundary of the construction zone (i.e., mixing zone). It was speculated that localized bathymetry / topography (the bulge into the waterway created by the volleyball court) was concentrating turbidity at the monitoring station. In response to the elevated measurements, the contractor

relocated the construction zone further to the north. Once the construction zone was relocated, no further turbidity exceedences occurred during dredging in RA 8. EPA was notified of the turbidity exceedences and the contractor's response to reduce turbidity.

Sheen was intermittently observed to occur as a result of dredging in RA 8. Debris and absorbent booms were deployed to contain sheen during remedial activities in RA 8 in accordance with project BMPs.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper concentrations in construction area samples ranged from 8.8 to 50.7 µg/L. Ambient concentrations ranged between 14 and 51.6 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.6.13 FISH MONITORING ACTIVITIES

An extension to the in-water work period was requested to continue work beyond February 14, 2005. Work to be performed in the extension period consisted of reinstallation of the seaplane floats in RA 8 using a vibratory hammer. EPA granted a work extension to March 15, 2005, and the City continued until work was completed on March 3, 2005. During the work extension period, specified BMPs and monitoring were required for in-water construction activities.

Fish monitoring consisted of visual observations within and adjacent to work areas and seining at designated locations to evaluate fish presence. Visual monitoring was performed at each in-water construction location. Seining for fish was performed at the following locations during the work extension period:

- Mouth of the Wheeler-Osgood Waterway;
- Volleyball Court in RA 19A;
- Simpson Peninsula;
- OVRA Site; and
- North Beach Habitat.

Seining was performed at a specific location contingent upon the location of in-water construction activities.

Visual monitoring for the presence of fish was required and performed for piling installation using a vibratory hammer to reinstall the seaplane float in RA 8 during the work extension period. Additionally, seining was performed at the Volleyball Court site in RA 19A during the time period when work was performed in RA 8 during the work extension period (February 16-17, 2005). No salmonids were captured in two seine sets performed at the Volleyball Court site.

3.1.7 REMEDIAL AREA 9

Remedial Area 9 (RA 9) is located in the mouth of the Wheeler-Osgood Waterway between Wheeler-Osgood Stations 5+00 and 10+00 (Figure 2). It was a hotspot area measuring approximately 100 feet by 500 feet and is surrounded by no action areas. RA 9 required dredging to a uniform elevation of -8 feet MLLW and backfilling with channel sand cap material to match the grade in the adjacent area. As detected chemical concentrations exceeded the SQOs in the post-dredge samples, the channel sand cap ultimately placed in RA 9 constituted a cap.

3.1.7.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 9 includes:

- Removal and reinstallation of floats and gangway at Marine Floats, Inc.;
- Removal and replacement of piling;
- Dredging;
- Capping with channel sand cap material;
- Surveying;
- Sediment and cap verification sampling; and
- Water quality monitoring.

3.1.7.2 DESIGN MODIFICATIONS

As stated in Section 3.1.7, the remedial design for RA 9 was to dredge to an elevation of -8 feet MLLW and backfilling with channel sand cap material. However, a cap was placed in RA 9 in response to the presence of chemical concentrations greater than the SQOs in post-dredge samples (Figure 3). The cap placed in RA 9 is comprised of three feet of channel sand cap material. Additional detail concerning capping performed in RA 9 is presented in Section 3.1.7.8.1.

3.1.7.3 PREPARATION FOR CONSTRUCTION

The preparation for dredging was primarily accomplished in a pre-construction meeting on August 2, 2005. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance.

Topics discussed included:

- Health and safety requirements for working around the dredge and pipeline;
- Rehandling of dredge material;
- Reporting requirements;
- Containment booms at the site of dredging and other environmental BMPs;
- Simpson safety rules for work at the dredge discharge point at the CDF;
- Surveys; and
- Dredge contact information.

All floats belonging to Marine Floats, Inc. were removed and relocated to the head of the Foss Waterway for temporary storage during dredging and capping operations.

Four treated timber piling were removed and disposed of as discussed in Section 3.1.7.7.

Pre-dredge hydrographic surveys were also performed in preparation for construction.

3.1.7.4 DREDGING

Dredging commenced on October 5, 2005, with the hydraulic dredge Lofgren. A considerable number of buried timber piling requiring additional effort to remove were encountered along the southwest portion of the dredge cut. The dredging was completed on October 10, 2005. Approximately 11,491 CY of material was dredged and pumped by pipeline to the CDF for disposal.

3.1.7.5 CAPPING / BACKFILLING

Capping with imported channel sand cap material commenced on October 26, 2005, and proceeded intermittently until completion on November 10, 2005, with derrick and clamshell placement. Approximately 17,966 tons of channel sand was placed to cap RA 9. All floats were returned on November 17, 2005, with four new galvanized steel piling being driven to replace the treated timber piles that were removed.

3.1.7.6 SURVEYING

Hydrographic surveys were conducted to confirm dredge depths and limits as well as cap thickness. Dredge surveys were reviewed and approved by the CM Team prior to commencing capping operations. Cap surveys were reviewed by the Corps at the time of the Pre-Final Inspection with no issues noted. Figure 6 presents the post-construction conditions in RA 9.

3.1.7.7 DEMOLITION AND DISPOSAL

Four creosote treated timber piling were removed between July 21- 27, 2005, at Marine Floats, Inc. in preparation for dredging in RA 9. Piling removal consisted of placing debris and absorbent booms around the work areas to contain floating debris and any possible petroleum sheen; using a derrick to extract four individual piling; placing the piling onto a plastic lined barge; and transferring the piling (approximately 8 tons) into containers at the Middle Waterway Peninsula for transport and disposal at the Rabanco Landfill. These piling removed from RA 9 were combined with piling removed from other portions of the Thea Foss Waterway for disposal (Table C-2). These piling were transported to the Rabanco Landfill on March 14, 2005.

3.1.7.8 SEDIMENT / CAP VERIFICATION SAMPLING AND ANALYSIS

Sediment and cap verification sampling and analysis were performed as specific components of the remedial action were completed in RA 9. Sediment and cap verification sampling were performed in RA 9 between October and December 2005. A summary of the results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment and cap verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

The thickness of the channel sand cap placed in RA 9 was verified by hydrographic survey as the cap was placed as a response action. As stated in Section 3.1.7.6, cap surveys were reviewed as part of the Pre-Final Inspection and no issues were noted. Therefore, no cap verification coring was performed for the channel sand cap placed in RA 9.

3.1.7.8.1 Post-Dredge, Prior-to-Cap

Samples were collected from three stations in RA 9 once dredging had been completed and prior to capping the area. The post-dredge surface samples (RA9-001-051012-G, RA9-002-051012-G, and RA9-003-051012-G) were collected on October 12, 2005 (Table B-1) (Figure B-3). A field duplicate sample (RA9-006-051012-G) was also collected for quality control.

PAHs and N-nitrosodiphenylamine were detected in Sample RA-09-001-051012-G and the associated field duplicate, RA-09-006-051012-G, at concentrations exceeding the SQOs (Table B-21). Mercury and pesticides were detected in Sample RA-09-002-051012-G at concentrations exceeding the SQOs. All other detected chemical concentrations and analytical detection limits were below the SQOs for these samples. The detected chemical concentrations and analytical detection limits were below the SQOs in Sample RA-09-003-051012-G.

The CQAP states that the average concentration of the post-dredge samples will be compared to the SQOs. The average concentration for several PAHs and one pesticide are greater than the SQO in samples collected from RA 9. Because the average concentration of one or more chemicals is greater than the SQO, placement of channel sand cap material in RA 9 constitutes a cap and monitoring will be performed as part of the City's future OMMP activities. Additional dredging was not performed as completion of remedial actions in RA 9 were on the critical path for meeting the enforceable schedule and a portion of RA 9 had already been dredged to a depth of eight feet and additional dredging may have affected the adjacent shoreline.

3.1.7.8.2 Dredge Boundary Verification

Dredge boundary verification samples were collected from surface sediments located in the channel on the east and west sides of the boundary of RA 9 following the completion of dredging. The two dredge boundary verification samples (RA9-004-051012-G and RA9-005-051012-G) were collected on October 12, 2005. Neither the detected concentrations nor analytical detection limits exceeded SQOs in the dredge boundary samples (Table B-22). Therefore, no response actions or additional sampling were required.

3.1.7.8.3 Cap Verification

Cap verification samples were collected in RA 9 upon the completion of channel sand cap material placement. The three cap verification samples (RA-09-011-051214-G, RA-09-012-051214-G, and RA-09-013-051214-G) were collected from the surface of the completed cap on December 14, 2005. Neither the detected concentrations nor analytical detection limits exceeded SQOs in the cap verification samples (Table B-23). Therefore, no response actions or additional sampling were required.

3.1.7.9 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during dredging and capping activities in RA 9 in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris boom, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQC.

The results of in-situ monitoring for temperature, turbidity, and DO consistently met water quality standards specified in the project WQC. Dissolved silver was not detected or detected at concentrations below the water quality standard. Detection limits and detected concentrations were below water quality criteria for sliver. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper concentrations in construction area samples ranged between 14 and 15 µg/L. The ambient copper concentration was 14 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.8 REMEDIAL AREA 12

Remedial Area 12 (RA 12) is an isolated area located in the east central portion of the channel of the Wheeler-Osgood Waterway (Figure 2). Work in RA 12 included dredging two feet and backfilling with channel sand cap material to match the adjacent channel bottom. Habitat enhancement work on the adjacent shoreline slopes of the waterway was completed in the 2002-2003 construction season under the UAO. Due to the elevation of the Wheeler-Osgood Waterway, work in the waterway was restricted to high tides with minimal time allowed for dredging and backfilling activities.

3.1.8.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 12 included the following:

- Dredging;
- Placement of channel sand cap material;
- Surveying;
- Sediment verification sampling; and
- Water quality monitoring.

3.1.8.2 PREPARATION FOR CONSTRUCTION

The preparation for dredging was primarily accomplished in a pre-construction meeting on July 14, 2004. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance.

Topics discussed included the following:

- Health and safety requirements;
- Pre-dredge and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;
- Water quality monitoring requirements; and
- Containment booms at the site of dredging and other environmental BMPs.

Several meetings were held prior to construction to coordinate the temporary relocation of floats associated with the business of Marine Floats, Inc., to provide access for the dredge and dump barge to the head of the waterway. Manson assisted Marine Floats, Inc. in moving floats to provide clearance. Pre-dredge surveys were performed and dredge templates generated to guide the two feet of dredging.

3.1.8.3 DREDGING

Dredging of RA 12 commenced on February 22, 2005, under an EPA approved extension to the fish window. Work was performed with a clamshell dredge at tides higher than elevation +10 feet MLLW. Dredged material was placed into dump scows and transported to the CDF for disposal. Approximately 3,733 CY of material was dredged and disposed in the CDF. Dredging in RA 12 was completed on February 26, 2005.

As described in more detail below, an area of petroleum sheen was observed at low tide after dredging of RA 12 had been completed. This area, adjacent to the northeastern boundary of RA 12, was excavated from shore on a low tide (i.e. in the dry) using a backhoe on July 8, 2005. Approximately 200 CY of material from this area was loaded into lined trucks and transported to the CDF for disposal.

3.1.8.4 CAPPING / BACKFILLING

The capping of the small shoreline excavation adjacent to the northeastern boundary of RA 12 was accomplished during a low tide (i.e., in the dry) with a shore-based Telebelt on July 19, 2005. A total of 313 tons of channel sand cap material was used to cap this area.

On September 12, 2005, backfilling of RA 12 commenced with the Telebelt from shore. This activity continued until September 15, 2005, with the Telebelt backfilling all of the area it could reach from shore.

Backfilling of the remainder of RA 12 commenced on October 21, 2005, with a derrick and clamshell placing channel sand cap material at high tide. The backfilling was completed on October 25, 2005. A total of approximately 6,762 tons of imported channel sand cap material was used for the backfill of RA 12.

3.1.8.5 SURVEYING

Pre and post-dredge hydrographic surveys were performed. The post-dredge surveys were reviewed and approved prior to backfilling RA 12 and capping of the sheen source removal area. Post backfill and cap surveys were taken and were reviewed by the Corps during the Pre-Final Inspection with no issues noted. Figure 6 presents the post-construction conditions in RA 12.

3.1.8.6 SEDIMENT VERIFICATION SAMPLING AND ANALYSIS

Sediment verification sampling and analysis were performed as specific components of the remedial action were completed in RA 12. Sediment verification sampling was performed in RA 12 in March 2005 and July 2005. A summary of the results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

Due to a discrepancy in the design documents, the sediment verification sampling requirements for RA 12 identified in the CQAP were for dredging to final grade, not dredging followed by backfilling that was the final design for RA 12. The Corps requested clarification of the CQAP requirements for sampling of RA 12, which was

provided to the Corps and EPA in emails on June 7, 2005 and June 22, 2005. The clarification of CQAP requirements and sampling performed in RA 12 were approved by EPA in an email dated July 19, 2005.

3.1.8.6.1 Post-Dredge, Prior-to-Backfill

Samples were collected at three stations once dredging had been completed in RA 12 and prior to backfilling the area. The post-dredge surface samples (RA-12-001-050309-G, RA-12-002-050309-G, and RA-12-003-050309-G) were collected on March 9, 2005 (Table B-1) (Figure B-3). A field duplicate sample (RA-12-005-050309-G) was also collected for quality control purposes.

The detected chemical concentrations and detection limits in the post-dredge samples were less than the SQOs for all but four low molecular weight polycyclic aromatic hydrocarbons (LPAH) at one station (Table B-24). The sample from the center of RA 12 (RA-12-002-050309-G) had detected concentrations of acenaphthene, anthracene, fluourene, phenanthrene, and total LPAHs that exceeded the SQOs.

Although the detected concentrations of these compounds and total LPAHs, were between 1.1 and approximately 1.5 times the SQO, the average concentrations for these compounds in the post-dredge, prior-to-backfill samples were below the SQOs. The Final Design CQAP states that the average concentration of the post-dredge, prior-to-backfill samples will be compared to the SQOs. Because the average concentrations are below the SQOs, placement of channel sand cap material in RA 12 constitutes a backfill and no monitoring for the purposes of cap placement integrity monitoring will be required as part of the City's future OMMP activities.

3.1.8.6.2 Sheen Source Removal

Observations of the northeastern dredge cut boundary at RA 12 at low tide identified the presence of a lens of wood that contained petroleum hydrocarbons. The lens was observed to be less than six inches thick and approximately 35 feet wide. The lens was observed to produce petroleum sheen at low tide and emitted a strong petroleum odor. The City submitted a plan for removal of this additional material on June 14, 2005, and EPA approved this plan on June 27, 2005.

Removal of the sediment with wood and petroleum hydrocarbons in this area was performed on July 8, 2005. Visual observations during excavation indicated that the material that was the source of the sheen had been removed. A post-dredge sample was collected to evaluate the removal of the material (RA-12-014-050711-G) on July 11, 2005. A field duplicate sample (RA-12-015-050711-G) was also collected for quality control.

The detected concentrations of several PAHs, total LPAHs, and p,p'-DDE exceeded the SQOs in the samples (Table B-25). Three feet of channel sand cap material was then placed in this area on July 19, 2005. Because the chemical concentrations in the post-dredge samples exceeded the SQOs, the channel sand cap material placed in the sheen source removal area constitutes a cap and the area will be monitored as part of the City's future OMMP activities.

3.1.8.6.3 Dredge Boundary Verification

One dredge boundary verification sample was collected once dredging had been completed in RA 12. The dredge boundary verification sample (RA-12-004-050309-G) was collected on March 9, 2005, from surface sediment located west of RA 12. Neither the detected concentrations nor analytical detection limits exceeded SQOs in the dredge boundary sample (Table B-26). Therefore, no response actions or additional sampling were required.

3.1.8.7 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during dredging activities in RA 12 in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature, turbidity, and DO consistently met the water quality standards specified in the project WQCs.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper concentrations in construction area samples ranged between 13.7 and 16.1 µg/L. The associated weekly ambient copper concentration was 13.8 µg/L. Although the maximum construction monitoring copper concentration was marginally greater than the weekly ambient concentration, the detected construction concentration was not greater than the overall ambient concentrations detected in the Thea Foss Waterway. Therefore, no response action was identified to be necessary based on communication with EPA. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.8.8 FISH MONITORING ACTIVITIES

An extension to the in-water work period was requested to continue work in RA 12 beyond February 14, 2005. Work during the extension period consisted of the clamshell dredging of RA 12 and disposal of the dredged material, by barge, into the CDF prior to closure of the CDF containment berm. EPA granted a work extension to March 15, 2005, and the City continued until work was completed on March 3, 2005. During the work extension period, specified BMPs and monitoring were required for in-water construction activities.

Fish monitoring consisted of visual observations within and adjacent to work areas and seining at designated locations to evaluate fish presence. Visual monitoring was performed at each in-water construction location. Seining for fish was performed at the following locations during the work extension period:

- Mouth of the Wheeler-Osgood Waterway;
- Volleyball Court in RA 19A;
- Simpson Peninsula;
- OVRA Site; and
- North Beach Habitat.

Seining was performed at a specific location contingent upon the location of in-water construction activities.

BMPs and monitoring required and performed for dredging in RA 12 during the work extension period included:

- Enclosing the dredging area within a fish exclusion barrier / containment boom with a six-foot deep silt curtain;
- Performing intensive water quality monitoring;
- Biologist observations for the presence of fish; and
- Seining to evaluate for the presence of fish.

The seining site associated with dredging in RA 12 is the mouth of the Wheeler-Osgood Waterway. During the work extension period when dredging was performed in RA 12 (February 22-26, 2005), one salmonid (Steelhead) was captured and released in three seine sets performed at mouth of the Wheeler-Osgood Waterway.

3.1.9 REMEDIAL AREA 14

Remedial Area 14 (RA 14) is located on the east side of the Thea Foss Waterway under and adjacent to the J.M. Martinac Shipbuilding facility (Figure 2). Work in RA 14 was originally started in the 2002-2003 construction season under the UAO, but was ceased under the middle pier due to the contractor's safety concerns with the stability of the structure. The work performed under this contract involved shoring of structural building elements considered damaged or decayed beyond adequate structural capacity; removal of debris piles that accumulated from years of shipbuilding; and dredging and constructing a 3-foot thick slope cap consisting of 18 inches of filter material, 18 inches of quarry spalls, and habitat mix placed at a rate of 15 tons per 1,000 SF over the area under and adjacent to the wharf.

3.1.9.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 14 includes:

- Structural shoring;
- Debris removal;
- Under wharf capping;
- Dredging;
- Slope capping;
- Surveying;
- Cap boundary verification sampling; and
- Water quality monitoring.

3.1.9.2 PREPARATION FOR CONSTRUCTION

During the Early Work phase of construction in the 2002-2003 construction season, work under the central wharf was suspended due to concerns about the structural integrity of the wharf and the safety of crews working beneath it while removing debris and installing the slope cap. As a result, the contractor for this project was required to provide an independent assessment and shoring plan for the facility to accommodate the slope capping work. Manson submitted a report from JRP Engineering providing specific shoring design for deteriorated beams and pile under the wharf.

Upon review and confirmation of the structural remedy, work commenced in RA 14 on May 25, 2004, with a pre-construction meeting held on the site. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance.

Topics discussed at the preconstruction meeting included:

- Health and safety requirements;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;
- Capping tolerances and surveys;
- Water quality monitoring requirements; and
- Containment booms at the site of dredging and other environmental BMPs.

Work under the Martinac wharves began on May 26, 2004, with the repairs to the underdock structure of the central wharf to make the area safe for the capping activities. On June 6, 2004, an asbestos abatement team removed pipe insulation from an abandoned pipe under the wharf. The structural repairs were completed on June 7, 2004, and remain as permanent improvements at Martinac.

3.1.9.3 DREDGING

On August 22, 2005, a clamshell dredge was used to remove approximately 262 CY of material from the face of the wharves. With EPA's approval, this material was temporarily placed at the bottom of the slope where the hydraulic dredge Lofgren picked up the material and completed the slope dredging within 24 hours of the initial clamshell dredging.

3.1.9.4 CAPPING / BACKFILLING

As mentioned above, capping under Martinac began in the 2002-2003 construction season under the UAO. This work completed the capping beneath the north and south wharves between elevations +2 feet MLLW and +13 feet MLLW. Thick slope capping under the central wharf began on July 9, 2004, between elevations +13 feet MLLW and +2 feet MLLW, in the dry during low tides. Filter material was placed using buckets, conveyors, bobcats and hand labor to attain a minimum depth of 18 inches as confirmed by survey reference marks located on the pile bents under the structure. Quarry spalls and habitat mix followed the filter material once each material layer was verified for minimum thickness. Initial capping work between elevations +13 feet MLLW and +2 feet MLLW was completed under the central wharf on September 9, 2004.

Work on completing the underpier capping below elevation +2 feet MLLW for all three wharves began on September 17, 2005, using a conveyor and hand placement at times. The work was slow and sporadic and became a "go to" place for available crews. The cap was completed under all three wharves using a 130-foot reach Telebelt to place filter material, quarry spalls and habitat mix. This final work began on December 27, 2005, and was completed on January 4, 2006. All work was done during low tides at night.

Following the minor dredging in front of the Martinac wharves, the RA 14 slope was capped with a thick slope cap by derrick and clamshell between August 29, 2005 and September 6, 2005.

Approximate quantities of the various construction activities were as follows:

- Filter Material (underpier) 2,638 Tons
- Quarry Spalls (underpier) 1,807 Tons
- Habitat Mix (underpier) 448 Tons
- Filter Material (slope) 1,999 Tons
- Riprap (slope) 1,473 Tons
- Habitat Mix (slope) 62 Tons

3.1.9.5 SURVEYING

Prior to starting debris pile removal Manson conducted in-place topographic surveys of the debris piles to determine the extent of removal and baseline for original grade to establish a datum for measuring capping layer thicknesses. Once the debris piles were removed, elevation marks at 18 inches and 24 inches were set on each pile that supported the wharf to allow for over placement of cap material. Similar marking were placed on each pile for the subsequent cap layer. Cap layer thicknesses were verified by the on-site inspector.

For open water slope capping, hydrographic surveys were taken following dredging and after each of the two layers of cap material. Figure 5 presents the post-construction conditions in RA 14.

3.1.9.6 DEMOLITION AND DISPOSAL

3.1.9.6.1 Wharf Substructure Demolition

Prior to removing debris piles from beneath the central wharf, the contractor removed a dilapidated timber substructure that was obstructing access. The substructure was comprised of treated and untreated wood timber and piling. The wood substructure was demolished and removed from beneath the wharf on May 25-27, 2004, and placed in a solid waste container. The wood timber and piling were transported by LeMay Trucking to the LRI Landfill for disposal on June 15, 2004, after additional debris from the Temporary Marina Parking Lot was placed in the container. Approximately 5.5 tons of treated and untreated wood was disposed of resulting from the substructure removal (Table C-4).

3.1.9.6.2 Debris Pile Removal and Disposal

Eleven debris piles consisting of soil, metal, and other debris were planned to be removed from beneath the central wharf at Martinac Shipbuilding in support of slope capping. The debris piles ranged from 5 CY to 50 CY in size. Samples were collected from the soil/debris piles at Martinac Shipbuilding on April 26, 2004 and May 6, 2004. The debris piles were characterized in order to identify the appropriate method of disposal. Samples were collected in accordance with the Stockpile Sampling Quality Assurance Project Plan (QAPP), amended by the Addendum to the Stockpile QAPP – Waste Sampling and Analysis at Martinac Shipyard.

Samples collected were analyzed for:

- Resource Conservation and Recovery Act (RCRA) 8 metals using Toxicity Characteristic Leaching Procedure (TCLP) extraction and EPA Method 6010/7471;
- Carcinogenic polycyclic aromatic hydrocarbons (CPAHs);
- Chlorinated pesticides;
- Polychlorinated biphenyls (PCBs); and
- Diesel and oil-range petroleum hydrocarbons.

The results from the sampling and analysis of the debris piles were transmitted to EPA on May 27, 2004, and to the Corps on June 17, 2004. Three debris piles were sampled and found to be Subtitle C waste (piles 1, 2, and 7). The remaining debris piles were Subtitle D waste. The detected concentrations of lead exceeded the Dangerous Waste Toxicity Characteristic Criteria in debris piles 1, 2, and 7. Waste in these three piles was approved for disposal at the Chemical Waste Management Landfill (CWM Landfill) in Arlington, OR on June 4, 2004. Debris piles 3 through 6 and 8 through 11 were authorized by the Tacoma-Pierce County Health Department (TPCHD) on February 6, 2004, for disposal at LRI.

The debris piles were managed separately. Debris piles that consisted of Subtitle D wastes were excavated and transported by Aspen Trucking to LRI. Debris piles that were comprised of Subtitle C wastes were transported by Puget Sound Trucking Lines and Union Pacific Railroad and disposed of at the CWM Landfill.

Manson excavated the solid waste debris piles during low tides and placed the material into lined trucks on June 28-30, 2004, July 1-2, 2004, and July 6-9, 2004. The Subtitle D waste was excavated using a combination of handpicking, a bobcat with an excavator bucket, a trackhoe and a vactor (i.e., vacuum truck). The Subtitle D waste (46 tons) was transported to LRI in lined dump trucks by Aspen Trucking (Table C-5).

Manson excavated the Subtitle C waste debris piles during low tides and placed the material into ten lined containers on June 30, 2004, July 1-2, 2004, and July 6-8, 2004. The Subtitle C waste was excavated using a combination of handpicking, a bobcat with an excavator bucket, and a trackhoe (which operated between the exclusion zone and the containers). Waste containers were placed on visqueen to contain and control waste as it was being placed into containers. A total of approximately 125 tons of Subtitle C waste was excavated and transported by Puget Sound Trucking Lines and Union Pacific Railroad. The Subtitle C waste was transported and disposed of at the CWM Landfill on July 8, 2004, July 13, 2004, and July 15, 2004 (Table C-6).

After excavation was completed, the final surface was capped with filter fabric, filter material, quarry spalls and habitat mix.

3.1.9.6.3 Timber Removal and Disposal

Upon initial excavation work in the shipway area at Martinac, it was discovered that a subgrade timber structure supporting the shipway rails extended into the excavation area at a depth of approximately one-foot below the existing grade. This prohibited a bulldozer from removing the three feet of sediment necessary to allow placement of a thick slope cap. In response, per the City's direction, Manson excavated around the timbers, and with Martinac approval, cut the timbers off leaving a six-inch to eight-inch cantilevered overhang beyond the supporting pile. This permitted continued use of the bulldozer and dredge to remove sediment from the shipway.

The excavation and timber removal was performed on August 18-19, 2004. The timber debris (approximately 13 tons) was hauled to LRI by Scarsella Brothers (Scarsella) for disposal on August 26, 2004 (Table C-7).

3.1.9.6.4 Asbestos Abatement

During a pre-construction inspection on April 5, 2004, that was performed prior to demolition of the pier substructure, an unused insulated pipe was observed. It was suspected that the insulation contained asbestos material. On June 6, 2004, Performance Abatement Services (PAS), an asbestos abatement team, removed the pipe insulation from the pipe under the pier. The material was collected and double bagged. Nine bags of material were removed and transported to Greater Wenatchee Regional Landfill for disposal.

3.1.9.7 CAP VERIFICATION SAMPLING AND ANALYSIS

Cap boundary verification sampling and analysis was performed upon completion of the remedial action in RA 14. Cap boundary verification sampling was performed in RA 5 adjacent to the slope cap in RA 14 on January 9, 2006. A summary of the results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Cap boundary verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

3.1.9.7.1 Cap Boundary Verification

Cap boundary verification samples were collected from surface sediments in RA 5, 50 feet west of the slope cap placed in RA 14 following the completion of capping in RA 14 (Figure B-2). The two cap boundary samples (RA-14-001-060109-G and RA-14-002-060109-G) were collected on January 9, 2006 (Table B-1). A field duplicate sample (RA-14-003-060109-G) was also collected for quality control. Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the cap boundary samples (Table B-12). Therefore, no response action or additional sampling was required.

3.1.9.8 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed at RA 14 during debris removal, dredging, and capping activities at Martinac Shipbuilding in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 3 through Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature, turbidity, and DO consistently met the water quality standards specified in the project WQCs. Sheen and nearshore turbidity was intermittently observed in the 2004-2005 construction season as a result of debris removal and dredging in the shipway at RA 14. Debris and absorbent booms were deployed to contain sheen during remedial activities in RA 14 in accordance with project BMPs.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper concentrations in construction area samples ranged from 11 to 31.2 µg/L. The associated weekly ambient copper concentration was 11 to 21 µg/L. Although the maximum construction monitoring copper concentration was marginally greater than the weekly ambient concentration, the detected construction concentration was not greater than the overall ambient concentrations detected in the Thea Foss Waterway. Therefore, no response action was identified to be necessary based on communication with EPA. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

On August 19, 2004, black turbid water and surficial sheen was observed adjacent to the southern shipway at Martinac Shipyard where excavation was being performed above the waterline at low tide to remove creosote treated timbers and piling and prepare the area for capping. Groundwater flowing across the excavation area transported black silt and sheen to the adjacent surface water. The construction area was enclosed by two booms. The boom closest to the shoreline was comprised of a containment boom with a six-foot silt curtain and an absorbent boom. The second boom was comprised of a containment boom with a six-foot silt curtain. The absorbent boom associated with the boom located closest to the shoreline contained the sheen. The black silt was captured within the containment booms.

Manson Construction stopped work and covered the source area with filter fabric and slope cap filter material. Additionally, Manson's water quality personnel collected surface water samples adjacent to the construction area. Water quality monitoring was performed at the time of sampling and the temperature, DO, and turbidity met the water quality standards. EPA performed a site visit and looked at the samples that were collected. Sample analysis was not required based on EPA's review of the site and samples.

3.1.9.9 FISH MONITORING ACTIVITIES

The City requested that debris pile removal and thick slope capping at RA 14 be allowed to start prior to the August 15, 2004, closure of the fish window. EPA's approval for the work activity in RA 14 was conditioned on the City providing a fish biologist to monitor and seine the area within a fish exclusion barrier. Fish monitoring, including seining, were conducted by representatives from Grette and Associates daily during construction activities.

One juvenile salmonid was observed and captured within the fish boom during seining performed on July 1, 2004, the first day of construction activities. The salmonid was released outside of the fish exclusion barrier. Pole netting was performed after July 1, 2004, as beach seining was inefficient and posed a hazard to captured fish. On the remaining days of fish monitoring during construction at Martinac (July 2, 2004; July 6, 2004; July 9, 2004; July 12, 2004; July 13, 2004; and July 14, 2004), no salmonids were observed or captured within the fish exclusion barrier. Other fish species were captured that were typical of the nearshore Puget Sound environment, including starry flounder, Pacific herring, shiner perch, gunnel, and surf smelt. Reports of findings were provided to EPA.

3.1.10 REMEDIAL AREA 15

Remedial Area 15 (RA 15) lies against the eastern shoreline of the Thea Foss Waterway behind City Marina (renamed Delin Docks in 2005) (Figure 2). It is bounded on the south by the north end of the Johnny's Dock Restaurant parking lot and on the north by the south end of the City Marina parking lot. It includes the shoreline slope of the waterway down to a depth of -17 feet MLLW where it borders the east boundary of RA 16.

The work in RA 15 consisted of establishing a 2H:1V slope by dredging to elevation -17 feet MLLW, filling where the existing slope was too steep, and covering it with a thick slope cap consisting of 18 inches of slope cap filter material, 18 inches of quarry spalls, and habitat mix applied at a rate of 25 tons per 1,000 SF.

3.1.10.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 15 includes:

- Timber pile and debris removal;
- Slope dredging to a bottom depth of -17 feet MLLW;
- Thick slope capping;
- Surveying; and
- Water quality monitoring.

3.1.10.2 DESIGN MODIFICATIONS

While planning the dredging and capping work in RAs 15 and 16, it was discovered that some areas requiring remediation were not included within the original design remediation area boundaries. This determination was based on comparing the Design Analysis Report with the project plans and specifications.

To address this discrepancy, the west boundary of RA 15 was shifted approximately 25 feet to the west to meet the revised RA 16 east boundary. This eliminated the "No Action Area" gap between RAs 15 and 16 that was shown on the original drawings. Hart Crowser revised the remediation boundaries to encompass the missed area, resulting in additional dredging in RAs 15 and 16.

The dredge and cap work in the southernmost portion of RA 15, adjacent to the sheetpile wall, was eliminated to preserve the shallow grades in this area and stability of the adjacent slope and wall. This was a slope stabilization but not remediation.

The revised plan sheets were submitted to EPA for approval, which was received on December 16, 2004, via email. Subsequently, those revised plans were re-issued to Manson.

Following float removal, at the marina owner's option, the floats at City Marina were reconfigured by their own designers and reinstalled by Manson in the 2005-2006 construction season. The new configuration did not increase the overwater coverage and, therefore, no additional permit was required for installation as part of this project. The plans were submitted to EPA by the owner and were approved.

3.1.10.3 PREPARATION FOR CONSTRUCTION

The preparation for dredging was primarily accomplished in a pre-construction meeting on August 2, 2005. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance.

Topics discussed included:

- Health and safety requirements;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Containment booms at the site of dredging and other environmental BMPs;
- Dredge and capping tolerances; and
- Water quality requirements.

All marina floats and treated timber guide piling were removed. Refer to RA 16 for more information regarding this activity.

Pre-dredge hydrographic surveys were also performed in preparation for construction.

3.1.10.4 DREDGING

Dredging commenced on February 3, 2005, with a clamshell dredge and proceeded concurrently with the adjacent dredging in RA 16. Dredging was completed on February 27, 2005, with the exception of a small corner near the southernmost marina gangway that was dredged hydraulically on August 11, 2005. Approximately 4,100 CY of material was dredged and transported by dump scow to the CDF for disposal.

3.1.10.5 CAPPING / BACKFILLING

Manson placed the riprap toe berm with Derrick 3 on March 1, 2005, under an extension to the fish window approved by EPA. The toe berm was complete from Stations 59+75 to 62+00.

Slope capping resumed on July 22, 2005, and was completed on August 18, 2005. Capping material included approximately 2,756 tons of slope cap filter material; 2,152 tons of riprap; and 443 tons of habitat mix.

3.1.10.6 STORMWATER OUTFALLS

Stormwater Outfalls 248 and 249 were extended five to ten feet to clear the thick slope cap. A concrete pipe section was used to extend Outfall 248 and HDPE pipe was used for Outfall 249. Riprap splash pads were constructed below both outfalls to prevent erosion.

3.1.10.7 SURVEYING

Pre-dredge hydrographic surveys were performed over the entire RA 15 area between Stations 59+50 to 62+25. Topographic surveys were performed along the upper bank

portions. Post dredge surveys were similarly performed upon completion of dredge activity along the slope and keyway.

Final hydrographic surveys of the dredging in RAs 15 and 16 were completed, reviewed and approved by the CM Team. In addition, the Corps reviewed the surveys as part of the Pre-Final Inspection process and no issues were noted. Figure 7 presents the post-construction conditions in RA 15.

3.1.10.8 DEMOLITION AND DISPOSAL

Timber piling and an associated bulkhead were removed between February 3, 2005 and March 1, 2005, in preparation for capping the slope in RA 15 adjacent to Johnny's Dock Marina. Those piling located below elevation +5 feet MLLW were pulled. Piling located above elevation +5 feet MLLW were cut off at the mudline with the pile stubs left in the ground to preserve the stability of the existing slope. These remaining piling were covered with a minimum three-foot thick slope cap.

Piling and bulkhead removal procedures consisted of placing debris and absorbent booms around the work areas to contain floating debris and any possible petroleum sheen; using a derrick to extract individual piling or a clamshell bucket to cut off piling below the mudline, as appropriate; placing the extracted or cut piling onto plastic lined barges; and transferring the piling (approximately 108 tons) from the barges into containers at the Middle Waterway Peninsula or Manson's staging area at the SR 509 Bridge for transport and disposal at the Rabanco Landfill. Piling and bulkhead material removed from RA 15 were combined with piling removed from other portions of the Thea Foss Waterway for disposal (Table C-2). The piling were placed in containers by Rhine and transported to the Rabanco Landfill on March 14, 2005.

3.1.10.9 SEDIMENT VERIFICATION SAMPLING AND ANALYSIS

Sediment verification sampling was not required in RA 15.

3.1.10.10 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during demolition / piling removal, dredging, capping, piling installation, and marina construction activities in RA 15 in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature, turbidity, and DO consistently met the water quality standards specified in the project WQCs. Sheen was observed as a result of piling removal and slope dredging in RA 15. Debris and absorbent booms

were deployed to contain sheen during remedial activities in RA 15 in accordance with project BMPs.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper concentrations in construction area samples ranged between 18.6 and 21.3 µg/L. The ambient copper concentration was 21.8 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.10.11 FISH MONITORING ACTIVITIES

An extension to the in-water work period was requested to continue work in RA 15 beyond February 14, 2005. Work to be performed during the extension period consisted of dredging the toe berm trench at the shoreline slope and installing the toe berm in RA 15. The construction activities were required to allow for disposal of clamshell dredged material, by barge, in the CDF prior to closure of the CDF containment berm and stabilize the shoreline slope during the fish window period. EPA granted a work extension until March 15, 2005, and the City continued until work was completed on March 3, 2005. During the work extension period, specified BMPs and monitoring were required for in-water construction activities.

Fish monitoring consisted of visual observations within and adjacent to work areas and seining at designated locations to evaluate fish presence. Visual monitoring was performed at each in-water construction location. Seining for fish was performed at the following locations during the work extension period:

- Mouth of the Wheeler-Osgood Waterway;
- Volleyball Court in RA 19A;
- Simpson Peninsula;
- OVRA Site; and
- North Beach Habitat.

Seining was performed at a specific location contingent upon the location of in-water construction activities.

BMPs and monitoring required and performed for dredging and placement of riprap for the toe berm in RA 15 during the work extension period included:

- Enclosing the dredging area within a fish exclusion barrier / containment boom with a six-foot deep silt curtain;
- Performing intensive water quality monitoring;
- Biologist observations for the presence of fish; and
- Seining to evaluate for the presence of fish.

The seining site associated with dredging in RA 15 is the mouth of the Wheeler-Osgood Waterway. During the work extension period when dredging was performed in RA 15 (February 21, 2005 through March 1, 2005), one salmonid (Steelhead) was captured and released in five seine sets performed at mouth of the Wheeler-Osgood Waterway.

3.1.11 REMEDIAL AREA 16

Remedial Area 16 (RA 16) is on the east side of the Thea Foss Waterway between approximate Stations 52+34 and 62+50 generally under the City Marina (renamed Delin Docks in 2005). It is bounded on the south by RA 20, on the north by RA 5, on the west by the channel line and RAs 17 and 18, and on the east by RA 15 on the southern half and by a natural recovery area along the shoreline on the northern half (Figure 2).

The work in RA 16 consisted of dredging to the design elevation of -17 feet MLLW to remove chemical concentrations greater than the SQOs.

To accomplish the dredging, City Marina was temporarily removed and then reinstalled following the completion of remedial actions.

3.1.11.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 16 includes:

- Marina removal and reinstallation;
- Initial dredging to elevation -17 feet MLLW;
- Subsequent re-dredging and capping in response to chemical concentrations greater than the SQOs;
- Surveying;
- Water quality monitoring; and
- Sediment and cap verification sampling.

3.1.11.2 DESIGN MODIFICATIONS

While planning the dredging and capping work in RAs 15 and 16, it was discovered that some areas requiring remediation were not included within the original design remediation area boundaries. This determination was based on comparing the Design Analysis Report with the project plans and specifications.

To address this discrepancy, the east boundary of RA 16, adjacent to RA 15, shifted east by approximately 25 feet to meet the revised western boundary of RA 15. This eliminated the "No Action Area" gap between RAs 15 and 16 that was shown on the contract drawings. The RA 16 boundary north of RA 15 also shifted approximately 50 feet east to include previously missed remediation areas resulting in additional dredge work. Hart Crowser revised the remediation boundaries on the plans to encompass the missed areas, resulting in additional dredging in RAs 15 and 16. The revised drawings were approved by EPA in an email dated December 16, 2004. Subsequently, those plans were re-issued to Manson.

Additionally, as stated in Section 3.1.11, the remedial design for RA 16 was to dredge to -17 feet MLLW to remove sediment with chemical concentrations greater than the SQOs. However, a cap was placed in two portions of RA 16 in response to the presence of chemical concentrations greater than the SQOs in post-dredge samples (Figure 3). The cap placed in RA 16 is comprised of three feet of channel sand cap material.

Additional detail concerning capping performed in RA 16 is presented in Section 3.1.11.8.1.

3.1.11.3 PREPARATION FOR CONSTRUCTION

The preparation for dredging was primarily accomplished in a pre-construction meeting on July 14, 2004, for the initial clamshell dredging. A second pre-construction meeting was held for hydraulic dredging on August 2, 2005. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance at both meetings.

Topics discussed during the two meetings included:

- Health and safety requirements including working around the hydraulic dredge and pipeline;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;
- Water quality monitoring requirements;
- Containment booms at the site of clamshell dredging and other environmental BMPs;
- Spill response; and
- Simpson safety rules for work near the CDF during disposal of dredge material.

Pre-dredge hydrographic surveys were also performed in preparation for construction.

Additionally, boat owners were notified prior to removal of the floats to let them know that they would need to relocate their boat to the temporary moorage provided at Dock Street Marina.

3.1.11.4 DREDGING

The initial dredging in RA 16 began on January 10, 2005, following dredging in RA 20. Manson removed the finger floats south of City Marina's D float and dredged north from the northern boundary of RA 20 to the south side of D float at approximate Station 61+25 with Derrick 3. Subsequent to that, remaining boats on C and D floats were relocated so that floats could be removed on February 19, 2005.

With the removal of C and D floats, Manson began dredging the adjacent RA 15 with the Andrew on February 17, 2005, and continued westward through approximately 100 feet of RA 16. Dredging in this initial area of RA 16 proceeded north to approximate Station 59+25 and was completed on February 28, 2005.

The City requested and EPA granted an extension to the in-water construction season allowing the dredging to continue to February 28, 2005. Approximately 11,700 CY of material was dredged from RA 16 during the 2004-2005 construction season. All dredging was accomplished with the dredge Andrew and Derrick 3 using a 12 CY clamshell bucket. The material was placed in dump scows and transported to the CDF for disposal.

Dredging resumed in the southern portion of RA 16 with the hydraulic dredge Lofgren on August 10, 2005, and was completed the following day. Post-dredge sediment verification samples were collected from the southern portion of RA 16 on August 12, 2005 (Section 3.1.11.8.1). Chemical concentrations exceeded the SQOs in these samples. The grid areas represented by the samples with chemical exceedences (i.e., between Stations 59+00 and 62+00) were subsequently overdredged three feet to elevation -20 feet MLLW on August 19-20, 2005. Chemical concentrations were less than the SQOs in subsequent sediment verification sampling performed in the southern portion of RA 16.

The remainder of City Marina was removed on September 13-14, 2005, and initial dredging of the northern portion of RA 16 was conducted from September 16-22, 2005. Post-dredge sediment verification samples were collected from the northern portion of RA 16 on September 23, 2005. Chemical concentrations exceeded the SQOs in two samples collected from the northern portion of RA 16. The grid areas represented by the samples with chemical exceedences were subsequently overdredged three feet to elevation -20 feet MLLW on October 1-2, 2005. Overdredging chemical concentrations exceeded the SQOs in subsequent sediment verification samples collected from these overdredged areas. Capping of the grid areas with exceedences of the SQOs was performed as noted in Section 3.1.11.5.

When completed, the dredge quantity from RA 16 totaled approximately 56,680 CY.

3.1.11.5 CAPPING / BACKFILLING

Chemical concentrations in two sediment verification samples collected upon completion of overdredging in the northern portion of RA 16 exceeded the SQOs. Additional overdredging was determined not to be an option as the guide piling for the reinstallation of the marina were onsite and would have been too short for the deeper water. Therefore, a three-foot thick channel sand cap was placed within the grid areas represented by the samples with SQO exceedences (from Stations 52+50 to 55+25 and from Stations 57+00 to 58+85). Capping in RA 16 occurred from October 7-19, 2005. Approximately 17,318 tons of channel sand cap material was placed in RA 16.

3.1.11.6 SURVEYING

Final hydrographic surveys of the dredging and capping in RA 16 were completed, reviewed and approved by the CM Team prior to capping and reinstallation of the marina. The Corps reviewed the surveys as part of the Pre-Final Inspection process and no issues were noted. Figure 7 presents the post-construction conditions in RA 16.

3.1.11.7 DEMOLITION AND DISPOSAL

Removal and disposal of timber piling and marina floats from City Marina were performed in preparation for remediation in RA 16. Piling and marina float removal consisted of placing debris and absorbent booms around the work areas to contain floating debris and sheen; using a derrick to extract approximately 120 individual piling; placing the piling onto plastic lined barges; and transferring the piling (approximately 260 tons) from the barge into containers to the Middle Waterway

Peninsula or Manson's staging area at the SR 509 Bridge for transport and disposal at the Rabanco Landfill (Table C-2).

Removal of City Marina piling and floats were performed by Manson on February 19, 2005 and September 13-14, 2005. The floats were temporarily moored in the head of the Thea Foss Waterway south of the SR 509 Bridge and later removed from the water with a shore-based Manitowoc crane. The floats were stockpiled at the staging area south of the SR 509 Bridge. In all, approximately 548 tons of floats were removed and recycled (Table C-8).

A floating laundry room from City Marina was also removed and demolished between July 27, 2005 and August 9, 2005. The laundry room was removed from the water using the shore-based Manitowoc crane and placed in the staging area south of the SR 509 Bridge. The laundry room was then dismantled and placed into containers for disposal. Approximately 28 tons of debris that was generated from demolition of the laundry room was disposed of at the City of Tacoma Solid Waste Landfill.

3.1.11.8 SEDIMENT / CAP VERIFICATION SAMPLING AND ANALYSIS

Sediment and cap verification sampling and analysis were performed as specific components of the remedial action were completed in RA 16. Sediment and cap verification was performed in RA 16 between August 2005 and January 2006. A summary of the results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment and cap verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

The thickness of the channel sand cap placed in RA 16 was verified by hydrographic survey as the cap was placed as a response action. As stated in Section 3.1.11.6, cap surveys were reviewed as part of the Pre-Final Inspection and no issues were noted. Therefore, no cap verification coring was performed for the channel sand cap placed in RA 16.

3.1.11.8.1 Post-Dredge, No Cap or Backfill

Samples were collected from two stations in the southern portion of RA 16 upon completion of dredging to the design elevation (i.e., -17 feet MLLW). The two post-dredge surface samples (RA-16-001-050812-G and RA-16-002-050812-G) were collected on August 12, 2005 (Table B-1) (Figure B-4). A field duplicate sample (RA-16-006-050812-G) was also collected for quality control. The post-dredge samples collected from the southern portion of RA 16 had detected concentrations of mercury, SVOCs, the pesticide p,p'-DDE, or PCBs that exceeded the SQOs (Table B-27).

The grid areas within the southern portion of RA 16 represented by Samples RA-16-001-050812-G, RA-16-002-050812-G, and RA-16-006-050812-G were overdredged three feet to -20 feet MLLW on August 19-20, 2005, in response to the SQO exceedences. Two additional post-dredge samples (RA-16-008-050822-G and RA-16-009-050822-G) were collected on August 22, 2005, upon completion of overdredging at the same positions as Samples RA-16-001-050812-G and RA-16-002-050812-G. A field duplicate sample (RA-16-013-050822-G) was also collected for quality control.

The detected chemical concentrations and detection limits were less than the SQOs in the parent sample collected from the southernmost portion of RA 16 (RA-16-008-050822-G) (Table B-28). However, an anomaly occurred in the analysis of certain PAHs on the field duplicate (RA-16-013-050822-G). The detected concentrations of certain PAHs and total high molecular weight polycyclic aromatic hydrocarbons (HPAH) slightly exceeded the SQOs in the field duplicate sample collected at this station. The field duplicate analysis of these PAHs is an anomaly that is not supported by three separate analyses from the same field sample: the parent sample analysis, the laboratory matrix spike (MS) analysis on the field duplicate, and the laboratory matrix spike duplicate (MSD) analysis. Additionally, no other detected concentrations or detection limits exceeded the SQOs in the duplicate sample.

Four distinct aliquots were analyzed for PAHs at the southernmost station in RA 16: the parent sample, the field duplicate sample, the MS, and the MSD. Three of these analyses verify that the station is less than the SQO for PAHs, while one analysis had the anomaly. It is believed that the field duplicate sample likely contained a minor component of material that affected the sample results.

The detected chemical concentrations and detection limits were less than the SQOs in the sample collected from the second sample station located in the southern portion of RA16 (RA-16-009-050822-G).

Based on these results, the southern portion of City Marina was reinstalled. A meeting was held with EPA and the Corps on September 29, 2005, during which the results for Sample RA-16-013-050822-G were discussed. In the meeting it was agreed that Sample RA-16-013-050822-G alone required no additional response actions, and that a final determination of whether a response action was warranted in the southern portion of RA 16 would be based on the cap boundary samples collected in the southern portion of RA 16 upon completion of capping in RA 20. The detected chemical concentrations and detection limits were less than the SQOs in the cap boundary samples collected from the southern portion of RA 16 as discussed in Section 3.1.11.8.2.

Samples were collected from three stations in the northern portion of RA 16 upon completion of dredging to the design dredge elevation (i.e., -17 feet MLLW). The three post-dredge surface samples (RA-16-003-050923-G, RA-16-004-050923-G, and RA-16-005-050923-G) were collected on September 23, 2005. Multiple PAHs were detected in Sample RA-16-003-050923-G at concentrations exceeding the SQOs (Table B-27). All other detected chemical concentrations and analytical detection limits were below the SQOs for this sample. Detected chemical concentrations and analytical detection limits did not exceed SQOs in Sample RA-16-004-050923-G. Two metals were detected in Sample RA-16-005-050923-G at concentrations that exceed the SQOs. All other

detected chemical concentrations and analytical detection limits were below the SQOs for this sample.

The grid areas within the northern portion of RA 16 represented by Samples RA-16-003-050923-G and RA-16-005-050923-G were overdredged three feet to -20 feet MLLW on October 1-2, 2005, in response to the SQO exceedences. Two additional post-dredge samples (RA-16-016-051003-G and RA-16-017-051003-G) were collected on October 3, 2005, upon completion of overdredging at the same positions as Samples RA-16-003-050923-G and RA-16-005-050923-G. A field duplicate sample was also collected for quality control (RA-16-018-051003-G).

Chrysene was detected in Sample RA-16-016-051003-G at a concentration exceeding the SQO. Two metals were detected in Sample RA-16-017-051003-G at concentrations exceeding the SQO. All other detected chemical concentrations and analytical detection limits were below the SQOs for these samples (Table B-28).

As stated above, additional overdredging was determined not to be an option as the guide piling for the reinstallation of the marina were onsite and would have been too short for the deeper water. Therefore, three feet of channel sand cap material was placed within the grid areas represented by the Samples RA-16-016-051003-G and RA-16-017-051003-G in response to the SQO exceedences.

A cap verification sample was collected from the surface of the channel sand cap placed in each grid area with SQO exceedences. Sample RA-16-020-051019-G was collected on October 19, 2005, from the southernmost capped area in RA 16 where the detected concentration of chrysene exceeded the SQO in Sample RA-16-016-051003-G. A field duplicate sample was also collected for quality control (RA-16-022-051019-G). No detected concentrations or analytical detection limits exceeded SQOs in the cap verification sample collected from this grid area (Table B-29). No further response actions were required in the grid area that was capped in the southern portion of RA 16 as the detected concentrations and analytical detection limits were less than the SQOs in the cap verification samples.

Sample RA-16-024-051024-G was collected on October 24, 2005, from the northernmost capped area in RA 16 where the detected concentrations of metals exceeded the SQO in Sample RA-16-017-051003-G. A field duplicate sample was also collected for quality control (RA-16-025-051024-G). No detected concentrations or analytical detection limits exceeded SQOs in the cap verification sample collected from this grid area (Table 29). No further response actions were required in the grid area that was capped in the northern portion of RA 16 as the detected concentrations and analytical detection limits were less than the SQOs in the cap verification samples.

3.1.11.8.2 Cap Boundary Verification

Cap boundary verification samples were collected from surface sediments in RA 16, 50 feet west of the cap placed in RAs 18 and 20 following the completion of capping in RAs 18 and 20. The two cap boundary samples (RA-16-031-060120-G and RA-16-032-060120-G) were collected on January 20, 2006. A field duplicate sample (RA-16-033-060120-G) was also collected for quality control. Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the cap boundary samples (Table

B-30). Therefore, no response action or additional sampling is required in the southern portion of RA 16.

3.1.11.9 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during piling and marina demolition and reinstallation, dredging, and capping activities in RA 16 in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature, turbidity, and DO consistently met water quality standards specified in the project WQCs. Sheen was intermittently observed to occur as a result of dredging in RA 16. Debris and absorbent booms were deployed to contain sheen during remedial activities in RA 16 in accordance with project BMPs.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper concentrations in samples collected during construction in RA 16 ranged from 18.6 to 21.3 µg/L. The ambient copper concentration was 21.8 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.11.10 FISH MONITORING ACTIVITIES

An extension to the in-water work period was requested to continue work in RA 16 beyond February 14, 2005. Work to be performed in RA 16 during the extension period consisted of removing the C and D floats and pilings at City Marina. The construction activities were required to provide access for critical work in RA 15 slope areas (dredging and capping). EPA granted a work extension until March 15, 2005, and the City continued until work was completed on March 3, 2005. During the work extension period, specified BMPs and monitoring were required for in-water construction activities.

Fish monitoring consisted of visual observations within and adjacent to work areas and seining at designated locations to evaluate fish presence. Visual monitoring was performed at each in-water construction location. Seining for fish was performed at the following locations during the work extension period:

- Mouth of the Wheeler-Osgood Waterway;
- Volleyball Court in RA 19A;

- Simpson Peninsula;
- OVRA Site; and
- North Beach Habitat.

Seining was performed at a specific location contingent upon the location of in-water construction activities.

BMPs and monitoring required and performed for dredging and marina demolition (i.e. piling and C and D float removal in the City Marina) in RA 16 during the work extension period included:

- Enclosing the dredging and piling removal areas within a fish exclusion barrier / containment boom with a six-foot deep silt curtain;
- Performing intensive water quality monitoring;
- Biologist observations for the presence of fish; and
- Seining to evaluate for the presence of fish.

The seining site associated with dredging and marina demolition in RA 16 is the mouth of the Wheeler-Osgood Waterway. During the work extension period when dredging was performed in RA 16 (February 18-19, 2005), two salmonids (both Chinook) were captured and released in three seine sets performed at the mouth of the Wheeler-Osgood Waterway.

3.1.12 REMEDIAL AREA 17

Remedial Area 17 (RA 17) is comprised of a portion of the central channel of the Thea Foss Waterway. It is bounded on the south by RA 18 (approximate Station 58+90), on the north by RA 6 (approximate Station 52+35), on the east by RA 16, and on the west by RA 19A (Figure 2).

The work in RA 17 consisted of dredging to the design elevation of -23 feet MLLW to remove chemical concentrations greater than the SQOs.

3.1.12.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 17 includes:

- Removal of debris;
- Initial dredging to elevation -23 feet MLLW;
- Subsequent overdredging and capping in response to chemical concentrations greater than the SQOs;
- Surveying;
- Water quality monitoring; and
- Sediment and cap verification sampling.

3.1.12.2 DESIGN MODIFICATIONS

As stated in Section 3.1.12, the remedial design for RA 17 was to dredge to -23 feet MLLW to remove sediment with chemical concentrations greater than the SQOs. However, a cap was placed in two portions of RA 17 in response to the presence of chemical concentrations greater than the SQOs in post-dredge and cap boundary samples (Figure 3). The caps placed in RA 17 are comprised of three feet of channel sand cap material. Additional detail concerning capping performed in RA 17 is presented in Sections 3.1.12.7.1 and 3.1.12.7.2.

3.1.12.3 PREPARATION FOR CONSTRUCTION

The preparation for dredging was primarily accomplished in a pre-construction meeting on July 14, 2004, for the initial clamshell dredging. A second pre-construction meeting was held for hydraulic dredging on August 2, 2005. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance at both meetings.

Topics discussed during the two meetings included the following:

- Health and safety requirements including working around the clamshell dredge, hydraulic dredge, and pipeline;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;
- Water quality monitoring requirements;
- Containment booms at the site of dredging and other environmental BMPs;
- Spill response; and

- Simpson safety rules for work near the CDF during disposal of dredge material.

Pre-dredge hydrographic surveys were also performed in preparation for construction.

Additionally, the City retained the diving company Sunchasers Inc. to perform an underwater inspection of the debris fields identified on the plans (Section 3.1.4.3).

3.1.12.4 DREDGING

Dredging to remove debris in RA 17 was initiated in conjunction with the adjacent debris removal in RA 6 from February 8-17, 2005. The debris was removed with the clamshell dredge Vulcan that was equipped with a 14 CY bucket. The Vulcan dredged continuously 24 hours per day for 10 days to remove the debris identified in the project plans in areas of RAs 5, 6, 17, and 18. The Vulcan loaded the material into dump scows for transport and disposal into the CDF.

As the purpose of this dredging was to remove surficial and near surface debris that could interfere with later hydraulic dredging, the dredge depth was generally five feet or less below the surface. The dredge was unsuccessful in removing monolithic concrete structures in two locations along approximate Stations 52+60 to 52+80. The first structure was found approximately 55 feet east of the baseline and the other was 200 to 215 feet east of the baseline. Both were determined to be the remains of piers from an old bridge crossing the waterway. Discussions with EPA and the Corps led to the determination that these existing, encroaching structures would not be removed (Appendix F).

The initial dredging for debris removal was completed February 15, 2005.

Dredging resumed in RA 17 with the hydraulic dredge Lofgren on August 12, 2005, and was completed on August 15, 2005, under an EPA-authorized early start of the construction season. Post-dredge sediment verification samples were collected from RA 17 on August 23, 2005 (Section 3.1.12.7.1). Chemical concentrations exceeded the SQOs in a sample collected from the southern portion of RA 17. The grid area represented by the sample with chemical exceedences (i.e., between Stations 57+00 and 58+75) was subsequently overdredged three feet to -26 feet MLLW on October 11, 2005. Chemical concentrations were greater than the SQOs in subsequent sediment verification sampling performed in the southern portion of RA 17 so the area was subsequently capped.

The total quantity of material removed during dredging and overdredging was approximately 16,658 CY.

3.1.12.5 CAPPING / BACKFILLING

Chemical concentrations in the sediment verification sample collected upon completion of overdredging in the southern portion of RA 17 exceeded the SQOs. Three feet of channel sand cap material was placed within the grid area represented by the sample with SQO exceedences (from Stations 57+00 and 58+75). Capping of this southern portion of RA 17 occurred from February 2-4, 2006.

Because the southern portion of RA 17, abutting RA 18, was capped in the location of a required cap boundary verification sample, the cap boundary verification sample station was relocated to a position 50 feet north of the cap placed in RA 17. The cap boundary verification sample contained chemical concentrations that exceeded the SQOs. As Manson had demobilized the dredge Lofgren and capping the CDF was well underway, overdredging in this area was not an option. Therefore, three feet of channel sand cap material was placed in the central portion of RA 17 represented by the sample with SQO exceedences (from Stations 54+85 to 57+00). Capping of the central portion of RA 17 occurred on February 4, 2006.

When completed, the capping between Stations 54+85 and 58+75 totaled approximately 14,118 CY of imported channel sand cap material.

3.1.12.6 SURVEYING

Pre-dredge hydrographic surveys were performed over the entire area of RA 17. Post-dredge surveys were similarly performed upon completion of all dredge, overdredge and capping activities. The Corps reviewed the surveys as part of the Pre-Final Inspection process and no issues were noted. Figure 7 presents the post-construction conditions in RA 17.

3.1.12.7 SEDIMENT / CAP VERIFICATION SAMPLING AND ANALYSIS

Sediment and cap verification sampling and analysis were performed as specific components of the remedial action were completed in RA 17. Sediment and cap verification sampling was performed in RA 17 between August 2005 and January 2006. A summary of the results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment and cap verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

The thickness of the channel sand cap placed in RA 17 was verified by hydrographic survey as the cap was placed as a response action. As stated in Section 3.1.12.6, cap surveys were reviewed as part of the Pre-Final Inspection and no issues were noted. Therefore, no cap verification coring was performed for the channel sand cap placed in RA 17.

3.1.12.7.1 Post-Dredge, No Cap or Backfill

Samples were collected from three stations in RA 17 upon completion of dredging to the design dredge elevation (i.e., -23 feet MLLW). The post-dredge surface samples (RA-17-001-050923-G, RA-17-002-050923-G, and RA-17-003-050923-G) were collected

on September 23, 2005 (Table B-1) (Figure B-4). A field duplicate sample (RA-17-004-050923-G) was also collected for quality control.

The detected concentrations of p,p'-DDD and p,p'-DDE were greater than the SQOs in the duplicate sample (RA-17-004-050923-G) collected from the southern portion of RA 17 (Table B-31). No other detected concentrations or analytical detection limits exceeded SQOs in the samples collected from the southern portion of RA 17. Additionally, neither the detected concentrations nor analytical detection limits exceeded SQOs in the post-dredge samples collected from the central and northern portions of RA 17 (RA-17-002-050923-G and RA-17-003-050923-G).

The grid area within the southern portion of RA 17 represented by Sample RA-17-004-050923-G (i.e., Stations 57+00 to 58+75) was overdredged three feet to -26 feet MLLW on October 10-11, 2005, in response to the SQO exceedences. An additional post-dredge sample (RA-17-005-051014-G) was collected on October 14, 2005, at the same position as Sample RA-17-004-050923-G upon completion of overdredging. Pesticides were detected in Sample RA-17-005-051014-G at concentrations exceeding the SQOs (Table B-32).

Three feet of channel sand cap material was placed within the grid area represented by Sample RA-17-005-051014-G in response to the SQO exceedences. Additional dredging would have created a depression in the southern portion of RA 17. A cap verification sample (RA-17-021-060123-G) was collected from the surface of the channel sand cap placed in the southern portion of RA 17 on January 23, 2006. No detected concentrations or analytical detection limits exceeded SQOs in the cap verification sample collected from the grid area (Table B-33). No further response actions were required in the grid area that was capped in the southern portion of RA 17 as the detected concentrations and analytical detection limits were less than the SQOs in the cap verification samples.

3.1.12.7.2 Cap Boundary Verification

The southern portion of RA 17 was capped in response to SQO exceedences. The cap was located in the area of the RA 18 cap boundary verification sample. Therefore, the RA 18 cap boundary verification sample station was relocated to a position 50 feet north of the cap placed in RA 17. The cap boundary verification sample (RA-17-022-060123-G) was collected on January 23, 2006, following the completion of capping in RA 17. The detected concentrations of bis(2-ethylhexyl)phthalate and PCBs were greater than the SQOs in the cap boundary sample collected in RA 17 (Table B-34).

Three feet of channel sand cap material was placed within the area represented by Sample RA-17-022-060123-G (from Stations 54+85 to 57+00) in response to the SQO exceedences because completion of remedial actions in RA 17 were on the critical path for meeting the enforceable schedule. A cap verification sample (RA-17-031-060206-G) was collected from the surface of the channel sand cap placed in the central portion of RA 17 on February 6, 2006. A field duplicate sample (RA-17-032-060206-G) was also collected for quality control. No detected concentrations or analytical detection limits exceeded SQOs in the cap verification sample collected from the grid area (Table B-33). No further response actions were required in the grid area that was capped in the

central portion of RA 17 as the detected concentrations and analytical detection limits were less than the SQOs in the cap verification samples.

3.1.12.8 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during dredging and capping activities in RA 17 in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature, turbidity, and DO consistently met water quality standards specified in the project WQCs.

Water quality samples were collected and analyzed for metals in the adjacent remedial areas of RAs 6 and 18. Dissolved silver was not detected in these water quality samples. The dissolved copper concentrations detected in these construction area samples are consistently comparable to concentrations at their respective up-current ambient monitoring locations. Copper concentrations in samples collected during construction in RA 16 ranged from 13.5 to 25.1 µg/L. The ambient copper concentrations ranged form 16.8 to 29.4 µg/L. The results of samples collected in these construction areas and respective ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.13 REMEDIAL AREA 18

Remedial Area 18 (RA 18) is a portion of the Thea Foss Waterway channel. It is bounded on the south by RA 21 at approximate Station 62+40 and on the north by RA 17 at approximate Station 58+85. The east and west sides are defined by the channel lines and RAs 16 and 19A, respectively (Figure 2).

3.1.13.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 18 includes:

- Dredge to the design elevation of -24 feet MLLW;
- Thick channel sand capping;
- Surveying;
- Water quality monitoring; and
- Sediment and cap verification sampling.

3.1.13.2 PREPARATION FOR CONSTRUCTION

The preparation for dredging was primarily accomplished in a pre-construction meeting on July 14, 2004, for the initial clamshell dredging. A second pre-construction meeting was held for hydraulic dredging on August 2, 2005. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance at both meetings.

Topics discussed during the two meetings included:

- Health and safety requirements including working around the clamshell dredge, hydraulic dredge, and pipeline;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;
- Water quality monitoring requirements;
- Containment booms at the site of clamshell dredging and other environmental BMPs;
- Spill response; and
- Simpson safety rules for work near the CDF during the disposal of dredge material.

Pre-dredge hydrographic surveys were also performed in preparation for construction.

3.1.13.3 DREDGING

The City requested and EPA approved a two-week extension of the in-water construction season to allow critical clamshell dredging activities to be completed in the 2004-2005 construction season prior to closure of the CDF Containment Berm. With this extension, initial dredging in RA 18 began on February 25, 2005, and was accomplished in conjunction with the initial dredging in RA 16 from approximate Stations 62+40 and 61+50. The purpose of the dredging in the 2004-2005 construction season was to provide an area of separation between the partial cap placed in RA 21 and the remaining dredging in RA 18. Approximately 719 CY of

dredge material was removed during the initial clamshell dredging and was transported by dump scow to the CDF for disposal.

A one-week early dredging start was requested from, and approved by EPA, for the 2005-2006 in-water construction season. With this approval, hydraulic dredging with the Lofgren commenced within RA 18 on August 12, 2005, and was completed the next day. This hydraulic dredging occurred between Stations 61+50 and 58+85. Approximately 1,892 CY of material was hydraulically dredged and pumped via the hydraulic pipeline to the CDF for disposal.

An approximate total of 2,611 CY was dredged from RA 18 and disposed of in the CDF.

3.1.13.4 CAPPING / BACKFILLING

Placement of a 36-inch thick channel sand cap began on August 15, 2005, and proceeded intermittently as material and equipment was made available until it was completed on January 20, 2006. Due to evidence of contamination on completed channel sand cap areas by construction residuals, a decision was made to change the cap placement sequence. The cap placement sequence was changed from placement of two 18-inch lifts to an initial placement of 24 inches of channel sand cap and then waiting until all dredging had been completed. Following the completion of dredging, the final 12-inch lift was placed when material and equipment was available. All placement was accomplished by clamshell. Approximately 13,330 tons of import channel sand cap was placed in RA 18.

3.1.13.5 SURVEYING

Post-dredge surveys were performed following initial dredging to confirm dredge depths, and were approved by the CM Team. Surveys for the remainder of RA 18 were performed following the hydraulic dredging and were approved by the CM Team. Post-cap surveys were performed and all surveys were reviewed by the CM Team and the Corps with no issues noted. Figure 7 presents the post-construction conditions in RA 18.

3.1.13.6 SEDIMENT / CAP VERIFICATION SAMPLING AND ANALYSIS

Sediment and cap verification sampling and analysis were performed as specific components of the remedial action were completed in RA 18. Sediment verification sampling was performed in RA 18 between August 2005 and January 2006. A summary of the results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment and cap verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

3.1.13.6.1 Post-Dredge, Prior-to-Cap

Samples were collected at three stations in RA 18 once dredging had been completed and prior to capping. The results from post-dredge, prior-to-cap sample analyses are for information only and are not for determining compliance. The post-dredge surface samples (RA-18-001-050812-G, RA-18-002-050812-G, and RA-18-003-050812-G) were collected on August 12, 2005 (Table B-1) (Figure B-4). Post-dredge samples collected in RA 18 had detected concentrations of multiple metals, SVOCs, pesticides, and total PCBs that were greater than the SQOs (Table B-35). RA 18 is a remedial area that was subsequently capped so no response actions were required based on the sample results.

3.1.13.6.2 Cap Verification, First Lift

Samples were collected at two stations in RA 18 after the first lift of channel sand cap material (i.e., 18-inches) had been placed. Samples collected from the initial lift of cap material are for evaluating cap placement procedures. The first lift samples (RA-18-004-050822-G and RA-18-005-050822-G) were collected on August 22, 2005. Neither the detected concentrations nor analytical detection limits exceeded SQOs in the samples collected from the first lift of the channel sand cap placed in RA 18 (Table B-36). No modifications to cap placement procedures were necessary based on the first lift sample results in RA 18.

3.1.13.6.3 Cap Verification, Final Lift

Samples were collected at two stations in RA 18 after the second or final lift of channel sand cap material was placed. The samples collected from the final lift are for the purpose of evaluating compliance of the completed cap with the SQOs. The final lift samples (RA-18-021-060120-G and RA-18-022-060120-G) were collected on January 20, 2006. Neither the detected concentrations nor analytical detection limits exceeded SQOs in the samples collected from the final lift of the channel sand cap placed in RA 18 (Table B-37). No response actions were required in RA 18 based on cap verification sample results.

3.1.13.6.4 Cap Boundary Verification

The CQAP required the collection of a cap boundary verification sample in RA 17, 50 feet north of the northern boundary of capping in RA 18. The results for the cap verification sample are discussed in Section 3.1.12.7.2. Because the southern portion of RA 17 abutting RA 18 had been capped in the location of a required a cap boundary verification sample, the cap boundary verification sample station was relocated to a position 50 feet north of the cap placed in southern portion of RA 17.

3.1.13.6.5 Cap Verification Core

Cap verification coring was performed at two stations in RA 18 where the cap is comprised of channel sand material. Cap verification cores are for the purpose of evaluating compliance of the completed cap with cap thickness criteria. The coring was performed January 26, 2006, at positions that were co-located with cap verification

final lift samples collected in RA 18 (i.e., RA-18-021-060120-G and RA-18-022-060120-G). Cap verification cores were recovered from one station in the northern portion of RA 18 (RA-18-022-060126-C) and multiple attempts were made to collect a core in the southern portion of RA 18. The following summarizes coring activities and results for cap verification coring in RA18.

Station RA-18-021 – Initial coring in RA 18 was performed at Station RA-18-021 on January 26, 2006. The initial three coring attempts met refusal at approximately four to five feet deep and had no recovery within the core. The core location was repositioned 50 feet to the south where two additional cores were attempted. The fourth and fifth cores at RA-18-21 were driven between approximately six and a half and seven feet, which is greater than the five-foot minimum requirement for core penetration. However, no recovery was present within the cores.

The project specifications state that the site survey will take precedence if core recovery is less than 80 percent. Because there was no recovery in the cores attempted at RA-18-021 (i.e., less than 80 percent), the cap survey takes precedence to verify that the cap in RA 18 meets the minimum cap thickness requirement of three feet at Station RA-18-021. The final cap placement surveys for RA 18 have been reviewed by the Corps as part of the Pre-Final Inspection and no issues were noted.

Additionally, the quantity of material placed in RA 18 also confirms the cap thickness meets the minimum cap thickness requirement of three feet in RA 18. The calculated quantity of material necessary to produce a three-foot thick cap in RA 18 is approximately 6,500 cubic yards. The actual quantity of cap material placed in RA 18 is approximately 9,370 cubic yards.

Station RA-18-022 – Two cores were driven at Station RA-18-022. The initial core at Station RA-18-022 was driven approximately seven feet, which is greater than the five foot minimum requirement for core penetration. Silt and clay were present beneath the cap verifying penetration of the core through the cap material. Recovery within the core was 30.5 inches. Thirteen of the 30.5 inches of recovered material within the core was cap material. Based on the percent recovery within the core (36%), the cap material thickness was calculated to be approximately 36 inches (Table B-38).

A second core was performed at RA-18-022 to evaluate cap material thickness. The second core was driven approximately five and a half feet . Recovery within the core was 32 inches. Twenty-four of the 32 inches of recovered material within the core was cap material. Based on the percent recovery within the core (49%), the cap material thickness was calculated to be approximately 50 inches.

The cores that were collected in the northern portion of RA 18 indicate the presence of three feet or more of channel sand cap material at coring location RA-18-022.

3.1.13.7 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during dredging and capping activities in RA 18 in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5

WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature, turbidity, and DO consistently met water quality standards specified in the project WQCs. Sheen was intermittently observed to occur as a result of dredging in RA 18. Debris and absorbent booms were deployed to contain sheen during remedial activities in RA 18 in accordance with project BMPs.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper was detected at construction area samples at concentrations between 21.9 and 25.1 µg/L. The ambient copper concentration was 29.4 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.14 REMEDIAL AREAS 19A AND 19B

Remedial Areas 19A and 19B (RAs 19A and 19B) are comprised of a portion of the southwestern shoreline of the Thea Foss Waterway (Figure 2). It is bounded on the south by the cantilevered sheetpile wall separating the City and Utilities work areas (approximate Station 70+10), on the north by RA 6 (approximate Station 52+50), and on the east by RAs 17, 18, 21, and 22. RAs 19A and 19B required active remediation including dredging and capping to depths to support subsequent construction and operation of the Dock Street Marina (aka Alber's, City View, and 17th Street Marinas). Work in both RAs began with the demolition and disposal of piling and old marina floats.

The work in RA 19A included dredging from approximate Stations 62+50 to 52+50 along the slope at 2H:1V, between elevations +0 feet MLLW and -13 feet MLLW, followed by the application of a thick slope cap section. In addition, the work in RA 19A included dredging from the bottom of the slope between approximate Stations 68+00 to 52+50 at approximate elevation -13 feet MLLW to the Thea Foss Waterway channel line, followed by application of a thick channel sand cap.

The work in RA 19B included dredging a 2H:1V slope from the top of the existing bank to a bottom depth of -13 feet MLLW from Stations 70+10 to 62+50, followed by application of a thick slope cap section. The bottom dredging proceeded horizontally from the toe of slope to the channel line at an elevation of -13 feet MLLW. From approximate Stations 70+10 to 65+50, a six-inch thick grout-filled Uniform Section Mat (USM) was placed on the bottom from approximately four feet into the channel across the channel line and up to an elevation of +3 feet MLLW. The USM was then overlain with a 12-inch layer of channel sand and the slopes covered with a thick slope cap section consisting of 18 inches of filter material, 18 inches of light riprap, and overlain with habitat mix applied at a rate of 25 tons per 1,000 SF.

3.1.14.1 SUMMARY OF CONSTRUCTION

Construction performed in RAs 19A and 19B includes:

- Demolition and disposal of piling and marina floats;
- Dredging;
- Slope capping (i.e., grout mat, thick slope cap, and channel sand cap);
- Surveying;
- Dock Street Marina construction;
- Sediment and cap verification sampling; and
- Water quality monitoring.

3.1.14.2 PREPARATION FOR CONSTRUCTION

The diverse nature of work in this area necessitated two pre-construction meetings. On July 14, 2004, a pre-construction meeting was held to prepare for the dredging in RA 19B and disposal of dredge material into the CDF. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance.

Topics discussed included the following:

- Pre and post-dredge survey requirements;
- Dredge tolerances;
- Water quality monitoring requirements;
- Containment booms at the site of dredging and across the mouth of the St. Paul Waterway;
- Template requirements for the grout mat; and
- Coordination with the Utilities' contractor.

A second pre-construction meeting was held on January 8, 2004, to coordinate the placement of the grout mat. Representatives of the City, KPFF, Floyd|Snider, Manson, ACC Hurlen, and Pacific Erosion Control (PEC) attended.

Topics discussed included the following:

- Coordination with the Utilities' contractor;
- Installation of the geotextile underliner;
- Installation of the mat fabric;
- Verification of coverage;
- Grout pumping to fill the mat;
- Diver inspection; and
- Water quality monitoring requirements.

3.1.14.3 DREDGING

Work in RA 19B included dredging a 2H:1V slope from the top of the existing bank, which varies from +13.5 feet MLLW to approximately +15 feet MLLW, to a bottom depth of -13 feet MLLW from Stations 70+10 to 62+50. Dredging proceeded from the toe of the slope to the channel line where necessary to a minimum depth of -13 feet MLLW. Work in RA 19A included dredging a 2H:1V slope from an elevation of +0 feet MLLW to -13 feet MLLW from approximate Stations 62+50 to 52+35, and dredging from the toe of the slope at elevation -13 feet MLLW horizontally to the Thea Foss Waterway channel line from approximate Stations 68+00 to 52+50. Dredging from Stations 52+35 to 54+50 was completed in the 2004-2005 construction season.

Dredging performed in preparation for placement of the grout mat between Stations 65+50 and 70+10 began on January 1, 2004, and was initially completed on January 3, 2004, by the clamshell dredge Vulcan. Manson's grout mat subcontractors, ACC Hurlen and PEC, mobilized to the site on January 14, 2004. A pre-placement underwater inspection performed for PEC determined that additional dredging work needed to be accomplished prior to installation of the grout mat. Manson remobilized and used both the Vulcan and a long reach backhoe on a barge to complete the dredging and slope grading for the grout mat.

Dredging the slope and bottom between Stations 65+50 and 54+50 commenced with the Vulcan on February 2, 2004. Generally, the slopes were cut at 2H:1V although some minor steepening occurred along the marginal float for the Dock Street Marina to insure that float grounding would not occur at the most extreme low tides.

All dredging in RAs 19A and 19B, with the exception of the northernmost 175 feet of RA 19A, was completed by February 6, 2004. The remaining dredging in RA 19A was completed during the 2004-2005 construction season. With the exception of the southernmost 200 feet to the sheetpile wall at Station 70+10, all dredging proceeded from south to north. The eastern dredge limits extended approximately 25 feet across the channel line into the channel to provide separation between future channel dredging and the completed caps and marina floats.

In all, approximately 31,065 CY of material was dredged from the slopes and bottoms of the two RAs in preparation for slope capping beneath the Dock Street Marina. All of dredge material was disposed of the in the CDF.

3.1.14.4 CAPPING / BACKFILLING

All capping shoreward of the channel lines is considered slope capping in the specifications. For the purposes of this report, slope capping will refer to the capping of the 2H:1V slopes along the sides of the waterway. Harbor area capping refers to the area between the toe of the slope and the channel line and channel capping refers to the area between the two channel lines.

All of the slopes in RAs 19A and 19B received a thick slope cap consisting of 18 inches of slope cap filter material overlain with 18 inches of light loose riprap. Finally, habitat mix was spread over the surface of the riprap at a rate of 25 tons per 1,000 SF between elevation -10 feet MLLW and +13 feet MLLW from approximate Station 62+50 to 70+10. From approximate Stations 54+00 to 62+50, habitat mix was placed between elevations -10 feet MLLW and +0 feet MLLW as habitat mix was already in place above elevation +0 feet MLLW from an earlier project on the upper slope. The slope was steepened from 2V:1H to 1.75V:1H between approximate Stations 62+50 and 65+00 to prevent marina floats from grounding on the slope at the lowest tides. Also, the slope at approximate Station 62+75 was steepened from 2V:1H to 1.5V:1H to prevent the gangway landing float from grounding at the lowest tides.

Slope capping operations began with the placement of a toe berm of light loose riprap in a key trench at the bottom of the slope. The purpose of the berm is to stabilize the material placed above it on the slope. Following the toe berm construction, the 18-inch layer of slope cap filter material was placed by clamshell. Following placement and verification of the 18-inch slope cap filter material layer, an 18-inch layer of light loose riprap was then placed by clamshell. Frequent hydrographic surveys confirmed the depth of the layer. The layers of slope cap material were generally placed from the bottom of the slope to the top.

With completion of the riprap layer, habitat mix was placed by clamshell in a fashion similar to the placement of the filter material. As the rate of placement of the habitat mix was designed to primarily fill the voids in the riprap and not create a distinct layer, confirmation of the placement rate was accomplished by tracking the quantity placed over the area covered.

Channel sand capping consisted of placing imported channel sand from the toe of the slope to the channel line with a clamshell. Over the grout mat area, channel sand cap

was placed in a single 12-inch layer. This layer was completed prior the end of the 2003-2004 construction season.

From the north end of the grout mat, a thick channel sand cap was placed in two 18-inch lifts for a total cap thickness of 36 inches. Confirmation sampling was accomplished at the completion of each lift. Manson placed the first 18-inch lift between approximate Stations 65+50 to 62+50 before the end of the 2003-2004 construction season. Channel sand capping was not complete north of Station 62+50 prior to the end of the construction season.

Capping work in the north end of RAs 19A and 19B recommenced on July 15, 2004, starting at Station 62+50 working north to Station 52+34. Capping work in RAs 19A and 19B was completed on August 10, 2004.

The results of supplemental sampling in RAs 19A and 19B indicated some minor recontamination of the cap surface from construction residuals. Based on an EPA-approved proposal, the City directed Manson to place an additional six inches of channel sand cap material between Stations 70+10 and 66+40 as a corrective action. This work was accomplished using telescoping conveyor belt equipment (i.e., Telebelt) with a 130-foot reach from December 13-17, 2005. Confirmation samples were collected from the surface of the additional cap material placed in RAs 19A and 19B on January 4, 2006, and discussed in Section 3.1.14.8.

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).

3.1.14.4.1 Grout Mat

As mentioned above, ACC Hurlen and PEC mobilized onsite on January 14, 2004. Beginning at Station 70+10, PEC, using underwater assistance from Global Diving, stretched Mirifi 600 geotextile from the upper bank to the toe trench beyond the channel line over the entire footprint area of the grout mat. The geotextile was held in place with sand bags and served the purpose of providing a smooth surface over which to spread the USM fabric without damage.

After spreading the geotextile, PEC was delayed for three days while the contractor for the remediation work in the waterway south of Station 70+10 completed their sheetpile wall at that location. On January 17, 2004, the contractor completed the wall and PEC was given unobstructed access to install the grout mat.

PEC pulled 25-foot wide sections of USM fabric from anchorage points on shore to the toe trench across the channel line and connected the fabric sections together. After the entire mat was in place, filling of the grout mat began on January 22, 2004. The grout was pumped into the mat through fabric filling ports from shore using a long-reach pump truck. A diver constantly monitored the filling operation to ensure uniform distribution of the grout to the full six-inch depth and to ensure that there were no leaks in the mat. Filling proceeded from the channel line to the shoreline and from Station 70+10 to the north end of the mat. The mat was completed on February 4, 2004.

In all, a total of 6,756 SY of mat was installed and filled with 1,093 CY of 6000# grout.

3.1.14.5 SURVEYING

At Alber's Wharf and the 17th Street Access Pier, pre-dredge lead line soundings were conducted in areas not accessible to the survey boat. Topographic surveys were performed along the upper bank portions south of approximate Stations 62+50 to 65+00. Post-dredge surveys were similarly performed prior to capping and installation of the grout mat. All surveys were reviewed and approved by the CM Team. Deficiencies were noted for correction and resurveyed for compliance.

Hydrographic surveys on the capping layer previously placed on the grout mat indicated that the layer was thin as compared to the same surveys conducted at the end of the previous dredge season. Manson had divers verify the cap thickness in questionable locations to confirm cap thickness over the grout mat. Divers confirmed the slope capping layer over the grout mat met and or exceeded minimum thicknesses. The study also showed that the grout mat had settled in areas producing the questionable survey profiles.

Cap thickness for the six-inch supplemental capping at the south end of RA 19 could not be verified with hydrographic surveys due to the presence of the marina and the accuracy tolerance of the survey equipment. For this area, grids of known sizes were laid out with floating lines and a quantity of material needed to produce the six-inch thickness with the Telebelt was calculated. The quantity of material supplied to the Telebelt and tracking of the placement was monitored to ensure coverage and that the correct depth was placed.

Dredging and capping surveys were reviewed by the CM Team and the Corps at the time of the Pre-Final Inspection with no issues noted. Figure 7 presents the post-construction conditions in RAs 19A and 19B.

3.1.14.6 DEMOLITION AND DISPOSAL

Removal and disposal of timber mooring dolphins, individual piling, and marina floats was performed in preparation for remediation in RAs 19A and 19B and construction of piers for the Dock Street Marina. Dolphin, piling, and marina float removal consisted of placing debris and absorbent booms around the work areas to contain floating debris and any possible petroleum sheen; using a derrick to lift floats out of the water and to extract approximately 46 individual piling and five dolphins; placing the piling onto plastic lined barges; and transferring the piling (approximately 130 tons) and marina floats (approximately 30 floats) from the barge into containers at the Middle Waterway Peninsula for transport of the piling and floats to the Rabanco Landfill for disposal (Table C-9).

Removal of the existing marina floats, piling, and dolphins was performed by Manson between August 23, 2003 and September 16, 2003. Transfer, transport, and disposal of the debris were performed for Manson by Rhine from September 4-18, 2003.

3.1.14.7 SEDIMENT / CAP VERIFICATION SAMPLING AND ANALYSIS

Sediment and cap verification sampling and analysis were performed as specific components of the remedial action were completed in RA 19. Sediment and cap verification sampling were performed in RAs 19A and 19B between January 2004 and August 2004. Supplemental sampling was performed in RAs 19A and 19B between November 2004 and October 2005 to evaluate the presence of construction residuals in completed cap areas. Additionally, cap verification sampling was performed in RA 19B and the southern portion of RA 19A in January 2006, upon completion of the placement of additional cap material in response to the presence of construction residuals. A summary of the results of sediment verification, cap verification, and supplemental sampling is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment and cap verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

3.1.14.7.1 Post-Dredge, Prior-to-Cap

Samples were collected at eight stations in RA 19A once dredging had been completed and prior to capping. The results from post-dredge, prior-to-cap sample analyses are for information only and are not for determining compliance. Collection of post-dredge surface samples in RA 19A included the following (Table B-1) (Figure B-4):

- Two samples (RA-19A-001-010804-G and RA-19A-002-010804-G) on January 8, 2004, in the area to be capped by the grout mat;
- Three samples (RA19A-003-020604-G, RA19A-004-020604-G, and RA19A-005-020604-G) and a field duplicate sample (RA-19A-009-021604-G) on February 6, 2003, from the area north of the grout mat in the area to be capped with channel sand material; and
- Three samples (RA-19A-006-021604-G, RA-19A-007-021604-G, and RA-19A-008-021604-G) on February 16, 2004, from the north end of RA-19A in the area to be capped with channel sand material.

Multiple PAHs, phthalates, pesticides, and PCBs were detected at concentrations greater than the SQOs in post-dredge samples collected from the area capped by the grout mat (RA-19A-001-010804-G and RA-19A-002-010804-G) in the southern portion of RA19A (Table B-39). Most detected concentrations were less than twice the SQO. Additionally, the detection limits for 2,4-dimethylphenol, benzyl alcohol, and N-nitrosodiphenylamine were greater than the SQOs due to the detected concentrations of other compounds.

Relatively few chemicals were detected at concentrations greater than the SQOs in post-dredge samples collected from RA 19A north of the grout mat in the area of channel sand cap. The post-dredge sample collected north of the area capped by the

grout mat (RA19A-003-020604-G) contained mercury and PAHs at concentrations greater than the SQOs. In four of the post-dredge samples collected from RA 19A (RA19A-009-020604-G, a duplicate of RA19A-004-020604-G, RA19A-005-020604-G, RA-19A-006-021604-G, and RA-19A-007-021604-G), only one chemical was detected at a concentration greater than the SQOs. No chemicals were detected at concentrations greater than the SQOs in the remaining post-dredge samples collected from RA 19A (RA19A-004-020604-G and RA-19A-008-021604-G).

Detection of chemical concentrations greater than the SQOs in RA 19A were anticipated as the design for this area included capping. RA 19A has been capped with slope, grout mat, and channel sand caps.

3.1.14.7.2 Cap Verification, First Lift

Samples were collected at three stations in RA 19A after the first lift of channel sand cap material (i.e., 18-inches) had been placed. Samples collected from the initial lift of cap material are for evaluating cap placement procedures. Collection of cap verification, first lift samples included the following:

- One sample (RA-19A-013-022704-G) on February 27, 2004, north of the grout mat; and
- Two samples (RA-19A-014-040726-G and RA-19A-015-040726-G) and a field duplicate sample (RA19A-016-040726-G) on July 26, 2004, at two additional stations requested by EPA.

The detected chemical concentrations did not exceed the SQOs in the samples collected from the first lift of the channel sand cap placed in RA 19A (Table B-40). The practical quantitation limit (PQL) for 2,4-dimethylphenol exceeded the SQO in samples RA-19A-014-040726-G, RA-19A-015-040726-G, and RA19A-016-040726-G. However, the method detection limits (MDL) in these samples did not exceed the SQO. Therefore, in accordance with the Final Design CQAP, Sediment Sampling Operations Manual, the data was not rejected and was acceptable for evaluating compliance with the SQOs. No other PQLs or MDLs exceeded the SQOs for analytes that were not detected. No modifications to cap placement procedures were necessary based on the first lift sample results in RA 19A.

3.1.14.7.3 Cap Verification, Final Lift

Samples were collected at five stations in RA 19A after the second or final lift of channel sand cap material was placed. In areas where the grout mat was placed, the final lift samples were collected from the 12-inch lift of channel sand cap material placed on top of the grout mat. In areas where two, 18-inch lifts of channel sand cap were placed to construct the cap in RA 19A, the samples were collected from the second 18-inch lift of channel sand cap material. The samples collected from the final lift are for the purpose of evaluating compliance of the completed cap with the SQOs. Cap verification, final lift samples included the following:

- Two samples (RA-19A-011-022704-G and RA-19A-012-022704-G) collected on February 27, 2004, from channel sand cap placed on top of the grout mat; and

- Three samples (RA-19A-018-040809-G, RA-19A-019-040809-G, and RA19A-20-040809-G) and a field duplicate sample (RA19A-021-0400809-G) collected on August 9, 2004, north of the grout mat.

Detected chemical concentrations were less than the SQOs in the cap verification final lift samples collected in RA 19A (Table B-41). The PQL for 2,4-dimethylphenol exceeded the SQO in samples RA-19A-18-040809-G, RA-19A-19-040809-G, RA19A-20-040809-G, and RA19A-021-040809-G. However, the MDLs in these samples did not exceed the SQO. Therefore, in accordance with the Final Design CQAP, Sediment Sampling Operations Manual, the data was not rejected and was acceptable for evaluating compliance with the SQOs. No other PQLs or MDLs exceeded the SQOs for analytes that were not detected.

3.1.14.7.4 Cap Verification Cores

Cap verification cores were collected from three stations in RA 19A where the cap is comprised of channel sand material (i.e., not the grout mat). Cap verification cores are for the purpose of evaluating compliance of the completed cap with cap thickness criteria. The three cores (RA-19A-018-040809-Core, RA-19A-019-040809-Core, and RA19A-020-040809-Core) were collected on August 9, 2004, and were co-located with cap verification final lift samples (RA-19A-018-040809-G, RA-19A-019-040809-G, and RA19A-20-040809-G).

The cap verification cores were driven through the completed cap and into the underlying sediment. The cores were driven to depths between five and a half and seven and a half feet, which is greater than the five-foot minimum requirement for core penetration (Table B-38). The depth of core penetration and the recovery of cap material in the cores were documented in field logs and were used to calculate the cap thickness. The results for cores collected in RA 19A indicate that the cap thickness ranges from five to six feet, which is significantly greater than the three-foot minimum requirement.

3.1.14.7.5 Cap Boundary Verification

The CQAP identified the collection of cap boundary verification samples at two locations in RA 17 subsequent to completion of capping in RA 19A. The intent of the samples was to monitor potential impacts of cap placement in RA 19A on dredged surfaces in RA 17.

The cap boundary verification samples were not collected as the components of capping in RA 19A (i.e., dredging, placement of channel sand cap material) occurred prior to completion of dredging in the adjacent portion of RA 17. The modification to the CQAP for cap verification sampling was transmitted to EPA in a letter dated September 16, 2005. The approval for the CQAP modification was received in an email from EPA dated October 4, 2003.

3.1.14.8 SUPPLEMENTAL SAMPLING IN RAS 19A AND 19B

Supplemental sampling and analysis was performed to evaluate chemical concentrations in completed cap areas within RAs 19A and 19B in response to the

identification of contamination in the Utilities project area associated with construction residuals. Supplemental sampling in RAs 19A and 19B included the following:

- Surface samples (0-2 and 0-10 cm) were collected from two stations in RA 19B on November 9, 2004. Two samples were collected from the sediment compliance interval (i.e., 0-10 cm) for comparison with the SQOs (CA-19B-03-0-10 and CA-19B-06-0-10). Several PAHs exceeded the SQOs in the compliance monitoring samples collected from RA 19B (Table B-42);
- Surface samples (0-2 and 0-10 cm) were collected from three stations in RA 19A on December 2, 2004. Three samples were collected from the sediment compliance interval (i.e., 0-10 cm) for comparison with the SQOs (CA-19A-022-0-10, CA-19A-023-0-10, and CA-19A-024-0-10). A sample duplicate was also collected for quality control (CA-19A-025-0-10). Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the compliance monitoring samples collected from RA 19A (Table B-43);
- Surface samples (0-10 cm) were collected from two stations in RA 19B on May 10, 2005. The samples were collected to evaluate compliance with the SQOs (CA-19B-03-050510-G and CA-19B-06-050510-G). Several PAHs, PCBs, and/or p,p'-DDE exceeded the SQOs in the samples collected from RA 19B (Table B-44); and
- Surface samples (0-10 cm) were collected from eight stations in RA 19A on October 12, 2005. The samples were collected to evaluate compliance with the SQOs (RA-19A-026-051012-G through RA-19A-033-051012-G). Pesticides were detected at concentrations greater than the SQOs in the sample collected from the southernmost station in RA 19A (i.e., RA-19A-033-051012-G) (Table B-45).

Placement of additional cap material in RA 19B and the southern portion of RA 19A was proposed in response to chemical concentrations that exceeded the SQOs in supplemental samples. The proposed response actions in RAs 19B and 19A were transmitted to EPA in memoranda dated October 24, 2005 and November 28, 2005, respectively. EPA approved the response actions in emails sent December 13, 2005.

As discussed in Section 3.1.14.4, an additional six inches of channel sand cap material was placed in RA 19B and the southern portion of RA 19A using a Telebelt from December 13-17, 2005. Cap verification samples were collected from one station in RA 19A and two stations in RA 19B upon the completion of additional cap placement. The samples were collected for the purpose of evaluating compliance of the completed cap with the SQOs.

The additional cap material placement samples (RA-19A-034-060104-G, RA-19B-010-060104-G, and RA-19B-011-060104-G) were collected on January 4, 2006. A field duplicate was also collected for quality control (RA-19A-035-060104-G). Neither the detected concentrations nor analytical detection limits exceeded SQOs in the samples collected from the additional channel sand cap placed in RAs 19A and 19B (Table B-46). No additional response actions were required in RAs 19A or 19B based on the cap verification sample results.

3.1.14.9 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during demolition / piling removal, dredging, capping, and pile driving and marina construction activities in RAs 19A and 19B in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 2 through Interim No. 5 WQCs. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO during dredging, capping, and disposal activities. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature and DO consistently met water quality standards specified in the project WQCs. Turbidity infrequently exceeded the criteria (i.e., ambient turbidity plus 10 NTUs) during capping activities in the 2004-2005 construction season. Turbidity exceedences were generally less than 10 NTUs above the criteria. The contractor reduced the rate at which capping material was being placed in an effort to reduce the measured turbidity. EPA was notified of turbidity exceeding the water quality criteria.

Sheen was intermittently observed as a result of dredging in RA 19. Debris and absorbent booms were deployed to contain sheen during all remedial activities in RA 19 in accordance with project BMPs.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper was detected at concentrations between 7.6 and 42.4 µg/L in the construction area samples. The associated weekly ambient copper concentrations ranged between 9.2 and 27.7 µg/L. With the exception of one sample (i.e., 42.4 µg/L), all samples collected from the construction area were either less than or comparable to ambient concentrations during nine separate sampling events. Although the maximum construction monitoring copper concentration was marginally greater than the weekly ambient concentration, the detected construction concentration was not greater than the overall ambient concentrations detected in the Thea Foss Waterway. Therefore, no response action was identified to be necessary based on communication with EPA. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

Sampling and analysis for COCs was performed during initial dredging activities and during installation of the grout mat in RA 19. The samples were analyzed for total and dissolved metals, PAHs, phthalates, chlorinated pesticides, PCBs, and organic carbon. The results of COC sampling were compared to the results of Dredging Elutriate Testing (DRET) as required in the WQC. The results from COC sampling were comparable to or less than the results from the DRET. Memoranda presenting the

results of COC sampling were provided to EPA for review on February 9, 2004 and March 23, 2004. EPA provided approval for the COC monitoring results in an email on July 13, 2004.

3.1.15 REMEDIAL AREA 20

Remedial Area 20 (RA 20) extends from approximate Stations 70+10 to 62+50 on the east side of the Thea Foss Waterway between the east channel line and the east shoreline of the waterway. It encompasses the north half of the Foss Landing (formerly Pick's Cove) and all of Johnny's Dock Marina (Figure 2).

3.1.15.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 20 includes:

- Removal and reinstallation of Foss Landing and Johnny's Dock Marina;
- Demolition and debris removal;
- Slope dredging;
- Dredging to a bottom depth of -13 feet MLLW;
- Slope capping with thick slope and quarry spall cap;
- Habitat mix placement under Johnny's Dock Restaurant;
- Channel sand capping;
- Sheetpile wall construction;
- Habitat area construction;
- Surveying;
- Water quality monitoring; and
- Sediment and cap verification sampling.

3.1.15.2 DESIGN MODIFICATIONS

3.1.15.2.1 Design Revisions at Johnny's Dock Marina

Prior to commencing work in the area south of Johnny's Dock Marina (Stations 65+50 to 67+50), it was discovered that the existing timber bulkhead that was to remain in place was in conflict with the design layout of the new sheetpile wall. The timber pile bulkhead was removed and installation of the steel sheetpile wall began at the southernmost work point heading north. Immediately upon removal of the timber bulkhead, the existing slope started to fail. Temporary sheetpile shoring, additional excavation behind the wall, and other stabilizing measures were initiated to allow installation of the designed sheetpile wall.

While installing the portion of the south sheetpile wall adjacent to the building, the existing concrete sidewalk began to subside, requiring the removal for safety reasons. The sidewalk was reconstructed after the completion of the north sheetpile wall and pilecap.

From Stations 63+75 to 66+00 near Johnny's Dock Restaurant, the existing slope was very steep. Some minor building settlement and some lateral movement of the newly installed sheetpile wall adjacent to the building were noticed as work commenced in the area. The dredge template was revised to fit the required three-foot slope cap on top of the existing slope to the maximum extent practicable to reduce the dredge cut near the building while avoiding grounding of marina floats during extreme low tide events.

At the north sheetpile wall, the top of the slope in front of the wall was lowered from elevation +9 feet MLLW to +5 feet MLLW to prevent marina floats from grounding at low tide. This required changing a portion of the sheetpile from the designed AZ36 Section to the much stronger AZ48 Section. Additionally, at the south end of this wall, 23 feet of new wall was added to support the change in dredging and slope configuration. A design revision was made and the drawings revised to reflect this change. This revision was submitted to and approved by EPA.

3.1.15.2.2 Modifications to the Capping Sequence

Due to evidence of contamination on completed channel sand cap areas by construction residuals, a decision was made to change the cap placement sequence. The cap placement sequence was changed from placement of two 18-inch lifts to placement of a 24-inch initial lift in the 2004-2005 construction season, followed by placement of the final 12 inches of channel sand cap material during the 2005-2006 construction season after all dredging in the waterway had been completed. This change was approved by EPA.

3.1.15.2.3 Design Revisions at Foss Landing

Several areas where floats were grounding were identified after the capping work was completed. In the vicinity of the gangway support float, the nearshore end of the float would ground at low tide. Several measures were taken to ensure the float would not ground. The nearshore end of the gangway support float was shortened by approximately four feet, nine inches. The gangway was also shifted west so that it would land properly on the modified float. This was accomplished by extending the abutment support at the top of the gangway by four feet. These changes were made to fit the design to field conditions.

3.1.15.3 PREPARATION FOR CONSTRUCTION

The following pre-construction meetings were held for various elements of work within RA 20:

- Foss Landing removal on July 14, 2004;
- South sheetpile wall at Johnny's Dock on July 28, 2004;
- Outfall extension at Johnny's Dock South on August 27, 2004;
- Foss Landing dredging on August 27, 2004;
- Removal of Johnny's Dock South on October 6, 2004;
- North sheetpile wall at Johnny's Dock on December 9, 2004; and
- Reinstallation of Foss Landing on December 29, 2004.

Topics of discussion at all pre-construction meetings included:

- Task overview;
- Health and safety planning;
- Scope of work;
- Environmental concerns;
- Equipment to be used;

- Work schedule; and
- Monitoring and sampling requirements.

The meetings were attended by representatives of the City, KPFF, Floyd|Snider, Manson, and Manson subcontractor's where appropriate.

3.1.15.4 MARINA REMOVAL AND REINSTALLATION

Work began in RA 20 on July 16, 2004, with the removal of the north float section of the Foss Landing. The floats were removed by cutting off the float guide piling at low tide and allowing the tide to raise the floats over the shortened piling. The entire float section was then towed to the Wheeler-Osgood Waterway for temporary storage and reconfiguration by the owner.

Boats in the southern portion of Johnny's Dock Marina were relocated to the new Dock Street Marina on October 4, 2004. Removal of the south side of Johnny's Dock Marina began on October 12, 2004, and was completed on October 13, 2004, with Manson's Derrick 3 pulling guide piling with a vibratory hammer. All timber piles were cut up and disposed of and the steel pipe piles were salvaged for future reuse. Due to the deteriorated condition of the concrete floats in a portion of the marina, the owner requested that the floats be removed from the water and disposed of. The floats were temporarily moored in the south end of the waterway and then removed with Manson's shore-based crane on the southwest side of the SR 509 Bridge. The floats were temporarily stored for drying before being hauled off by Rhine for disposal.

Manson began reinstallation of the north portion of Foss Landing with Derrick 3 driving 12-inch diameter steel guide piling on January 6, 2005, and completed the work on January 8, 2005.

At the owner's option, the floats at both Foss Landing and Johnny's Dock Marinas were reconfigured by their own designers. The new configurations had no increase in over water coverage, and, therefore, no additional permit was required for installation as part of this project. The plans were submitted to EPA by the owner and were approved.

The reinstallation of the new and reconfigured portion of the south side of Johnny's Dock Marina began on January 31, 2005, and was completed on February 2, 2005. Johnny's then completed the float utility systems with their own contractors. Boats were returned from their temporary moorage at Dock Street Marina on February 15, 2005.

Boats in the north portion of Johnny's Dock Marina were relocated to Dock Street Marina on December 9, 2004, allowing the removal of the remaining floats at Johnny's Dock Marina on December 10, 2004. The deteriorated concrete floats from the north portion of the marina were removed from the water and disposed of in the same fashion as those from the south side of Johnny's Dock Marina. The timber piling was likewise disposed of and the steel pile salvaged for reuse. The wooden floats were taken to the Wheeler-Osgood Waterway for reconfiguration by the owner.

Manson began reinstallation of the north side of Johnny's Dock Marina on February 18, 2005, under an EPA approved in-water construction season extension, with Derrick 3

using a vibratory hammer to drive the new and salvaged steel pipe pile. Johnny's contractor completed the marina utilities on April 8, 2005, and the boats temporarily moored at Dock Street Marina returned to north side of Johnny's Dock on April 9 -10, 2005.

3.1.15.5 DREDGING

Manson began dredging in RA 20 on August 31, 2004, with the dredge Andrew. The dredging was periodic as it was done in three distinct areas: Foss Landing, the south side of Johnny's Dock Marina, and the north side of Johnny's Dock Marina. Access to each of these areas was dependent on other construction activities so the dredging could not proceed from south to north continuously. Additionally, Manson dredged in RAs 18, 21 and 22 concurrently with the RA 20 dredging. All dredging was accomplished with either the Andrew or Derrick 3.

Dredging continued at Foss Landing through September 16, 2004, with the Andrew alternating between RAs 20 and 22.

Dredging in the south side of Johnny's Dock Marina began on October 22, 2004, and was completed on December 8, 2004. During dredging in the southeastern corner of the small cove south and adjacent to Johnny's Dock Restaurant, Manson encountered a subsurface monolithic concrete structure. An investigation identified that the surface of the structure was below finished bottom grade and would be covered with channel sand cap so it was left in place.

Manson commenced dredging the north side of Johnny's Dock Marina on December 17, 2004, at the sheetpile wall between WP3 and WP6. The dredging was completed and the slope cap placed immediately in front of the new wall. Dredging of the north side of Johnny's Dock Marina was completed on January 17, 2005.

In all, approximately 12,289 CY of dredge material was removed from RA 20 by clamshell and transported by dump scow to the CDF for disposal.

3.1.15.6 CAPPING / BACKFILLING

As with the dredging, the slope and channel sand capping was accomplished as three separate activities, one for each of the marina areas. In each case, the capping work began with the placement of the riprap toe berm, followed by placement of the 18-inch slope cap filter material, then either 18 inches of quarry spalls or light loose riprap, followed by habitat mix at a rate of 25 tons per 1,000 SF over riprap and 15 tons per 1,000 SF over quarry spalls. Slope capping was followed initially by the placement of a 24-inch layer of channel sand cap on the harbor area.
Slope capping in the Foss Landing area began with the riprap toe berm on September 18, 2004, and concluded with the placement of habitat mix over the thick riprap slope cap on December 11, 2004.

Manson followed on with the south side of Johnny's Dock Marina with the placement of a thick quarry spall slope cap topped with habitat mix. At the southwest corner of Johnny's Dock Restaurant, the slope cap changed from a thick quarry spall cap to a thick riprap slope cap.

For the slope under Johnny's Dock Restaurant, Manson used a conveyor belt to place 25 tons of habitat mix per 1,000 SF. This work was accomplished at low tide on the evening of January 28, 2005.

On the north side of Johnny's Dock Marina, after dredging, slope capping adjacent to the sheetpile wall followed immediately to buttress the wall and prevent possible movement of the wall. This was accomplished on November 19, 2004.

Due to evidence of contamination on completed channel sand cap areas by construction residuals, a decision was made to change the cap placement sequence to placement of a 24-inch initial lift in the 2004-2005 construction season, followed by placement of the final 12 inches of channel sand cap material during the 2005-2006 construction season after all dredging in the waterway had been completed.

The initial 24-inch lift of channel sand cap in the Foss Landing area began on September 24, 2004, and was completed on October 6, 2004. The material was placed with the Andrew, which was concurrently placing material in RAs 20 and 22. The initial 24-inch lift of channel sand cap was placed on the south side of Johnny's Dock Marina intermittently between December 23, 2004 and January 13, 2005. The initial 24-inch channel sand cap layer was placed in the north side of Johnny's Dock Marina beginning December 29, 2004, and was completed on February 16, 2005.

Beginning in early December 2005, the City initiated a phased temporary relocation of boats moored at Foss Landing and Johnny's Dock Marina to facilitate placement of the final 12 inches of channel sand cap in RA 20 using a barge mounted, 130-foot reach, Telebelt. On December 12, 2005, Manson began placing the sand at the south end of RA 20. Placement proceeded north in conjunction with placement of the final lift of channel sand cap material in RAs 19B, 21, 22, and the southern portion of 19A. Placement of the final 12-inch lift of the 36-inch thick channel sand cap was completed on January 18, 2006. In all, approximately 4,355 tons of import channel sand cap material was placed in RA 20 by Telebelt.

Final cap quantities in RA 20 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.

3.1.15.7 STORMWATER OUTFALLS

Stormwater Outfall 245 was extended through the south sheetpile wall with the addition of approximately ten feet of HDPE pipe. A riprap splash pad was constructed beneath the outfall to prevent erosion.

Two small four to six-inch outfalls were discovered on the north side of Johnny's Dock that were not shown on the plans. Both of these outfalls were extended approximately ten feet through the north sheetpile wall. Due to their small size, splash pads were not required.

3.1.15.8 SHEETPILE WALLS

ACC Hurlen began construction of the south sheetpile wall with demolition of the existing timber bulkhead in late July 2004. First, the shoreline behind the bulkhead was excavated in an attempt to present a stable slope to allow driving of the wall. Installation of the sheetpile wall commenced August 7, 2004. ACC Hurlen used a vibratory hammer to install the sheetpile. On August 16, 2004, the piling between WP9 and WP10 began to shift outward away from shore, as the slope behind the wall began to show signs of failure. On the night of August 24, 2004, stormwater built up behind the wall between WP9 and WP10 causing further displacement of the wall, which could not be corrected. To prevent further slope movement, a temporary sheetpile wall was driven behind the new wall. When the slope was stabilized, the new wall was removed and re-driven without incident and completed on September 8, 2004. Following the re-driving, ACC Hurlen installed the 18-inch diameter steel plumb and batter piles from September 8-13, 2004, and drove the final sheets in the south wall with a floating derrick on September 14, 2004. The steel pipe piles were driven with an impact hammer. ACC Hurlen deployed an air curtain around the pile driving area during the full time the impact hammer was being used.

ACC Hurlen constructed the south sheetpile wall concrete cap and completed it on October 19, 2004. This was followed by removal of the temporary sheetpile wall, backfill, paving and landscaping. All work associated with the south sheetpile wall was completed on November 22, 2004.

ACC Hurlen began installation of the north sheetpile wall at Johnny's on December 13, 2004, beginning at WP2 and working to WP1. Some concrete and timber obstructions were encountered near WP1 but were removed. Work progress resumed at WP3 and then stopped on December 21, 2004, when it was discovered that some of the sheets had not been ordered long enough and ACC Hurlen had to splice on additional length. Driving resumed on January 7, 2005, and proceeded to WP6 where the last half sheet had to be eliminated due to a large concrete obstruction. This necessitated a minor realignment of the wall between WP6 and WP6A. Driving was completed on January 14, 2005. ACC Hurlen immediately began constructing the concrete wall cap and completed it on February 22, 2005. A new gangway approach pier was constructed by Manson and completed on March 10, 2005. Parking lot restoration was completed on April 29, 2005, and landscaping was completed on May 6, 2005.

3.1.15.9 HABITAT ENHANCEMENT

On September 24, 2004, Manson began construction of the small habitat area on the point between Foss Landing and south side of Johnny's Dock Marina. A backhoe was used on shore at low tide to perform the excavation and slope grading, place an 18-inch layer of slope filter material, and an 18-inch layer of quarry spalls. The work was completed in two days. Manson later placed habitat mix over the entire area and set six pieces of LWD to complete the area on January 19, 2005.

3.1.15.10 SURVEYING

Hydrographic surveys were conducted in RA 20 after dredging to confirm dredge depths and limits. Hydrographic surveys were also performed following placement of

the toe berm riprap, slope cap filter material, and thick slope riprap layer. Surveys were reviewed and approved prior to the placement of the next lift of cap material.

A combination of topographic surveys and onsite continuous inspection were used to confirm placement of cap material above +5 feet MLLW. Inspectors confirmed the placement of the 18-inch layer of slope cap filter material through visual observation and computation tonnage on material placed over a known area. Topographic surveys were performed following placement of riprap and compared with the post-dredge slope to verify the 3-foot final cap thickness.

Dredging and capping surveys were reviewed by the CM Team and the Corps at the time of the Pre-Final Inspection with no issues noted. Figure 7 presents the post-construction conditions in RA 20.

3.1.15.11 DEMOLITION AND DISPOSAL

All timber piling from the removal of the marinas, the timber bulkhead at Johnny's Dock, miscellaneous other piling, and the foundation piling under a former on-shore bridge abutment were removed, cut, and transported to an approved landfill for disposal.

The deteriorated concrete floats from Johnny's Dock Marina were hauled offsite by Rhine where they were processed to separate the concrete from the wood and Styrofoam. The wood and Styrofoam were disposed of at a landfill and the concrete crushed for recycling.

3.1.15.11.1 Foss Landing–Demolition Piling Removal and Disposal

Sixteen treated piling were removed on September 3-5, 2003, during demolition of Foss Landing. Piling removal consisted of placing debris and absorbent booms around the work areas to contain floating debris and sheen; using a derrick to extract 16 individual piling; placing the piling onto plastic lined barges; and transferring the piling (approximately 108 tons) from the barge into containers to the Middle Waterway Peninsula for transport and disposal at the Rabanco Landfill. The piling removed from Foss Landing were combined with piling removed from other portions of the Thea Foss Waterway for disposal on March 14, 2005 (Table C-2).

The timber structure on the shoreline between the Johnny's Dock Marina and Foss Landing was demolished on March 23, 2004, and placed into a container. The container was transported to the Rabanco Landfill by Rhine on April 21, 2004, and consisted of approximately 24 tons of wood debris (Table C-10).

3.1.15.11.2 Johnny's Dock Marina–Asphalt Removal and Recycling

An area of asphalt was saw cut and removed to provide access to underlying material that was sloughing down the shoreline behind the existing timber bulkhead at the south side of the Johnny's Dock Marina. Approximately 24 CY of asphalt was removed by ACC Hurlen and loaded into a Rhine truck and hauled to WM Dickson for recycling on July 23, 2004 (Table C-11).

3.1.15.11.3 Johnny's Dock Marina–Existing Timber Bulkhead Demolition

Demolition of the existing timber bulkhead constructed of treated piling, timbers, and whalers occurred from August 3-9, 2004, on the south side of Johnny's Dock Marina. The wood debris was cut and placed into containers and transported by Rhine to the Rabanco Landfill for disposal. A total of approximately 96 tons of wood debris was disposed of from this location (Table C-12).

3.1.15.11.4 Johnny's Dock Marina–Additional Piling Removal and Disposal

Additional steel and treated piling were removed along the sheetpile wall at Johnny's Dock Marina, north and south of the restaurant between October 2004 and January 2005. The piling removed included a total of nine steel and 38 creosote treated piling.

Piling removal consisted of placing debris and absorbent booms around the work areas to contain floating debris and sheen; using a derrick to extract individual piling; placing the piling onto plastic lined barges; and transferring the piling (approximately 115 tons) from the barge into containers to the Middle Waterway Peninsula for transport and disposal at the Rabanco Landfill. The piling removed from Johnny's Dock Marina were combined with piling removed from other portions of the Thea Foss Waterway for disposal on March 14, 2005 (Table C-2).

3.1.15.11.5 Johnny's Dock Marina–Concrete Removal and Disposal

Concrete from the existing timber bulkhead and other abandoned structures at Johnny's Dock Restaurant was removed from August 3-12, 2004. The concrete was temporarily stockpiled at the Middle Waterway Peninsula and then disposed of in the CDF.

3.1.15.11.6 Johnny's Dock Marina–Temporary Sheetpile Wall

Excavation of soil and concrete was conducted in the Johnny's Dock parking lot on September 1, 2004, in support of the construction of the sheetpile wall. Approximately 149 CY of material was excavated (5 yards of concrete and 144 yards of soil). Concrete was temporarily stockpiled by Roadway at the Middle Waterway Peninsula on September 1, 2004, and then disposed of in the CDF. Soil was temporarily stockpiled in a bermed, lined, and covered stockpile area under the 11th Street Bridge by Roadway on September 1, 2004. The stockpiled soil was subsequently used as backfill for the parking lot when construction of the new sheetpile wall had been completed.

3.1.15.11.7 Removal and Replacement of Johnny's Dock Marina

The former concrete floats at Johnny's Dock Marina (north and south) were removed between October 12, 2004 and February 25, 2005. The floats were temporarily moored in the head of the Thea Foss Waterway south of the SR 509 Bridge and later removed from the water with a shore-based Manitowoc crane. The floats (approximately 122 tons) were transported by Rhine to the Rabanco Landfill for disposal on October 20, 2004 and January 13, 2005 (Table C-13).

3.1.15.11.8 Slab Replacement at Johnny's Dock Marina

On October 19-21, 2004, the existing concrete walkway slab south of Johnny's Dock Restaurant experienced significant settlement due to adjacent construction, and was demolished and replaced. The demolished concrete was taken to the Middle Waterway Peninsula, temporarily stockpiled, and then disposed of in the CDF.

3.1.15.12 SETTLEMENT MONITORING

Contract requirements provided for periodic settlement monitoring to occur while working within 50 feet of a structure. Manson performed settlement monitoring of Johnny's Dock Restaurant as required for work in RA 20. Additional settlement monitoring was necessary as building movement was observed during construction, and several structural inspections were performed throughout to ensure structural integrity of the building.

3.1.15.13 SEDIMENT / CAP VERIFICATION SAMPLING AND ANALYSIS

Sediment and cap verification sampling and analysis were performed as specific components of the remedial action were completed in RA 20. Sediment and cap verification sampling was performed in RA 20 between August 2004 and January 2006. Supplemental sampling was performed in RA 20 between November 2004 and August 2005, to evaluate the presence of construction residuals in areas that had received the initial lift of channel sand cap material and chemical concentrations in sediment present below the cap. A summary of the results of sediment and cap verification sampling and supplemental sampling is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment and cap verification samples were analyzed for COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

3.1.15.13.1 Post-Dredge, Prior-to-Cap

Samples were collected from four stations in RA 20 once dredging had been completed and prior to capping. The results from post-dredge, prior-to-cap sample analyses are for information only and are not for determining compliance. Collection of post-dredge surface samples in RA 20 included the following (Table B-1) (Figure B-4):

- One sample (RA-20-001-040917-G) and a field duplicate sample (RA-20-003-040917-G) on September 17, 2004;
- Two samples (RA-20-002-041208-G and RA-20-003-041208-G) on December 8, 2004; and
- One sample (RA-20-004-041229-G) on December 29, 2004.

Metals (i.e., lead and mercury), bis(2-ethylhexyl)phthalate, 2,4-dimethyphenol, pesticides, and PCBs were detected at concentrations greater than the SQOs in the post-dredge sample and field duplicate collected from the southern portion of RA 20 (RA-20-001-040917-G and RA-20-003-040917-G) (Table B-47). The detected concentrations of PAHs and/or pesticides were greater than the SQOs in samples collected from the central portion of RA 20 (RA-20-002-041208-G and RA-20-003-041208-G). Phenanthrene and butylbenzylphthalate were detected at concentrations greater than the SQOs in the sample collected from the northern portion of RA 20 (RA-20-004-041229-G). These exceedences were anticipated as the design for this area included capping. RA 20 is capped with slope and channel sand cap material.

3.1.15.13.2 Cap Verification, First Lift

Cap placement in RA 20 consisted of an initial 24-inch lift followed by placement of the final 12 inches of cap material. Samples were collected from four stations in RA 20 after the first lift of the channel sand cap material had been placed. Samples collected from the initial lift of cap material are for evaluating cap placement procedures. Collection of cap verification, first lift samples in RA 20 included the following:

- One sample (RA-20-005-041007-G) and a field duplicate sample (RA-20-006-041007-G) on October 7, 2004;
- One sample (RA-20-005-050309-G) on March 9, 2005; and
- Two samples (RA-20-006-050310-G and RA-20-007-050310-G) were collected on March 10, 2005.

Two cap verification, first lift sample stations were inadvertently identified as Station 5 (i.e., RA-20-005) (Table B-48). However, the samples collected from these stations are unique because the sample identification includes the sample date. Therefore, the sample station designations and sample identifications have not been changed.

Neither the detected concentrations nor analytical detection limits exceeded SQOs in the samples collected from the first lift of the channel sand cap placed in RA 20. No modifications to cap placement procedures were necessary based on the first lift sample results in RA 20.

3.1.15.13.3 Supplemental Sampling Performed After Placement of the First Lift of Cap Material in RA 20

Supplemental sampling and analysis was performed to evaluate chemical concentrations in RA 20 after placement of the initial lift of channel sand cap material in response to the identification of contamination in the Utilities project area associated with construction residuals. Supplemental sampling in RA 20 included the following:

- Surface samples (0-2 and 0-10 cm) were collected from two stations in the southern portion of RA 20 (CA-20-01 and CA-20-04) on November 9, 2004. Two samples were collected from the sediment compliance interval (i.e., 0-10 cm) to evaluate compliance with the SQOs (CA-20-01-0-10 and CA-20-04-0-10). A sample duplicate was also collected from the compliance interval for

quality control (CA-20-08-0-10). Acenaphthene was slightly greater than the SQO in the compliance monitoring sample (CA-20-04-0-10) collected from one supplemental sample station in RA 20 (Table B-49);

- Sediment cores were collected on December 1, 2004, from two stations in the southern portion of RA 20 that were co -located with previous supplemental surface sample stations (CA-20-01 and CA-20-04). Subsurface sediment samples were collected from multiple depths to evaluate chemical concentrations in sediment that was capped. At the southernmost supplemental sample station (CA-20-01), three sample intervals below the initial lift of channel sand cap material were selected for analysis (i.e., CA-20-01-29-60, CA-20-01-60-90, and CA-20-01-90-104). At the northernmost supplemental sample station (CA-20-04), one sample interval below the initial lift of channel sand cap material was selected for analysis (i.e., CA-20-04-26-58). A field duplicate sample (CA-20-01A-29-60) was also collected for quality control. The detected concentrations of PAHs, bis(2-ethylhexyl)phthalate, pesticides, and PCBs were greater than the SQOs in the core samples (Table B-50). These exceedences were anticipated as the design for this area includes capping. RA 20 is capped with slope and channel sand cap material.
- Surface samples (0-10 cm) were collected from two stations in the southern portion of RA 20 on May 10, 2005. The samples (CA-20-01-050510-G and CA-20-04-050510-G) were collected to evaluate compliance with the SQOs. Neither the detected concentrations nor analytical detection limits exceeded SQOs in the samples collected from the initial lift of channel sand cap placed in the southern portion of RA 20 (Table B-51); and
- A surface sample (0-10 cm) was collected from a station in the northern portion of RA 20 on September 14, 2005. A field duplicate sample was also collected for quality control. The sample and sample duplicate (CA-20-08-050914-G and CA-20-09-050914-G) were collected to evaluate compliance with the SQOs. Neither the detected concentrations nor analytical detection limits exceeded SQOs in the samples collected from the initial lift of channel sand cap placed in the northern portion of RA 20 (Table B-52)

No response actions were required in RA 20 based on the supplemental sampling of the initial lift of channel sand cap material. Placement of the final lift of channel sand cap material and cap verification sampling were performed as discussed in Section 3.1.15.13.4.

3.1.15.13.4 Cap Verification, Final Lift

Samples were collected at four stations in RA 20 after the final lift of channel sand cap material was placed using a Telebelt. The samples collected from the final lift are for the purpose of evaluating compliance of the completed cap with the SQOs. Cap verification, final lift samples included the following:

- Two samples (RA-20-21-060104-G and RA-20-22-060104-G) collected on January 4, 2006; and
- Two samples (RA-20-23-060116-G and RA-20-24-060116-G) and a field duplicate sample (RA-20-25-060116-G) collected January 16, 2006.

Neither the detected concentrations nor analytical detection limits exceeded SQOs in the samples collected from the surface of the final lift of channel sand cap placed in RA 20 (Table B-53). No additional response actions were required in RA 20 based on the cap verification sample results.

3.1.15.13.5 Cap Verification, Core

Cap verification cores were collected from four stations in RA 20 where the cap is comprised of channel sand cap material. Cap verification cores are for the purpose of evaluating compliance of the completed cap with cap thickness criteria. Two cores were collected from the southern portion of RA 20 (RA-20-021-060109-C and RA-20-022-060109-C) on January 9, 2006 and from the northern portion (RA-20-023-060117-C and RA-20-024-060117-C) of RA 20 on January 17, 2006. The cores were co-located with cap verification final lift samples (RA-20-021-060104-G, RA-20-022-060104-G, RA-20-023-060116-G, and RA-20-024-060116-G). The following summarizes coring activities and results for cap verification coring in RA 20.

RA-20-021 – On January 9, 2006, coring was initiated at the southernmost station in RA 20 (RA-20-021). In the initial two attempts, only cap material was observed in the recovered cores indicating that the core likely did not penetrate the capping material. The initial two cores at RA-20-021 met refusal at between approximately three fee and six and a half feet in depth and an angular rock was observed in the bottom of the second core. The refusal of the initial two cores and observation of an angular piece of rock in the second core indicated that the coring location was within the area of the shoreline slope cap. Therefore, the core location was repositioned 20 feet offshore (i.e., west) and a third core was performed.

The third core at RA-20-021 was driven six feet, four inches. A plug of sediment was present in the "nose" (i.e., end of the core) verifying penetration of the core through the cap material. Recovery within the core was 36 inches (Table B-38). Thirty-three of the 36 inches of recovered material within the core was comprised of cap material. Based on the percent recovery within the core (47%), the cap material thickness was calculated to be approximately 70 inches (inverse percent recovery x cap material thickness measured within the core).

RA-20-022 – The core at Station RA-20-022 was also collected on January 9, 2006. The core was relocated to a position that was beyond the footprint of the shoreline slope cap which was detected during coring at RA-20-021. The core at RA-20-022 was driven six and a half feet . A plug of sediment was present in the nose verifying penetration of the core through the cap material. Recovery within the core was 46 inches. Twenty-eight of the 46 inches of recovered material within the core was cap material. Based on the percent recovery within the core (59%), the cap material thickness was calculated to be approximately four feet.

RA-20-023 – Coring was initiated in RA 20 at the Station RA-20-023 on January 17, 2006. The core at RA-20-023 was driven seven feet. Silt with wood debris was present in the core below the cap material verifying penetration of the core through the cap. Recovery within the core was 41 inches. Nineteen of the 41 inches of recovered material within the core was cap material. Based on the percent recovery within the core (49%), the cap material thickness was calculated to be approximately 39 inches.

RA-20-024 – The core at Station RA-20-024 was also collected on January 17, 2006, and was driven six feet, three inches. Silt with wood debris was present in the core below the cap verifying penetration of the core through the cap material. Recovery within the core was 43 inches. Twenty-four-inches of the 43 inches of recovered material within the core was cap material. Based on the percent recovery within the core (57%), the cap material thickness was calculated to be approximately 42 inches.

The results for cores collected in RA 20 indicate that the cap thickness ranges from three feet, three inches to five feet, four inches, which is greater than the three-foot minimum requirement.

3.1.15.13.6 Cap Boundary Verification

As stated in Section 3.1.11.8.2, a cap boundary verification sample was collected from surface sediments in RA 16, 50 feet north of the cap placed in RA 20 following the completion of capping in RAs 18 and 20. The cap boundary sample (RA-16-031-060120-G) was collected on January 20, 2006. A field duplicate sample (RA-16-033-060120-G) was also collected for quality control. Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the cap boundary sample (Table B-30). Therefore, no response action or additional sampling is required in the southern portion of RA 16 as a result of the capping performed in RA 20.

3.1.15.14 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during demolition / piling removal, dredging, capping, sheetpile wall construction, and pile driving and marina construction activities in RA 20 in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5 WQCs. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO during demolition, dredging, capping, and disposal activities. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature and DO consistently met water quality standards specified in the project WQCs. Turbidity was measured at concentrations greater than the criteria on several occasions during the 2004-2005 construction season in RA 20 when multiple construction activities were occurring in close proximity and mixing zone boundaries overlapped. The measured turbidities were approximately 10 to 20 NTUs above the WQ criteria. The turbidity measurements were reported to the EPA.

Sheen was regularly generated during dredging in the southern portion of RA 20. The frequency with which sheen was observed as a result of dredging decreased as

dredging proceeded north in RA 20. The sheen that was observed in RA 20 was likely the result of the release of petroleum-based non-aqueous phase liquid (NAPL) that was present in the dredged sediment. Debris and absorbent booms were deployed to contain sheen during all remedial activities in RA 20 in accordance with project BMPs.

Dissolved silver was not detected in water quality samples or was detected at concentrations below the water quality criteria. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper was detected at concentrations between 14 and 46.4 µg/L in construction area samples. The associated weekly ambient copper concentrations were between 14 and 31.4 µg/L. For all samples and stations where ambient samples were collected, the concentrations of copper were less than or comparable to ambient concentrations. A sample was not collected for copper analysis from the ambient stations coincident with the construction monitoring event when copper was detected at a concentration of 46.6 µg/L so a comparison to the ambient concentration was not possible. Although a comparison to a weekly ambient concentration was not possible, the detected construction concentration was not greater than overall ambient concentrations detected in the Thea Foss Waterway. Therefore, no response action was identified to be necessary based on communication with EPA, The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.15.15 FISH MONITORING ACTIVITIES

An extension to the in-water work period was requested to continue work in RA 20 beyond February 14, 2005. Work to be performed in RA 20 during the extension period consisted of installing piling at Johnny's Dock using a vibratory hammer. The construction activity allowed boats to be relocated from City Marina, allowing critical construction work to be completed in RA 15 and RA 16 (dredging and capping). EPA granted a work extension until March 15, 2005, and the City continued until work was completed on March 3, 2005. During the work extension period, specified BMPs and monitoring were required for in-water construction activities.

Fish monitoring consisted of visual observations within and adjacent to work areas and seining at designated locations to evaluate fish presence. Visual monitoring was performed at each in-water construction location. Seining for fish was performed at the following locations during the work extension period:

- Mouth of the Wheeler-Osgood Waterway;
- Volleyball Court in RA 19A;
- Simpson Peninsula;
- OVRA Site; and
- North Beach Habitat.

Seining was performed at a specific location contingent upon the location of in-water construction activities.

Visual monitoring for the presence of fish was required and performed for piling installation using a vibratory hammer to reinstall the northern portion of Johnny's Dock Marina in RA 20 during the work extension period. Additionally, seining was performed at the mouth of the Wheeler-Osgood Waterway during the time period when work was performed to reinstall the Johnny's Dock Marina during the work extension period (March 1, 2005 and March 3, 2005). No salmonids were captured in two seine sets performed at the mouth of the Wheeler-Osgood Waterway.

3.1.16 REMEDIAL AREA 21

Remedial Area 21 (RA 21) is near the southern end of the Thea Foss Waterway between approximate Stations 62+40 and 68+00. It is bounded on the south by RA 22, on the north by RA18, and on the east and west by RAs 20 and 19A, respectively (Figure 2). The work in RA 21 consisted of dredging the channel bottom to a minimum elevation of -24 feet MLLW followed by application of a thick channel sand cap.

3.1.16.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 21 includes:

- Dredging;
- Channel sand capping;
- Surveying;
- Sediment and cap verification sampling; and
- Water quality monitoring.

3.1.16.2 PREPARATION FOR CONSTRUCTION

The preparation for dredging was primarily accomplished in a pre-construction meeting on July 14, 2004. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance.

Topics discussed included the following:

- Health and safety requirements;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;
- Water quality monitoring requirements; and
- Containment booms at the site of dredging and other environmental BMPs.

A strip along the channel line between RAs 21 and 19A was dredged in advance of the main dredging in RA 21 to provide separation from the completed cap in RA 19A.

3.1.16.3 DREDGING

Work in RA 21 consisted of dredging the channel to a depth of -24 feet MLLW. Manson predominantly used the derrick Andrew to accomplish the work, although two days of dredging were recorded by Derrick 3. A bottom dump barge was used to transfer dredged material to the CDF for disposal.

The method of operation Manson used was to cut a 50-foot wide swath using an environmental bucket as the dredge moved along a north-south axis. The cuts in RA 21 were labeled cut #4 (on the east side of the channel) and cut #5 (on the west side of the channel). Manson started dredging in cut #4 on November 15, 2004, and finished with cut #5 on December 4, 2004.

In late November 2004, the City directed Manson to use a full length silt curtain (a fabric curtain that covers the entire water column from the water's surface to the bottom sediments) to protect the completed cap in RA 19 from the dredging in RA 21. The City based this direction upon results received from sediment sampling on completed caps adjacent to dredging activities, conversations with regulatory oversight personnel, and input from sediment transport experts. The curtain was deployed along the outer row of piling of the newly constructed marinas along the west side. Manson then completed dredging in cut #5 along this curtain.

In all, approximately 13,554 CY of material was dredged from RA 21 by clamshell and transported by dump scow to the CDF for disposal.

3.1.16.4 CAPPING / BACKFILLING

The plans called for placement of the three-foot cap in two 18-inch lifts. However, as discussed in Section 3.1.15.2.2, the decision was made to place an initial lift of 24 inches followed by a 12-inch final lift when all dredging activities in the Thea Foss were completed. Manson placed the initial 24 inches of the first lift of channel sand cap in RA 21 over the course of five days in February 2005 and March 2005. The final capping in RA 21 was accomplished by Telebelt between December 19, 2005 and January 13, 2006. RA 21 was capped concurrently with RAs 20 and 22. The approximate total initial quantity of channel sand cap for these three areas was 8,501 tons. During the final Telebelt capping in RA 21, an additional 4,464 tons was placed, for a total of 12,965 tons.

3.1.16.5 SURVEYING

Hydrographic surveys were conducted to confirm dredge depths and limits as well as capping depth. Surveys were reviewed by the CM Team and the Corps as part of the Pre-Final Inspection process with no issues noted. Figure 7 presents the post-construction conditions in RA 21.

3.1.16.6 SEDIMENT VERIFICATION SAMPLING AND ANALYSIS

Sediment and cap verification sampling and analysis were performed as specific components of the remedial action were completed in RA 21. Sediment and cap verification sampling were performed in RA 21 between December 2004 and January 2006. Supplemental sampling was performed in RA 21 between November 2004 and October 2005 to evaluate the presence of construction residuals in areas that had received the initial lift of channel sand cap material and chemical concentrations present in sediment below the cap. A summary of sediment and cap verification sampling and supplemental sampling results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment and cap verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

3.1.16.6.1 Supplemental Sampling Prior to Remedial Actions in RA 21

Supplemental sampling and analysis was performed to evaluate chemical concentrations in RA 21 prior to remedial actions in response to the identification of contamination in the Utilities project area that was associated with construction residuals. Supplemental sampling performed in RA 21 prior to remedial actions included the following (Table B-1) (Figure B-4):

- Surface samples (0-2 and 0-10 cm) were collected from one station in the southern portion of RA 21 on November 9, 2004 (CA-21-07). One sample was collected from the sediment compliance interval (0-10 cm) to evaluate chemical concentrations in surface sediment to be dredged (CA-21-07-0-10). Metals, PAHs, pesticides, and PCBs were detected at concentrations that were greater than the SQOs in the sample (CA-21-07-0-10) (Table B-54).
- A sediment core was collected on December 1, 2004, from a station in the southern portion of RA 21 that was co-located with the previous supplemental surface sample station (CA-20-07). Subsurface sediment samples were collected from multiple depths in the core to evaluate chemical concentrations in sediment to be dredged. Five sample intervals were selected for analysis (CA-21-07-10-40, CA-21-07-40-70, CA-21-07-70-100, CA-21-07-100-130, and CA-21-07-130-150). The detected concentrations of zinc, PAHs, pesticides, and PCBs were greater than the SQOs in the core samples (Table B-55).

No response actions were required in RA 21 based on the supplemental sampling performed prior to remedial actions. The exceedences in supplemental surface and cores samples were anticipated as the design for this area included dredging and capping. The area where the supplemental samples were collected was subsequently dredged and capped per the remedial action design.

3.1.16.6.2 Post-Dredge, Prior-to-Cap

Samples were collected from three stations in RA 21 once dredging had been completed and prior to capping. The results from post-dredge, prior-to-cap sample analyses are for information only and are not for determining compliance. Collection of post-dredge surface samples in RA 21 included the following:

- Two samples (RA-21-001-041208-G and RA-21-002-041208-G) and a field duplicate sample (RA-21-003-041208-G) on December 8, 2004; and
- One sample (RA-21-004-041229-G) on December 29, 2004.

The post-dredge samples collected from RA 21 contained detected concentrations of PAHs and dibenzofuran that were greater than the SQOs (Table B-56). Additionally, the sample or sample duplicate collected from the southern portion of RA 21 (RA-21-001-041208-G or RA-21-003-041208-G) contained detected concentrations of mercury, pesticides, and PCBs at concentrations greater than the SQOs. These exceedences

were anticipated as the design for this area includes capping. RA 21 was subsequently capped with channel sand cap material.

3.1.16.6.3 Cap Verification, First Lift

Cap placement in RA 21 consisted of an initial 24-inch lift followed by placement of the final 12 inches of cap material. Samples were collected from three stations in RA 21 after the first lift of the channel sand cap material had been placed. Samples collected from the initial lift of cap material are for evaluating cap placement procedures. The cap verification, first lift samples (RA-21-005-050310-G, RA-21-006-050310-G, and RA-21-007-050310-G) were collected on March 10, 2005.

Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the samples collected from the first lift of the channel sand cap placed in RA 21 (Table B-57). No modifications to cap placement procedures were necessary based on the first lift sample results.

3.1.16.6.4 Supplemental Sampling Performed After Placement of the First Lift of Cap Material in RA 21

Supplemental sampling and analysis was performed to evaluate chemical concentrations in RA 21 after placement of the initial lift of channel sand cap material in response to the identification of contamination in the Utilities project area associated with construction residuals. Supplemental sampling in RA 21 after the placement of the first lift of channel sand cap material included the following:

- A surface sample (0-10 cm) was collected from a station in the northern portion of RA 21 on September 14, 2005 (CA-21-08). The sample (CA-21-008-050914-G) was collected to evaluate compliance with the SQOs. Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the sample collected from the initial lift of channel sand cap placed in the northern portion of RA 21 (Table B-58).
- A sediment core was collected on October 14, 2005, from a station in the central portion of RA 21 (RA-21-002) that was co-located with the previous post-dredge sediment verification sample station. The detected concentrations in the post-dredge sample (RA-21-002-041208-G) had exceeded the SQOs and were greater than the concentrations used to model the effectiveness of the channel sand cap placed in RA 21. Subsurface sediment samples were collected from multiple depths in the core to further evaluate chemical concentrations in sediment that was capped. The evaluation was to identify whether dredging had only removed surficial, moderately contaminated sediment exposing underlying, more contaminated sediments or if the elevated concentrations in the post-dredge samples were the result of a thin layer of construction residuals. Two samples representing one-foot intervals below the initial lift of channel sand cap material were selected for analysis (RA-21-002-051014-16-25-C and RA-21-002-051014-25-34-C). A field duplicate sample (RA-21-002-051014-25-34-D) was also collected for quality control. The samples were analyzed for PAHs and mercury which were used in modeling the effectiveness of channel cap material during the remedial design. Neither the detected

concentrations nor analytical detection limits exceeded the SQOs in the core samples (Table B-59). Based on the core sample results, the chemical concentrations detected in the post-dredge samples was due to a thin layer of construction residuals.

No response actions were required in RA 21 based on the supplemental sampling performed after placement of the initial lift of channel sand cap material. Placement of the final lift of channel sand cap material and cap verification sampling were performed as discussed in Section 3.1.16.6.5.

3.1.16.6.5 Cap Verification, Final Lift

Samples were collected at three stations in RA 21 after the final lift of channel sand cap material was placed using a Telebelt. The samples collected from the final lift are for the purpose of evaluating compliance of the completed cap with the SQOs. Cap verification, final lift samples included the following:

- One final lift cap verification sample (RA-21-021-060104-G) collected on January 4, 2006; and
- Two final lift cap verification samples (RA-21-022-060120-G and RA-21-023-060120-G) collected on January 20, 2006.

Neither the detected concentrations nor analytical detection limits exceeded SQOs in the samples collected from the surface of the final lift of channel sand cap placed in RA 21 (Table B-60). No additional response actions were required in RA 21 based on the cap verification sample results.

3.1.16.6.6 Cap Verification, Core

Cap verification cores were collected from three stations in RA 21 where the cap is comprised of channel sand. Cap verification cores are for the purpose of evaluating compliance of the completed cap with cap thickness criteria. One core was collected from the southern portion of RA 21 (RA-21-021-060109-C) on January 9, 2006, and from the central and northern portion of RA 21 (RA-21-022-060120-C and RA-21-023-060120-C) on January 20, 2006. The cores were co-located with cap verification final lift samples (RA-21-021-060104-G, RA-21-22-060120-G, and RA-21-23-060120-G). The following summarizes coring activities and results for cap verification coring in RA 21.

Station RA-21-021 – Two cores were driven at the southernmost station in RA 21 on January 9, 2006. The initial core at RA-21-021 was driven six feet, two inches . Sand with shell fragments and gravel was present beneath the cap material in the core verifying penetration of the core through the cap material. Recovery within the core was 48 inches. The interface between the cap and underlying sediment was observed to be distinct. Twenty-two inches of the 48 inches of recovered material within the core was cap material. Based on the percent recovery within the initial core (65%), the cap material thickness was calculated to be approximately 34 inches.

A second core was collected in RA 21 to evaluate cap thickness. The second core was collected approximately 10 feet north of the initial core location. The second core at RA-22-021 was driven approximately seven feet (Table B-38). Sand with shell and

gravel was observed in the core beneath the cap material verifying penetration of the core through the cap material. Recovery within the core was 41.5 inches. Twenty-five inches of the 41.5 inches of recovered material within the core was cap material. Based on the percent recovery within the core (49%), the cap material thickness was calculated to be approximately 51 inches.

Station RA-21-022 – Coring was initiated in RA 21 on January 20, 2006. The initial coring attempt was rejected at RA-21-022 as it met refusal at approximately four feet deep. The core location was repositioned 10 feet to the north for the second core attempt.

The core was driven six and a half feet. Recovery within the core was 54.5 inches. Fourteen of the 45.5-inches of recovered material within the core was cap material. Based on the percent recovery within the core (58%), the cap material thickness was calculated to be approximately 24 inches.

Although the core collected from Station RA-21-022 indicated that 24 inches of cap material was present, the post-placement cap surveys verify that three feet or more of cap material are present in RA 21. In a situation where the core findings differ from the results of cap surveys, the project specifications state that the survey will take precedence if the core recovery is less than 80 percent. Because the core recoveries were less than 80 percent, the cap survey takes precedence to verify that the cap in RA 21 meets the minimum cap thickness requirement of three feet. The final cap placement surveys for RA 21 have been reviewed by the Corps as part of the Pre-Final Inspection and no issues were noted.

Additionally, the quantity of material placed in RA 21 also confirms the cap thickness meets the minimum cap thickness requirement of three feet. The calculated quantity of material necessary to produce a three-foot thick cap in RA 21 is approximately 8,050 cubic yards. The actual quantity of cap material placed in RA 21 is 9,430 cubic yards.

Station RA-21-023 – Coring was also attempted on January 20, 2006. The core at Station RA-21-023 was driven seven feet, five inches. Recovery within the core was 64 inches. Sixteen of the 64 inches of recovered material within the core was cap material. Based on the percent recovery within the core (72%), the cap material thickness was calculated to be approximately 22 inches.

As stated above, although the core collected from Station RA-21-023 indicated that 22 inches of cap material was present, the post placement cap surveys verify that three feet or more of cap material are present in RA 21. Because the core recoveries were less than 80 percent, the cap survey takes precedence to verify that the cap in RA 21 meets the minimum cap thickness requirement of three feet. The final cap placement surveys for RA 21 have been reviewed by the Corps as part of the Pre-Final Inspection and no issues were noted. The quantity of material placed in RA 21 also confirms the cap thickness.

3.1.16.7 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during dredging and capping activities in RA 21 in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to the EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature and DO consistently met water quality standards specified in the project WQCs. Two turbidity exceedences occurred during dredging in RA 21. These exceedences were less than 10 NTUs above criteria. EPA was notified of the turbidity exceedences.

Sheen was regularly generated during dredging in the southern portion of RA 21. The frequency with which sheen was observed as a result of dredging decreased as dredging proceeded north in RA 21. Debris and absorbent booms were deployed to contain sheen during all remedial activities in RA 21 in accordance with project BMPs.

Dissolved silver was detected at or slightly greater than the detection limit in water quality samples. Both the detected silver concentrations and detection limits were less than the water quality criteria for silver. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper was detected in construction area samples at concentrations ranging from 9.8 to 11 µg/L. The ambient copper concentration was detected at 11 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.16.8 FISH MONITORING ACTIVITIES

An extension to the in-water work period was requested to continue work in RA 21 beyond February 14, 2005. Work to be performed in RA 21 during the extension period consisted of placement of channel sand cap. The placement of cap contained the dredged channel, preventing transport of contaminants from the post-dredge surface to adjacent, newly capped areas. EPA granted a work extension until March 15, 2005, and the City continued until work was completed on March 3, 2005. During the work extension period, specified BMPs and monitoring were required for in-water construction activities.

Fish monitoring consisted of visual observations within and adjacent to work areas and seining at designated locations to evaluate fish presence. Visual monitoring was performed at each in-water construction location. Seining for fish was performed at the following locations during the work extension period:

- Mouth of the Wheeler-Osgood Waterway;
- Volleyball Court in RA 19A;
- Simpson Peninsula;
- Olympic View Restoration Site; and
- North Beach Habitat.

Seining was performed at a specific location contingent upon the location of in-water construction activities.

BMPS and monitoring required and performed for capping in RA 21 during the work extension period included the following:

- Performing intensive water quality monitoring;
- Biologist observations for the presence of fish; and
- Seining to evaluate for the presence of fish.

The seining sites associated with capping in RA 21 are the Volleyball Course site and mouth of the Wheeler-Osgood Waterway. During the work extension period when capping was performed in RA 21 (February 18-19, 2005 and March 2-3, 2005), no salmonids were captured in two seine sets at the Volleyball Court and no salmonids were captured in two seine sets performed at the mouth of the Wheeler-Osgood Waterway.

3.1.17 REMEDIAL AREA 22

Remedial Area 22 (RA 22) is comprised of the full width channel at the southern end of the project between Stations 68+00 and 70+10. It is bounded on the east by RA 20, on the west by RA 19B, on the north by RA 21, and on the south by the Utilities' project area (Figure 2). The work in RA 22 consisted of dredging the channel bottom between Stations 68+00 and 70+10 to an elevation of at least -24 feet MLLW; applying a thick channel sand cap; and building a rock buttress to support the cantilevered portion of a submerged sheetpile wall installed by the Utilities at the southern end of the RA.

3.1.17.1 SUMMARY OF CONSTRUCTION

Construction performed in RA 22 includes:

- Dredging;
- Channel sand capping;
- Placing light loose riprap and habitat mix for the buttress;
- Surveying;
- Sediment and cap verification sampling; and
- Water quality monitoring.

3.1.17.2 PREPARATION FOR CONSTRUCTION

A strip along the channel line between RAs 22 and 19B was dredged in advance of the main dredging in RA 22 to provide separation between the dredging and the completed RA 19B cap. In addition, pre-construction surveys of the areas to be dredged were performed on 25-foot centers perpendicular to the waterway baseline.

The preparation for dredging was primarily accomplished in a pre-construction meeting on July 14, 2004. Representatives of the City, KPFF, Floyd|Snider and Manson were in attendance.

Topics discussed included the following:

- Health and safety requirements;
- Pre and post-dredge survey requirements;
- Reporting requirements;
- Dredge tolerances;
- Water quality monitoring requirements; and
- Containment booms at the site of dredging and other environmental BMPs.

3.1.17.3 DREDGING

Work in RA 22 consisted of dredging the channel to a depth of -24 feet MLLW between Stations 68+00 and 70+10. Manson used the clamshell dredge Andrew to accomplish the work. This area required approximately 10 feet of material to be removed and was accomplished from September 9-17, 2004, in conjunction with the adjacent dredging in RA 20. The bottom dump was used to transfer dredged material to the CDF for disposal.

In all, approximately 4,665 CY of material was dredged from RA 22. All dredge material was disposed of in the CDF.

3.1.17.4 CAPPING / BACKFILLING

The plans called for placement of the three-foot cap in two 18-inch lifts. However, to minimize the possibility of recontamination of the final cap surface, the decision was made to complete the capping activities after all of the dredging in the waterway was completed. Therefore, the City consulted with EPA and the Corps, and agreed to place the cap in an initial 24-inch lift and then place a final 12-inch lift after dredging in all areas of the Thea Foss Waterway was completed. This was later changed to 18 inches due to surface recontamination discovered during sampling and testing (Section 3.1.17.7.3).

The initial 24-inch capping was accomplished in conjunction with adjacent RA 20 capping by clamshell placement between September 29, 2004 and October 6, 2004. The final capping in RA 22 was accomplished by Telebelt from December 14-17, 2005.

The initial channel sand cap quantity is 2,486 tons. The final 12-inch cap was placed by Telebelt and required an additional 2,000 tons in RA 22, for a total of 4,486 tons.

3.1.17.5 ROCK BUTTRESS

The southern end of RA 22 adjoins the Utilities' work area at Station 70+10. The remedy in the Utilities' work area included capping the existing sediment surface, while the remedy in City's work area required dredging and capping. As a result, at Station 70+10 there is an approximate 10-foot change in elevation. The nearly 10-foot change in elevation required installation of a submerged sheetpile wall at the transition along Station 70+10. To provide a gradual transition between the 10-foot elevation differences at this sheetpile wall, a sloped rock buttress was to be installed on the north side of the wall under the Utilities' construction contract.

The Utilities finished their scheduled work in advance of the City's contractor completing the dredging on the north side of the sheetpile wall. Therefore, rather than remobilizing their contractor to build the rock buttress, the Utilities requested that the City have their contractor build the rock buttress for them under a request for change (RFC) to the City's contract.

The rock buttress was constructed of light loose riprap sloping at 1.5H:1V from the top of the wall to the north and down to the dredged surface. The rock was covered with one foot of habitat mix. Manson placed a total of 410 tons of rock over the course of two days (September 27, 2004 and January 6, 2005). The placement of 38 tons of habitat mix was accomplished on January 6, 2005, after the completion of the rock placement.

3.1.17.6 SURVEYING

Hydrographic surveys were conducted to confirm dredge depths and limits as well as capping depth. Surveys were reviewed by the CM Team and the Corps as part of the

Pre-Final Inspection process with no issues noted. Figure 7 presents the post-construction conditions in RA 22.

3.1.17.7 SEDIMENT VERIFICATION SAMPLING AND ANALYSIS

Sediment and cap verification sampling and analysis were performed as specific components of the remedial action were completed in RA 22. Sediment and cap verification sampling was performed in RA 22 between August 2004 and January 2006. Supplemental sampling was performed in RA 20 between November 2004 and May 2005 to evaluate the presence of construction residuals in areas that had received the initial lift of channel sand cap material and chemical concentrations present in sediment below the cap. A summary of sediment and cap verification sampling and supplemental sampling results is provided below. Tables and figures presenting the results of each sampling event are presented in Appendix B.

All data presented in this report was provided to EPA and the Corps for review in previous submittals (Table B-1). Additionally, the analytical results are provided electronically in Appendix B.

Sediment and cap verification samples were analyzed for the COCs identified for the Thea Foss and Wheeler-Osgood Waterways. The analytical results for COCs were compared to the SQOs. The COCs and SQOs are presented in Table B-2.

3.1.17.7.1 Post-Dredge, Prior-to-Cap

Samples were collected from three stations in RA 22 once dredging had been completed and prior to capping. The results from post-dredge, prior-to-cap sample analyses are for information only and are not for determining compliance. Post-dredge surface sampling included the collection of three samples (RA-22-001-040917-G, RA-22-002-040917-G, and RA-22-003-040917-G) on September 17, 2004 (Table B-1) (Figure B-4).

Post-dredge samples collected from RA 22 contained detected concentrations of mercury, PAHs, butylbenzylphthalate, dibenzofuran, pesticides, and PCBs that were greater than the SQOs (Table B-61). These exceedences were anticipated as the design for this area includes capping. RA 22 was subsequently capped with channel sand cap material.

3.1.17.7.2 Cap Verification, First Lift

Cap placement in RA 22 consisted of an initial 24-inch lift followed by placement of and additional 18 inches of cap material. A sample was collected from RA 22 after the first lift of the channel sand cap material had been placed. Samples collected from the initial lift of cap material are for evaluating cap placement procedures. The cap verification, first lift sample (RA-22-004-041007-G) was collected on October 7, 2004.

Neither the detected concentrations nor analytical detection limits exceeded SQOs in the sample collected from the first lift of the channel sand cap placed in RA 22 (Table B-62). No modifications to cap placement procedures were necessary based on the first lift sample results in RA 22.

3.1.17.7.3 Supplemental Sampling Performed After Placement of the First Lift of Cap Material in RA 22

Supplemental sampling and analysis was performed to evaluate chemical concentrations in RA 22 after placement of the initial lift of channel sand cap material in response to the identification of contamination in the Utilities project area associated with construction residuals. Supplemental sampling in RA 22 included the following:

- Surface samples (0-2 and 0-10 cm) were collected from two stations in RA 22 (CA-22-02 and CA-22-05) on November 9, 2004. Two samples were collected from the sediment compliance interval (i.e., 0-10 cm) to evaluate compliance with the SQOs (CA-22-02-0-10 and CA-22-05-0-10). LPAHs were detected at concentrations greater than the SQOs in samples collected from the compliance monitoring interval in RA 22 (Table B-63);
- Sediment cores were collected on December 1, 2004, from two stations in RA 22 that were co-located with previous supplemental surface sample stations (CA-2-02 and CA-22-05). Subsurface sediment samples were collected from multiple depths to evaluate chemical concentrations in sediment that was capped. At the southernmost supplemental sample station (CA-22-02), one sample interval below the initial lift of channel sand cap material was selected for analysis (CA-22-02-33-63). At the northernmost supplemental sample station (CA-22-05), one sample interval below the initial lift of channel sand cap material was also selected for analysis (CA-22-05-60-90). Neither the detected concentrations nor analytical detection limits exceeded SQOs in the core samples collected from beneath the initial lift of channel sand cap placed in RA 22 (Table B-64).
- Surface samples (0-10 cm) were again collected from two stations in RA 22 on May 10, 2005. The samples (CA-22-02-050510-G and CA-22-05-050510-G) were collected to evaluate compliance with the SQOs. Neither the detected concentrations nor analytical detection limits exceeded the SQOs in the northernmost sample (CA-22-05-050510-G) collected from the initial lift of channel sand cap placed in RA 22 (Table B-65). The detected concentrations of PAHs, p,p'-DDE, and PCBs were greater than the SQOs in the southernmost sample (CA-22-02-050510-G) collected from the initial lift of channel sand cap placed in RA 22.

Placement of a minimum of 18 inches of channel sand cap material for the final lift of cap in RA 22 was proposed in response to chemical concentrations that exceeded the SQOs in the supplemental samples. The proposed response action for RA 22 was transmitted to EPA in a memorandum dated October 24, 2005. EPA approved the response action in an email sent December 13, 2005.

As discussed in Section 3.1.17.4, a minimum of 18 inches of channel sand cap material was placed in the final lift of RA 22 using a Telebelt from December 14-17, 2005. Cap verification sampling was performed in RA 22 upon completion of the placement of the final lift of channel sand cap material as discussed in Section 3.1.17.7.4.

3.1.17.7.4 Cap Verification, Final Lift

A sample was collected from RA 22 after the final lift of the channel sand cap material had been placed. Samples collected from the final lift are for the purpose of evaluating compliance of the completed cap with the SQOs. The cap verification, final lift sample (RA-22-21-060104-G) was collected in RA 22 on January 4, 2006. Neither the detected concentrations nor analytical detection limits exceeded SQOs in the sample collected from the final lift of the channel sand cap placed in RA 22 (Table B-66). No additional response actions were required in RA 22 based on the cap verification sample results.

3.1.17.7.5 Cap Verification, Core

Cap verification coring was performed at one station in RA 22 where the cap is comprised of channel sand. Cap verification cores are for the purpose of evaluating compliance of the completed cap with cap thickness criteria. One core was collected from RA 22 (RA-22-021-060109-C) on January 9, 2006. The core was co-located with the cap verification final lift sample (RA-22-021-060104-G). The following summarizes coring activities and results for cap verification coring in RA 22.

RA-22-021 – Two cores were driven in RA 22. The initial core was attempted at the base of the sheetpile wall buttress. Observations during coring indicated that the initial core location was within the sheetpile wall transition slope adjacent to the Utilities area. Therefore, the core was relocated approximately 20 feet to the north and a second core was collected to evaluate the cap material thickness.

The second core at RA-22-021 was driven seven feet (Table B-38). Glacial till with shell fragments was observed in the end of the core verifying penetration of the core through the cap material. Recovery within the core was 46 inches. Twenty-eight inches of the 46 inches of recovered material within the core was cap material. Based on the percent recovery within the core (55%), the total cap material thickness was calculated to be approximately 51 inches.

The results for the core collected in RA 22 indicate that the cap thickness ranges from four feet, three inches , which is greater than the three-foot minimum requirement.

3.1.17.8 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during dredging, capping, and construction of the buttress slope at the sheetpile wall in RA 22 in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5 WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature and DO consistently met water quality standards specified in the project WQCs. Turbidity infrequently exceeded the criteria (i.e., ambient turbidity plus 10 NTUs). Turbidity exceedences were generally less than 10 NTUs above the criteria. When there was an exceedence, the contractor modified construction activities (i.e., slowed the rate of dredging or cap material placement) to reduce the measured turbidity. All turbidity exceedences were reported to EPA.

Sheen was observed during dredging activities in RA 22. Debris and absorbent booms were deployed to contain sheen during all remedial activities in RA 22 in accordance with project BMPs.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper was detected at concentrations between 18.2 and 21.8 µg/L in construction area samples. The associated weekly ambient copper concentration was 18 µg/L. Although the maximum construction monitoring copper concentration was marginally greater than the weekly ambient concentration, the detected construction concentration was not greater than the overall ambient concentrations detected in the Thea Foss Waterway. Therefore, no response action was identified to be necessary based on communication with EPA. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities are not causing further increases in the copper concentration.

3.1.18 REMEDIAL ACTION AREA SURFACE

The completed remedial action area surface in the Thea Foss and Wheeler-Osgood Waterways is comprised of dredged, capped, and backfilled surfaces. Numerous samples were collected from the surface of the dredged and capped areas that comprise the surface of the remedial action areas to verify compliance with project chemical criteria (i.e., SQOs). Additionally, sediment verification sampling was performed in portions of natural recovery and no action areas adjacent to areas of active remediation to evaluate whether construction activities affected adjacent surface sediment.

The samples that characterize the surface of the complete remedial action areas and adjacent areas that required monitoring during construction are summarized in Table B-67 and presented in Figures B-5 through B-8. Table B-67 identifies each sample and sample type and also provides the sample coordinates. The previous sections discuss the results for all samples that comprise the surface of the remedial action areas and adjacent areas that were sampled as part of the Thea Foss and Wheeler-Osgood Waterways Remediation Project.

Sediment and cap verification sampling of the surface of completed remedial action areas was performed to confirm that the completed remedial action area complied with project chemical criteria. Additionally, the analytical results for the surface of capped areas provide the baseline for future monitoring to be performed as part of the OMMP. In dredged areas, additional sediment sampling and analysis will be performed as part of the OMMP to establish the baseline for future compliance monitoring. The analytical results for samples collected from natural recovery areas provide the baseline for future natural recovery monitoring.

3.1.19 ST. PAUL WATERWAY CDF CONSTRUCTION

The St. Paul Waterway Confined Disposal Facility (CDF) is an approximate 11 acre site in the St. Paul Waterway located between the St. Paul / Middle Waterway Peninsula on the west and the Simpson Pulp Mill on the east. The maximum depth of the waterway prior to construction was approximate elevation -20 feet MLLW (Figure 8). Simpson is the owner of the waterway.

The waterway was previously used by Simpson as a log raft holding area and log haul out for timber supplying their lumber mill.

To create the confinement, the waterway was deepened and a berm was placed across the head of the waterway. The CDF was capped upon completion of disposal of all dredge material.

3.1.19.1 SUMMARY OF CONSTRUCTION

Construction performed in the CDF includes:

- Demolition and disposal of timber piling and the existing Log Haul Out Facility (LHOF);
- Dredging;
- Construction of an offset berm;
- Construction of a containment berm;
- Disposal of dredge material;
- Capping;
- Construction of a perimeter surface drainage system;
- Installation of settlement monitoring plates;
- Surveying; and
- Water quality monitoring.

3.1.19.2 PREPARATION FOR CONSTRUCTION

In mid August 2003, the first pre-construction meeting was held to prepare for construction activities associated with the dredging of the upper five feet of the CDF. Representatives of the City, KPFF, Floyd|Snider and Manson attended. Topics of discussion included:

- Hydrographic surveys;
- Piling removal and disposal;
- Puget Sound Dredged Disposal Analysis (PSDDA) disposal requirements;
- Offset berm construction; and
- Water quality monitoring requirements.

In early November 2003, a second pre-construction meeting was held in preparation for hydraulic dredging to deepen the remainder of the CDF. Topics of discussion included:

- Hydraulic dredging;
- Pipeline installation and monitoring;

- Puyallup Delta disposal procedures and controls;
- Coast Guard notifications;
- Maintaining access to Simpson's fuel and chip docks;
- Surveying; and
- Water quality monitoring.

A third pre-construction meeting was held on January 24, 2005, for construction and closure of the CDF offset berm. Topics of discussion included:

- Scope of work;
- Environmental concerns;
- Fish Protection Plan;
- Health and safety; and
- Schedule.

3.1.19.3 DESIGN MODIFICATIONS

3.1.19.3.1 CDF Dredging

The project specifications allowed the contractor to propose deepening the CDF below the design elevation of -50 feet MLLW provided that the contractor prepare a Geotechnical Feasibility Report and submit that report for review and approval. Manson engaged the services of GeoEngineers to investigate the feasibility of deepening the CDF to -60 feet MLLW and submitted their report on July 1, 2003. The revised design modified the slope on the west side of CDF from the original design of 2H:1V to 1.5H:1V. This change increased the theoretical capacity of the CDF by approximately 47,500 CY.

The report was reviewed by Hart Crowser and the agencies and approved on August 1, 2003.

After award of the contract but prior to the approval of the Remedial Design, it was determined through agency negotiations that the use of the Thea Foss Borrow Area at the mouth of the Thea Foss Waterway as a source of future channel capping material was not the preferred option. Instead, it was determined that material dredged from the deepening of the CDF below the initial five feet would be placed on the Puyallup River Delta for later retrieval and beneficial reuse as channel cap material. Based on this modification, the disposal location for material dredged from the CDF was changed from the original plan of 100 percent disposal at the Commencement Bay PSDDA site to a combination of placement at PSDDA, on the Puyallup River Delta, and at upland sites. This change was incorporated in the Remedial Design approval granted in early November 2003.

3.1.19.3.2 Offset and Containment Berms

The design of the offset and containment berms called for a series of underwater blended riprap training dikes, from five to eight feet in height, to be placed on either side of the berm section and filled between with select fill, followed by the placement of another set of training dikes and another lift of select fill. The design was based on economy, as select fill is a much cheaper material than blended riprap. The placement

of the dikes and select fill was to continue to an approximate elevation of +12 feet MLLW with select fill and slope armor materials used to complete the berm to design height.

Manson requested approval to build two larger monolithic dikes to form the interior and exterior faces of the berm and then to fill the interior with select fill. Manson's rationale was that even though the material was more expensive, the proposed method would save equipment and labor time. Manson's request was approved with the consent of the designer and the agencies.

3.1.19.4 Demolition and Disposal

3.1.19.4.1 Piling Removal and Disposal

Piling removal in the St. Paul Waterway was initiated in mid-August 2003 in preparation for CDF construction. Piling removal consisted of placing debris and absorbent booms around the work areas to contain floating debris and sheen; using a derrick to extract individual piling; placing the piling onto plastic lined barges; and transferring the piling from the barge into containers at the Al Powers dock on the Hylebos Waterway for transport and disposal at the Rabanco Landfill.

Additional piling removal was performed within the area comprising the CDF during the 2004-2005 construction season. On July 27-28, 2004, the additional piling were removed from the CDF, placed on plastic lined barges, and transferred into containers on the Middle Waterway Peninsula. The piling were transported to the Rabanco Landfill on July 28-29, 2004 (Table C-14).

3.1.19.4.2 Untreated Log Removal and Recycling

On April 2, 2004 and April 6, 2004, approximately 206 tons of untreated logs were removed by Rhine from the Middle Waterway Peninsula. The logs were transported to Recovery 1 for recycling (Table C-15).

3.1.19.5 Initial Mechanical Dredging

The mechanical dredge Viking, with a 14 CY bucket, began excavation of the upper five feet of material in the CDF as well as that required for the toe of the offset berm on October 1, 2003, working 24 hours per day, and completed this activity on October 11, 2003. All of this material was transported from the St. Paul to the offshore PSDDA disposal site.

The Viking then moved to begin construction of the offset berm on October 15, 2003, and completed approximately 2/3 of the berm by November 8, 2003. The remainder of the berm was constructed during the 2004-2005 construction season and completed on January 30, 2005.

On November 14, 2003, the Viking returned to the CDF to complete slope dredging on the northwest boundary of the CDF. The material above elevation +13 feet MLLW was removed and disposed of at LRI. Material below elevation +13 feet MLLW was dredged and disposed of at the PSDDA disposal site.

3.1.19.6 HYDRAULIC DREDGING

The remaining material removed during the deepening of the CDF was placed on the Puyallup River Delta to augment the delta instead of being taken to the Commencement Bay PSDDA site. The material was placed over the leading edge of the delta, but no deeper than elevation -50 feet MLLW. The intent was to then recover up to 2/3 of the volume of this material for Thea Foss channel capping in the future. Where Manson had originally planned for all CDF dredging to be accomplished with a mechanical dredge, this change allowed Manson to use a hydraulic dredge for this work.

Manson mobilized the hydraulic dredge Lofgren and began dredging the CDF to elevation -60 feet MLLW on October 17, 2003, and continued until December 16, 2003. The Lofgren dredged 24 hours per day with the exception of December 3-9, 2003, when the cutterhead shaft broke.

Dredged material was transported through a 26-inch floating pipeline approximately one-half mile to a discharge barge with a submerged 30-foot long vertical diffuser pipe. The build-up of material on the outer slope of the Delta was monitored every other day by hydrographic survey and the discharge barge was continually moved within the disposal area to prevent localized sediment build-up.

The reach on the Lofgren was not long enough to dredge to -60 feet MLLW within the CDF except on the lower tides. On December 2, 2003, the cutterhead shaft broke on the Lofgren. When the shaft was repaired on December 9, 2003, Manson tried to work the low tides but the series of tides at that time did not produce low tides with sufficient time to accomplish any efficient dredge pattern. Therefore, dredging to -60 feet MLLW was completed with the mechanical dredge Vulcan.

During the three weeks the Lofgren dredged, approximately 246,315 CY of material was dredged from the CDF and placed on the northwest quadrant of the Puyallup River Delta.

3.1.19.7 WEST BANK EXCAVATION AND DISPOSAL

Material comprising the west bank of the CDF was excavated and disposed of as part of CDF construction during the 2003-2004 construction season. The excavation and disposal activities consisted of excavation of material from between the elevations of +0 feet MLLW and +18 feet MLLW using a shore-based trackhoe during low tides when the material was exposed; transporting the material from the excavation to a stockpile located in the upland area west of the CDF using off-road dump trucks; and loading the stockpiled material, approximately 15,000 tons, into dump trucks with trailers and hauling the material to LRI for disposal (Table C-16).

Excavation and stockpiling of the material was performed for Manson by Scarsella on November 11-14, 2003. Transport and disposal of the stockpiled material was performed by Scarsella on November 18-24, 2003.

3.1.19.8 FINAL MECHANICAL DREDGING

Completion of dredging in the CDF from approximately -50 feet MLLW to -60 feet MLLW was very inefficient with the Lofgren's short ladder reach, therefore the Vulcan was mobilized on December 20, 2003, to complete the final dredging within the CDF. The Vulcan completed the work and demobilized on December 28, 2003. All of this material was taken to the Commencement Bay PSDDA site for disposal.

Manson was unable to dredge the southernmost slope of the CDF due to the continued operation of the existing log haul out. Hydrographic surveys showed that the total volume of material left to be removed in this area was approximately 3,000 CY. Additionally, the area contained a substantial quantity of sunken logs and other debris. Based upon the relatively small additional capacity to be gained from dredging and the difficulty of removing the debris, the decision was made to not dredge this final area.

Final construction quantities show that 138,485 CY of the material dredged to construct the CDF went to PSDDA disposal, 246,315 CY went to the Puyallup River Delta for beneficial reuse, and 17,850 CY was transported upland to LRI.

3.1.19.9 OFFSET BERM CONSTRUCTION

Manson began construction of the offset berm on October 15, 2003, with the Viking working a single shift per day of varying hours due to the need to work the tides. Berm construction began at Station 7+58 on the northeast end with work progressing to the south. The berm was completed, with the exception of final grading of the top portion above elevation +13 feet MLLW, to approximate Station 3+00 on November 8, 2003, when Manson could go no further due to the continued operation of Simpson's existing log haul out at the head of the waterway.

Continuation of the dredging for the offset berm foundation commenced on August 6, 2004, at approximate Station 2+50 with the dredge Andrew. Dredging continued almost daily through August 17, 2004, when surveys confirmed that all foundation dredging had been completed. All material dredged was loaded into the dump scow and transported to the PSDDA site for open water disposal.

On October 10, 2004, Manson resumed work to complete the offset berm with the placement of riprap at approximate Station 2+50. Work continued for three days until the Andrew was relocated to another, higher priority area of the project.

Work again resumed on the offset berm on January 24, 2005, with the Vulcan placing the remaining rock and select fill for the berm. Due to the need to work the highest tides to complete the offset berm, the Vulcan began to alternate between the offset and containment berms to maximize the use of the equipment. The Vulcan completed its placement of the final riprap material for the offset berm on February 19, 2005. Manson's subcontractor, Scarsella, completed placement of the select fill and final shaping of the offset berm from shore.

3.1.19.10 CONTAINMENT BERM

Manson began construction of the approximate 360-foot long CDF containment berm on January 27, 2005, on the east side of the waterway working toward the west. On February 2, 2005, Manson moved the Vulcan to the west side of the opening and began working toward the east through February 4, 2005. At this time the containment berm had been advanced from the east and west sides, leaving an approximate 125-foot wide opening in the middle to elevation -4 feet MLLW to allow the continued barge disposal of dredge material from the Thea Foss in the CDF.

Manson completed the closure on March 3, 2005, under an EPA authorized extension to the fish window. They then continued to place rock and select fill on the inner side of the berm through March 7, 2005, to increase the width of the berm to its full design section and its height to elevation +14 feet MLLW. The Vulcan was then demobilized and was replaced by the Scandia that commenced completion of the berm on March 14, 2005. The Scandia placed riprap on the interior face of the berm and select fill to complete the berm to its full height of approximately +18 feet MLLW. All placement of berm material was completed by the Scandia on March 22, 2005, and the berm crown was completed with the shore-based equipment on March 23, 2005.

3.1.19.11 DISPOSAL OF DREDGE MATERIAL

Mechanical dredging in the Thea Foss began on January 1, 2004, with the initial dredging in RA 19. From that date through February 28, 2005, when the planned clamshell dredging was completed, dredge material was loaded into closed dump scows and transported to the CDF for disposal. Dump locations were shifted around inside the CDF to prevent mounding of the material and obtain more uniform placement.

Hydraulic dredging began in the Thea Foss on August 8, 2005, in RA 16 with the dredge Lofgren. Material was transported via 27-inch diameter discharge pipeline from the dredge to the CDF for disposal. The routing of the pipeline included an adjustable length of floating steel line on pontoons from the dredge to the north side of the 11th Street Bridge where it came ashore on the south side of Fire Station 18.

From that point, the line switched from steel to heavy wall HDPE pipe that ran east, parallel to 11th Street, to Middle Waterway Street, generally above ground with the exception of buried crossings under rail lines, “D” Street, and the parking lot at King Salmon Marine. The pipeline turned north at Middle Waterway Street and paralleled Middle Waterway Street. The dredge pipeline crossed the Log Haul Out Road in an additional buried crossing prior to reaching the CDF. At the CDF it joined to a steel floating line attached to a spill barge in the CDF.

The Lofgren dredged and pumped material to the CDF continuously from five to seven days per week until the final hydraulic dredging in the Thea Foss was completed on October 23, 2005. The disposal rate during this time averaged approximately 6,000 CY per day.

A minor amount of additional dredging was completed utilizing a clamshell dredge, primarily in areas that were inaccessible to the hydraulic dredge. Since the berm was

closed and inaccessible to barge disposal, sediments were offloaded from barge to trucks and transported over land to the CDF for disposal. All dredging on the project was completed on November 14, 2005.

The filling of the CDF proceeded generally from the containment berm to the southern end with the spill barge being continuously moved around the CDF to prevent mounding. Following final disposal, the Lofgren continued to pump water into the CDF to maintain a depth sufficient to allow a final hydrographic survey and remove all floating line.

Two 3-foot diameter discharge weirs were installed at the east and west sides of the containment berm to allow water from hydraulic dredging to be released from the CDF. The outlet elevation was set at +9 feet MLLW and the inlet elevation was controlled from between an elevation of +9 feet MLLW and +17 feet MLLW. Manson generally set the weir at +15 feet MLLW to maintain a greater capacity to allow sediments to settle out of the water before discharge. The weirs were removed when capping of the CDF commenced.

3.1.19.12 CDF CAPPING

The design anticipated that the surface elevation of the dredge material would be approximately +9 feet MLLW across the CDF upon completion of the disposal of dredge material from the Thea Foss and Wheeler-Osgood Waterways. Based upon this, the design estimated that a total of 168,450 CY of material would be required to bring the CDF to the final grade.

Upon completion of the disposal of dredge material, the surface elevation of the material in the CDF varied from approximately +13 feet MLLW at the extreme northern end near the containment berm to approximately -10 feet MLLW in a small area in the center of the CDF. Based upon this information, estimates indicated that the total fill material required to bring the CDF cap to the final design grade would be greater than the design estimate.

Sources of material to fill and cap the CDF included material excavated from the Middle Waterway Tideflat Habitat (MWTH) and import cap material. All of the material excavated from the MWTH was placed in the CDF. The design estimated that a total of 115,100 CY of material would be excavated to construct the MWTH. Although, when completed, approximately 125,700 CY of material was actually excavated from the MWTH and placed in the CDF.

The City worked with Manson and their subcontractor, Scarsella , to identify additional sources of import fill material to cap the CDF. In all, seven separate import sources were eventually used for CDF cap material:

Import Source	Approximate Quantity	
SR 161 excavation	27,105 tons	18,070 CY
Hylebos Creek Mitigation Site excavation	15,000 tons	10,000 CY (1)
Tacoma Public Utilities parking lot excavation	74,385 tons	49,590 CY
Puyallup River levee reduction	42,305 tons	28,205 CY
SR 16 excavation, Miles Sand & Gravel Roy Pit, and Manke Sand & Gravel Marine View Drive Pit	106,855 tons	71,235 CY
Approximate Total Quantity	265,650 tons	177,100 CY

(1) This is an estimated quantity. A unit weight of 1.5 tons/CY was used to determine the Approximate Total Quantity.

Each source of import material was sampled and tested to ensure that the source met the requirements for imported cap material prior to granting approval for the source. All sources of CDF cap material met the requirements of the design specifications.

Scarsella constructed the CDF cap working from the south end of the CDF toward the north and from west to east. At the north end, where the surface elevation of dredge material was above +9 feet MLLW, the dredge material was relocated within the CDF with excavators to areas with elevations below +9 feet MLLW. The material was relocated ahead of the placement of cap to ensure that the material dredged from the Thea Foss and Wheeler-Osgood Waterways was at or below an elevation of +9 feet MLLW prior to being capped.

The material excavated from the MWTH was generally placed at the lower elevations on top of material dredged from the Thea Foss and Wheeler-Osgood Waterways and was covered with imported CDF cap material. The work proceeded with the placement of material excavated from the MWTH during the night followed by the placement of import cap material during the daylight hours to cover the material placed the night before.

CDF capping began on November 1, 2005, and concluded with final grading on March 3, 2006. The approximate 125,700 CY excavated from the MWTH, combined with the approximate 177,100 CY of import resulted in a total final quantity of approximately 302,800 CY of fill and cap material.

On March 30, 2006, during the Pre-Final Inspection of the CDF, sheen was observed on the surface of several puddles in a localized area on the west central portion of the CDF. The puddles were located in and adjacent to a haul road used by construction equipment and where construction equipment was parked when not in use. Absorbent pads and booms were placed in the puddles and the area was monitored. When the sheen was no longer present, the absorbent materials were collected and transported offsite for disposal. The source appeared to be the equipment stored and or operating in that area.

3.1.19.13 CDF Drainage System

The design of the CDF storm drainage system called for the construction of quarry spall lined drainage ditches along the east and west boundaries of the CDF cap. On the west side there were to be two crossings onto the cap over buried 24-inch diameter

drainage pipe. The bottom of both drainage ditches was to be elevation +13.5 feet MLLW.

Both drainage ditches were constructed in accordance with the plans with the following minor variations:

- The crossings in the west drainage ditch were relocated to provide better access for Simpson's future use of the area;
- The bottom elevation of the west ditch was raised from +13.5 feet MLLW to +15.5 feet MLLW to prevent water from Simpson's existing bioswale (the ditch's discharge location) from backing up into the drainage ditch; and
- The plans called for only one side of the east ditch to be lined with quarry spalls as the designer had assumed that the other side of the ditch would be a pre-existing riprap slope from the former St. Paul Waterway. This was not the case and the finished slope was found to be bare. The quarry spall lining was placed to prevent future erosion of that slope.

3.1.19.14 SURVEYING

During the course of CDF construction, the following surveys were performed:

- Pre-dredge hydrographic;
- Post-dredge hydrographic;
- Offset berm hydrographic and topographic;
- Containment berm hydrographic and topographic;
- Hydrographic surveys every other day to monitor the deposition of material being disposed of on the northwest face of the Puyallup River Delta;
- Hydrographic condition survey of the CDF immediately prior to berm closure to determine the quantity of mechanically dredged material deposited in the CDF; and
- Hydrographic survey following the final placement of dredge material in the CDF to record the final surface elevation of the dredge material and to estimate the amount of fill and cap material required to complete the CDF.

Copies of all surveys are available in the project record (see Section 1.0).

The results of the condition survey performed prior to berm closure mentioned above, conducted on March 1, 2005, showed that approximately 197,687 CY had been placed in the CDF as a result of mechanical dredging in the Thea Foss and Wheeler-Osgood Waterways by the end of the 2004-2005 construction season. Dredge quantities calculated from post-dredge surveys of the Thea Foss and Wheeler-Osgood Waterways indicated that a total dredge quantity of approximately 183,500 CY had been placed in the CDF as a result of mechanical dredging. From these two measured quantities, a bulking factor of 1.07 has been computed for mechanical dredging.

Following the placement of dredge material from hydraulic dredging in the Thea Foss and Wheeler-Osgood Waterways during the 2005-2006 season, the CDF was surveyed again. It was determined that the volume of dredge material in the CDF was approximately 455,200 CY while surveys from the waterway dredging indicated that a

total of approximately 425,379 CY had been placed in the CDF. From these numbers, a final bulking factor of 1.07 has been computed.

At the completion of capping the CDF, a final topographic survey was performed to confirm conformance with the design finish grades (Figure 9). Twelve settlement monitoring plates were installed at an approximate elevation of +9 feet MLLW to provide a means to measure settlement and consolidation of the dredge material over time. The initial elevation of each plate was documented.

3.1.19.15 CDF WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during demolition, dredging, excavation, and offset berm construction activities and during disposal of sediment in the CDF in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and the project WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting monitoring results. The following sections describe results of water quality monitoring during construction and sediment disposal in the CDF.

3.1.19.15.1 Monitoring of CDF Construction Activities

Visual and in-situ water quality monitoring was performed during demolition, dredging, excavation, and offset berm construction activities that were performed to construct the CDF.

Visual water quality monitoring was performed during demolition of piling within the St. Paul Waterway. In-situ water quality monitoring was performed to measure temperature, turbidity, and DO during dredging, excavation, and offset berm construction. Samples were also collected for TSS and metals during dredging and offset berm construction.

Visual indications of water quality impacts were not observed during visual monitoring of the demolition (i.e., piling removal) activities. The results of in-situ monitoring for temperature and DO consistently met the water quality standards specified in the WQC.

Turbidity frequently exceeded the criteria (i.e., ambient turbidity plus 10 NTUs) during initial construction activities in the St. Paul Waterway. The construction activities performed to construct the CDF (i.e., dredging and offset berm construction) consisted of the dredging of clean sediment and placement of clean import materials. Multiple factors attributed to the turbidity exceedences during initial construction activities that included the following:

- The St. Paul Waterway is a relatively small, confined area;
- The St. Paul Waterway was shallow during initial construction activities and much of the dredging was occurring in water less than 15 feet deep;
- Initial dredging consisted of using a clamshell dredge to remove a fine silt from the surface of the entire waterway that when re-suspended did not settle quickly;

- Due to the shallowness of the waterway, the movement of tugs and barges into and out of the waterway caused re-suspension of sediment away from construction activities; and
- The compliance monitoring stations were initially well within the shallow, confined areas of the St. Paul Waterway (i.e.,150 and 300 feet from construction).

After removal of the finer silt from the surface, deepening of the St. Paul Waterway, initiation of hydraulic dredging, and modification of the compliance monitoring stations, turbidity consistently met the water quality criteria.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper was detected at concentrations between 8.8 and 21.4 µg/L in construction area samples. The ambient concentrations of copper ranged from 8.6 to 19.4 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities did not cause further increases in the copper concentration.

Groundwater seeps were observed at multiple locations along the eastern shoreline of the St. Paul Waterway outside of the CDF containment berm. Water quality parameters (temperature, salinity, pH, dissolved oxygen, and conductivity) were measured and samples were taken at two seep locations. Based on the results, the seeps were identified to be discharging brackish groundwater. The results of groundwater seep sampling were provided to EPA in a memorandum dated July 28, 2005. As the seeps were determined to be the result of groundwater discharge, and not construction activities, no corrective action was warranted as part of remedial activities.

3.1.19.16 MONITORING DURING DUMP SCOW DISPOSAL

Clamshell dredging was performed in the Thea Foss and Wheeler-Osgood Waterways during the 2003-2004 and 2004-2005 construction seasons. Clamshell dredged material was placed in split-bottom, bottom-dump barges and transported to the CDF for disposal. Tugboats piloted the barges to the CDF.

Disposal of sediment within the CDF followed a specific set of procedures to contain the sediment and debris or other residual materials within the CDF. The following BMPs were developed and followed by the contractor when disposing of sediment in the CDF:

- A debris and oil absorbent boom (i.e., containment boom) was maintained across the mouth of the St. Paul Waterway and was attached to each shoreline;
- As a barge and tug approached the CDF, the containment boom was opened by a support vessel to allow the barge and tug to enter the CDF;
- When the barge and tug were within the CDF, the support vessel closed the containment boom and attached the boom to the shoreline;

- The tug operator contacted the contractor's water quality monitoring personnel, who were present at the CDF, by radio/cell phone for permission to open the bottom-dump barge to discharge the sediment;
- The split-bottom, bottom-dump barge was opened and the dredged material was discharged within the CDF;
- The split-bottom, bottom-dump barge was then closed and the tug operator recorded the location coordinates for the sediment discharge within the CDF;
- When the discharge of sediment from the barge was completed, the contractor's water quality personnel visually inspected the waterway and performed water quality monitoring;
- The contractor's water quality monitoring personnel then directed the opening of the containment boom after the discharge of sediment. The procedures for opening the containment boom were based on the following:
    - The presence or absence of debris or sheen on the water;
    - Tidal flow rate and direction;
    - Wind speed and direction;
    - Whether opening the containment boom would cause or facilitate the release of debris or sheen to the mouth of the St Paul Waterway; and
    - Results of water quality monitoring (visual and instrumental);
- The containment boom was opened by a support vessel, in the manner directed by the water quality personnel, to allow the barge and tug to exit the CDF;
- After the barge and tug exited the CDF, the boom was closed immediately;
- The containment boom remained closed until the next disposal event; and
- Floating debris was regularly removed from the surface of the CDF by support vessels (skiffs and/or work boats).

Visual and in-situ water quality monitoring were performed during disposal of sediment with bottom dump barges in the CDF.

Visual water quality monitoring was performed to monitor compliance with environmental BMPs. In-situ water quality monitoring was performed to measure temperature, turbidity, and DO during disposal activities. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQC.

The results of in-situ monitoring for temperature and DO consistently met water quality standards specified in the project WQC. Turbidity exceeded WQ criteria on one occasion during the 2004-2005 construction season. Turbidity was measured at 30.7 NTUs. However, the contractor performed a second round of monitoring at this station and turbidity was measured at 8 NTUs.

Debris and sheen were generated as a result of disposal of dredge materials in the CDF. Debris and absorbent booms were deployed to contain debris and sheen during all disposal activities in accordance with project BMPs.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper was detected at concentrations between 7.4 and 19 µg/L in construction area samples. The ambient

concentration was 19 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities did not cause further increases in the copper concentration.

3.1.19.17 CDF Containment Berm

Visual and in-situ water quality monitoring was performed during construction of the CDF containment berm. The containment berm was constructed when clamshell dredging was nearing completion, in preparation for hydraulic dredging.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs. In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO and TSS analyses in accordance with the project plans and WQC. The results of in-situ monitoring for temperature, turbidity, and DO consistently met water quality standards specified in the project WQC.

3.1.19.18 Monitoring During Hydraulic Dredging

Visual and in-situ water quality monitoring was performed in the St. Paul Waterway to evaluate water quality during hydraulic dredge discharge into the CDF. Water quality monitoring was performed daily in the St. Paul Waterway whether or not discharge was occurring through the CDF weirs.

It should be noted that substantial discharge through the weirs only occurred on four days during hydraulic dredge discharge into the CDF. Generally, hydraulic dredge discharge into the CDF occurred for less than 10 hours a day, six days a week. Additionally, less sediment was disposed of in the CDF than was estimated by the design providing more capacity for water. As a result, the hydraulic dredge discharge would generally raise the water level of the CDF on a daily basis but not to the level requiring discharge through the weirs.

Visual water quality monitoring was performed to monitor compliance with environmental BMPs (i.e., containment by debris and absorbent booms). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQC.

DO was slightly below WQ criteria once during monitoring in the St. Paul Waterway on August 23, 2005. On this occasion, DO was measured at 4.9 mg/L, which was 0.1 mg/L below the Class B WQ standard for DO (5.0 mg/L) in the St. Paul Waterway. This occurred when there was no discharge from the CDF weirs and was likely attributable to a seasonal decline in DO in the waterway.

Turbidity exceeded WQ criteria on multiple occasions during monitoring in the St. Paul Waterway between August 9, 2005 and September 23, 2005. All but one turbidity exceedence during this period occurred when little to no flow was occurring from the CDF weirs. The maximum turbidity that was measured was 51.5 NTUs at 150 feet from

the weir outfall. EPA and the Corps agreed that construction activities did not require any modifications to curb the exceedences.

Multiple factors attributed to the turbidity exceedences that included the following:

- The St. Paul Waterway is a relatively small, confined area;
- The St. Paul Waterway was shallow as it was low tide during most of the monitoring events and waterway depths were less than 20 feet at the monitoring locations;
- Multiple construction activities were occurring in the St. Paul Waterway at the same time including construction of the Peninsula Habitat and North Beach Habitat Berm;
- Construction of the Peninsula Habitat and North Beach Habitat Berm further confined and constricted the St. Paul Waterway and reduced mixing within the waterway (i.e., the water quality monitoring locations were within the area confined by Simpson on the east, the CDF containment berm on the south, Peninsula Habitat on the west, and North Beach Habitat Berm to the north); and
- Water from the Puyallup River that contained a substantial quantity of fines would frequently enter the St. Paul Waterway increasing the turbidity.

Turbidity exceeded WQ criteria on one other occasion, September 24, 2005, during discharge from the east weir of the CDF. Turbidity reached a maximum of 26.8 NTUs at 150 feet from the discharge weirs. The contractor's water quality monitoring personnel notified the Lofgren to slow their pumping rate and the Lofgren was subsequently shut down to reduce the turbidity concentration. EPA was notified of all instances of turbidity exceeding the water quality criteria.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper was detected at concentrations between 12.2 and 32.0 µg/L in construction area samples. The ambient concentration of copper was between 11.9 and 22 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities did not cause further increases in the copper concentration.

Sampling and analysis for COCs was performed during weir discharge from the CDF on October 5, 2005. The results of COC sampling were compared to the results of Modified Elutriate Testing (MET) as required in the WQC. The results from COC sampling were comparable to or less than the results from the MET. The data from COC monitoring at the CDF was provided to EPA in the September 2005 Monthly Water Quality Monitoring Report.

3.1.19.19 CDF Fish Monitoring and Protection Activities

Fish monitoring and protection activities were performed during CDF construction and disposal of material within the CDF as described in the following sections.

3.1.19.19.1 Fish Monitoring Activities During CDF Construction and Disposal

An extension to the in-water work period was requested beyond February 14, 2005, to dispose of sediment within the CDF and complete construction of the CDF containment berm. EPA granted a work extension to March 15, 2005, and the City continued until work was completed on March 3, 2005. During the work extension period, specified BMPs and monitoring were required for in-water construction activities.

Fish monitoring consisted of visual observations within and adjacent to work areas and seining at designated locations contingent on the work area to evaluate fish presence. The seining sites associated with disposal of sediment within the CDF and completion of the CDF containment berm were located at the North Beach Habitat and the Simpson peninsula.

BMPs and monitoring required and performed for sediment disposal and CDF containment berm construction during the work extension period included the following:

- Enclosing the CDF by maintaining a fish exclusion barrier / containment boom with a six-foot deep silt curtain across mouth of St. Paul Waterway;
- Performing intensive water quality monitoring;
- Biologist observations for the presence of fish; and
- Seining to evaluate for the presence of fish.

During the work extension period when disposal within the CDF was occurring (February 15, 2005 through February 28, 2005), four salmonids (all Chinook) were captured and released in five seine sets at the North Beach Habitat site and two salmonids (one Chinook and one Steelhead) were captured and released in six seine sets at the Simpson Peninsula site.

During the work extension period when containment berm construction was being performed (February 16, 2005 through March 3, 2005), two salmonids (both Chinook) were captured and released in ten seine sets at the Simpson Peninsula site and five salmonids (four Chinook and one Chum) were collected and released in 11 seine sets at the North Beach Habitat site.

During final closure of the CDF (i.e., construction of the containment berm to elevation +14 feet MLLW) the procedures specified in the Fish Protection Plan were implemented as discussed in Section 3.1.19.19.2.

3.1.19.19.2 Fish Protection Procedures and Monitoring During CDF Closure

Fish protection monitoring and procedures were performed prior to and during closure of the CDF in accordance with EPA approved Final Design CQAP, St. Paul Waterway CDF Berm Closure Fish Protection Plan, and project plans and specifications. Construction on the containment berm effectively closed the CDF on March 2, 2005. Fish protection monitoring and procedures were performed on February 28, 2005 through March 2, 2005.

On February 28, 2005, prior to initiation of the closure of the CDF, Parametrix fish biologists conducted a fish survey using visual observations and hydro-acoustic monitoring in order to guide possible fish removal actions. Hydro-acoustic monitoring was conducted throughout the waterway using a multi-beam sonar fish finder operated from a boat. The hydro-acoustic survey was conducted in order to estimate the numbers and probable types of fish present in the CDF. The hydro-acoustic survey was conducted in nine transects oriented approximately parallel to the length of the CDF and five transects oriented perpendicular.

Visual observations were conducted along the shorelines to search for juvenile and adult salmon, and other fishes that might be present where the hydro-acoustic equipment was not effective. The fish biologists observed the shallow shoreline water within the CDF to detect signs of fish movement such as a wake from swimming fish.

Approximately 34 fish were detected using the hydro-acoustic monitoring during the February 28, 2005 survey. The majority of the fish that were detected were near the bottom along the southwest side of the CDF. The biologists believed that it was possible that some of the fish observed could have been salmonids. However, the fish biologists believed that the absence of larger fish within the water column was an indication that the fish that were observed were not salmonids. Additionally, no salmonids or other fish were observed during the visual survey of the shoreline.

On March 1, 2005, the day berm closure was initiated, the biologists performed additional visual surveys of the shoreline and hydro-acoustic surveys where fish had been identified the previous day, and beach seining at three accessible sites. No fish were detected by visual observations of the shoreline. Smaller numbers of fish were detected by the hydro-acoustic surveys than detected during the surveys on February 28, 2005. Fish collected in the beach seine sets conducted prior to closure included one juvenile Chinook (Oncorhynchus tshawytscha), three juvenile starry flounder (Platichthys stellatus), one Pacific staghorn sculpin (Leptocottus armatus), 48 juvenile Pacific sand lance (Ammodytes hexapterus), and four sub-adult Pacific herring (Clupea harengus). All fish collected were released into Commencement Bay.

Construction of the containment berm and closure of the CDF continued on March 2, 2005. Visual surveying of the shoreline, hydro-acoustic surveys of the waterway, and beach seine sampling continued during final closure of the berm. Visual observations were made of the shallow water along the entire shoreline and no fish were detected. A hydro-acoustic survey was made of the nearshore areas where fish were previously observed. The hydro-acoustic survey detected only three small fish where fish had previously been detected on February 28, 2005. Beach seine sets were made at three locations within the CDF. No fish were collected in the first five sets. Two threespine stickleback (Gasterosteus aculeatus) were collected in the final beach seine set and were released into Commencement Bay.

The visual, hydro-acoustic, and beach seine observations indicate that few fish were present within the CDF at the time of the berm closure. A single juvenile Chinook was collected on March 1, 2005, and no juvenile salmon were observed or collected during the March 2, 2005, beach seine efforts performed during final berm closure. The containment berm was constructed to an elevation of +14 feet MLLW, closing the CDF on March 2, 2005.

3.2 HABITAT/MITIGATION SITES

3.2.1 NORTH BEACH HABITAT – PENINSULA HABITAT & ST. PAUL BEACH HABITAT

The Peninsula and St. Paul Beach Habitat Areas, collectively called the North Beach Habitat, are located in the shallow water north of the St. Paul/ Middle Waterway Peninsula and eastward at the mouth of the former St. Paul Waterway in front of the CDF Containment Berm (Figure 8). The work consisted of the removal of approximately 900 treated and non-treated timber piling remaining from a pre-existing cargo pier and placement of fill materials to create shallow water habitat. Approximately six and a half acres of intertidal habitat were improved in this area (Figure 10).

3.2.1.1 SUMMARY OF CONSTRUCTION

Construction performed on the North Beach Habitat includes:

- Removal of piling;
- Construction of a habitat berm;
- Habitat construction with various materials between elevations -4 feet MLLW and +12 feet MLLW;
- Disposal of wood waste;
- Excavation and onsite reuse of material;
- Placement of large woody debris;
- Surveying; and
- Water quality monitoring.

3.2.1.2 PREPARATION FOR CONSTRUCTION

A pre-construction meeting was held in early August 2003, prior to removal of piling. Topics of discussion included:

- Equipment to be used;
- Schedule;
- Pile pulling;
- Debris containment;
- Transport and disposal;
- Health and safety;
- Environmental concerns; and
- Water quality monitoring.

In late June 2005, the City requested approval to begin work on the habitat area prior to the approved in-water work start date of July 15, 2005. EPA noted that the work could be done “in the dry” at low tides and that the activity was approved.

On June 24, 2005, a second pre-construction meeting was held prior to the start of the Peninsula Habitat. Topics of discussion included:

- Scope of work;
- Health and safety;
- Environmental concerns;
- Equipment to be used and methods of construction;
- Schedule; and
- Surveying.

The pre-construction meetings were attended by representatives of the City, KPFF, Floyd|Snider, Manson and Manson's subcontractors as necessary.

3.2.1.3 PILING REMOVAL AND DISPOSAL

Approximately 427 piling or approximately 800 tons were initially removed from the Peninsula Habitat area under the UAO during the 2002-2003 construction season and disposed of at the Rabanco Landfill. This activity is discussed in more detail in the Remedial Action Construction Report for the Early Work.

In preparation for construction of the Peninsula Habitat Area, additional piling removal and disposal was performed during the 2003-2004 construction season from August 12-21, 2003. Piling removal consisted of placing debris and absorbent booms around the work area to capture debris and any possible petroleum sheen; using a derrick to extract approximately 330 piling; placing the piling onto plastic lined barges; and transferring the piling (approximately 530 tons) from the barge into containers at Al Power's Dock for transport and disposal at the Rabanco Landfill. Transfer, transport, and disposal of the piling were performed for Manson by Rhine from August 15-29, 2003 (Table C-17).

Approximately 40 remaining piling (approximately 60 tons) were removed during the 2004-2005 construction season on July 28, 2004, following the same procedures, to complete preparation for construction of the Peninsula Habitat. Transfer, transport, and disposal of the piling were performed for Manson by Rhine on July 28, 2004 (Table C-17).

3.2.1.4 PENINSULA HABITAT

Work began on the Peninsula Habitat with the delivery and stockpiling of heavy riprap and select fill material on June 22, 2005. Stockpiling continued through July 5, 2005. Construction of the habitat area began on July 6, 2005, with the placement of select fill at low tide to construct an access way to the extreme north end of the site. Construction of the riprap armored barrier island at the north end of the habitat area began on July 7, 2005, with the placement of select fill and heavy riprap from elevation -4 feet MLLW up to elevation +12 feet MLLW. Work on the barrier island continued intermittently on days with tides below -1 feet MLLW. Upon completion of the heavy riprap placement, rounded river rock was placed over it at a rate of 10 tons per 1,000 SF and the habitat mix placed on the surface at the rate of 15 tons per 1,000 SF. The barrier island was completed on July 22, 2005.

Excavation of the "saddle" between the barrier island on the north and the peninsula to be constructed from the south began on July 21, 2005. The low point of the excavation was at elevation -2 feet MLLW and was backfilled with two feet of habitat mix to a final elevation of +0 feet MLLW. All work was accomplished with backhoes working during low tide periods. The excavated material contained wood waste that was unsuitable for reuse as habitat fill and was disposed of in the CDF.

Riprap slope protection was placed along the eastern boundary of the habitat area between the barrier island and the location of the habitat berm for the St. Paul Beach Habitat Area. The slope protection was designed to protect the habitat area from prop wash of tugs operating at Simpson's fuel pier and chip loading facility. The slope protection consisted of a four-foot layer of heavy riprap between elevations -4 feet MLLW and -12 feet MLLW. This riprap area was constructed by first placing rock in a linear berm with trucks to approximate elevation +2 feet MLLW and then using a long reach backhoe to place the rock down the slope to the lower elevations during low tides.

The work continued intermittently with excavation during the lowest tides and placement of select fill to extend the peninsula northward during the slightly higher tides. With completion of the excavation and placement of select fill, the entire area was overlain with a two-foot layer of habitat mix between elevations -4 feet MLLW and +13 feet MLLW.

With the completion of the habitat mix layer, six pieces of LWD were placed in the southwest corner of the habitat area and anchored in place. All work on the Peninsula Habitat portion of the North Beach Habitat Area was completed on September 14, 2005. Final quantities included approximately 2,860 CY of excavation; 14,255 tons of heavy riprap; 12,200 tons of habitat mix; 14,000 tons of import habitat fill material; and six pieces of LWD.

3.2.1.5 ST. PAUL BEACH HABITAT

Construction of the St. Paul Beach Habitat Area began on August 11, 2005, with the initial clamshell placement of riprap for the habitat berm. Work on the berm continued intermittently as equipment and material became available from other areas of the project to build the berm up from a waterway bottom elevation of approximately -20 feet MLLW to a finished height at -4 feet MLLW. The habitat berm was completed on December 5, 2005.

The initial imported habitat fill material was placed by clamshell in the deeper water behind the berm between September 2, 2005 and November 20, 2005. After initial placement of this material, filling continued with land-based equipment working at the lowest tides from January 5-20, 2006. The habitat fill material initially consisted of the material stockpiled on site from the excavation of the Hylebos Creek Mitigation site. Following that, select import fill material was placed to create a uniform gentle slope between the back of the habitat berm at -6 feet MLLW to the face of the CDF containment berm at approximate elevation +11 feet MLLW.

Following the placement of habitat fill material, the entire area was overlain with a two-foot layer of habitat mix as a final surface, except that from elevation +8 feet MLLW to

+13 feet MLLW a one-foot layer of habitat mix was placed over a one-foot layer of rounded river rock. This habitat area was substantially complete on January 20, 2006, with some minor final grading accomplished on January 27, 2006.

The material used in construction the St. Paul Beach Habitat Area included approximately 6,570 tons of riprap and select fill for the habitat berm and 81,685 combined tons of habitat fill, habitat mix and rounded river rock for the habitat area.

3.2.1.6 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was required during removal of piling from the peninsula and construction of the North Beach Habitat Area in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and the project WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting monitoring results. Visual indications of water quality impacts were not observed during visual monitoring of the piling demolition.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., dredge speed, containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO. Samples were also collected for DO and TSS analyses in accordance with the project plans and WQC.

The results of in-situ monitoring for temperature, turbidity, and DO consistently met water quality standards specified in the project WQC. Turbidity originating from the Puyallup River and originating from fines from habitat fill was intermittently observed to occur as a result of habitat construction. Turbidity did not exceed water quality standards.

3.2.2 MIDDLE WATERWAY CORRIDOR HABITAT

The Middle Waterway Corridor Habitat is a portion of the mitigation package for the Thea Foss and Wheeler-Osgood Waterways Remediation Project. Located near the mouth of the Middle Waterway on its eastern shoreline, this approximately 350-foot section of shoreline was rehabilitated by the removal of debris and the placement of clean substrate for stabilization and habitat improvement (Figure 8). This area provides a pivotal link between the restored sites to the west of the mouth of the Puyallup River and the extensively restored shorelines within the Middle Waterway. Approximately 0.7 acres of intertidal habitat were improved in this area (Figure 10).

3.2.2.1 SUMMARY OF CONSTRUCTION

The construction of the Middle Waterway Corridor Habitat includes:

- Removal of concrete debris from the slope;
- Excavation for a toe berm at the base of the slope;
- Placement of 18 inches of slope filter material on the slope;
- Placement of 18 inches of light loose riprap over the filter material;
- Placement of habitat mix over the riprap at the rate of 25 tons per 1,000 SF;
- Placement of one foot of rounded river rock over the flat portion of the beach; and
- Placement of one foot of habitat mix over the river rock.

3.2.2.2 PREPARATION FOR CONSTRUCTION

On January 20, 2004, a pre-construction meeting was held to prepare for the construction activities. In attendance were representatives of City, KPFF, Floyd|Snider, Manson and Scarsella. Scarsella was the subcontractor identified to perform the work.

Required import materials were submitted and approved in advance of material being brought on site. Materials and approved suppliers were as follows:

- Slope filter material from Glacier Northwest;
- Light loose riprap from Washington Rock; and
- Habitat mix and rounded river rock from Miles Sand and Gravel.

Scarsella indicated that they planned to perform the work below ordinary high water at nights during the low tide periods and that the work would be done in the dry to the extent practicable. When work was done in the water, a debris boom contained the area and water quality monitoring was performed. Work during the daytime included import and staging of the required materials from approved suppliers. Excavated sediment was to be placed in the CDF and concrete debris was to be recycled.

3.2.2.3 CORRIDOR HABITAT

During the daytime on January 21, 2004, Scarsella began the import of slope filter material and light loose riprap into stockpiles near the construction activity.

That night during low tide, Scarsella began the construction with removal of concrete debris along the slope and the excavation of the key for the toe berm. The sediments were disposed of in the CDF. Water quality monitoring was performed during the disposal activity and no exceedences were noted. The concrete was stockpiled for subsequent recycling. Riprap was placed to construct the toe berm along the excavated portion. As the tide started to come in, filter material and riprap were placed in their prescribed 18-inch lifts from the toe berm up the slope.

Then during the day on January 22, 2004, more materials were imported in preparation for the tidal work at night on the slope. That night, Scarsella finished the excavation for, and the construction of, the toe berm. As the tide came in, they finished placing the filter material and riprap up the slope.

Finally, during the day on January 23, 2004, Scarsella imported rounded river rock and habitat mix. That night at low tide, a foot of rounded river rock and a foot of habitat mix were placed waterward of the toe berm. As the tide came in, habitat mix was placed over the riprap on the slope, finishing the construction.

Final quantities of materials utilized for the Middle Waterway Corridor Habitat are as follows:

- 1,230 CY of excavation;
- 1,016 tons of filter material;
- 1,341 tons of riprap;
- 1,069 tons of rounded river rock; and
- 1,178 tons of habitat mix.

3.2.2.4 WATER QUALITY MONITORING

Water quality monitoring was performed during removal of concrete debris from the slope, excavation for the toe berm at the base of the slope, disposal of materials in the CDF, and capping of the area. This work was performed in the dry to the extent practical. Daily water quality monitoring reports were submitted to EPA documenting monitoring results.

Visual water quality monitoring was performed during excavation of the upper slope of the habitat corridor area (i.e., work performed in the dry). In-situ water quality monitoring was also performed to measure temperature, turbidity, and DO during concrete removal, excavation, disposal, and capping. Samples were also collected for TSS.

The results of in-situ monitoring for temperature and DO met the water quality standards specified in the WQC. Turbidity met the criteria except for during one event. The turbidity was marginally greater than the criteria (i.e., less than 2 NTUs above the criteria) at one station during placement of rounded river rock. At the time the exceedence occurred, capping was also being performed by others in the adjacent channel as part of the Middle Waterway remediation project. The exceedence was likely a result of overlapping construction activities that had not been identified prior to initiation of work.

3.2.3 MIDDLE WATERWAY TIDEFLAT HABITAT

The Middle Waterway Tideflat Habitat (MWTH) is located on the eastern shoreline of the Middle Waterway in the central portion of the waterway (Figure 8). Construction of the MWTH consisted of creating approximately six acres of intertidal habitat and enhancement of approximately three acres of existing Tideflat along approximately 1,450 linear feet of the shoreline (Figure 11).

An irrigation system was installed in the intertidal zone and along the upper shoreline area to supply sufficient fresh water to support the growth of brackish marsh species in the Tideflat habitat area.

3.2.3.1 SUMMARY OF CONSTRUCTION

Construction performed in the MWTH area includes:

- Demolition and disposal or recycling of buildings, slabs and other structures;
- Pre-construction and confirmation sampling and analysis;
- Excavation of approximately 125,000 CY of upland and offshore material;
- Placement of riparian soil between elevation +10 feet MLLW and +18 feet MLLW;
- Installation of jute matting between elevation +8 feet MLLW and +10 feet MLLW on the 3H:1V transition slope;
- Fencing; and
- Installation of a freshwater irrigation system.

3.2.3.2 PREPARATION FOR CONSTRUCTION

A pre-construction meeting was held on November 3, 2005. Topics of discussion included:

- Traffic control and safety including Simpson safety requirements and night operations;
- Scope of work including stockpile removal, haul roads, demolition of concrete bulkheads and habitat area excavation;
- Environmental concerns including equipment leaks and containment booms;
- Equipment to be used;
- Construction schedule; and
- Low tide operations.

3.2.3.3 PRE-CONSTRUCTION AND CONFIRMATION SAMPLING

Construction of the MWTH required a pre-construction investigation to characterize excavated material and site soil that would comprise the surface of the completed habitat. Confirmation sampling and analysis was also performed upon completion of the habitat excavation at two pre-construction sample locations to confirm that material with chemical concentrations exceeding the SQOs had been removed. Finally, confirmation sampling and analysis was also performed upon completion of the habitat excavation at the location where two Underground Storage Tanks (UST) were uncovered during construction and removed for offsite disposal.

The results of the pre-construction characterization and confirmation sampling and analysis were presented in the following documents:

- Pre-Construction Characterization Report, Thea Foss and Wheeler-Osgood Waterways Remediation Project, Parametrix, 2003;
- Construction Correspondence Memorandum 2012 (CR-2012), Middle Waterway Tideflat Habitat Characterization Results, September, 27, 2005; and
- Construction Correspondence Memorandum 2308 (CR-2308), Middle Waterway Tideflat Habitat Confirmation Sampling Results, April 13, 2006.

At six of eight pre-construction characterization sample stations within the MWTH site, the detected chemical concentrations were below the SQOs in samples collected at the completed habitat surface. These stations included MW-003 and MW-005 through MW-009 (Figure12). Additionally, the detected concentrations of petroleum hydrocarbons were substantially less than the MTCA Method A criteria in samples collected at these stations.

At one station, MW-010, the detected chemical concentrations in the parent sample collected at the habitat surface were well below the SQOs except for the detected PCB concentration. However, PCBs were not detected in the duplicate sample collected at this location at a detection limit less than the SQO. The detected concentrations of all other chemicals were also well below the SQOs in the duplicate sample. Therefore, confirmation samples were collected from Station MW-010 upon the completion of the habitat excavation to verify the removal of all material with PCB concentrations exceeding the SQOs. The detected concentrations for all chemicals were less than the SQOs in the confirmation samples collected at the final surface at Station MW-010.

At Station MW-004, the pre-construction characterization boring was not advanced to the depth of the habitat surface. The sample from Station MW-004 was collected four feet above the habitat surface. Additionally, the detected concentration of one PAH (dibenz(a,h)anthracene) slightly the exceeded the SQO at Station MW-004. The detected concentrations of all other chemicals were well below the SQOs. Therefore, a confirmation sample was collected from Station MW-004 upon the completion of the habitat excavation to verify the removal of all material with PAH concentrations exceeding the SQOs. The detected concentrations for all chemicals were less than the SQOs in the confirmation sample collected at the final surface at Station MW-004.

Finally, during excavation at the southern end of the MWTH, two USTs were uncovered. The USTs were removed and disposed of offsite (Section 3.2.3.5). Confirmation samples were collected from the former location of the USTs upon completion of the habitat excavation. The detected concentrations were less than the SQOs in the confirmation samples.

3.2.3.4 DEMOLITION AND DISPOSAL OR RECYCLING

Multiple demolition tasks were performed during the 2003-2004 construction season on the Middle Waterway Peninsula in preparation for construction of the MWTH. The demolition tasks consisted of the following:

- Demolition of the Middle Waterway "tin building" and recycling and disposing of the demolition debris;
- Asbestos abatement and demolition of an office building (300 Middle Waterway Street) and disposal of the abated materials and demolition debris;
- Demolition of concrete foundations and pavement and recycling of the demolition debris; and
- Monitoring well decommissioning.

Specific actions performed for each of the demolition tasks are described in further detail.

3.2.3.4.1 Middle Waterway Tin Building

Demolition of a metal building from the Middle Waterway Peninsula included:

- Demolition of the building structure;
- Separation of recyclable materials (tin, steel, copper wire, rail lines, and aluminum) from non-recyclable debris (wood and debris);
- Loading and transport of the recyclable materials, approximately 17 tons, to Schnitzer Steel Industries; and
- Loading and transport of non-recyclable materials, approximately 35 tons, into containers for disposal at the Rabanco Landfill.

Demolition of the metal building was performed for Manson by Rhine on September 16, 2003. Non-recyclable debris was transported to the Rabanco Landfill on the same day (Table C-18). Recyclable materials were transported to Schnitzer Steel on September 30, 2003.

3.2.3.4.2 300 Middle Waterway Street Office Building

Demolition of the 300 Middle Waterway Street office building included:

- Removing existing trash (i.e., paper, clothing, etc.) and debris (i.e., broken furniture, carpet, etc.) from within the building and placing it in a container;
- Abatement of asbestos containing flooring, pipe and wall insulation, ceiling tile and flooring mastic, roofing material, sheetrock joint compound, soil, and slip sheeting;
- Transport and disposal of the abated asbestos-containing material (approximately 70 CY) at the Greater Wenatchee Regional Landfill;
- Demolition of the office building (post asbestos abatement);
- Demolition of the concrete foundation;
- Loading of the demolished building structure into containers;
- Transport and disposal of the office building structure (approximately 110 tons) at the Rabanco Landfill; and
- Loading the remaining concrete foundation (approximately 16 CY) into a truck for transport to Wm. Dickson for recycling.

Office demolition activities were initiated on September 23, 2003, with the removal of trash and debris. Asbestos abatement was performed for Manson by PAS between

September 24, 2003 and October 22, 2003. Demolition and disposal of the office building was performed by Rhine on October 23-24, 2003 (Table C-18).

3.2.3.4.3 Foundations and Pavement Removal and Recycling

Concrete foundations and concrete and asphalt pavement were present at multiple locations on the Middle Waterway Peninsula in the area of the MWTH site. Demolition and recycling of the foundations and pavement consisted of breaking up the concrete foundations and concrete and asphalt pavement; sorting and consolidating the concrete and asphalt materials; and loading the material (3,080 CY) into trucks for transport to Wm. Dickson for recycling. Demolition and transport of the foundations and pavement was performed for Manson by Rhine from September 4-30, 2003 (Table C-18).

During pavement removal, creosote treated wood (i.e., railroad ties, piling, etc.) was encountered at multiple locations. The creosote treated wood debris was collected and transferred into containers for disposal at the Rabanco Landfill. The wood debris (approximately 30 tons) was transported to the landfill by Rhine on September 15, 2003, September 18, 2003, and October 10, 2003.

3.2.3.4.4 Monitoring Well Decommissioning

Two monitoring wells were identified on the Middle Waterway Peninsula for demolition and decommissioning (RD3-UMW-5 and RD3-UMW-10). Considerable effort was made to locate the wells through onsite exploration and historic research. The two wells were eventually located during construction and decommissioned.

During excavation adjacent to the St. Paul Waterway on February 16, 2004, components of monitoring well RD3-UMW-5 were uncovered in the construction area. Bollards and a circular area of bentonite were uncovered indicating the presence of the monitoring well. No well casing was observed in the bentonite indicating that the well had previously been decommissioned. However, additional excavation was performed to verify removal of the well. A Notice of Intent to Decommission a Well (Notification Number AE00852) was prepared and sent to Ecology. An Agency Validation receipt dated March 11, 2004, was received by the City verifying that Ecology received the notification.

During the initial excavation of well RD3-UMW-5 on March 1, 2004, only bentonite (i.e., no well casing) was observed. At approximately 13 feet below the ground surface, slotted PVC well screen was uncovered. The remaining component of the well was measured and it extended to approximately eight feet below the depth of the excavation (total depth of approximately 21 feet below ground surface). The excavation was continued and the remaining components of the well (i.e. well screen and well sump) were removed to complete the well decommissioning.

The second well was located visually on the edge of the St. Paul Waterway on September 3, 2004. The well was measured to be approximately 100 feet deep, matching the boring log for well RD3-UMW-10. A notice of Intent to Decommission a Well (Notification Number A60920) was prepared and sent to Ecology for well RD3-UMW-10. An Agency Validation Receipt dated September 29, 2004, was received by

the City verifying that Ecology received the notification. The well was decommissioned on September 24, 2004, by cutting the well off at grade and filling it with grout.

3.2.3.4.5 Piling Removal and Disposal

Nine dolphins consisting of three piling each (i.e., total of 27 piling) were removed from the MWTH during initial construction activities. The piling were either removed or broken off three feet below the mudline by Scarsella using an excavator at low tide when the piling were entirely exposed. Additionally, a float moored to the dolphins was also removed. The piling and float (approximately 18 tons) were disposed of at the Rabanco Landfill. Transfer, transport, and disposal of the piling were performed for Manson by Rhine on January 12, 2006 (Table C-19).

3.2.3.5 EXCAVATION

Rhine Construction, under subcontract to Manson, began the excavation / demolition phase of the work by removing slabs and chunks of concrete rubble from the shoreline on October 26, 2005. The concrete was removed from the north portion of the existing bank and staged in the immediate vicinity using hydraulic excavators with grapple thumbs. The blocks, chunks, and slabs that exceeded two feet in any dimension were broken down to two-foot minus using a hydraulic hammer mounted on an excavator. The reduced rubble was loaded with a wheel loader into an off-road dump truck and deposited into the bottom of the CDF. Rhine completed this portion of the work on November 16, 2005.

Scarsella began excavation of soil from the MWTH on November 11, 2005. The first soil that was moved consisted of a stockpile of upland material from the original CDF excavation and from a stockpile of import cap material from construction from SR 161. Both of these stockpiles were placed into the CDF using hydraulic excavators, wheel loaders, and articulating off-road dump trucks. On the night of November 15, 2005, Scarsella began excavation of the tidal area, working west to east (offshore to upland) and north to south, within the limits of the habitat site. The dendritic channels were excavated to depths ranging from elevation -6 feet MLLW at the northern end to an elevation of -2 feet MLLW at the south end. Hundreds of untreated timber piling, existing in bents approximately 15 feet apart with 6-8 piling per bent, were encountered and either removed completely or broken off at least two feet below finished grade. This finding slowed the pace of the excavation considerably due to the additional time needed to excavate around and break off the piling.

During excavation at the southern end of the MWTH, two USTs were uncovered on January 26, 2006. The USTs were removed from the habitat site and placed in a bermed, lined, and covered stockpile area. The material within the USTs was characterized and identified to be heavy heating oil. The oil and tanks were removed from the site and disposed of by Certified Cleaning Services on February 14, 2006 and February 16, 2006, respectively.

Substantial dimensional lumber scraps were also present at the southern end of the MWTH site. The wood debris was removed to two feet below finish grade and backfilled with filter material. All excavated material was placed into the CDF.

Scarsella completed construction of the MWTH on February 14, 2006. All material excavated from the MWTH was placed in the CDF on top of the contaminated sediment. The total quantity of material excavated from the MWTH and placed in the CDF was 125,700 CY.

3.2.3.6 HABITAT AREA CONSTRUCTION

Habitat area construction consisted of following:

- Lining the dendritic channels with filter material;
- Placing riparian topsoil;
- Installing biodegradable jute mat;
- Installing LWD;
- Installing an irrigation system; and
- Habitat plantings.

Approved filter material was imported from Miles Sand and Gravel to provide a two-foot thick lining of all drainage channels, and to fill beach voids caused by the removal of unsuitable material and wood waste. Approved riparian topsoil was placed in a six-inch thick lift between elevations +10 feet MLLW and +18 feet MLLW. Jute mat was placed between elevations +8 feet MLLW and +10 feet MLLW. Three LWD features were bedded and anchored on a small peninsula in the southwest corner of the habitat area.

Estimated final quantities for construction of the MWTH included approximately 125,700 CY of excavation; 6,005 tons of filter material; 2,970 tons of riparian topsoil; three pieces of large woody debris; and 2,080 SY of jute mat.

3.2.3.7 IRRIGATION SYSTEM

The marsh and riparian irrigation system is comprised of:

- Fresh water supply;
- Irrigation control system;
- A tidal level sensor system;
- Irrigation trunkline;
- Sprinkler heads; and
- Rain gauge.

Fresh water is supplied to the new system by Tacoma Water, and is isolated by double check valves. The control structure is above ground at the south end of the habitat. Float switches in an 18-inch standpipe connected to a saltwater inlet provide tidal data to the irrigation control. The marsh irrigation trunkline was buried running south to north from the control at an elevation of +13 feet MLLW, beginning with six-inch diameter PVC pipe and reducing to ¾-inch. Sprinkler heads were placed above finish grade every 20 to 23 feet along the trunkline. The riparian irrigation system is laid above ground along the inside of the fence line.

3.2.3.8 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during habitat construction including: excavation of soil and removal of upland debris (concrete riprap, concrete debris, treated and untreated piling); hauling and disposal of materials in the CDF; and placement of clean backfill. Water quality monitoring was performed in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and Interim No. 4 and Interim No. 5 WQC. Construction work was performed in the dry to the extent practical. Daily and monthly monitoring reports were submitted to EPA documenting monitoring results.

Visual water quality monitoring was performed during excavation of the upper slope of the habitat area (i.e., work performed in the dry) and to monitor compliance with construction and environmental BMPs (i.e., containment by debris and absorbent booms, etc.). A debris boom was continuously deployed around the MWTF habitat during construction. In-situ water quality monitoring was performed to measure temperature, turbidity, and DO during habitat construction. Samples were also collected for DO, TSS, and metals (i.e., copper and silver) analyses in accordance with the project plans and WQCs.

The results of in-situ monitoring for temperature, DO, and turbidity met the water quality standards specified in the WQCs.

Dissolved silver was not detected in water quality samples. The dissolved copper concentrations detected in construction area samples are consistently comparable to concentrations at the up-current ambient monitoring locations. Copper was detected at concentrations between 11 and 12 µg/L. The ambient copper concentration was 12 µg/L. The results of samples collected in the construction area and ambient locations identify that elevated copper concentrations are the result of ambient conditions and that remedial construction activities did not cause further increases in the copper concentration.

Sheen was observed in the Middle Waterway on two occasions, December 29, 2005 and February 13, 2006. Sheen was observed on December 29, 2005, resulting from a minor release of hydraulic oil on upland soil from a piece of construction equipment. The release had been contained and cleaned up on the previous day with no release to the waterway. However, sufficient oil remained on the soil to generate a sheen on stormwater on the following day. The contractor responded by deploying absorbent booms to contain the sheen. The soil was excavated and removed from the area.

On February 13, 2006, sheen was observed in the Middle Waterway resulting from the sinking of a Simpson log handling watercraft in the LHOF area. Simpson responded by deploying absorbent booms and absorbent pads.

3.2.4 PUYALLUP RIVER SIDE CHANNEL

The Puyallup River Side Channel (PRSC) is one of the central pieces of the habitat mitigation for the Thea Foss and Wheeler-Osgood Waterways Remediation Project. It is located along the left descending bank of the Puyallup River between East 11th Street and Lincoln Avenue (Figure 1). The project includes construction of a new setback flood control levee, excavation of the habitat area, placement of habitat materials, and breaching and lowering the elevation of the pre-existing levee structure (Figure 13). Approximately 5.3 acres of aquatic habitat were created.

3.2.4.1 SUMMARY OF CONSTRUCTION

Construction of the PRSC includes:

- Soil borings and analysis for pre-characterization of soils to be excavated and sediment quality at the finish excavated surface;
- Clearing and grubbing;
- Construction of approximately 1,800 LF of new Puyallup River levee;
- Excavation of an approximate 5.3 acre side channel habitat area;
- Disposal of solid and hazardous waste materials from excavation at approved disposal facilities;
- The lowering and breaching of the pre-existing levee to maximize habitat area and connect the habitat area to the river; and
- Armoring to protect the river side of the new levee and the breach in the pre-existing levee.

3.2.4.2 PREPARATION FOR CONSTRUCTION

On July 14, 2003, a pre-construction meeting was held to prepare for pre-construction sampling. In attendance were representatives of the City, KPFF, Floyd|Snider, Manson, Parametrix, and the Corps. Parametrix was the subcontractor identified to perform the pre-construction characterization work.

Pre-work requirements and submittals were identified and discussed during the meeting. A timeline for completion of submittals was identified so that the submittals would be completed prior to initiation of characterization activities. Additionally, the sampling, analysis, and reporting requirements were reviewed to clarify any remaining requirements for the characterization activities.

A second pre-construction meeting was held on April 28, 2005. Attendees included representatives from the City, KPFF, Floyd|Snider, Manson, Scarsella, Nor-Pac, Roadway, EPA, the Corps, and TPCHD. Topics of discussion included:

- Construction sequencing (north to south);
- Closure of culvert to Puyallup River;
- Levee road excavation/construction;
- Habitat excavation;
- Stockpile construction (Area 3 soils);
- Excavation of contaminated Areas 1, 2 and 3;
- Dewatering;

- Import materials;
- Levee breach (excavation);
- Health and safety;
- Waste handling (excavation/transport);
- Environmental issues; and
- Project closeout.

3.2.4.3 CORPS REAL ESTATE TRANSACTION

In September 2003, the Corps identified that an unexpected and undefined real estate transaction was required to be completed prior to excavation and breach of the levee. The City worked with the Corps and EPA to determine the form of that transaction and then to complete the action. Subsequently, the City produced multiple documents to support the real estate transaction that were presented as the Puyallup River Side Channel Wetland Enhancement Project Real Estate Transaction Documentation report prepared by the City and Floyd|Snider on May 4, 2004. At the end of March 2005, the Corps forwarded the required real estate documents to the City for execution. The transaction was completed and the project cleared for construction. The City and the Corps entered into a Cooperation Agreement for the Puyallup River Side Channel project to outline the terms and obligations related to construction and maintenance of the site. This agreement is included in the project record (see Section 1.0).

3.2.4.4 PRE-CONSTRUCTION CHARACTERIZATION, DELINEATION, AND CONFIRMATION SAMPLING

Construction of the PRSC required a pre-construction investigation to characterize excavated material and site soil that would comprise the surface of the completed habitat area. Additional delineation was performed prior to construction in two areas identified during the initial characterization where chemical concentrations exceeded the project chemical criteria. Finally, confirmation sampling and analysis was also performed at two locations where delineation had not been performed prior to excavation, and confirmation sampling and analysis was necessary to confirm that material with chemical concentrations exceeding the SQOs had been removed. The results of the pre-construction characterization, delineation activities, and confirmation sampling and analysis were presented in the following documents:

- Pre-Construction Characterization Report,;
- Puyallup River Side Channel Real Estate Transaction Documentation, Site Characterization Report; and
- Construction Correspondence Memorandum 2145 (CR-2145), Final Confirmation Sample Results for the Puyallup River Side Channel, November 28, 2005.

At seven of the 10 pre-construction characterization sample stations within the PRSC, the detected chemical concentrations were below the SQOs in samples collected at the habitat surface. Detected chemical concentrations were less than the SQOs in samples at and below the habitat surface at Stations HC-MW-1, HC-MW-2, PR002, PR004, PR005, PR007, and PR008 (Figure14). At three of 10 pre-construction characterization sample stations (PR001, PR003, and PR006), chemical concentrations in samples collected from the habitat surface were greater than the SQOs for one or more compounds.

Additional sampling and analysis was performed prior to the initiation of construction to delineate the extent of chemical concentrations exceeding the SQOs at PR006 and PR003. During construction of the PRSC, the area of contamination identified at PR006 and PR003 were excavated and the material disposed of offsite. An additional confirmation sample was collected east of PR003 (i.e., Station PRC-006) upon completion of the excavation to confirm removal of material with chemical concentrations greater than the SQOs. The detected chemical concentrations were less than the SQOs in the confirmation sample collected east of PR003.

Delineation and remediation of chemical concentrations exceeding the SQOs at Station PR001 was performed during construction of the PRSC. At PR001, material with chemical concentrations greater than the SQOs was excavated for offsite disposal or containment, and confirmation sampling and analysis was performed upon the completion of the excavation. Samples were collected from five locations surrounding PR001 (i.e. Stations PRC-001 through PRC-005) to confirm removal of material with chemical concentrations greater than the SQOs. The detected chemical concentrations were less than the SQOs in all confirmation samples collected from the area surrounding PR001.

The material excavated and designated for offsite disposal included all material present above the completed habitat surface, above the base upon which the new setback levee was constructed, and material that was removed from the areas surrounding PR001, PR003, and PR006. The results for sampling and analysis of these materials were compared to disposal criteria including criteria for Dangerous Waste (Chapter 173-303 WAC).

The results for samples collected from HC-MW-1, HC-MW-2, HC-MW-3, and PR002 through PR008 did not exceed dangerous waste criteria. Therefore, these materials were disposed of at a Subtitle D landfill in accordance with the Waste Management Plan.

At PR001, TCLP lead concentrations exceeded the Toxicity Characteristic criterion. Material excavated from PR001 during construction of the PRSC was disposed of at a Subtitle C Landfill or was placed in a Temporary Containment Unit (TCU) constructed on the former Tacoma Metals site located on the western boundary of the PRSC site.

3.2.4.5 CLEARING, GRUBBING, AND DEBRIS PILE DISPOSAL

Clearing and grubbing, and stockpiling of the clearing and grubbing debris on the PRSC site was performed in preparation for construction of the habitat site. Clearing and grubbing consisted of the following:

- Removing blackberry bushes and other vegetation; and
- Consolidating the clearing and grubbing debris into onsite stockpiles for future disposal.

Clearing, grubbing, and stockpiling of the debris was performed August 12-17, 2003, with some minor follow-up grubbing activity being performed on September 18, 2003. The material was to remain stockpiled for future disposal. However, on September 26, 2003, three stockpiles spontaneously combusted. The Tacoma Fire Department

responded and extinguished the three stockpiles. Other debris piles were spread out to prevent spontaneous combustion.

The debris from the three piles that were extinguished, approximately 285 tons, was loaded into containers and hauled to LRI the following day (September 27, 2003) for disposal (Table C-20). The remaining clearing and grubbing debris remained onsite and was transported offsite for disposal. The remaining four piles (approximately 700 CY / 1,050 tons) were hauled to LRI at a later date.

3.2.4.6 EXCAVATION

After the initial delay and completion of the property transfer, excavation began on May 3, 2005, at Station PR001 in the southern end of the habitat area where detected concentrations of lead exceeded the dangerous waste criteria. The source of the lead was identified to be battery casings and debris deposited at the southern portion of the site. This debris was suspected as having come from a non-ferrous metal reclamation facility previously operated by Tacoma Metals on the adjacent property.

The initial material that was excavated from the area around PR001 that contained battery casings and debris was placed in a lined, bermed, and covered stockpile. The excavated material was characterized as Subtitle C material and was transported offsite for disposal. Approximately 248 tons of Subtitle C material was loaded into trucks and hauled to the CWM Landfill on May 25, 2005 (Table C-21).

Through an agreement with Tacoma Metals' successors, and with agency approval, a lined TCU was constructed on the adjacent, former Tacoma Metals property. The battery waste and debris excavated from the PRSC was transported by offroad trucks to the TCU. The battery waste and debris is temporarily contained within the TCU for later treatment and/or disposal by Tacoma Metals' successors. Excavation, removal, and containment of the battery casings and debris in the TCU were completed on September 8, 2005. In all, an estimated 2,000 CY of excavated material was placed in the TCU. As of the date of the final RACR, the material remains stored in the TCU at the Tacoma Metals property and will handled in accordance with a June 9, 2005 letter from Ecology to the property owner's representative. The disposal option for the material has not yet been identified and will be determined as part of the Tacoma Metals MTCA site cleanup.

Excavation began at the north end of the site on May 6, 2005, and proceeded to the south with excavation for the foundation of the new levee. Construction of the levee base and excavation of the habitat area proceeded to the south, simultaneously.

On June 28, 2005, Scarsella unearthed what was later confirmed to be unexploded military ordnance (UXO). A U.S. Army Explosives Ordnance Disposal team (Army EOD) from Ft. Lewis detonated the recovered UXO on site. The City then contracted with EOD Technology (EODT), from Tennessee to conduct a site investigation in an attempt to locate any additional UXO. The investigation began on July 5, 2005, and concluded on July 7, 2005. Additional UXO were found and detonated onsite by Army EOD personnel from Ft. Lewis.

Damaged and deteriorated drums were also uncovered at the site in the area of the UXO. The material within the drums was a viscous, gelatinous substance that underwent sampling and analysis and was identified to be grease products containing solvents. Approximately twelve drums were identified and the drums and associated grease impacted soil were excavated and placed into containers. The approximately 31 tons of grease impacted soil and drums was designated Subtitle C waste and was transported to CWM's Aragonite Incineration Facility in Aragonite, UT for disposal (Table C-21).

Construction of the new levee and excavation of the habitat site resumed on July 11, 2005, and continued until July 27, 2005, when Scarsella again encountered UXO. The City remobilized EODT on August 3, 2005, to begin more extensive investigation and site clearing. EODT completed their work on August 10, 2005. A portion of the UXO was detonated on-site with the remainder detonated offsite by Army EOD personnel from Ft. Lewis. Scarsella returned to the site to resume excavation on August 13, 2005.

On September 8, 2005, Scarsella again encountered UXO in the southern portion of the site. The City again mobilized EODT. Scarsella discontinued work at the site until the site was cleared on September 15, 2005. Army EOD personnel from Ft. Lewis detonated the recovered UXO offsite. Scarsella resumed work at the site on September 20, 2005.

An area with metal debris including automotive engines was uncovered during EODT's work to clear UXO. The metal debris was segregated and placed in containers and characterized for disposal. The metal debris was characterized as Subtitle D waste. Approximately 36 tons of material was transported in the containers to Waste Management's Columbia Ridge Landfill in Arlington, OR on January 16, 2006 (Table C-22).

During excavation of the northern half of the habitat area, infiltrating water within the habitat site was pumped to the south central portion of the site. When excavation was initiated in the south central portion of the site, infiltrating water within the site was pumped to the northern portion of the site. After all debris was removed from the site, during final excavation and grading of the interior of the site, EPA approved discharge of water from the habitat site into the Puyallup River on October 15, 2005.

On November 9, 2005, the Corps provided approval for the new levee. With the Corps' approval and acceptance of the new levee, lowering of the existing levee began on November 14, 2005. Stockpiling of materials to armor the future levee breach was performed concurrent with the lowering of the existing levee. The area of the levee breach was also reduced to minimize the amount of material requiring excavation during the breach which was planned for a period of low river flow.

On December 12, 2005, the habitat area was surveyed and found to have some high spots that needed to be removed prior to the breach and flooding of the site. Scarsella began this cleanup work on December 19, 2005, and completed it on December 22, 2005.

Nearly all construction, with the exception of excavation of the levee breach was accomplished "in the dry" with land based equipment. All construction was observed and documented on a daily basis by City of Tacoma and KPFF inspectors

The final excavation quantity was approximately 113,168 CY. Of that total, approximately 2,000 CY of battery waste and debris was placed in the TCU on the adjacent property, approximately 90 tons of battery waste and debris was disposed of at the CWM Landfill, approximately 31 tons of drums and grease impacted soil was disposed of at CWM's Aragonite Incineration Facility, and approximately 36 tons of Subtitle D waste were transported to Waste Management's Columbia Ridge Landfill in Arlington, OR for disposal. Another 28,204 CY of clean material was excavated from lowering the pre-existing levee and was transported to the CDF where it was used for capping material. The remaining approximately 100,000 tons was transported to LRI for disposal (Tables C-20 and C-23).

3.2.4.7 LEVEE CONSTRUCTION

Construction of the new levee proceeded from north to south concurrently with excavation of the habitat area. The foundation of the new levee was excavated to a minimum elevation of +9 feet MLLW. In areas where wood waste or other unsuitable material was present at that elevation, it was over excavated until suitable foundation material was present or to an elevation of +3 feet MLLW, whichever was higher. Where overexcavation occurred, select fill was placed as backfill to elevation +9 feet MLLW and then levee fill material was placed to complete the levee to the design section.

A 24-inch thick layer of light riprap was placed on the waterward face of the completed levee from the top of the levee at elevation +23 feet MLLW to elevation +9 feet MLLW. The riprap was overlain with a six-inch layer of riparian topsoil and hydroseeded.

The top of the levee was surfaced with six inches of compacted crushed aggregate as a driving surface.

The approximate final quantities of material used for the new levee and as armoring for the levee breach were:

Select fill	19,988 tons
Heavy riprap	1,724 tons
Light riprap	7,733 tons
Quarry spalls	1,712 tons
Slope cap filter material	1,411 tons
Riparian topsoil	3,870 tons
Crushed surfacing	649 tons

3.2.4.8 BREACHING OF EXISTING LEVEE

The existing levee was lowered and the existing levee section was further reduced in preparation for a controlled breach that was scheduled for the low tides on the nights of January 11-12, 2006.

During the night of December 29, 2005, with the river at flood stage, the pre-existing levee failed in the area of the planned breach. Scarsella stabilized the breach area over the next few days and then began excavating the area to the final design configuration of the breach on January 13, 2006. The levee breach was completed on January 15, 2006.

Scarsella then began the final shaping of the pre-existing levee and completing the surfacing on the new levee. All work at the Puyallup River Side Channel habitat area was completed on February 2, 2006.

3.2.4.9 WATER QUALITY

Visual and in-situ water quality monitoring was performed during habitat excavation and backfilling with clean material, discharge from the stormwater outfall to lower the water level in the habitat site, and breaching of the existing levee to connect the excavated habitat site with the Puyallup River in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and the project WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting the monitoring results.

Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (containment by debris and absorbent booms, etc.). In-situ water quality monitoring was performed to measure temperature, turbidity, and DO during outfall discharge and breaching of the existing levee. Samples were also collected for DO and TSS analyses in accordance with the project plans and WQC.

The results of in-situ monitoring for temperature, DO and turbidity consistently met water quality standards specified in the project WQC.

3.2.5 HYLEBOS CREEK MITIGATION SITE (BUNKER PROPERTY)

At the time of final design approval by EPA on November 10, 2003, the City remained approximately 0.58 acres short of meeting the habitat mitigation requirements for the project. The City found an opportunity to purchase property that would aid in meeting our mitigation obligations. Additionally, the City has area wide initiatives relating to environmental protection such as preserving open spaces. The seller required that all the property he owned in that area be sold in one deal. The seller's requirements and the City's objectives were aligned, so a real estate transaction was consummated. Therefore, the additional mitigation site, the Hylebos Creek Mitigation Site (Bunker Property), was selected. The 11-acre parcel purchased by the City is located on and near Hylebos Creek, and is situated about 2/3-mile upstream from the head of the Hylebos Waterway (Figure 1). The southern limit of the site is on the east side of Hylebos Creek at the end of 4th St. East, just outside of the Fife city limits in unincorporated Pierce County. Conservation easements from the property owners were acquired by the City and plans for the site developed. Final EPA approval of the plans and specifications for development of this area was received on June 30, 2005. Approximately 0.6 acres of aquatic habitat were created in this area (Figure 15).

3.2.5.1 SUMMARY OF CONSTRUCTION

Construction performed at the Hylebos Creek Mitigation Site includes:

- Clearing and grubbing within the limits of the mitigation site:
- Demolition and disposal of an existing pile supported, one lane bridge;
- Excavation;
- Erosion protection;
- Construction of a timber pedestrian bridge;
- Placement of LWD; and
- Habitat area emergent and riparian planting.

3.2.5.2 DESIGN MODIFICATIONS

Minor modifications to the design were made to fit the site conditions and included:

- High slopes along the northern and eastern sections of the site were steepened from an approximate 2H:1V to an approximate 1.5H:1V to maintain the same area of habitat at finished elevation after surveys determined that the existing ground elevation was higher than depicted on the plans which were developed from a previous aerial survey;
- Some large natural boulders excavated on site were added along the creek edges below the new bridge abutments to prevent scour at the bridge;
- Additional boulders were added to the bank at the entry into the southerly of the two new channels to prevent erosion at the base of large existing trees to prevent scour and undermining of the root systems;
- The design indicated planting of new emergent plants on the east bank, north of the bridge and south of the newly constructed southern side channel. Native plants remained there undisturbed, and were well-established, so they were not removed. The area of new emergent plantings

in the contract was unchanged because the five to six-foot band for emergents was slightly broadened in the new southern channel; and
- Additional LWD was added to the site as a result of comments received from EPA following Pre-Final Inspection.

3.2.5.3 PREPARATION FOR CONSTRUCTION

A pre-construction meeting was held on August 3, 2005. Topics of discussion included:

- Site access, traffic control and safety around vehicles and equipment;
- Scope of work including surveying, protection of vegetation to remain, clearing and grubbing, excavation, bridge construction, and plantings;
- Environmental concerns including equipment fluid leaks and prevention of sediments from entering the creek;
- Equipment to be used; and
- Construction schedule

3.2.5.4 DEMOLITION AND DISPOSAL

On August 25, 2005, demolition of the pre-existing single lane bridge began by first removing the concrete deck and beams. Plastic sheets were placed under the bridge to catch concrete chips and dust from the demolition and to prevent the material from entering the creek. A vacuum truck was then used to collect the debris from the plastic.

The existing bridge was supported on creosote treated pile bents on both sides of the stream within the limits of the channel. The piling could not be extracted and, therefore, were broken off several feet below the stream bed using an excavator. The piling were combined with other piling removed as part of the Thea Foss and Wheeler-Osgood Waterways Remediation Project. The Ecology blocks were salvaged and reused.

Upon completion of the demolition, the constricted channel at the bridge site was widened to match the up and down stream channel widths and the slope was protected with some large natural boulders that were collected during the excavation of the mitigation site.

3.2.5.5 HABITAT AREA CONSTRUCTION

Clearing and grubbing of the hillside site began on August 3, 2005. A silt fence was installed along the east bank of Hylebos Creek from the southern to northern limits of the work. Trees and other vegetation identified to remain undisturbed were delineated with high visibility plastic fencing. The larger trees that were removed were stockpiled on the site for future use as large woody debris and habitat logs. All other vegetation was removed from the site and disposed of.

Excavation began on August 8, 2005, at the upper north end of the site and proceeded down and to the south. Excavators loaded off-road dump trucks and the material was

transported to a temporary stockpile area on the adjacent Jordon property immediately south of the site.

The excavation continued, except for the period between August 15-21, 2005, when Scarsella's crew and some of the equipment returned to the Peninsula Habitat Area to take advantage of low tides. As final grades were achieved in the backwater channels, the large woody debris and habitat logs were placed.

On September 9, 2005, Scarsella began moving the temporary stockpile on the Jordon property to the St. Paul/Middle Waterway Peninsula for stockpile and future use as habitat fill and CDF cap material. The temporary haul road was established through the Jordon property to 8th St. East.

All excavation was completed on September 19, 2005. In all, approximately 25,043 CY of material was removed to create the mitigation site. Removal of this same quantity of material to the St. Paul Peninsula was completed on this date.

3.2.5.6 EROSION CONTROL

As the excavation continued, straw filled "wattles" were installed perpendicular to the slope in three parallel rows in approximate 10 foot elevation increments. Following the installation of the wattles, biodegradable jute mat was placed over the entire slope and anchored in place with pins. Mulch was then sprayed on the slope to provide a growth medium for the hydroseeding that followed. The various elements of erosion control proceeded along with the excavation.

3.2.5.7 LARGE WOODY DEBRIS

Seven pieces of LWD and 11 habitat logs were placed in general accordance with the plans. As mentioned above, these were installed from the north to the south as final grade was achieved in the excavation as the creation of the backwater channels prevented reentry into the area with equipment required for the placement. All were anchored in place with duckbill anchors and cables. In addition, some pieces of LWD were buried in the ground and weighted down with boulders recovered during the excavation. On July 26, 2006, three additional LWD were placed in response to EPA comments following the Pre-Final Inspection. As part of the Final Inspection process, the City agreed to place additional LWD at specific locations during the baseline monitoring year.

3.2.5.8 BRIDGE CONSTRUCTION

A 60-foot long prefabricated wooden pedestrian bridge was installed across Hylebos Creek to provide access to a trail running through the Jordan property. Construction of the concrete abutments at either end of the bridge began on September 10, 2005. The bridge was delivered to the site and set in place by crane on January 5, 2006.

3.2.5.9 RESPONSE TO POSSIBLE RELEASE NOTIFICATION

On February 22, 2006, the City was notified by EPA of a possible release identified as a sheen on Hylebos Creek with the potential to affect the Hylebos Creek Mitigation Site. City Construction Management and EPA personnel were dispatched to the site.

Sheen was not observed within the City mitigation site. However, irregular shaped sheen spots with fractured edges that were generally one-inch or less in diameter and that shattered when disturbed were observed to be flowing down stream in Hylebos Creek. The sheen that was observed was characteristic of biological sheen (i.e., non-petroleum) or film that is associated with iron bacteria growth. Upon further inspection, iron bacteria growth was observed (i.e., red-orange fibrous mats) at multiple locations upstream of the Hylebos Creek Mitigation Site at the base of the existing hillsides and recently excavated surfaces of the Jordan habitat site where groundwater seeps were present. The iron bacteria growth and associated biological film observed within and adjacent to Hylebos Creek is a common, naturally occurring phenomenon. Therefore, no additional response action was warranted.

3.3 PUYALLUP RIVER DELTA / BORROW AREA

The original source of channel sand cap material for the Thea Foss Waterway was a 300-foot wide by 1,400-foot long area centered at the mouth of the Thea Foss Waterway. This area was provided by the Washington State Department of Natural Resources in lieu of a monetary contribution as the agency's portion of the overall remediation cost for the waterway.

The borrow source site identified in the plans and specifications was determined to be unfavorable by EPA after the contract was awarded. This decision was made following EPA consultation with other resource agencies who felt that the existing and viable surface and epibenthic habitat in the borrow area would be destroyed and not recover for years. Additionally, the agencies felt that in the long-term, the nature of the area would change due to the increased water depth. It was then agreed that the material dredged to deepen the St. Paul Waterway could be used to augment the emerging Puyallup River Delta, and that up to 2/3 of the volume of this material could later be recovered for beneficial reuse as cap and/or habitat fill material.

Alternative location for placement of the material on the Delta included placement into the lower river channel for natural dispersion of the material across the Delta. The Port of Tacoma objected to this, expressing concerns that much of the material could end up being deposited at the mouth of the Sitcum Waterway and impact navigation.

Another alternative was placement of the material on top of the leading edge of the Delta where it could easily be recovered for reuse. This alternative was rejected when geotechnical analysis showed that placing a surcharge on the top of the Delta could result in a high potential for slope failure and slides.

A third alternative was to place the material along the western to northwestern face of the emerging delta between elevations -50 feet MLLW and -20 feet MLLW. This alternative was determined to have the least potential impacts and was selected.

Initially it was anticipated that the area for recovery and beneficial reuse of the material would be the face of the Delta, however, historical information showed that the outer areas of the Delta had previously been the site for disposal of potentially contaminated material from dredging in Port areas many years ago and there was a risk of recovered material not meeting the SQO requirements for channel capping. Ultimately, an area approximately 400 feet wide by 1,200 feet long previously used by Simpson at the mouth of the Puyallup River was identified as the borrow area.

3.3.1 SUMMARY OF CONSTRUCTION

Construction planned at the Puyallup River Delta and Borrow Area included dredging to deepen the CDF with placement of the dredged material along the west and northwest face of the emerging delta; sampling and characterization of the borrow area; and the recovery and beneficial reuse of material for channel sand capping in the Thea Foss, habitat fill for the Peninsula and St. Paul Beach Habitat areas, and possibly for CDF capping.

Between October 17, 2003 and December 16, 2003, approximately 246,315 CY of material was dredged from the CDF and placed on the northwest quadrant of the Puyallup River Delta between elevations -50 feet MLLW and -20 feet MLLW. Additional information about dredging to deepen the CDF and placement of the material on the Puyallup River Delta are discussed in Section 3.1.19.6.

3.3.2 BORROW AREA CHARACTERIZATION

A plan for sampling the 1,200-foot long by 400-foot wide Puyallup River Borrow Area to characterize the material for reuse was developed by Hart Crowser and approved by EPA on June 24, 2004. In accordance with the approved plan, five sediment cores were collected from this proposed borrow area at the mouth of the Puyallup River. Sediment cores were collected on August 11-12, 2004.

Based upon the sampling results, a plan for recovery of the materials at the Puyallup River Borrow Area and possible uses of the material was developed by Manson and approved by the City and EPA on May 2, 2005. However, there were several constraints noted in Manson's report that ultimately led to a decision not to excavate borrow material from the Puyallup River Borrow Area. The most significant reasons were:

- Elevation of the river bottom would limit equipment working only to extreme high tides.
- A significant amount of extra dredge pipe and floating pontoons would need to be mobilized to the site.
- There would need to be multiple mobilizations to the borrow site to accommodate construction sequencing.
- The borrow material that was desired was below the fine silty sand, which created a need to dispose of additional material prior to reaching acceptable borrow material.

3.4 DOCK STREET MARINA

A new marina in RAs 19A and 19B was constructed in conjunction with the Foss Waterway Development Authority (FWDA). Dock Street Marina (aka Alber's, City View, and 17th Street Marinas) was used from 2004-2006 to temporarily moor commercial and recreational boats displaced from the four existing marinas on the Thea Foss Waterway while remedial action cleanup work was carried out at those locations. Dock Street Marina is located on the west side of the waterway between approximate Stations 57+50 and 68+50.

The old City View Marina was demolished to make way for the new Dock Street Marina, temporarily referred to during construction as Alber's Wharf and Marina, City View Marina, and the 17th Street Access Pier. After construction these marinas were combined and given the permanent name of Dock Street Marina.

3.4.1 ALBER'S WHARF AND MARINA / CITY VIEW MARINA

3.4.1.1 SUMMARY OF CONSTRUCTION

Construction performed at the Alber's Wharf and Marina / City View Marina includes:

- Construction of a concrete wharf approximately 143 feet long by 60 feet wide which is founded on thirty-six 20-inch octagonal pre-stressed concrete pile;
- Construction of a Marina Support Building;
- Installation of a 120-foot access gangway at the Alber's Wharf and Marina / City View Marina;
- Installation of concrete floats for a total of 39 slips ranging from 40 feet to 60 feet in length; and
- Installation of electrical, telephone, data, cable, potable water, sewer pump out, and fire protection systems internal to the float systems.

3.4.1.2 PREPARATION FOR CONSTRUCTION

Preparation for marina construction commenced with two pre-construction meetings held on August 6, 2003 and August 20, 2003. Attendees included representatives from the City, KPFF, Floyd|Snider, Manson, Dalton Electric, Bering Mechanical, Shoreside Construction, and Reid Middleton and Associates.

Topics discussed included:

- Health and Safety requirements;
- Environmental concerns;
- Surveying and settlement monitoring requirements;
- Site preparation and staging;
- Concrete pouring; and
- Subcontractor scopes of work.

3.4.1.3 ALBER'S WHARF AND MARINA / CITY VIEW MARINA CONSTRUCTION

Pile driving commenced on October 21, 2003, with the Norseman using an ICE I-62 diesel hammer. The initial driving was slow as the landside two rows of piling necessitated waiting for highest tides to be able to get the Norseman close enough to the beach to reach the pile locations. Additionally, unanticipated driving conditions necessitated dynamic pile analysis to appropriately adjust the hammer energy to prevent damage to the piling. One pile was broken and a replacement was driven adjacent to it.

Pile caps were formed and poured on February 6, 2004 and February 12, 2004. Precast deck panels were delivered to the site and set in place on March 2, 2004. During the welding of the rebar between deck panels, it was discovered that the supplier had placed the wrong grade of rebar in the panels and had not provided A706 weldable bar. The designer provided a modification to the welding process and the work progressed.

Visual water quality monitoring was required for driving of new piles for the Alber's Wharf. In accordance with EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and the project WQC, daily and monthly water quality monitoring reports were submitted to EPA documenting monitoring results.

Visual indications of water quality impacts were not observed during visual monitoring of pile driving activities. Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., containment by debris and absorbent booms, no evidence of distress to fish, etc.).

Work continued on Alber's Wharf and Marina / City View Marina through the summer and into the 2004-2005 construction season. Floats for the marina were delivered via truck transport to the staging area south of the 509 Bridge from June 1-29, 2004. The floats were offloaded with the Manitowoc and stacked on dunnage. Each float was inspected as they were offloaded. A small number of floats were noted to have minor cracking and or spalling of the concrete. Manson and their subcontractor, Shoreside, were notified of these observations. Shoreside sent a float repair crew out to patch and seal the defects that were to be below the waterline prior to placing any floats in the water. Repairs were confirmed by onsite inspectors.

Manson began driving guide piles for floats in the marina, including placement of the gangways, from August 15, 2004 to September 7, 2004, with the exception of two floats at the gangway landing. Discrepancies in the shop drawings resulted in problems that occurred while attempting to set the gangway at Alber's Wharf and Marina, which resulted in the need for two new floats to be fabricated to land the gangway properly. The new floats were delivered and installed on October 8, 2004, in time to make utility connections from the pier to the floats.

The structural concrete work was completed with topping slab placement on Alber's Wharf in two separate pours placed in alternating sections between construction joints spanning in the east-west direction on August 9, 2004 and August 13, 2004, respectively.

Work on the support facility commenced on July 30, 2004, by Mayer Construction, Manson's subcontractor. Curbs were placed with minor grade changes to account for the sloped marina deck. Concrete Masonry Unit (CMU) walls were installed after the curbs. Along with the CMU placement, Mayer began framing the walls and roof structure for the support facility on September 7, 2004. Work also continued on the metal fabrications (i.e., handrails and security gate structure), float hardware (i.e., dock boxes, life rings, cleats, rub strips, etc.) as well as installation of marina utilities including sewer, water, electrical, communications, and fire protection in anticipation of relocating vessels from the north side of Johnny's Dock Marina, which occurred on December 9, 2004, a day after receiving temporary occupancy on the marina from the City.

A number of items remained incomplete after receiving temporary occupancy including the security gate and gatehouse, the support facility, telephone and fire alarm systems, and sewer pumpout system. These items were individually completed, tested and commissioned as work allowed. A punch list walk with the designers, FWDA and the City was formally conducted on January 26, 2005, upon primary completion of both marinas. Manson and its subcontractors worked on completing punch list activities for both marinas after completing in-water work for the 2004-2005 construction season. All punch list items were completed in May 2005.

3.4.2 17TH STREET MARINA

3.4.2.1 SUMMARY OF CONSTRUCTION

Construction performed at the 17th Street Marina includes:

- Construction of a concrete access pier with parallel walkways and open interior founded on 14 pre-stressed 20-inch octagonal concrete pile;
- Installation of a 90-foot gangway to the marina floats;
- Installation of concrete floats for a total of 33 slips ranging from 36 feet to 45 feet in length; and
- Installation of electrical, telephone, cable, potable water, sewer, and fire protection systems internal to the float systems.

3.4.2.2 PREPARATION FOR CONSTRUCTION

Preparation for marina construction commenced with two pre-construction meetings held on August 6, 2003 and August 20, 2003. Attendees included representatives from the City, KPFF, Floyd|Snider, Manson, Dalton Electric, Bering Mechanical, Shoreside Construction, and Reid Middleton and Associates.

Topics discussed included:

- Health and Safety requirements;
- Environmental concerns;
- Surveying and settlement monitoring requirements;
- Site preparation and staging;
- Concrete pour; and
- Subcontractor scopes of work.

3.4.2.3 17TH STREET MARINA CONSTRUCTION

Pile driving commenced on November 3, 2003, with the Norseman and the I-62 hammer. The 14 piles were driven in two days. At bent C6, the pile apparently hit a subsurface obstruction and deflected so badly the pile was broken. The broken pile could not be removed and two new piles, one on either side, had to be driven. The cap at this location was modified to capture the two piles.

Pile caps were formed and poured on May 6, 2004. Precast double tee concrete deck panels were set on May 17, 2004, and second stage closure pours were made.

Visual water quality monitoring was required for driving of new piles for the 17th Street Access Pier in accordance with the EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and the project WQC. Daily and monthly water quality monitoring reports were submitted to EPA documenting monitoring results. Visual indications of water quality impacts were not observed during visual monitoring of pile driving activities.

Work continued on the 17th Street Marina through the summer and into the 2004-2005 construction season. Floats for 17th Street Marina were delivered via truck transport to the staging area south of the 509 Bridge between June 1, 2004 and July 27, 2004. The floats were offloaded with a crawler crane and stacked on dunnage. The floats were inspected as they were delivered noting any corrective action required, if any, to the contractor.

Guide pile and floats for the 17th Street Marina were installed in conjunction with Alber's and City View during the period from August 15, 2004 to September 7, 2004.

Structural concrete work for the 17th Street Marina was completed with the topping slab placed on June 18, 2004. Manson's subcontractor, General Mechanical, had difficulty finishing the slab and tooling the construction joints on the south leg of the pier due to the concrete setting up early. General Mechanical elected to green-cut the slab. Green cutting caused problems that resulted in an unacceptable number of spalls and a crooked joint running the length of the pier. The CM Team noted the deficiencies and requested a corrective procedure for repair of the topping slab. General Mechanical proposed patching the joint then dry cutting it with a beveled diamond saw and also repairing the spalls and sealing the deck with a pigmented sealer after the repairs cured out. This condition was reviewed with FWDA representative, Bill Iyall, and was deemed acceptable. Several test samples of the sealer were proposed to the CM Team with one being selected. General Mechanical completed repairs to the topping slab from July 12-23, 2004, at which time General Mechanical and Manson performed a freeze-thaw test on the patches with dry ice to demonstrate adhesion and durability of the repairs. A pigmented sealer was placed on the topping slab after the testing was performed to seal the patches from water infiltration.

Metal fabrications for the security gate and handrails were installed on the pier starting August 12, 2004. Along with upland pier work, Manson began driving guide pile for floats in the marina, including placement of the gangway, from August 19, 2004 to September 7, 2004. Work also continued on the float hardware (i.e., dock boxes, life

rings, cleats, rub strips, etc.) as well as installation of marina utilities including sewer, water, electrical, communications, and fire protection in anticipation of relocating vessels from Johnny's Dock south, which occurred on October 9-10, 2004, after receiving temporary occupancy from the City on October 7, 2004.

A number of items remained incomplete after receiving temporary occupancy including the security gate and gatehouse, marina pier lighting, telephone, cable and fire alarm systems, and sewer pumpout system. These items were individually completed, tested and commissioned as work allowed. A punch list walk with the designers, FWDA and the City was formally conducted on January 26, 2005, upon primary completion of both marinas (Alber's / City View and 17th Street). Manson and its subcontractors worked on completing punch list activities for the marinas after completing in-water work for the 2004-2005 construction season. All punch list items were corrected by May 2005. Submittal of the final as-built drawings and operation and maintenance manuals occurred in February 2006.

3.4.3 TEMPORARY MARINA PARKING LOT

It was necessary to provide parking for the temporary tenants of the new Dock Street Marina who boats were to be temporarily moored at Dock Street Marina from other marinas within the Thea Foss Waterway while remediation was performed at those marinas. Temporary parking was not addressed nor provided for in the original construction contract. Therefore, a temporary marina parking lot, on Development Site 1 south of Alber's Mill, was constructed for the marina users.

3.4.3.1 SUMMARY OF CONSTRUCTION

Construction performed at the Temporary Marina Parking Lot includes:

- Debris removal and disposal;
- Excavated soil characterization, removal and disposal;
- Excavation;
- Storm drainage swale construction and discharge; and
- Parking lot development.

3.4.3.2 DEBRIS REMOVAL AND DISPOSAL

Various debris including wood and trash were present at the location of the Temporary Marina Parking Lot at initiation of construction. The debris was the result of materials left by previous construction activities at the Alber's Mill site. The debris was placed in a solid waste container and transported by LeMay Trucking to LRI for disposal on June 15, 2004. Approximately 8.5 tons of debris was disposed of from the site (Table C-24).

3.4.3.3 EXCAVATED SOIL CHARACTERIZATION, REMOVAL, AND DISPOSAL

Sampling was conducted on May 27, 2004, at the Temporary Marina Parking Lot to characterize soil to be excavated as part of parking lot construction. The soil characterization was performed to evaluate whether the soil to be excavated could be

reused onsite or would be sent offsite for disposal in accordance with the site-specific cleanup action plan.

Samples were collected in accordance with the Stockpile Sampling QAPP as amended by the Addendum to the Stockpile QAPP – Revised Soil Sampling and Analysis at Marina Parking Lot. The following areas were sampled:

- 80-foot long utility trench to be excavated for an electrical conduit;
- 60-foot long utility trench to be excavated for a stormwater line;
- 3,500 SF bioswale to be excavated for stormwater management; and
- 4,500 SF area requiring grading.

Samples were also collected from the final surface of the bioswale and grading footprint to characterize soil that would remain in-place in these areas.

Several PAHs were detected at concentrations that exceeded the site specific cleanup criteria in the electrical and stormwater utility trench locations. Soils sampled in the bioswale and grading area did not exceed cleanup criteria. The results were transmitted to EPA, Ecology, and the Corps on June 24, 2004. Approval for disposal of soil excavated from the electrical and stormwater utility trenches and reuse of soil excavated from the bioswale and grading areas was received from Ecology on July 1, 2004. Approval for disposal of soil excavated from the electrical and stormwater utility trenches as solid waste at LRI was granted by the TPCHD on July 12, 2004.

3.4.3.4 EXCAVATION

On August 24, 2004, the soil contaminated with PAHs was excavated from the two utility trenches at the Temporary Marina Parking Lot. The soil was loaded directly into trucks by the excavator. Three loads of soil were transported from the parking lot by Reed Hauling and Scarsella to LRI. Approximately 84 tons of soil was disposed of at the landfill (Table C-24).

3.4.3.5 TEMPORARY MARINA PARKING LOT DEVELOPMENT

The Temporary Marina Parking Lot is a rectangular area of approximately 1.33 acres. The design provided standard parking spaces for 50 cars on a gravel surface with concrete wheel stops. Site drainage is collected in an on-site drainage swale that outlets into the City storm system. The gravel surface is four inches of crushed surface top course per WSDOT Standard Specification Section 9-03.9(3). Approximately 346 CY of gravel surfacing was placed on-site. A single central light pole and 500 LF of security fencing were also included.

3.4.3.6 TEMPORARY MARINA PARKING LOT PETROLEUM SPILL

On January 25, 2005, a petroleum release occurred at the Temporary Marina Parking Lot when equipment was stolen from a trailer attached to a stolen vehicle parked on the northeast corner of the site. The trailer contained equipment for applying spray-on texturing that included a hydraulic pump and small gasoline engine. The hydraulic pump was hastily removed when it was stolen from the trailer. A fuel line and the hydraulic lines attached to the pump were left to drain on the ground. It was

estimated that up to 10 gallons of hydraulic oil and two gallons of gasoline were released. The release impacted the surface of the recently completed gravel parking lot in an area approximately 15 feet wide by 20 feet long. A Manson employee observed oil and gasoline discharging from the trailer and immediately took steps to control the release.

The initial response included stopping the flow of oil and gas from the disconnected lines. Additionally, oil absorbent pads and booms were immediately placed on and around the spill area. Saturated oil absorbents were collected and bagged for disposal. The spill area was covered with a tarp and cordoned off and Certified Cleaning Services, a spill response contractor under contract to the City, was called to the site.

The following morning, on January 26, 2005, Certified Cleaning Services excavated and stockpiled the impacted gravel and soil on visqueen adjacent to the spill area. Approximately three CY of gravel and soil were impacted by the spill (7.74 tons). Upon completion of the excavation, both the excavation and the stockpile were covered with visqueen. The stockpiled material was transferred to a roll-off box on January 27, 2005.

Samples were collected from the post-excavation surface and the stockpile and submitted for analysis on January 26, 2005. Confirmation samples were collected from the post-excavation surface to evaluate compliance with cleanup standards. An Encore sampler was used to collect a sample from the excavation surface for gasoline-range petroleum hydrocarbons (NWTPH-G) and benzene, toluene, ethylbenzene, and xylene (BTEX) analyses. A sample was also collected from the excavation surface and analyzed for diesel and oil-range petroleum hydrocarbons (NWTPH-Dx).

Gasoline was the only compound detected in the confirmation samples. The detected gasoline concentration was well below the MTCA Method A cleanup level. Additionally, the analytical detection limits for all compounds were well below the site-specific cleanup standards specified in the Final Parcel 10 (Harmon) and 21st Street Right of Way (ROW) Site Specific Action Plan and Method A Cleanup Levels for unrestricted site use. The results of confirmation sampling and analysis were submitted to the Washington State Department of Ecology (Ecology) Site Manager for review. The excavated area was backfilled and returned to use upon approval from Ecology.

A sample was collected from the stockpile of excavated material and analyzed for diesel, oil, and gasoline-range petroleum hydrocarbons (NWTPH-Dx and NWTPH-G) and BTEX to evaluate the appropriate method of disposal. Oil, gasoline, and BTEX compounds were detected in the sample. The sample results were submitted to TPCHD and TPS Technologies Inc. for review. The detected concentrations of all compounds were considered acceptable by TPCHD and TPS Technologies, Inc. for disposal of the excavated material at TPS Technologies, Inc. The roll-off box of excavated material was transported to TPS Technologies, Inc. by Phillips Services Corp.

3.4.4 16TH STREET RIGHT OF WAY – EXCAVATED SOIL CHARACTERIZATION, REMOVAL, AND DISPOSAL

A sanitary sewer line was installed in the 16th Street ROW between Dock Street and the waterway to service the 17th Street Marina. Sampling was conducted on May 27, 2004, at the 16th Street ROW to characterize soil to be excavated to install this sanitary sewer line. The soil characterization was performed to evaluate whether the soil to be excavated could be reused onsite or would be sent offsite for disposal in accordance with the site-specific cleanup action plan.

Samples were collected in accordance with the Stockpile Sampling QAPP, as amended by the Addendum to the Stockpile QAPP – Revised Soil Sampling and Analysis at 16th Street Waterline Excavation.

Several PAHs were detected at concentrations that exceeded the site-specific cleanup criteria in the soil to be excavated to install the sanitary sewer line. Therefore, soil excavated from the sanitary sewer line required offsite disposal. Results were transmitted to EPA, Ecology, and the Corps on June 24, 2004. Approval for offsite disposal of soil excavated from the sewer line was received from Ecology on July 1, 2004. Approval for disposal of the soil as solid waste at LRI was granted by TPCHD on July 12, 2004.

On September 30, 2004 and October 1, 2004, the soil contaminated with PAHs was excavated from the utility trench in the 16th Street ROW to install a sanitary sewer line. The soil was loaded directly into trucks by the excavator. Five loads of soil were transported by Maplewood Trucking to LRI. Approximately 225 tons of soil was disposed of at the landfill (Table C-25).

3.5 SIMPSON ACTIVITIES

3.5.1 SIMPSON LOG HAUL ROAD

The Simpson log haul road was constructed to provide a route between the relocated Log Haul Out Facility (LHOF) on the St. Paul Peninsula and the Simpson Lumber Mill log storage area (Figure 8). The road is approximately 900 feet long and 50 feet wide and includes a storm drainage system.

3.5.1.1 SUMMARY OF CONSTRUCTION

Construction performed on the log haul road includes:

- Waste pre-characterization of an approximate 30,000 CY stockpile of material located in the roadway alignment that had been previously excavated in conjunction with the construction of the Simpson Lumber Mill;
- Removal and disposal of the stockpile;
- Excavation to subgrade;
- Road construction including crushed base, asphalt treated base, asphalt concrete pavement, and concrete pavement;
- Storm drainage system;
- Curbing; and
- Surveying.

3.5.1.2 PREPARATION FOR CONSTRUCTION

A pre-construction meeting was held with representatives of the City, KPFF, Floyd|Snider, Manson and Simpson Tacoma Kraft on October 10, 2003. Topics of discussion included:

- Stockpile removal and survey;
- Road survey and storm drain alignment;
- Estimated excavation quantities;
- Erosion control;
- Electrical power line location;
- Submittals; and
- Project coordination.

3.5.1.3 PENINSULA STOCKPILE REMOVAL

Removal of the Peninsula stockpile was required to construct the log haul road and storm drainage systems. To determine the chemical nature of the material in the stockpile, Parametrix performed a pre-construction characterization sampling and analysis investigation for Manson. Composite samples were collected from 20 grid blocks (PS-001 through PS-020) established on the stockpile. The composite samples were sent to Severn Trent Laboratories (STL) for analysis. Results of the analysis indicated that the material was not suitable for unrestricted offsite reuse. Based on the sample results the material was characterized as Subtitle D waste and was disposed of at LRI.

Approximately 28,500 CY of stockpile material was loaded and transported to LRI by Scarsella between September 22, 2003 and October 14, 2003 (Table C-26).

3.5.1.4 ACCESS ROAD

Prior to building the access road and its drainage system, a 36-inch stormwater main was constructed to replace Simpson's existing stormwater discharge to the St. Paul Waterway. Manson's subcontractor, Scarsella, started installing the 36-inch stormwater line during negative tides the night of October 26, 2003. This included the installation of the outfall and the first two sections of pipe. Work proceeded east then south installing in sequence from manhole to manhole. As the work progressed south, timber debris was encountered during trench excavation. The system was installed to the last manhole short of the inlet behind the planned offset berm during the 2003-2004 construction season.

Work to complete the last section of stormwater main started on January 25, 2005, working from manhole #6 to the inlet behind the offset berm. Manhole risers and frames and grates were set at manholes in completed areas of the drainage swale. A square grate, in lieu of angled, was placed at the inlet. Work was completed February 13, 2005.

Construction of the access road began on December 1, 2003, with subgrade preparation and installation of imported subgrade material. Work began as the weather turned to rain making the existing soil conditions unsuitable to meet compaction requirements. As a result, a change order was issued to import subgrade conditioning material to enable the contractor to meet compaction requirements during inclement weather. The subgrade and base were completed and the initial lift of asphalt treated base was placed on December 12, 2003. Installation of the 18-inch storm drain system for the access road took place concurrently with the road construction. Minor revisions in grade were made to better meet existing conditions.

Concurrent with subgrade construction for the asphalt road section, Scarsella prepared the subgrade for the log haul turnaround area (hammerhead) on December 9, 2003. The hammerhead was placed in two separate pours on December 18-19, 2003. Sawcutting of the control joints followed each night after concrete placement. Joint sealant was placed January 22, 2004.

Upon completing the concrete hammerhead, the access road was paved on January 18-19, 2004. Road construction was substantially complete with the installation of extruded curbing on March 4, 2004.

3.5.1.4.1 Design Revisions

As the peninsula stockpile was removed, the material near the bottom was better than anticipated, which reduced the amount of stockpile material requiring disposal by raising the final road elevations under the stockpile.

During excavation for the stormwater mains, buried wood waste was discovered. Revisions were made in the vertical alignment of the storm drain systems that allowed

them to be raised. In addition, the following revisions were made to the 36-inch stormwater main:

- The connection to Simpson's site drainage system was revised to connect at the outfall of the existing system in the area behind the offset berm; and
- A concrete collar was added to the outfall pipe section to counteract the buoyancy forces during high tide.

3.5.2 SIMPSON FUEL DOCK

The Simpson Fuel Dock is located near the mouth of the St. Paul Waterway on the east bank adjacent to the Simpson Paper Mill (Figure 8). The construction of the St. Paul North Beach Habitat Area north of the CDF containment berm required reconfiguration of the existing fuel pier moving the barge berth to the northwest.

3.5.2.1 SUMMARY OF CONSTRUCTION

Construction performed on the Fuel Dock includes:

- Demolition of a portion of the existing timber dock and catwalk moorage system;
- Driving of 24-inch octagonal pre-cast concrete piling for the pier extension, access bridge and three breasting dolphins;
- Setting pre-cast concrete deck panels;
- Cast in place concrete placement;
- Extension of the fuel and steam lines;
- Erection of a small pre-engineered steel shed;
- Lighting installation;
- Miscellaneous steel work;
- Driving of steel piling and construction of a fender system; and
- Surveying.

3.5.2.2 DESIGN MODIFICATIONS

Minor problems with alignment were encountered upon verifying each pile's as-driven location requiring a slight adjustment in the berthing line. This adjustment was made with minor modifications to the dolphin pile caps to accommodate this alignment.

3.5.2.3 PREPARATION FOR CONSTRUCTION

Representatives of the City, KPFF, Floyd|Snider and Manson attended a pre-construction meeting on July 25, 2003. Topics of discussion included:

- Pile driving and equipment;
- Pier construction;
- Materials;
- Quality control;
- Health and safety;
- Environmental protection;
- Schedule and coordination with Simpson;

- Surveying; and
- Water quality monitoring.

3.5.2.4 DEMOLITION

Manson began partial demolition of the existing fuel pier at Simpson in preparation for driving pile for the extension of the pier. Demolition included removal of the existing timber planked pier, substructure and supporting timber pile, extraction of existing timber-pile dolphins, steel-frame concrete dolphins, curbs and handrails, security fencing, and containment enclosure for the existing fuel valve assembly. Demolition also included relocation of the existing fuel valve connection assembly to the new pier extension.

Piling and wood debris resulting from demolition was transported by Rhine to the Rabanco Landfill for disposal (Table C-27). The steel-frame concrete dolphin piling were transported by Rhine to Wm. Dickson for recycling.

Demolition of the fuel dock began July 29, 2003, and was completed August 11, 2003. Transport and disposal of the timber piling and wood debris occurred on August 13, 2003 and August 15, 2003. Recycling of the steel wrapped piling occurred on August 28, 2003.

3.5.2.5 CONSTRUCTION

Fuel pier extension construction commenced with new dolphin and pier extension pre-stressed concrete pile driving on July 30, 2003. This work was completed on August 3, 2003.

Pier extension and dolphin pile caps were completed in the middle of September 2003, allowing for pre-stressed panel and subsequent topping slab placement. Fuel pier concrete work was substantially completed on October 13, 2003. The fueling system, pipe valves, containment shed, and operator's shed were relocated starting October 15, 2003, and completed on December, 15, 2003, with the testing of the steam trap assembly. Other activities included installation of handrails and reinstallation of timber decking on the old pier. Telephone communication and security systems were installed and tested over the next couple weeks culminating in the delivery and offloading of the first fuel barge on December 30, 2003.

3.5.2.6 WATER QUALITY MONITORING

Visual water quality monitoring was required for demolition of existing piling and driving of new piles during Simpson fuel dock construction in accordance with EPA approved Final Design CQAP, Water Quality FSP, project plans and specifications, and the project WQC. Daily water quality monitoring reports were submitted to EPA documenting monitoring results.

Visual indications of water quality impacts were not observed during visual monitoring of the demolition (i.e., piling removal) and pile driving activities. Visual water quality monitoring was performed to monitor compliance with construction and environmental BMPs (i.e., containment of debris).

3.5.3 SIMPSON LOG HAUL OUT FACILITY

Construction of a new Log Haul Out Facility (LHOF) on the St. Paul/Middle Waterway Peninsula was necessary to replace the existing facility at the head of the St. Paul Waterway operated by Simpson Timber Company (Figure 8). The existing facility was demolished to allow completion of the CDF for disposal of contaminated dredge material from the Thea Foss and Wheeler-Osgood Waterways.

3.5.3.1 SUMMARY OF CONSTRUCTION

Construction performed on the Log Haul Out Facility includes:

- Excavation and backfill;
- Dredging and holding cell construction;
- Driving of 24-inch octagonal pre-cast concrete foundation piling;
- Driving of 24-inch diameter steel pipe piling;
- Construction of a sloping 100-foot long pre-fabricated steel bridge to support the rails for the log haul out carriage;
- Construction of an upper concrete abutment with steel debris baskets;
- Installation of a prefabricated steel log bundle carriage;
- Construction of a pre-engineered metal building;
- Installation of electric motors, hydraulic pumps and hydraulic winch;
- Construction of a remote operator's station;
- Extension of the electrical service along Middle Waterway Street and the new log haul road;
- Construction of an access ramp, gangway and steel support and guide piling, and installation of 300 LF of pre-cast concrete walkway floats for log boom access;
- Driving of steel piling for securing log booms;
- Site lighting;
- Surveying;
- Water quality monitoring;
- Testing and training; and
- Relocation of the existing operator's breakroom trailer.

3.5.3.2 DESIGN MODIFICATIONS

As designed, the LHOF placed the bark debris collection trap below Mean Higher High Water (MHHW) creating a situation in which the collected bark would have drifted out with tides above +12 feet MLLW. The designers were asked to make modifications in the design to correct this situation. Revised plans were prepared and upland LHOF abutment pile driving began on July 28, 2003. The abutment was completed on September 5, 2003.

As submittals began to arrive, it was determined that the 12-foot by 12-veet pre-engineered mechanical building was not large enough to house the winch, electrical panels, motors, hydraulic reservoirs and pumps while still providing electrical code clearance requirements and maintenance access to the equipment. The building size was increased to 20-feet by 20-feet.

During the testing of the LHOF in May 2004, it was determined that the specified winch was not large enough to raise the larger log bundles regularly received by Simpson. The winch requirements were modified to account for the larger loads and a new winch was obtained and installed. The revision increased the cable size from 5/8-inch to one-inch and the guide rollers on the log haul out carriage and abutment were revised to accommodate the increased cable diameter.

3.5.3.3 PREPARATION FOR CONSTRUCTION

Representatives of the City, KPFF, Floyd|Snider and Manson attended a pre-construction meeting on July 25, 2003. Topics of discussion included:

- Pile driving;
- Equipment;
- Materials;
- Methods and procedures;
- Quality control;
- Health and safety;
- Environmental concerns; and
- Scheduling and sequencing.

3.5.3.4 DREDGING

As the work on the LHOF was to begin, Manson was also working for others on a separate remediation project on the Middle Waterway. As they were completing the dredging on that project in the vicinity of the haul out ramp, Manson requested approval to dredge the approximate 1,000 CY under the carriage rail bridge at the LHOF that would be required for that installation. The request was submitted to EPA and Interim WQC No. 2 was issued on August 22, 2003, to allow this work.

At that time, the CDF dredging had not begun and there was no place to dispose of dredged material. The City and Manson worked together in developing a proposal for the construction of a temporary, bermed and lined dredge material containment area at the northern tip of the St. Paul/Middle Waterway Peninsula. The proposal was submitted to EPA and approved. The containment area was constructed by pushing up earth berms and lining the interior with an impermeable liner. The capacity of the containment area was approximately 2,200 CY.

The dredging was accomplished by clamshell dredge on September 9, 2003, and the material was re-handled into the cell, to be held until such time that the CDF dredging was completed. Approximately 1,100 CY of dredge material was placed in the containment area.

Sampling and analysis of water contained within the containment area was performed on November 14, 2003, to facilitate discharge of the water prior to disposal of the contained sediment. The contained water was largely comprised of stormwater resulting from fall storm events and a record rainfall that occurred in November 2003. A small component of the contained water consisted of water released from sediment placed in the containment area.

The data was transmitted to EPA with a request to allow discharge of the contained water into the St. Paul Waterway. EPA provided approval to discharge the contained water in a letter dated November 24, 2003.

Manson discharged the water while applying the following BMPs:

- Water was withdrawn from the containment area at a location away from the sediment;
- The intake pump was kept off the bottom of the containment area to minimize entrainment of any particulates that may have settled on the bottom; and
- The discharge point was kept in the surface water so that the water was not allowed to run over soil or the shoreline and then into the surface water.

The contained sediment (approximately 1,100 CY) was transferred into the CDF using the derrick Vulcan on January 24, 2004, after completion of the discharge of water within the containment area.

Decommissioning and removal of the containment area was performed on January 27, 2004.

3.5.3.5 LOG HAUL OUT FACILITY CONSTRUCTION

With the issuance of Interim WQC No. 3 on September 30, 2003, in-water work commenced with the driving of four steel piles for the approach ramp to the floating walkway, 20 steel piles for the walkway, and 24 steel piles for containing and securing log booms at the LHOF. All steel piling were driven with a vibratory hammer.

Additionally, the two large 18-inch diameter steel piles for the lower end support of the carriage bridge were driven with an impact hammer. An air curtain was deployed around each pile as they were driven. The piles were sand filled and cut off at an elevation of -10 feet MLLW.

The steel carriage rail bridge was set in place and the log carriage installed. With the completion of the roadway, the foundation of the mechanical equipment building was constructed. Several revisions were made to the building, equipment and controls to insure the system performance met Simpson's needs, that safety concerns were adequately addressed, and that the completed facility provided redundant environment protection features. None of the revisions involved any remedial actions.

The LHOF includes two 125 HP electric hydraulic pumps, a hydraulic winch and remote operator's station. Dual containment for the approximate 300 gallons of system hydraulic fluid was provided. The facility is capable of raising 45-ton log bundles out of the water at a rate of approximately 2.4 fps.

Additional work to support the LHOF included:

- Lighting, including the extension of the electrical distribution lines to the facility and the installation of nine high mast light clusters;

- An approximate 75-foot square log lay down area was constructed adjacent to the LHOF to temporarily hold logs until they could be moved down the new road to Simpson's mill storage area; and
- A 50-foot long, pile supported aluminum access span and installation of 300 lineal feet of 5-foot wide floating concrete walkway. A 45-foot gangway connected the access span and the floating walkway.

Work on the LHOF continued sporadically through the next few months and was finally completed for testing in late May 2004. Testing over the next week indicated that the winch was undersized and incapable of raising the largest of the log bundles Simpson typically handled. A decision was made to replace the winch and Manson located one and had it delivered and installed on June 21, 2004. On June 28, 2004, the LHOF was turned over to Simpson for a two-week trial period.

The LHOF trial period confirmed that the LHOF met all performance criteria and the facility was turned over to Simpson, which in turn gave its approval for the demolition of the existing haul out facility in the St. Paul Waterway.

The demolition of the existing haul out facility began at the end of July 2004 and was completed within a week.

3.5.3.6 WATER QUALITY MONITORING

Visual and in-situ water quality monitoring was performed during log removal and dredging for the offset berm at the location of the former LHOF, located at the head of the CDF. The water quality monitoring events were performed coincident with dredging of the offset berm and disposal of sediment in the CDF and dredging for the offset berm (Section 3.1.19.15). Results of this sampling are applicable to these project components.

Visual water quality monitoring was performed during float installation, piling removal, and installation for the new LHOF to monitor compliance with construction BMPs (i.e., containment by debris and absorbent booms, etc.).

In-water construction was not conducted at the location of the new LHOF during the 2004-2005 construction season.

Visual water quality monitoring was performed during piling removal, pile driving, and LOHF construction to verify compliance with construction BMPs (i.e., containment by debris and absorbent booms). No visual water quality problems were reported for these construction activities.

3.5.3.7 DEMOLITION AND DISPOSAL

3.5.3.7.1 Removal of Timber Dolphins and Piling Adjacent to New LHOF

Piling and dolphin removal was conducted in the 2004-2005 construction season in preparation for construction of the new LHOF. Old timber mooring dolphins and piling were located in the Middle Waterway adjacent to the location of the new LHOF.

Dolphin and piling removal was initiated on February 5, 2004. Piling removal consisted of placing debris and absorbent booms around the work area to capture debris and any possible petroleum sheen; using a derrick to extract the piling; placing the piling onto plastic lined barges; and transferring the piling (approximately 79 tons) from the barge into containers for transport and disposal at the Rabanco Landfill. Transfer, transport, and disposal of the piling were performed for Manson by Rhine from February 9-16, 2004 (Table C-28).

3.5.3.7.2 Land Clearing at Old LHOF

Scrap wood and logs were removed from the area of the old log haul out structure. The wood debris (approximately 49 tons) was placed in trucks on October 18, 2004, and transported by Rhine to Recovery 1 for recycling (Table C-28).

3.6 MISCELLANEOUS CONSTRUCTION ACTIVITIES

3.6.1 OLYMPIC VIEW RESOURCE AREA DOLPHINS

As part of an enhanced package of mitigation activities, the City proposed the removal of approximately 20 piling in four dolphins from the Olympic View Resource Area (OVRA). The dolphins on this recently restored area had been used by two derelict vessels for moorage. The vessels were removed under the state Derelict Vessel Act and the removal of the dolphins prevented future instances of derelict vessels mooring at the site. Moorage of vessels at the dolphins caused shading of one of the few eelgrass beds in Commencement Bay.

Removal of the timber mooring dolphins was performed at the OVRA site in November 2003. Piling removal consisted of placing debris and absorbent booms around the work area to capture debris and any possible petroleum sheen; using a derrick to extract approximately 20 piling; placing the piling onto plastic lined barges; and transferring the piling (approximately 52 tons) from the barge onto the Middle Waterway Peninsula for temporary storage.

The piling were cut up and loaded into containers by Manson on March 3-10, 2004. The containers were transported by Rhine to the Rabanco Landfill on March 5, 2004 and March 12, 2004 (Table C-29).

4.0 CHRONOLOGY OF EVENTS

The Consent Decree was signed by the City of Tacoma (City) and funding parties on September 30, 2002, and became effective on May 9, 2003. The Consent Decree required that the City begin the process for obtaining a contractor to perform the work within 20 days following the U.S. Environmental Protection Agency's (EPA) conditional approval of the final design. While the final design was not yet approved by EPA, the City advertised the project for bid in February 2003, so as to allow work to begin during the 2003-2004 construction season. Bids were received on April 29, 2003. The bid submitted by Manson Construction Company (Manson) was accepted by the City Council and the contract was executed on May 21, 2003. The contract start date was June 10, 2003.

After contract execution, Manson immediately began preparation and submittal of numerous work plans, schedules and other submittals required by the contract documents. The approved plans were compiled into a comprehensive, three-volume document entitled Remedial Action Documents, dated December 18, 2003.

In the summer of 2003, as the City continued to work toward overall final design approval, it was determined that certain components of the work could begin. As the work continued to finalize the design elements, the City requested authorization to begin some specific work so as not to lose time during the first in-water construction season. This required, however, the issuance of an interim Water Quality Certification (WQC) by EPA. The first Interim WQC was issued on July 28, 2003, and authorized the following six activities:

- Driving six concrete piling upland for the new Log Haul Out Facility (LHOF);
- Forming of concrete for LHOF abutment;
- Driving 27 concrete piling in the water for the Simpson Fuel Dock;
- Partial demolition of the existing fuel dock;
- Piling removal within the St. Paul Waterway Confined Disposal Facility (CDF); and
- Piling removal on the St. Paul Peninsula.

The second Interim WQC was issued on August 22, 2003, and authorized work on the following activities:

- Dredging of approximately 1,000 CY of material in the Middle Waterway as needed for the LHOF and in conjunction with the dredging being performed for remediation of the Middle Waterway; and
- Removal of timber piling in Remedial Area 19 (RA 19) in preparation for installation of the grout mat and other remedial activities.

The third Interim WQC was issued on September 30, 2003, and authorized work on the following activities:

- Beginning of construction of the CDF, including removal of the upper five feet of existing sediment using a clamshell dredge with Puget Sound Dredged Disposal Analysis (PSDDA) disposal;
- Construction of the offset berm in the CDF;
- Removal of additional timber piling in the CDF footprint as well as the existing LHOF;
- Construction of the new LHOF and stormwater outfall in the Middle Waterway;
- Removal of existing concrete debris and a timber wharf structure, including piling, also in the Middle waterway;
- Removal of additional piling and debris in the Thea Foss Waterway;
- Dredging of approximately 800 CY of material for the toe key in RA 19;
- Installation of 48 concrete piling for the Alber's Wharf;
- Installation of 13 concrete piling for the 17th Street Access Pier;
- Placement of a thick slope cap in RA 19; and
- Placement of the grout mat cap in RA 19.

EPA provided final design approval on November 10, 2003, along with the overall WQC (Interim WQC No. 4) for remaining remedial activities to be performed. An additional certificate (Interim WQC No. 5) was issued by EPA on July 5, 2005, for the remainder of the project.

The following is a tabular listing of the significant milestones that occurred during the course of the Thea Foss and Wheeler-Osgood Waterways Remediation Project. Included in the table are enforceable project components and their date of completion. Numerous other activities, submittals and events occurred during the course of the project, and information on these elements can be found in Section 3.0 of this report, and in the project files.

Date	Event
September 8, 1983	Commencement Bay Nearshore/Tideflats (CB/NT) site placed on National Priorities List.
August 1985	Ecology completes the Remedial Investigation for the CB/NT site and publishes the results.
February 1989	Feasibility Study for the CB/NT site is published.
May 1, 1989	EPA and Ecology enter into a Cooperative Agreement designating EPA as the lead agency for remediation of contaminated sediments and Ecology as the lead agency for source control.
September 30, 1989	EPA issues Record of Decision for the CB/NT site, including the Thea Foss and Wheeler-Osgood Waterways as problem areas.

Date	Event
March 23, 1994	City enters into a voluntary Administrative Order on Consent (AOC) to perform additional pre-remedial design study and remedial design for the contaminated sediments in the Thea Foss and Wheeler-Osgood Waterways.
August 1, 1994	City enters into a Funding and Participation Agreement with other responsible and interested parties to facilitate mutual cooperation during design development.
July 1997	EPA issues ESD that modifies the sediment cleanup standard for PCBs.
Winter 1998	Independent arbitrator is hired by the PRP group to develop a cost allocation approach.
October 25, 1999	City submits a Technical Memorandum per EPA's request providing additional justification for No Action and Natural Recovery Areas.
July 2000	EPA prepares a Biological Assessment for the entire CB/NT Superfund site.
August 3, 2000	EPA issues a performance-based ESD to describe how the ROD should be implemented in the Thea Foss, Wheeler-Osgood, and Hylebos Waterways. The document described the significant differences between the ROD and the cleanup plans set forth in the ESD.
April 11, 2001	Non-binding arbitration process among PRPs is finalized with the issuance of a Preliminary Arbitration Report, leading to a mediation process.
June 6, 2001	EPA issues Special Notice Letter.
September 2001	Mediation process among PRPs is completed, resulting in a comprehensive settlement involving over 75 parties.
October 1, 2001	City submits a Good Faith Offer to EPA stating their offer to implement the remedial action in 80% of the waterway. Subsequently, an integrated settlement was reached among the PRPs, in which a group of private utilities took responsibility for performing the remedial action in the head of the Waterway (RAs 23 and 24) and the City took responsibility for performing the remedial action in RAs 1 through 22.
August 30, 2002	City enters into a Settlement and Escrow Agreement with the parties who joined the City's Consent Decree by cashing out their liability in accordance with the Foss arbitration and mediation process.

Date	Event
September 30, 2002	City and funding parties sign Remedial Action Consent Decree.
September 30, 2002	Following the City's offer to begin some of the isolated cleanup activities prior to execution of the Consent Decree, EPA issues a Unilateral Administrative Order (UAO) outlining the work to be performed in six action areas.
October 11, 2002	City submits draft final plans and specifications for UAO work.
November 6, 2002	City submits ESA Consultation "roadmaps" outlining the work to be performed in each of the six work areas under the UAO and their associated habitat impacts.
November 7, 2002	EPA approves design for project components to be completed under the UAO.
December 5, 2002	Construction work under the UAO begins.
December 6, 2002	NOAA issues final determination of "may affect, not likely to adversely affect" for UAO project components.
January 24, 2003	City submits the Final Design Documents for main construction project for EPA consideration.
February 6, 2003	US Fish and Wildlife Service issues final determination on UAO elements.
February 14, 2003	In-water work under UAO completed.
February 25, 2003	Main construction project advertised for bid.
March 3, 2003	Consent Decree lodged by the Department of Justice.
March 6, 2003	A Memorandum of Understanding (MOU) is executed between the City and the Utilities identifying the roles, responsibilities, and specific activities applicable to each party in the remediation of the Thea Foss Waterway.
March 12, 2003	Mandatory Pre-Bid meeting conducted.

Date	Event
March 19, 2003	City issues letter to EPA describing the process for selection of a Remedial Action Consultant and Contractor, along with the City's proposal for a Remedial Action Consultant, as they were already selected during the UAO phase of the project.
March 25, 2003	City issues letter to EPA with designation of the City's Project Coordinator and Alternate Project Coordinator.
April 29, 2003	Bids for main construction project received.
May 9, 2003	Consent Decree entered by the US District Court. This is the effective date of the Consent Decree.
May 14, 2003	Upon selection of the CDF as the disposal site for the project, the City submits JARPA permit application to use PSDDA disposal site for material to be dredged from the CDF. It was expected that the permit would be needed by August 1, 2003.
May 21, 2003	City awards construction contract to Manson Construction Company.
May 22, 2003	Following the bid and selection of the CDF as the disposal site, the City finalizes and submits the BA Addendum.
June 5, 2003	EPA requests formal consultation from NOAA on the remedial cleanup of the Thea Foss and Wheeler-Osgood Waterways.
June 5, 2003	City submits Manson Construction Company's Quality Management Plan to EPA, and subsequently reissues it on June 24, 2003 to address EPA comments.
June 6, 2003	City issues Draft Notice to Successors in Title for EPA review and approval.
June 10, 2003	City issues Notice to Proceed to Manson Construction Company.
June 16, 2003	Construction Partnering Session is held to bring together key players in the Foss Waterway cleanup to meet, understand project goals and approach, and agree on a partnership to complete the project on time and with all issues resolved.
June 23, 2003	City issues letter to EPA documenting the status of obtaining access agreements for work at the site.
June 26, 2003	City issues Recorded Notice to Successors-In-Title for EPA records.

Date	Event
July 1, 2003	City enters into DNR Use Authorization No. 22-074977 which allows for long-term placement of capping materials on state owned aquatic lands.
July 9, 2003	At EPA's request and to expedite the consultation process, the City prepares and submits a history of the development of the habitat mitigation plan.
July 14, 2003	City issues Final Technical Memorandum for Remedial Area 19 presenting the results of additional design study performed and updating the design for this area.
July 22, 2003	City enters into Site Access and Indemnification Agreement with the Foss Waterway Development Authority (FWDA) to provide for access to properties owned by the FWDA to allow for implementation of the remediation work under the Consent Decree.
July 24, 2003	EPA approves contractor's Final Construction Quality Control Plan submittal.
July 28, 2003	City enters into St. Paul Waterway Confined Disposal Facility and Habitat Restoration Project Memorandum of Agreement with Simpson to outline terms, roles, and responsibilities related to use of Simpson lands in the implementation of the remediation project.
July 28, 2003	Interim Water Quality Certification, CERCLA Remedial Action, Mobilization, Piling Removal, Pile Driving Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways.
July 28, 2003	Construction work begins on main project with driving of upland piling at the new Log Haul Out Facility.
July 29, 2003	City begins in-water construction work with removal of piling at the Simpson Fuel Dock.
July 30, 2003	City enters into Marina Relocation and Access Agreement with Foss Landing to allow for the City's access to their property during the project and to set forth other terms related to the remediation work within their marina.
August 7, 2003	EPA submits letter to the City indicating that ESA consultation had not substantively begun due to outstanding design issues.
August 14, 2003	City submits Consultant's annual update to their Quality Management Plan.

Date	Event
August 21, 2003	The City enters into a Settlement Agreement with the Washington State Department of Natural Resources which provides DNR's authorization to use State-owned aquatic lands for remedial actions required under the Consent Decree and provides the terms for settling DNR's liability at the site.
August 22, 2003	Interim Water Quality Certification No. 2, CERCLA Remedial Action, RA 19 Piling Removal, Log Haul Out Facility Dredging, Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways.
September 11, 2003	NOAA notifies EPA that additional information is needed before consultation can be initiated.
September 25, 2003	City receives PSDDA approval with 24 hour operations allowed.
September 30, 2003	City receives approved DNR Site Use Authorization for use of PSDDA site.
September 30, 2003	Interim Water Quality Certification No. 3, CERCLA Remedial Action, Selected Elements of 2003 In-Water Work, Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways.
October 1, 2003	City begins dredging to deepen CDF.
November 10, 2003	EPA provides approval of remedial design and Remedial Action Work Plan.
November 10, 2003	Water Quality Certification No. 4 for overall project is issued.
November 10, 2003	City issues "Final Basis of Design Technical Memorandum for Beneficial Reuse of the St. Paul Waterway Sediments at the Puyallup River Delta".
November 12, 2003	NOAA initiates formal consultation.
December 8, 2003	City issues Final Biological Assessment Addendum for the project reflecting the final approved design for the Waterways.
December 15, 2003	City issues a Technical Memorandum on Large Woody Debris Design.
December 15, 2003	City submits revised Remedial Action Work Plan Construction Schedule.

Date	Event
December 18, 2003	City issues revised habitat plans which reflect the final approved design.
December 18, 2003	City issues a Supplemental Volume to the Final Design Report compiling the additional submittals made during the completion of the design approval process.
December 18, 2003	City submits a three-volume compilation entitled Remedial Action Documents which contains the contractor's approved plan submittals.
December 28, 2003	Deepening of the CDF is completed.
January 1, 2004	Dredging in the Thea Foss Waterway begins.
January 24, 2004	City completes construction of the Middle Waterway Corridor Habitat Area.
February 10, 2004	City submits request for an extension to the fish window to complete certain work elements.
February 12, 2004	EPA grants extension to fish window until February 28, 2004.
February 28, 2004	In-water work completed for 2003-2004 construction season.
March 11, 2004	NOAA issues "Biological Opinion and Essential Fish Habitat Consultation for the Thea Foss and Wheeler-Osgood Waterways Superfund Remediation Action".
April 30, 2004	City submits planting plans for all habitat areas.
April 30, 2004	City submits Middle Waterway Freshwater Distribution System Design.
April 30, 2004	City submits OMMP Addendum reflecting final design.
June 30, 2004	City submits Contractor's annual update to their Quality Management Plan.
July 14, 2004	Pre-construction meeting for project dredging activities.
July 15, 2004	City begins in-water work for 2004-2005 construction season.

Date	Event
September 1, 2004	City submits Consultant's annual update to their Quality Management Plan.
September 3, 2004	City submits a letter to EPA requesting a modification to the enforceable schedule for the project.
September 22, 2004 and September 28, 2004	EPA provides comments on the City's request to modify the schedule and the City subsequently provides responses.
October 26, 2004	Through pre and post-dredge sampling, the City discovers that the adjacent completed cap in the Utilities' work area has become recontaminated. Potential sources of the contamination, including stormwater, through cap migration, and dredge residuals are examined.
October 29, 2004	City enters into Marina Relocation and Access Agreement with Johnny's Dock Marina to allow for the City's access to their property during the project and to set forth other terms related to the remediation work within their marina.
December 13, 2004	City submits Delta Survey, Draft Delta Dredging Plan, and Final Delta Characterization QAPP.
January 26, 2005	City submits request for an extension to the fish window to complete certain work elements.
February 7, 2005	EPA grants the City an extension until March 1.
February 24, 2005	EPA updates their response and grants City an extension to March 15, 2005.
March 1, 2005	NOAA provided an amendment to the Biological Opinion in response to the City's schedule extension for the work window to March 15.
March 3, 2005	City completes in-water work for 2004-2005 construction season.
March 10, 2005	City enters into Marina Relocation and Access Agreement with Foss Waterway Development Authority to allow for the City's access to the City Marina property during the project and to set forth other terms related to the remediation work within their marina. This agreement was subsequently amended on June 24, 2005.
March 10, 2005	City submits Final Delta Dredging Plan and Final Delta Characterization Report.

Date	Event
March 25, 2005	City completes construction of the CDF containment berm.
May 11, 2005	EPA transmits notice denying the City's September 3, 2004 schedule extension request and provided notice that Stipulated Penalties were accruing.
May 27, 2005	City submits Notice of Dispute regarding EPA's denial of the City's schedule extension requests of November 10, 2004 and March 4, 2005, triggering an informal negotiation period.
June 3, 2005	City submits final design for Hylebos Creek (Bunker) mitigation site to EPA for approval.
June 7, 2005	City requests early start of some construction activities.
June 20, 2005	City begins work below Ordinary High Water, but "in the dry" to begin 2005-2006 construction season.
June 21, 2005	NOAA provided an amendment to the Biological Opinion in response to begin work prior to the work window.
June 29, 2005	City submits Contractor's annual update to their Quality Management Plan.
June 30, 2005	EPA approves final design for the Hylebos Creek mitigation project.
July 5, 2005	Water Quality Certification No. 5 issued to correct a typographical error in WQC No. 4, which had it expiring before the project was scheduled to be completed.
July 6, 2005	City enters into Marina Relocation and Access Agreement with Foss Waterway Marina to allow for the City's access to their property during the project and to set forth other terms related to the remediation work within their marina.
July 18, 2005	City submits request to remove the requirement to perform the Total and Dissolved Constituents Study from the Stormwater Workplan Addendum (Attachment 1 to the Consent Decree Statement of Work).
August 22, 2005	City enters into Marina Relocation and Access Agreement with Petrich Marine Dock to allow for the City's access to their property during the project and to set forth other terms related to the remediation work within their business area.
August 30, 2005	City submits Consultant's annual update to their Quality Management Plan.

Date	Event
September 12, 2005	Settlement Agreement between the U.S. Environmental Protection Agency, Region X and the City of Tacoma Regarding the City's May 27, 2005 Notice of Dispute under Section XX of the RD/RA Consent Decree, No. C03-5117, is executed.
September 15, 2005	City completes construction of Peninsula Habitat Area.
September 29, 2005	Pre-final inspection of the Hylebos Creek mitigation site is held. EPA provided comments during and after the inspection.
November 14, 2005	City completes dredging in the Thea Foss and Wheeler-Osgood Waterways and filling of the CDF.
December 14, 2005	City submitted a two-week schedule extension request to complete the additional capping required in response to the recontamination that occurred as a result of dredge residuals.
January 5, 2006	EPA responded to the City's schedule extension request indicating that they would not approve any changes to the agreed upon schedule.
January 18, 2006	City provided written notification of a Force Majeure event relating to the discovery of a subsurface piling structure at the Middle Waterway Tideflat Habitat area and requests a 15-day schedule extension.
January 21, 2006	City completes construction of the St. Paul Beach Habitat Area.
February 2, 2006	City completes work on the Puyallup River Side Channel.
February 4, 2006	City completes capping of the Thea Foss and Wheeler-Osgood Waterways.
February 13, 2006	EPA denies the City's Force Majeure claim and the associated schedule extension request.
February 14, 2006	City completes construction of the Middle Waterway Tideflat Habitat and Freshwater System
February 28, 2006	City provides Notice of Dispute regarding EPA's denial of the Force Majeure claim.
March 1, 2006	City completes major hauling and placement of capping material in the CDF.

Date	Event
March 6, 2006	City completes construction of the drainage system at the CDF.
March 8, 2006	City completes the placement of the erosion control at the CDF.
September 19, 2006	City and EPA complete Final Inspection of Hylebos Creek project.

Enforceable Project Schedule

Task Name	Original Enforceable Date from EPA 11/10/03 Approval Letter	Modified Enforceable Schedule Date Based on September 12, 2005 Settlement Agreement	Actual Completion Date
Revised Delta Tech Memo	November 14, 2003	November 14, 2003	November 10, 2003
Revised RAWP Construction Schedule	December 15, 2003	December 15, 2003	December 15, 2003
Final Biological Assessment Addendum	December 15, 2003	December 15, 2003	December 8, 2003
Large Woody Debris Design	December 15, 2003	December 15, 2003	December 15, 2003
Planting Plans for all Habitat Plantings	May 1, 2004	May 1, 2004	April 30. 2004
Middle Waterway Freshwater Distribution System Design	May 1, 2004	May 1, 2004	April 30, 2004
OMMP Addendum – Institutional Controls Plan, MAMP revisions: Plantings Maintenance and Performance Criteria, Freshwater System Performance Criteria, PRSCH Performance Criteria for Siltation	May 1, 2004	May 1, 2004	April 30, 2004

Task Name	Original Enforceable Date from EPA 11/10/03 Approval Letter	Modified Enforceable Schedule Date Based on September 12, 2005 Settlement Agreement	Actual Completion Date
Puyallup River Side Channel Habitat Construction (including breach of the levee)	60 days following Corps authorization to breach levee	60 days following Corps authorization to breach levee – Received authorization on December 1, 2005	February 2, 2006
Intertidal and Riparian Habitat Plantings	First November 30 after Construction Completed at each habitat area	First November 30 after Construction Completed at each habitat area	North Beach and Peninsula – Completed by end of May 2006
			PRSC – Completed in March 2006
			MWTH – Completed by end of June 2006
St. Paul CDF – Excavation and Filling	September 12, 2005	November 30, 2005	November 14, 2005
St. Paul CDF – Containment Berm Construction	December 29, 2004	December 29, 2004	March 25, 2005
St. Paul CDF – Final Capping, Drainage, Erosion Control	November 16, 2005	March 1, 2006	March 8, 2006
Peninsula Habitat Area Construction	September 22, 2004	September 15, 2005	September 15, 2005
St. Paul Beach Habitat Construction	October 20, 2005	January 21, 2006	January 21, 2006

Task Name	Original Enforceable Date from EPA 11/10/03 Approval Letter	Modified Enforceable Schedule Date Based on September 12, 2005 Settlement Agreement	Actual Completion Date
Dredge Thea Foss and Wheeler-Osgood Waterways	September 12, 2005	November 30, 2005	November 14, 2005
Cap Thea Foss Waterway	October 6, 2005	January 21, 2006	February 4, 2006
Middle Waterway Corridor Habitat	February 14, 2004	February 14, 2006	January 24, 2006
Middle Waterway Tideflat Habitat and Freshwater System	November 16, 2005	January 30, 2006	February 14, 2006. Note: The freshwater system was operational in May 2006, prior to installation of plants in this area.
Delta Survey, Draft Delta Dredging Plan, and Final Delta Characterization QAPP	December 13, 2004	December 13, 2004	December 13, 2004
Final Delta Dredging Plan and Final Delta Characterization Report	March 13, 2005	March 13, 2005	March 10, 2005

5.0 PERFORMANCE STANDARDS AND CONSTRUCTION QUALITY CONTROL

The performance standards for remedial activities are summarized in Section 2.2. This section further describes the performance standards and compares the cleanup activities performed to these performance standards. Additionally, the chain of Quality Assurance and Quality Control plans are identified and their application to this project is summarized. An overall assessment of data quality is provided along with a discussion of the U.S. Environmental Protection Agency's (EPA) oversight activities.

5.1 COMPARISON TO PERFORMANCE STANDARDS

The Consent Decree, EPA Docket Number C03-5117, defines Performance Standards for this remedial action in Section IV, Page 16. This paragraph references the following documents: Record of Decision (ROD), Explanations of Significant Differences (ESD) (from 1997 and 2000), and the Statement of Work attached to the Consent Decree. In relevant part, these documents establish performance standards in the following general areas: sediment dredging, sediment capping, natural recovery, habitat mitigation, water quality, shoreline protection, waste management and disposal.

5.1.1 SEDIMENT DREDGING

Performance standards for dredging are consistent with the Commencement Bay Nearshore/Tideflats (CB/NT) ROD and Applicable or Relevant and Appropriate Requirements (ARAR), including the Clean Water Act, Rivers and Harbors Act, and the Endangered Species Act (ESA) requirements. These requirements fall into three major categories:

- Meeting the Sediment Quality Objectives (SQO) in areas that are dredged to clean;
- Maintaining water quality through compliance with EPA's Water Quality Certification (WQC); and
- Achieving required dredge depths to support Navigation requirements.

Attainment of the first two performance standards is documented in Section 3.0 discussions related to each Remedial Area (RA) with regard to water quality, sediment verification, dredged quantities, and disposal locations. Compliance with the U.S. Army Corps of Engineers (Corps) navigation depths have been verified by the final as-built survey. However, there are areas where pre-existing encroachments have not been completely removed. The City of Tacoma (City) and the Corps are negotiating a Memorandum of Agreement (MOA) that includes a figure showing these areas and formalizes the limits of the City's responsibility for the areas of encroachment (Appendix F). In accordance with this agreement, the City will initiate an informal deauthorization process for these areas within three months of finalization of the MOA.

Detailed descriptions of dredging in the individual RAs is covered in the appropriate areas of Section 3.0.

5.1.2 SEDIMENT CAPPING

The particle size of the cap material was selected to provide chemical and or physical containment of sediments with concentrations exceeding SQOs. In addition, selection of capping material reflects habitat restoration goals for the remedial areas. Fine-grained particles are typically more effective at reducing the migration of chemicals through a cap, while larger-grained particles can be used as armor to prevent erosion from wave action or propeller scour. The capping activities in this project meet the following EPA performance standards:

- Minimum thickness of three feet;
- Isolation of the contaminated sediment from ecological receptors;
- Stabilization of contaminated sediments, preventing resuspension and transport to other locations within the waterway;
- Reduction of contaminant transport via groundwater to levels that will not recontaminate surface sediments, cause adverse biological effects, or contaminate surface water at levels exceeding background concentrations or marine chronic water quality criteria; and
- Promotion of colonization by aquatic organisms.

Based on guidance from the Corps (1998), cap components and thickness for the channel areas and slopes address potential erosion (i.e., scour), bioturbation, consolidation, chemical isolation, and operational considerations.

The areas where caps were placed as part of remedial actions are presented in Figure 3. The sources of import material used for capping and types of capping material placed in each remedial area are summarized in Table 4. Detailed descriptions of capping in the individual RAs is covered in the appropriate areas of Section 3.0.

5.1.3 NATURAL RECOVERY / ENHANCED NATURAL RECOVERY

Natural recovery includes a variety of physical, chemical, and biological processes that result in a reduction of chemical concentration within the upper mixed layer over a period of time. Several processes, including chemical degradation, diffusion from the sediment matrix into the water column, burial of sediment exceeding SQOs under newly deposited clean material, and mixing of the sediment exceeding SQOs with clean sediments above and below through bioturbation may occur over time and assist in the natural recovery of those sediments with concentrations exceeding SQOs. Areas with concentrations that slightly exceed SQOs by low enrichment ratios and minor or no adverse effects in bioassay testing were designated for natural recovery. Natural recovery areas include:

- The harbor area north of the center line of the 11th Street Bridge to approximate Station 20+00;
- The shoreline around the head of the Wheeler-Osgood Waterway;
- An area outside the mouth of the Wheeler-Osgood Waterway; and
- The mudflat on the shoreline behind Delin Docks (formerly City Marina).

Enhanced natural recovery includes placement of a thin layer of clean sediments above the existing sediment surface to assist in the natural recovery of the sediments with minor exceedences of SQOs. RA 7 was selected for enhanced natural recovery during the design process. Portions of RAs 5 and 6 were also designated as enhanced natural recovery areas as a result of the identification of utility crossings in the area.

Natural recovery and enhanced natural recovery areas will be monitored in accordance with the Operations, Maintenance and Monitoring Plan (OMMP) (Figure 3).

5.1.4 HABITAT MITIGATION

Appropriate measures were taken during construction to avoid or minimize adverse impacts to the aquatic environment and are described in more detail in Section 3.0.

Habitat sites providing compensatory habitat mitigation for the habitat loss in the St. Paul Waterway and the temporary disruption of habitat in the Thea Foss and Wheeler-Osgood Waterways include the Middle Waterway Tideflat Habitat (MWTF), Middle Waterway Corridor Habitat, North Beach Habitat, Hylebos Creek Habitat and the Puyallup River Side Channel (PRSC) Habitat. Together, these sites meet the performance standard for Habitat Mitigation and are described in more detail in Section 3.0.

The Biological Opinion required that the habitat sites be completed within two years of taking the habitat in the St. Paul Waterway out of service or a prorated amount of additional habitat work would be required according to the formula (0.0083 acres of additional requirement per month and per acre that was not completed by October 1, 2005). The table below shows the mitigation projects that were completed past the October 1, 2005 deadline. EPA has indicated that upon completion of all work, they will provide a formal written demand for any additional mitigation required.

Mitigation Project	Target Date	Construction Completion Date	Months Past Target	Project Acres	Factor from BO	Required Additional Acres
Middle Waterway Tideflat	10/1/2005	2/14/2006	4.53	9.52	0.0083	0.36
North Beach	10/1/2005	1/27/2006	3.93	2.27	0.0083	0.07
					Total	0.43

The City will meet with EPA to determine the specific tasks necessary to satisfy this requirement.

5.1.5 WATER QUALITY

Remedial activities were conducted to improve and protect water quality in Commencement Bay and to satisfy federal and state Water Quality Standards. EPA issued WQCs establishing limits on turbidity, temperature and Dissolved Oxygen (DO) as well as monitoring requirements for remedial actions. Temporary control measures were undertaken to manage potential water quality impacts to surface water during debris removal. In-water capping was conducted in a manner that minimized sediment

resuspension. Best Management Practices (BMP) were employed during dredging to minimize transport of dredged sediment. Water quality monitoring results are detailed in daily and monthly water quality reports. Water quality monitoring, including the results with respect to each individual site and types of chemical analyses performed, are discussed in Section 3.0.

Water quality monitoring was performed for in-water activities in accordance with the WQCs administered by EPA which included:

- Interim Water Quality Certification dated July 28, 2003, for CERCLA Remedial Action – Mobilization, Piling Removal, Pile Driving – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways;
- Interim No. 2 Water Quality Certification dated August 22, 2003, for CERCLA Remedial Action – RA 19 Piling Removal, Log Haul Out Facility Dredging – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways;
- Interim No. 3 Water Quality Certification dated September 30, 2003, for CERCLA Remedial Action – Selected Elements of 2003 In-Water Work – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways;
- Interim No. 4 Water Quality Certification dated November 10, 2003 – Remaining Elements of 2003-2005 In-Water Work – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways; and
- Interim No. 5 Water Quality Certification dated July 5, 2005 – CERCLA Remedial Action – Remaining Elements of 2005-2006 In-Water Work – Thea Foss, Wheeler-Osgood and St. Paul/Middle Waterways.

The specific elements of water quality monitoring performed for the Thea Foss and Wheeler-Osgood Remediation Project consisted of the following:

- Pre-construction ambient water quality monitoring;
- Construction ambient water quality monitoring;
- Construction water quality monitoring; and
- Chemical of Concern (COC) water quality monitoring.

Water quality parameters measured and recorded during ambient and construction water quality monitoring included the following:

- Real time measurement of DO;
- Real time measurement of temperature;
- Real time measurement of turbidity;
- Real time measurement of salinity;
- Sample collection and analysis for Total Suspended Solids (TSS);
- Sample collection and analysis for copper and silver; and
- Sample collection and analysis for DO.

The results of ambient and construction water quality monitoring were reported in daily and monthly water quality monitoring reports. Daily water quality monitoring reports were faxed or emailed to EPA and the Corps (EPA's oversight personnel). Monthly water quality monitoring reports that consisted of a compilation of water quality monitoring data collected each month (including daily reports) were also prepared and submitted to EPA and the Corps.

COC sampling and analysis was performed in conjunction with construction water quality monitoring. Water quality monitoring for COC consisted of sample collection and analysis for the following total and dissolved parameters:

- Polycyclic aromatic hydrocarbons (PAH);
- Phthalates;
- Lead, mercury, and zinc;
- Polychlorinated Biphenyls (PCB);
- DDT, DDE, and DDD; and
- Total organic carbon.

The results of water quality monitoring for COC were similar to Dredging Elutriate Test (DRET) or Modified Elutriate Testing (MET) results performed in support of the remedial design. The results of this monitoring were reported to EPA and the Corps.

5.1.6 SHORELINE PROTECTION

Capping and related construction activities for the Thea Foss and Wheeler-Osgood Waterways are subject to requirements of the City Shoreline Ordinance (Chapter 13.10). The Waterways are located within the "S-8" and "S-10" Shoreline Districts. Construction activities were consistent with the State and City shoreline requirements. In compliance with the policies and objectives of the City Shoreline Ordinance, remedial actions included:

- Reduced loss of shoreline;
- Stabilization of existing and remaining shoreline areas; and
- Retainage of a property configuration that encourages water-dependent uses.

5.1.7 WASTE MANAGEMENT AND DISPOSAL

Debris and piling were managed in accordance with substantive requirements derived from the Minimum Functional Standards (Chapter 173-304 WAC). Some materials were determined to be Dangerous Wastes and were managed and disposed of in accordance with substantive requirements of Chapter 173-303 WAC and 40 CFR Parts 261-265. Offsite waste disposal was approved by EPA under the Off-Site Disposal Rule.

5.2 APPROVED CONSTRUCTION QA/QC PLANS

This section provides a brief description of the approved construction quality assurance and construction quality control (CQC) documents and procedures. Exceptions from these approved plans have been covered previously on a case-by-case basis in Section 3.0.

The Construction Quality Assurance Plan (CQAP), dated November 1, 2002, as amended August 14, 2003, was prepared by Hart Crowser for the City. This plan lays out the structure for managing quality for this project. It specifies the content of the Remedial Action Work Plan (RAWP). Requiring the contractor to prepare this document

was a quality assurance step to ensure the work was well planned and that important quality control steps were conducted. An important part of the RAWP was the CQC Plan.

The contractor submitted their Final CQC Plan on July 17, 2003. EPA reviewed, commented, and approved this plan on July 24, 2003. This plan details the contractor's approach to implementing quality control activities. A central feature of this plan is the delineation of the three phases of quality control; preparatory phase, initial phase, and follow-up phase. This approach ensures that the contractor:

- Is prepared for the work (has secured required submittals, approvals, materials, equipment and personnel prior to beginning the work);
- Has begun implementation of the work in accordance with the plans and specifications; and
- Maintains the level of workmanship throughout the completion of the work.

These steps are documented with checklists and daily CQC Reports. In addition, the Construction Management Team (CM Team) provided construction oversight throughout the course of the project. This ensured the contractor was adhering to the intent of the approved plans. These efforts are documented in the Inspector's Daily Reports. Construction records, including the CQC Reports and Daily Inspection Reports, are on file with the City.

5.3 DATA QUALITY

Analytical data was generated as part of the project for the following purposes:

- Sediment verification;
- Waste characterization for disposal; and
- Water quality monitoring.

The collection of this data was performed in accordance with the quality assurance project plans (QAPP) identified in Table 5.In specific instances, the QAPPs were amended with addenda to address sampling needs or requirements that were particular to a site, task, or location.

Severn Trent Laboratories (STL) and Analytical Resources, Inc. (ARI), fully accredited by the Washington State Department of Ecology (Ecology), performed analyses on samples collected as part of the project. Parametrix validated the laboratory data according to the EPA National Functional Guidelines and approved project QAPP requirements. The data quality review performed by Parametrix included a check of laboratories quality control results that included the following:

- Preparation and analytical holding times;
- Laboratory method blanks;
- Laboratory control samples and laboratory control sample duplicates;
- Laboratory replicates;
- Matrix spike (MS) and matrix spike duplicates (MSD);

- Surrogate compound recoveries; and
- Field quality control samples (i.e., field duplicates, rinseate blanks, etc.).

The complete laboratory results and results of data quality reviews document project data quality. Based on the project data quality reviews, data has been judged to be acceptable for use.

On February 1, 2006, the City received a letter from EPA transmitting a data quality review from the Corps. The City's subcontractors for laboratory analysis and data review generated responses, which were transferred to EPA on February 3, 2006. At EPA's request, the City retained an independent third party to perform a complete Data Validation on a subset of samples. CDM Federal Programs Corporation's report was submitted to EPA on April 4, 2006, and concluded that the data was suitable for use as qualified. Responses were provided to EPA comments on June 2, 2006 and June 26, 2006. A compilation of the data validation documentation was submitted to EPA on July 12, 2006 (Table 5).

5.4 EPA OVERSIGHT

EPA and the Corps provided oversight throughout the project. Weekly progress meetings were attended by the contractor, the CM Team (City, KPFF, and Floyd|Snider), Citizens for a Healthy Bay (CHB), Simpson, EPA and or its consultants, and the Corps. Construction quality issues were vetted at these meetings. A compendium of meeting minutes is held in the administrative records for the project. Additionally, various site visits by EPA and the Corps to the particular RAs were held as work was completed, including Pre-Final and Final Inspections.

Technical consultations were conducted on-site, via e-mail, and over the phone when issues of importance arose (i.e., water quality monitoring results, etc.). Formal written approvals were provided as required under the Consent Decree.

Vista 2000, a web-based construction management / document control software package was used during the construction project. This program allowed parties involved to view submittals, reports, data, correspondence and quality control documents on-line. This system has the advantage that an updated copy is instantly available to the entire team. There was substantial effort in getting the system up and running. The CM Team, Manson Construction Company (Manson), EPA's consultants, and the Corps used the software to help manage the project. This software was not accessible by EPA due to EPA security concerns and firewalls. However, hard copies of all pertinent Vista records were transmitted to EPA on a regular basis.

6.0 FINAL INSPECTION AND CERTIFICATIONS

6.1 FINAL INSPECTIONS OF REMEDIAL ACTIONS

Pre-Final and, where applicable, Final Inspections were conducted for remedial actions completed at each site during the Thea Foss and Wheeler-Osgood Waterways Remediation Project. These inspections included survey review, data review, and field inspections. Attendees included members of the Construction Management Team (CM Team), representatives from the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers (Corps), and other agencies as necessary. Pre-Final and Final Inspection Reports were prepared summarizing the remedial action, documenting inspection activities, and identifying the status of remedial actions. The reports were submitted to EPA for review and approval. These Final Inspection Reports are provided in Appendix D.

Photographs were taken throughout the construction project to document pre-construction and post-construction conditions as well as to document construction activities. Some of the project photographs are included herein in Appendix E. The remainder of the photographs will be retained electronically in the project record.

The following summarizes the inspections at the construction areas.

6.1.1 REMEDIAL ACTION SITES

6.1.1.1 REMEDIAL AREA 2

The Pre-Final Construction Inspection was performed on September 15, 2005. The inspection consisted of review of post-dredge and post-backfilling surveys. The Corps requested additional information concerning survey coordinates. This information was provided to Kym Takasaki on September 22, 2005, and approved the same day.

No final inspection of this area was needed as there were no outstanding work elements. EPA approved of the actions in RA 2 via email on September 26, 2005. The Final Inspection Report was submitted to EPA on October 26, 2005.

6.1.1.2 REMEDIAL AREA 4

The Pre-Final Construction Inspection was performed on September 15, 2005. The inspection consisted of review of post-dredge and post-backfilling surveys. The Corps requested additional information concerning survey information and boundary verification sampling. The survey information was provided to Kym Takasaki on September 22, 2005, and approved the same day.

With regard to the sampling information, the Corps had requested clarification as to why the confirmation core sample was not taken at the same time as the two surface samples. The additional information, including a summary of the boundary verification sampling performed was provided via email on September 27, 2005, and approved by the Corps the same day.

No final inspection of this area was needed as there were no outstanding work elements. EPA provided their approval of the information and the actions in Remedial Area 4 (RA 4) via email on October 4, 2005. The Final Inspection Report was submitted to EPA on November 2, 2005.

6.1.1.3 REMEDIAL AREA 5

The Pre-Final Construction Inspection/reviews were performed on October 27, 2005, January 12, 2006, and January 19, 2006. The inspection consisted of review of post-dredge and post-cap surveys. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on March 2, 2006.

6.1.1.4 REMEDIAL AREA 6

The Pre-Final Construction Inspection/review of post-dredge hydrographic surveys was performed on October 27, 2005, for all dredging and overdredging areas. Review of the survey for the three-foot cap at Stations 37+10 to 37+75 occurred on January 19, 2006. Review of the three-foot cap between Stations 48+80 and 50+80 occurred on January 23, 2006. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on March 2, 2006.

6.1.1.5 REMEDIAL AREAS 7 AND 7A

The Pre-Final Construction Inspection/review of post-dredge and slope capping hydrographic surveys was performed on January 12, 2006. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on February 16, 2006.

6.1.1.6 REMEDIAL AREA 8

The visual portion of the Pre-Final Construction Inspection at RA 8 was performed on the evening of January 12, 2006. The inspection consisted of observation of the slope cap and under structure capping at low tide. The post-dredge and slope capping surveys were reviewed on October 27, 2005. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on February 16, 2006.

6.1.1.7 REMEDIAL AREA 9

The Pre-Final Construction Inspection/reviews of post-dredge and post-capping hydrographic surveys were performed on October 27, 2005 and January 12, 2006, respectively. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on February 16, 2006.

6.1.1.8 REMEDIAL AREA 12

The Pre-Final Construction Inspection was performed on the evening of November 17, 2005, during low tide. The post-dredge and post-backfill surveys were reviewed on October 27, 2005 and January 12, 2006, respectively. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on February 16, 2006.

6.1.1.9 REMEDIAL AREA 14

The final visual portion of the Pre-Final Construction Inspection was performed at low tide on the evening of January 12, 2006. The inspection consisted of observation of the slope cap at low tide. The post-dredge and slope capping surveys were reviewed on January 19, 2006. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on February 24, 2006.

6.1.1.10 REMEDIAL AREA 15

The visual portion of the Pre-Final Construction Inspection was performed on September 15, 2005. The inspection consisted of observation of the slope cap at low tide. The post-dredge and slope capping surveys were reviewed on November 3, 2005. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on December 8, 2005. Following submittal of the Final Inspection Report, EPA requested a modification so an addendum to the RA 15 Final Inspection Report was issued on January 3, 2006.

6.1.1.11 REMEDIAL AREA 16

The Pre-Final Construction Inspection/review of post-dredge and post-capping hydrographic surveys was performed on November 3, 2005. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on March 2, 2006.

6.1.1.12 REMEDIAL AREA 17

The Pre-Final Construction Inspection/review of post-dredge and overdredge hydrographic surveys was performed on November 3, 2005. Initial cap surveys were reviewed on January 23, 2006, and final cap surveys were reviewed on March 10, 2006. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on April 11, 2006.

6.1.1.13 REMEDIAL AREA 18

The Pre-Final Construction Inspection/review of post-dredge and post-capping hydrographic surveys was performed on November 3, 2005 and January 23, 2006, respectively. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on March 2, 2006.

6.1.1.14 REMEDIAL AREAS 19A AND 19B

The visual portion of the Pre-Final Construction Inspection was performed at low tide on the evening of January 19, 2005. The inspection consisted of observation of the slope cap at low tide. The post-dredge and slope capping surveys were reviewed on November 3, 2005 and January 19, 2006. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on February 24, 2006.

6.1.1.15 REMEDIAL AREA 20

The visual portions of the Pre-Final Construction Inspection were performed at low tide on January 19, 2005 and March 29, 2005. The inspections consisted of observation of the slope cap at low tide, sheetpile wall installation and habitat area construction. The post-dredge and slope capping surveys were reviewed on November 3, 2005 and January 20, 2006. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on March 2, 2006.

6.1.1.16 REMEDIAL AREA 21

The Pre-Final Construction Inspection/review of post-dredge and post-capping hydrographic surveys was performed on November 3, 2005 and January 19, 2006, respectively. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on March 2, 2006.

6.1.1.17 REMEDIAL AREA 22

The Pre-Final Construction Inspection/review of post-dredge and post-capping hydrographic surveys was performed on November 3, 2005 and January 19, 2006, respectively. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on February 24, 2006.

6.1.1.18 ST. PAUL WATERWAY CDF

The Pre-Final Inspection of the CDF cap, drainage system, and erosion control was performed on March 30, 2006. No issues were identified during this Pre-Final Inspection.

No final inspection of the area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on May 5, 2006.

6.1.2 HABITAT / MITIGATION SITES

6.1.2.1 NORTH BEACH HABITAT – PENINSULA HABITAT & ST. PAUL BEACH HABITAT

6.1.2.1.1 North Beach Habitat – Peninsula Habitat

The Pre-Final Site Inspection was performed on September 15, 2005, at a tidal elevation of -1.1 feet MLLW. During the site walk nearly all the site was visible with the exception of the very outer edges. The attendees walked the entire site and were able to observe each type of material in place and compare their observations with the approved plans.

Corps participants noted a small area at the lowest point of the intertidal channel along the east side of the habitat area still had wood debris on the surface and did not appear to have been sufficiently covered with habitat mix. This condition was immediately brought to the attention of the contractor and corrected before the tide rose. It was reinspected the following day and found to be corrected. Photographs were taken to document the corrective action at low tide and were forwarded to the Corps.

Final surveys were taken during the week of September 19, 2005, and reviewed on October 6, 2005.

The Final Inspection Report was submitted to EPA on November 3, 2005.

6.1.2.1.2 North Beach Habitat –St. Paul Beach Habitat

A low tide Pre-Final Inspection with the regulatory agencies was performed on February 7, 2006. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on April 11, 2006.

6.1.2.2 MIDDLE WATERWAY CORRIDOR HABITAT

The Pre-Final Inspection was performed on February 2, 2004. Robert Clark (NOAA) requested placement of additional habitat mix over the toe berm as an additional enhancement to this area. This work was completed on February 16, 2004.

A Final Inspection was conducted on March 25, 2004. All parties agreed that the work was complete. The Final Inspection Report was submitted to EPA on March 25, 2004.

6.1.2.3 MIDDLE WATERWAY TIDEFLAT HABITAT

The low tide Pre-Final Inspection was performed on March 30, 2006. A pre-final review of the final surveys was conducted on March 10, 2006. No issues were identified during this Pre-Final Inspection.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on May 5, 2006.

6.1.2.4 PUYALLUP RIVER SIDE CHANNEL

Multiple Pre-Final Inspections were performed at this mitigation site. The first was inspection of the new levee on November 9, 2005. This inspection resulted in the approval to begin lowering the pre-existing levee. This inspection and the finalization of the setback levee easement deed resulted in the December 1, 2005, approval from the Corps to ultimately breach the pre-existing levee.

The second inspection consisted of an office review of the hydrographic survey of the excavated habitat area prior to the levee breach. This review took place on December 30, 2005, and was to confirm that the design depth and grades had been achieved. (Note that the levee self-breached just hours before this scheduled review.)

On February 7, 2006, a low water Pre-Final Site Inspection was conducted.

On March 10, 2006, the final surveys of this habitat area were reviewed. On March 14, 2006, Charles Ifft (Corps) approved the levee portion of the final construction.

No final inspection of this area was needed since no outstanding work elements were identified. The Final Inspection Report was submitted to EPA on March 14, 2006.

6.1.2.5 HYLEBOS CREEK MITIGATION SITE (BUNKER PROPERTY)

The Pre-Final Inspection was performed on September 29, 2005. Following the inspection, EPA provided comments about the design and construction of the area and the City worked with the agencies to resolve these issues. The Final Inspection was conducted on September 19, 2006, and the Final Inspection Report was also submitted on September 19, 2006.

6.1.3 PUYALLUP RIVER DELTA / BORROW AREA

6.1.3.1 PUYALLUP RIVER DELTA

Pre-Final and Final Inspections were not needed at the Delta where the dredged material was placed.

6.1.3.2 PUYALLUP RIVER BORROW AREA

The Puyallup River Borrow Area was identified as the location for this potential removal action, however, it was subsequently determined that this borrow area would not be used.

6.1.4 DOCK STREET MARINA

6.1.4.1 ALBER'S WHARF AND MARINA / CITY VIEW MARINA AND 17TH STREET MARINA

Since the Dock Street Marina is not part of the remediation project, Pre-Final and Final Inspections by EPA as required by the Consent Decree are not applicable. Final walk-through inspections were performed with the designers and the Foss Waterway Development Authority (FWDA), punch list items corrected, and the marinas were turned over to the FWDA.

6.1.5 SIMPSON ACTIVITIES

6.1.5.1 SIMPSON LOG HAUL ROAD, SIMPSON FUEL DOCK, AND SIMPSON LOG HAUL OUT FACILITY

Since the Simpson Log Haul Road, Simpson Fuel Dock, and Simpson Log Haul Out Facility are not part of the remediation project, Pre-Final and Final Inspections by EPA as required by the Consent Decree are not applicable. Final walk-through inspections were performed with the designers and Simpson, punch list items corrected, and the facilities were turned over to Simpson.

6.2 HEALTH AND SAFETY

Manson Construction Company (Manson) managed health and safety during the project. The Health and Safety Plan was overseen by Kathleen Becker, Manson's Project Health and Safety Officer, and Pat Barton, the Site Health and Safety Officer for the project.

A Health and Safety Plan was prepared by Argus Pacific Inc. for Manson for the Thea Foss and Wheeler-Osgood Waterways Remediation Project. Manson's Health and Safety Plan was for all work being performed as part the project and was developed to comply with Hazardous Waste Operations Criteria (WAC 296-62-300). Additional task specific health and safety plans were prepared by several of Manson's subcontractors for specific work that they performed. The additional task specific health and safety plans included the following:

- Health and Safety Plan prepared by Rhine for demolition activities, July 24, 2003;
- Project Health and Safety Plan Accident Prevention Plan prepared by Parametrix for performing sampling activities, July 2003; and
- Asbestos Abatement Work Plan by Performance Abatement Services for asbestos abatement activities, June 6, 2003.

The Project Health and Safety Officer conducted project health and safety training orientation for construction personnel and performed regular site inspections. The Site Health and Safety Officer provided supervision of on-site activities including safety for Manson personnel and subcontractors. Daily "Toolbox" safety meetings were performed by individual project foremen to identify job hazards for each specific activity on a daily basis.

One injury accident occurred during the 2003-2004 construction season. A Manson employee had his leg broken by a timber light pole that had been placed on a pavement surface. When the light pole started to roll, the Manson employee tried to stop the pole by placing his foot against the pole. The pole rolled onto his foot and against his leg breaking his leg.

Another injury accident occurred during the 2004-2005 construction season when a Manson employee tripped and fell off of Derrick 3 and into a skiff below, breaking his wrist.

During the 2005-2006 construction season, a Manson employee had a piece of metal puncture through his work boot while working at Martinac. He was treated with a tetanus shot and released.

A few other minor incidents occurred during the project and were documented in the weekly construction meeting minutes.

6.3 CERTIFICATION

This Remedial Action Construction Report is submitted in accordance with Section XIV, Paragraph 50(c) of the Consent Decree for the site. With this report, the City of Tacoma is requesting certification that the remedial action at the site has been completed in full satisfaction of the requirements of the Consent Decree. In Section 12.0 of this report, representatives for the City of Tacoma have indicated that the work has been properly completed.

7.0 OPERATION AND MAINTENANCE ACTIVITIES

The required post-construction operations and maintenance activities, necessary to verify that the long-term performance standards are met, are contained in the draft Operations, Maintenance and Monitoring Plan (OMMP) for the site. This plan is currently being reviewed and modified for consistency with the completed construction. The draft OMMP was developed concurrent with the remedial design and was drafted prior to the performance of remedial activities. Several modifications to the remedial design and response actions occurred during construction that necessitate revisions to operation and maintenance activities specified in the draft OMMP.

The following sections identify remedial design modifications and response actions which occurred during construction. These remedial design modifications and response actions will be evaluated during the post-construction review of the draft OMMP, to evaluate and identify the need for revisions to the operation and maintenance (O&M) activities set forth in the plan. Figure 3 provides an overview of the remedial actions performed in each remedial area (RA).

7.1 REMEDIAL ACTION SITES

7.1.1 REMEDIAL AREA 2

Post-dredge sample results indicate that the average chemical concentrations are less than the Sediment Quality Objectives (SQO) in RA 2 and, therefore, the channel sand cap material placed in RA 2 constitutes a backfill. Therefore, no modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions in RA 2.

7.1.2 REMEDIAL AREA 4

Post-dredge sample results indicate that the chemical concentrations are less than the SQOs in RA 4 and, therefore, the channel sand cap material placed in RA 4 constitutes a backfill. Therefore, no modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions in RA 4.

7.1.3 REMEDIAL AREA 5

The remedial actions performed in RA 5 were modified due to the presence of utilities crossing the waterway. As described in Section 3.1.3.2, submerged, buried utilities were identified to cross the Thea Foss Waterway between approximately 20 and 120 feet south of the 11th Street Bridge. The remedial actions that were to be performed in the northern portion of RAs 5, 6, and 7 had the potential to damage the utilities crossing the waterway. Therefore, additional sediment sampling and analysis was performed to characterize sediment in this area to evaluate the potential for modification of remedial actions in the area of the utility crossings. The detected chemical concentrations were below the SQOs in the three samples collected from the northern portion of RA 5 (Section 3.1.3.7.1).

Based on the location of the utility crossings and the results of sediment sampling and analysis, the remedial actions in the northern portion of RA 5 were modified. In the area north of Station 37+10 and adjacent to the Petrich Marine Dock, the remedial action was modified from dredging and placement of a thick slope cap to placement of six inches of quarry spalls to prevent erosion from prop scour. In the remaining portion of RA 5 north of Station 37+10, the remedial action was modified from dredging to natural recovery. The remedial actions were not modified in the area south of Station 37+10 except that three feet of channel sand cap material was placed as backfill on the transitional slope that was cut from the existing sediment surface in the natural recovery area north of Station 37+10 to the design dredge depth of -28 feet MLLW south of Station 37+10.

The OMMP requirements for natural recovery monitoring will be reviewed for the northern portion of RA 5 based on the modifications to the remedial design. No other modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions performed in the remaining portion of RA 5.

7.1.4 REMEDIAL AREA 6

Similar to RA 5, the remedial actions performed in RA 6 were modified due to the presence of utilities crossing the waterway. Additionally, a portion of RA 6 was capped in response to chemical concentrations exceeding the SQOs in post-dredge sampling. The modification to the remedial design and response action in RA 6 will be reviewed to evaluate and identify future O&M activities and revisions to the OMMP.

Submerged, buried utilities were identified to cross the Thea Foss Waterway south of the 11th Street Bridge. Additional sediment sampling and analysis was performed to characterize sediment in the northern portions of RAs 5, 6 and 7, to evaluate the potential for modification of remedial actions in the area of the utility crossings. The detected chemical concentrations were below the SQOs in the two samples collected from the northern portion of RA 6 (Section 3.1.4.7.1).

Based on the location of the utility crossings and the results of sediment sampling and analysis, the remedial actions in the northern portion of RA 6 were modified. In the area north of Station 37+10 the remedial action was modified from dredging to natural recovery. The remedial actions were not modified in the area south of Station 37+10 except that three feet of channel sand cap material was placed as backfill on the transitional slope that was cut from the existing sediment surface in the natural recovery area north of Station 37+10 to the design dredge depth of -31 feet MLLW south of Station 37+10.

The OMMP requirements for natural recovery monitoring will be reviewed for the northern portion of RA 6 based on the modifications to the remedial design.

Additionally, capping was performed in a grid area located in the southwestern portion of RA 6 in response to chemical concentrations exceeding the SQOs following dredging (Section 3.1.4.7.2). The remedial design for RA 6 in this area was dredging to remove all sediment with chemical concentrations greater than the SQOs. A thick channel cap

comprised of three feet of channel sand cap material was placed in the grid area in response to the exceedences.

The OMMP requirements for cap integrity and recontamination monitoring will be reviewed for RA 6. No other modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions performed in the remaining portion of RA 6.

7.1.5 REMEDIAL AREAS 7 AND 7A

Similar to RAs 5 and 6, the remedial actions performed in RA 7 were modified due to the presence of utilities crossing the waterway. Additional sediment sampling and analysis was performed to characterize sediment in the northern portions of RAs 5, 6, and 7, to evaluate the potential for modification of remedial actions in the area of the utility crossings.

The detected chemical concentrations were less than the SQOs in the sample collected from the northernmost portion of RA 7 between Stations 35+00 and 36+30 (Section 3.1.5.8.1). The detected concentration of a pesticide was greater than the SQO but less than the 2nd Lowest Apparent Effects Threshold (2LAET) criteria in the sample collected between Stations 36+30 and 37+10.

Based on the location of the utility crossings and the results of sediment sampling and analysis, the remedial actions in the northern portion of RA 7 were modified. In the area north of Station 36+30, the remedial action was modified from enhanced natural recovery to natural recovery. The remedial actions were not modified in the area south of Station 36+30.

The OMMP requirements for natural recovery monitoring will be reviewed for the northern portion of RA 7 based on the modifications to the remedial design. No other modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions performed in the remaining portion of RAs 7 and 7A.

7.1.6 REMEDIAL AREA 8

Remedial actions performed in RA 8 included habitat enhancement in two areas that were not originally included in the remedial design. These habitat enhancement elements were added as part of the final design approval for the project. A benched habitat area was built in the central portion of RA 8. In addition, large woody debris (LWD) was added to an area of the southern portion of RA 8.

The OMMP requirements for mitigation / restoration site monitoring will be reviewed based on the construction of these habitat enhancement areas in RA 8. No other modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions performed in the remaining portion of RA 8.

7.1.7 REMEDIAL AREA 9

The remedial design identified RA 9 as a dredge and backfill area. Post-dredge sample results indicated that the average chemical concentrations were greater than the SQOs

in RA 9 and, therefore, the channel sand material placed in RA 9 constitutes a cap rather than a backfill. The thick channel cap is comprised of three feet of channel sand cap material.

The OMMP requirements for cap integrity and recontamination monitoring will be reviewed for RA 9.

7.1.8 REMEDIAL AREA 12

Post-dredge sample results indicated that the average chemical concentrations were less than the SQOs in RA 12 and, therefore, the channel sand cap material placed in RA 12 constitutes a backfill. Therefore, no modifications to the O&M requirements outlined in the OMMP are necessary as a result of remedial actions in RA 12.

An area adjacent to northeastern boundary of RA 12 contained a lens of wood that emitted a petroleum hydrocarbon sheen. Excavation was performed to remove the wood and petroleum hydrocarbons and channel sand cap material was placed in the excavated area.

Post-dredge (i.e., post-excavation) sample results indicated that the average chemical concentrations were greater than the SQOs in the excavation area adjacent to the northeastern boundary of RA 12 and, therefore, the channel sand material placed in the excavation area constitutes a cap. The thick cap is comprised of three feet of channel sand cap material.

The OMMP requirements for cap integrity and recontamination monitoring will be reviewed for the area adjacent to RA 12.

7.1.9 REMEDIAL AREA 14

No modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions in RA 14. Cap integrity monitoring and collection and analysis of slope cap monitoring samples are specified as part of O&M requirements for RA 14.

7.1.10 REMEDIAL AREA 15

No modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions in RA 15. Cap integrity monitoring and collection and analysis of slope cap monitoring samples are specified as part of O&M requirements for RA 15.

7.1.11 REMEDIAL AREA 16

The remedial design for RA 16 was dredging to remove all sediment with chemical concentrations greater than the SQOs. However, capping was performed in two grid areas located in the northern and central portions of RA 16 in response to chemical concentrations exceeding the SQOs in post-dredge samples (Section 3.1.11.8.1). A thick cap comprised of three feet of channel sand cap material was placed in the grid areas with chemical concentrations exceeding the SQOs.

The OMMP requirements for cap integrity and recontamination monitoring will be reviewed for these capped portions of RA 16. No other modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions performed in the remaining portions of RA 16.

7.1.12 REMEDIAL AREA 17

The remedial design for RA 17 was dredging to remove all sediment with chemical concentrations greater than the SQOs. However, capping was performed in two grid areas located in the central and southern portions of RA 17 in response to chemical concentrations exceeding the SQOs in post-dredge samples (Section 3.1.12.7.1). A thick channel cap comprised of three feet of channel sand cap material was placed in the grid areas with chemical concentrations exceeding the SQOs.

The OMMP requirements for sample collection and analysis of cap integrity and recontamination monitoring will be reviewed for the capped portions of RA 17. No other modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions performed in the remaining portion of RA 17.

7.1.13 REMEDIAL AREA 18

No modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions performed in RA 18. Cap integrity monitoring and collection and analysis of recontamination monitoring samples are specified as part of O&M requirements for RA 18.

7.1.14 REMEDIAL AREAS 19A AND 19B

No modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions in RAs 19A and 19B. Cap integrity monitoring and collection and analysis of recontamination monitoring samples are specified as part of O&M requirements for RAs 19A and 19B.

7.1.15 REMEDIAL AREA 20

Remedial actions performed in RA 20 included habitat enhancement along a portion of the shoreline that was not originally included in the remedial design. A requirement to place LWD on the shoreline area in the south central portion of RA 20 was added during the final design approval process.

The OMMP requirements for mitigation / restoration site monitoring will be reviewed based on the construction of the habitat enhancement in RA 20. No other modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions performed in remaining portion of RA 20.

7.1.16 REMEDIAL AREA 21

No modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions in RA 21. Cap integrity monitoring and collection and analysis of recontamination monitoring samples are specified as part of O&M requirements for RA 21.

7.1.17 REMEDIAL AREA 22

No modifications to the requirements outlined in the OMMP are necessary as a result of remedial actions in RA 22. Cap integrity monitoring and collection and analysis of recontamination monitoring samples are specified as part of O&M requirements for RA 22.

7.1.18 ST. PAUL WATERWAY CDF

No modifications to the requirements outlined in the OMMP are necessary as a result of construction of the CDF. Groundwater quality monitoring is specified as part of O&M requirements for the CDF.

7.2 HABITAT/MITIGATION SITES

7.2.1 NORTH BEACH HABITAT – PENINSULA HABITAT & ST. PAUL BEACH HABITAT

No modifications to the requirements outlined in the OMMP are necessary as a result of construction of the North Beach Habitat - Peninsula Habitat and St. Paul Beach Habitat sites. Mitigation / restoration site monitoring is specified as part of O&M requirements for the North Beach Habitat - Peninsula Habitat and St. Paul Beach Habitat sites.

7.2.2 MIDDLE WATERWAY CORRIDOR HABITAT

No modifications to the O&M requirements outlined in the OMMP are necessary as a result of construction of the Middle Waterway Corridor Habitat site. Mitigation / restoration site monitoring is specified as part of O&M requirements for the Middle Waterway Corridor Habitat site.

7.2.3 MIDDLE WATERWAY TIDEFLAT HABITAT

No modifications to the requirements outlined in the OMMP are necessary as a result of construction of the Middle Waterway Tideflat Habitat (MWTH) site. Mitigation / restoration site monitoring is specified as part of O&M requirements for the MWTH site.

7.2.4 PUYALLUP RIVER SIDE CHANNEL

No modifications to the requirements outlined in the OMMP are necessary as a result of construction of the Puyallup River Side Channel (PRSC) Habitat site. Mitigation / restoration site monitoring is specified as part of O&M requirements for the PRSC Habitat site.

7.2.5 HYLEBOS CREEK MITIGATION SITE (BUNKER PROPERTY)

This site was added to the project as part of the final design approval process. O&M requirements for this mitigation/restoration area will be included in the OMMP.

7.2.6 BERG SCAFFOLDING MITIGATION SITE

Remedial actions performed in the Utilities project area included habitat enhancement along the southeastern shoreline adjacent to the Berg Scaffolding property that was not originally included in the remedial design. A bench habitat area was added to the project as part of the final design approval process. This bench was constructed along the eastern shoreline from south of the SR 509 Bridge to the head of the waterway in the Utilities project area.

Mitigation / restoration site monitoring is specified in the draft OMMP and will be reviewed based on the construction of this habitat enhancement in the Utilities' project area.

7.2.7 SR 509 BRIDGE / ESPLANADE MITIGATION SITE

Remedial actions performed in the Utilities project area included habitat enhancement along the western shoreline beneath and adjacent to the SR 509 Bridge that was not originally included in the remedial design. This habitat enhancement area was added as part of the final design approval process. A habitat bench was constructed along the western shoreline from approximately 100 feet on the north side of the SR 509 Bridge to approximately 100 feet south of the bridge in the Utilities project area.

Mitigation / restoration site monitoring is specified in the draft OMMP and will be reviewed based on the construction of this habitat enhancement in the Utilities' project area.

7.3 PUYALLUP RIVER DELTA / BORROW AREA

No O&M is required for the Puyallup River Delta Augmentation Area. The Puyallup River Borrow Area was not utilized as part of this project.

7.4 DOCK STREET MARINA

Construction of the Dock Street Marina was completed and fully accepted by the FWDA on June 21, 2005. All equipment manuals were turned over to the marina operators upon completion, and O&M of the marina is the responsibility of the FWDA.

7.5 SIMPSON ACTIVITIES

7.5.1 SIMPSON LOG HAUL ROAD

No O&M is required for the Simpson Log Haul Road.

7.5.2 SIMPSON FUEL DOCK

Relocation/modification of the Simpson Fuel Dock was completed December 30, 2003. The completed Fuel Dock was turned over to Simpson on completion of the Final Inspection and transfer of the equipment manuals. O&M of the Fuel Dock is the responsibility of Simpson.

7.5.3 SIMPSON LOG HAUL OUT FACILITY

The Simpson Log Haul Out Facility (LHOF) was completed July 29, 2004, and received the certificate of occupancy on February 24, 2005. The completed LHOF was turned over to Simpson on completion of the Final Inspection and transfer of the equipment manuals. O&M of the LHOF is the responsibility of Simpson.

8.0 SUMMARY OF PROJECT COSTS

The following is an estimated cost accounting for each Remedial Area/construction site for costs incurred on the project:

CDF Construction and Sediment Disposal	$12,613,774.68
Sheetpile Wall at Johnny's Dock	$2,328,638.44
Peninsula Habitat	$704,869.19
Middle Waterway Corridor Habitat	$2,858,058.82
Puyallup River Side Channel	$5,931,214.61
Grout Mat RA 19A and 19B	$879,681.31
Dredge and Cap Thea Foss and Wheeler-Osgood Waterways	$11,553,725.88
Middle Waterway Tideflat Habitat	$463,053.78
Hylebos Creek Mitigation Site	$908,547.84
Miscellaneous Construction Activities	
Fuel Pier	$942,840.61
Log Haul Out Facility	$2,282,256.59
LHOF Road Construction	$1,838,052.06
Dock Street Marina	$5,234,505.77
Environmental Controls	$4,908,602.25
Administrative Costs	$1,371,733.33
Existing Structures in Thea Foss and Wheeler-Osgood Waterways Demo/Protect/Rebuild	$3,751,511.20
Total Project Costs	**$58,571,066.36**

The following is the final cost accounting for each Remedial Area/construction site as reported in the Remedial Action Construction Report for 2002 Construction Activities:

Johnny's Seafood	$1,061,417
Martinac Shipbuilding	$716,561
St. Paul/Middle Waterway Peninsula Timber Piling Removal	$650,130
Thea's Park	$1,117,030
Totem Marine	$1,292,141
Wheeler-Osgood Waterway Remediation	$647,115
Total Estimated Direct Cost	$5,484,516
Mobilization/Demobilization	$250,000
Total Estimated Cost	**$5,734,516**

8.1 EPA OVERSIGHT COSTS

In accordance with Section XVII, Paragraph 57 of the Consent Decree for the site, the City of Tacoma (City) will be responsible for paying the U.S. Environmental Protection Agency's (EPA) oversight costs in accordance with the National Contingency Plan, excluding the first $1,260,000.00. No billings have been received by the City at this time.

8.2 COST AND PERFORMANCE SUMMARY

The following presents the project costs for all work under the Administrative Order on Consent (AOC), Unilateral Administrative Order (UAO), and Consent Decree (CD). Because there is no active process in the remedy scheme, there are no operating parameters that affected cost and performance.

The following conditions and characteristics were most influential (but in no particular order) on the cost of the performance of the remedy:

- Design approval came after the construction contract was publicly bid and, therefore, change orders were required to complete the work in accordance with the approved plans and specifications;
- Filling the CDF did not use up as much space as anticipated (i.e., dredge quantity was low and dredge material did not bulk up), therefore, a substantial additional quantity of import cap material was required to bring the former St. Paul Waterway up to final grade;
- In some instances, dredge to clean areas did not test clean and required re-dredging and /or capping; and
- A dredging activity on this project was associated with contaminants on an adjacent sediment cleanup, requiring additional study and placement of additional capping.

Investigation		
Hart Crowser		$7,019,999
City Staff, Lab, Consulting		$1,501,416
EPA Oversight		$1,231,977
Arbitration		$1,293,070
Foss Source Control		$749,198
	Subtotal	$11,795,660
Design		
Hart Crowser		$3,008,571
City Staff, Lab, Consulting		$643,464
Simpson Design Costs		$1,300,000
EPA Oversight		$527,990
	Subtotal	$5,480,025
Construction		
Contractors		$63,487,371
Construction Monitoring and Oversight		$11,074,858
Payments to Existing Marinas for Lost Business		$240,000
Operation of Marinas		$229,006
	Subtotal	$75,031,235
Post Remedy O&M (Estimated)		
Long Term Monitoring		$1,139,000
Habitat Monitoring		$1,021,000
	Subtotal	$2,160,000
Insurance Premiums		
Simpson Insurance Policy		$511,607
	Subtotal	$511,607
Community Relations		
EnviroIssues		$49,999
	Subtotal	$49,999
	Total Cost	$95,028,526

The following presents the total expenditures on the Thea Foss and Wheeler-Osgood Waterways compared to the estimate from the 1989 Record of Decision (ROD). The figures from the ROD were converted to 2006 dollars for comparison. Overall, the ROD estimate underestimated the total cleanup costs.

	City Costs	Utilities Costs	Total Costs	ROD (2006 $$)
Investigation	$11,795,660	$725,977	$12,521,637	
Design	$5,480,025	$2,198,458	$7,678,483	
Construction	$75,031,235	$7,186,588	$82,217,823	
Insurance Premiums	$511,607	$333,384	$844,991	
Community Relations	$49,999	$11,479	$61,478	
	$92,868,526	$10,455,886	$103,324,412	$16,728,234
Post Remedy O&M (Estimated 10 years)	$2,160,000	$1,003,480	$3,163,480	
	$2,160,000	$1,003,480	$3,163,480	$3,886,780
Total Cost	$95,028,526	$11,459,366	$106,487,892	$20,615,014

9.0 OBSERVATIONS AND LESSONS LEARNED

The following comments are generally applicable lessons learned and relate to the overall project.

9.1 FLEXIBILITY ON REGULATORY DECISIONS IS KEY IN MAINTAINING SCHEDULE

The U.S. Environmental Protection Agency (EPA) and other agencies were particularly helpful in objectively evaluating the City of Tacoma's (City) requests for flexibility on the construction means and methods which helped maintain the project schedule. Specifically, two actions had a significant positive effect on the schedule for completion of the work:

- Extensions of the in-water work window for critical elements of the work allowed the contractor to recover significant amounts of time where work had exceeded the duration that had been estimated and reflected in the schedule; and
- Approval of the re-handling of limited amounts of dredge material by clamshell to hydraulic dredge allowed the St. Paul Waterway Confined Disposal Facility (CDF) to be closed on schedule.

In addition, EPA helped the project by reviewing draft submittals on short turn-around times. EPA also allowed some elements of the work to begin before remedial design approval through the issuance of interim Water Quality Certifications.

9.2 U.S. ARMY CORPS OF ENGINEERS CONSTRUCTION OVERSIGHT

The U.S. Army Corps of Engineers (Corps), through a cooperative agreement with EPA, provided continual construction oversight on the project. The field representatives were knowledgeable in all aspects of dredging, capping, and related activities. Not only did they understand the complexities of the project and some of the difficulties encountered, they often provided recommendations and observations based upon their experience with similar work.

Corps representatives were a valuable resource during construction due to their experience with dredging and capping activities. They also proved to be a valuable liaison between the Construction Management Team (CM Team) and other departments within the Corps when coordination was required.

9.3 SEQUENCING WITH IMMEDIATELY ADJACENT REMEDIATION PROJECTS

While the Thea Foss and Wheeler-Osgood Waterways Remediation Project involved the majority of the waterway, the head of the waterway was remediated under a separate contract, managed by others collectively referred to as the "Utilities". The Utilities' project was completed and capped prior to the City beginning dredging on the remainder of the waterway.

Consequently, when the City came to dredge its area some contamination of the Utilities' area occurred immediately adjacent to the southern limits of the City's dredging. The contamination was attributed to the transport of construction residuals. This occurred despite the City's best efforts to prevent it by:

- Regulation of the speed of the dredge bucket;
- Use of an environmental bucket;
- Deployment of containment booms;
- Intensive water quality monitoring; and
- Oversight of the construction activity by representatives of the City, the Utilities, EPA, and the Corps.

Although the City adjusted its capping sequence within its own work area to mitigate the potential of recontamination through construction residuals, the presence of the Utilities' completed cap was pre-existing and the range of mitigation measures employed to prevent contaminating it were not effective.

The City believes that consideration should be given to the timing of adjacent projects to mitigate or prevent one project's activities from possibly damaging the completed work of the other.

The City, in coordination with the Utilities and EPA, implemented a corrective action within the Utilities' project area. The corrective action included placement of additional capping material in the portion of the Utilities' project area affected by construction residuals, and confirmation sampling to verify compliance with the sediment quality objectives (SQO). Chemical concentrations were less than the SQOs in the area affected by construction residuals upon completion of the corrective action. Information concerning implementation of the corrective action and the results of compliance sampling are presented in Appendix G.

9.4 CAPPING IN RESTRICTED AREAS

As with many in-water remediation projects, this project required capping in areas with severely restricted access. Capping was required under piers, covered moorage, and within marinas where traditional methods of placement with a derrick and clamshell or a short conveyor hung from a derrick was impossible due to limited reach or overhead cover.

The CM Team suggested that capping in these areas be done with a Telebelt, which is a truck-mounted extendable conveyor with a reach of up to 130 feet. The contractor accepted the suggestion and modified a small flat deck barge to carry the Telebelt and hopper for cap material. The hopper was fed from a separate material barge by front end loader. With a 130-foot reach and the ability to swing 360 degrees, the Telebelt proved to be ideal for capping in restricted areas with material up to four inches in size.

This innovative capping method was a lesson learned that may have application in other projects.

9.5 REMEDIAL ACTION CONSTRUCTION SCHEDULE

The City and EPA disagreed on the basis for the Enforceable Schedule for the Remedial Action required by the Consent Decree. The City proposed an enforceable schedule based upon its contract provisions with Manson Construction Company (Manson) as detailed in the plans and specifications. However, EPA required that the enforceable schedule be based upon the contractor's working schedule submittal.

The City objected to EPA, stating that the contractor's working schedule submittal:

- Was incomplete and missing activities;
- Appeared to have optimistic completion dates for many activities; and
- Was a tool the contractor used to plan his work and would be subject to many modifications as the complexities of the job unfolded and unexpected conditions were discovered.

EPA rejected the City's objection and adopted the dates on the contractor's schedule as the basis for the enforceable schedule.

The City believes that the enforceable schedule for a competitively bid public works project should be based on the provisions of the plans and specifications and not the contractor's working schedule submissions.

9.6 ELECTRONIC DOCUMENTATION MANAGEMENT

The CM Team selected a web-based Electronic Document Management Service (EDMS) for the transmittal, filing, and sharing of all project records. The benefits of this service included:

- On-site and remote access to all project documents for those involved in the project;
- An electronic filing system that allowed documents to be easily linked to related documents and information, and to be filed in multiple locations such as by project location, by specification section, and by type of document;
- The immediate electronic dissemination of information eliminated the need for multiple copies and time consuming copy distribution;
- A historical, date-stamped record of all actions and persons involved in the initiation, review, response and disposition of all documents;
- A significant reduction in clerical staff required; and
- Simplified search and retrieval of filed documents.

It would have been very helpful to have email as an integral part of this service but it was not available and email documents had to be linked to records within the EDMS.

9.7 FULL-TIME COMMUNITY RELATIONS STAFF PERSON IS ESSENTIAL

The City assigned a full-time Community Relations Specialist to the project whose responsibilities included:

- Preparation of timely press releases with informative progress information and the schedule of upcoming work;
- Distribution of targeted information to residents, businesses, and users of the waterway concerning hours of operation and construction activities, including location on the waterway and equipment working;
- Establishment of a 24-hour hotline with information on the project and the ability for the caller to leave a message for personal response within hours of the call;
- Coordination of responses to all media inquiries related to the project; and
- Coordination of periodic private and commercial boat moves with boat owners and marina operators, and frequent updates of upcoming relocation requirements.

The presence of this individual on the project team removed much of the outside pressure and information requirements from the daily duties of the CM Team, allowing that group to focus on the complexities of construction.

9.8 IMMEDIATE HYDROGRAPHIC SURVEY CAPABILITY

To keep critical equipment efficiently working at all times without costly standby or unnecessary moves, it is necessary to have the capability for instant intermediate hydrographic surveys to confirm that required dredge limits or thickness of various cap layers had been achieved.

Manson, with its on-site, full time survey boat and staff, was able to immediately survey a discrete completed element of the dredging and capping and have the cross-sections printed on the survey vessel for immediate review on shore by the CM Team. Where deficiencies were noted, this provided the capability for instant feedback to the crew performing the work, for immediate corrective action or the approval to move on to another element of the work.

9.9 CHANNEL STATIONING

Three construction plan sheets in the construction documents included the channel base line that provided waterway stationing with 100-foot intervals. More specific plan sheets were provided for many of the areas along the sides of the waterway in the form of larger scale details. However, channel stationing was not included in those details. This created difficulty in relating the location of specific elements in the details to its relationship with the channel base line without the benefit of AutoCAD. In hindsight, provision of a tie to the channel base line in all large scale detail drawings would have been helpful.

For future work, we would recommend that the contractor be required to install visible, semi permanent markers on both sides of the waterway every 100 feet with stationing stenciled or otherwise provided on the marker with the appropriate station (e.g., Station 57+00). By lining up the markers on both sides of the channel, one would be able to quickly determine location.

10.0 COMMUNITY RELATIONS

As the cleanup proceeded, the City aimed to keep the many partners and stakeholders, city and county residents, businesses and other interested parties informed of every phase. Communications planning began with formal and informal primary research.

A formal telephone survey was conducted by Elway Research in November 2002, on behalf of the City's Environmental Services. The survey revealed that most of the City's residents considered environmental issues "critical" or "very important."

In May 2003, EnviroIssues conducted informal interviews with key community leaders, confirming that "a broad range of people and groups feel they have a stake in the cleanup and are proud to be associated with a cleaner Foss and a revitalized Tacoma." Leaders often described the project as "a good story" for the media, community, and broader Puget Sound region.

To carry out a comprehensive community outreach program, the City hired a full-time community relations specialist in July 2003, to direct project communications throughout the three years of major cleanup activities. The goals of the City's communications plan were to make project partners and stakeholders, city residents, and other interested parties understand and support the environmental and economic development benefits of the cleanup.

Communication for the City's role in the Thea Foss Waterway cleanup fell into three major categories and phases:

- Specific demolition and construction activities;
- Overview of project's significance to region and environment as a whole; and
- Public education on maintaining the waterway's restoration.

The following community relations activities were performed during the construction phase of the project.

10.1 ROUND-THE-CLOCK INFORMATION SOURCES

The City established the following ways for the community to access project information 24 hours a day:

- Hotline connected to a pager for quick response to citizen questions or complaints, which resulted in 12 calls in the first construction season, 17 calls in the second construction season, and no calls during the third construction season, covering a variety of topics including noise complaints, marina relocation questions, job or contract prospecting, and general project questions;
- Website updated frequently with construction schedule and project history;
- Email account monitored regularly, which resulted in 11 inquiries the first construction season, 18 in the second construction season, and 11 in the third construction season, including noise complaints, marina relocation

questions, general project inquiries, and community group presentation requests; and
- Large, full-color interpretive signs along the waterfront at key public gathering places were installed in the spring of 2004, with content to be updated after construction.

10.2 MEDIA RELATIONS

Recognizing that newspapers, TV, and radio news outlets reach thousands of people with one story and convey third-party credibility through their objective coverage, the City of Tacoma (City) launched an aggressive media relations campaign to make citizens aware of the cleanup project. The community relations specialist established ongoing relationships with local and regional reporters and actively pitched stories to a variety of media.

In October 2003, the City participated with the U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), Department of Natural Resources, other resource agencies, environmental groups and Potential Responsible Parties (PRP) on a media boat tour of Commencement Bay Superfund sites. The boat tour resulted in dozens of newspaper, TV and radio stories on cleanup of the whole bay.

Media coverage was consistent through construction, with numerous stories featuring the cleanup activities, issues arising during the cleanup, and related economic development along the waterfront and included:

- Newspaper stories, including front-page articles in The News Tribune as well as coverage in the Seattle Times, Seattle Post-Intelligencer, Seattle Daily Journal of Commerce, The Associated Press and Business Examiner;
- TV stories on KING 5 News;
- In-depth segments on TV Tacoma's Cityline program;
- Radio stories on KPLU and KIRO;
- Story in Sea Magazine; and
- Inclusion as one of the Seattle Daily Journal of Commerce's "Top 20 Public Projects of 2003".

Publicity included stories on topics such as:

- Recontamination on previously cleaned areas of the Foss;
- EPA threat of stipulated penalties for missing two interim construction deadlines;
- Unexploded ordnance discovered at the Puyallup River Side Channel site;
- Effluent pipeline break at Simpson:
- Receipt of MTCA grant funding;
- Tie-in between cleanup and redevelopment; and
- Completion of hydraulic dredging.

Despite the setbacks, media coverage continued to be relatively positive, with reporters more comfortable making the connection between environmental cleanup and economic development.

10.3 TARGETED COMMUNICATIONS

While waterway residents, businesses and boat owners all had a vested interest in general cleanup news and schedules, specific audiences wanted more targeted messages. Marina managers and boat owners, for instance, wanted to know how boat relocation plans would work and perhaps provide opportunities to reconfigure marinas during the cleanup. The new fine art glass gallery, on the other hand, wanted to know how and when construction vibration might affect their inventory.

The City developed several ways to reach separate audiences with the specific information they needed, including:

- Full-color fold-out fact sheet to explain project scope, general schedule, cost, and what citizens could do to help keep the waterway clean;
- Periodic Dredge Report newsletters mailed to business owners, residents, resource agency representatives, and other citizens interested in the project;
- Periodic emails (weekly during heavy construction) to a distribution list including interested residents, businesses, agencies, and environmental groups affected by or affiliated with the cleanup, including: Simpson Investment Company, Thea's Landing, Museum of Glass, Port of Tacoma, Citizens for a Healthy Bay (CHB) and Foss Waterway Development Authority (FWDA);
- Coordination with other points of contact within the City (City Manager's Office, Public Works Department, Mayor's Office, Tacoma Police Department) to ensure quick, accurate response;
- On-site community relations staff checking in with waterway businesses and residents during particularly noisy or disruptive work;
- Informational articles placed in publications from other agencies, including EPA and CHB; and
- Pre-construction partnering session with CM Team members, contractors, and agency representatives to facilitate communication.

10.4 EVENTS AND PRESENTATIONS

To reach citizens beyond the waterway, the City maintained a presence at such community events as Maritime Fest, Farmers Market, Livable Communities Fair and University of Washington Tacoma's Science Day. Booths included knowledgeable project representatives, informational handouts, reference aerial photos and maps, and a hands-on dredging activity for kids.

The City and its contractors also presented information about the cleanup project to such community groups as Washington Hydrologic Society, Puyallup River Watershed Council, Environmental Services Citizen Advisory Panel, Evergreen State College students, University of Washington students, Clover Park Technical College students, Thea's Landing residents, FWDA board members, Rotary 8's Protect Planet Earth

Committee, Puget Sound Action Team, and the EPA National Estuary Program. The City also participated with EPA and CHB on a presentation at EPA's national community involvement conference in Denver, focusing on elements of a successful community relations campaign. Finally, City staff presented information about the cleanup, the operations and maintenance requirements for the project, and institutional controls at the Annual Waterway Stewardship Meetings sponsored by the Foss Waterway Development Authority.

10.5 PUBLIC EDUCATION AND STEWARDSHIP

The City EnviroChallenger Program, which provides environmental lessons to more than 900 Tacoma elementary school classrooms each year, added information about cleanup activities to reinforce messages in its lessons on water quality, watersheds, and the life cycle of a salmon. Post-assessment materials with nonpoint source pollution lessons were sent home with students to discuss with their families.

In partnership with the Tacoma-Pierce County Health Department (TPCHD), the City is encouraging all Thea Foss Waterway marinas to pursue EnviroStars certification as a way to demonstrate their commitment to environmental stewardship of the waterway. At time of publication, all but one of the waterway marinas has received EnviroStars certification.

The City also partnered with CHB on a surface water education program, supported by $36,000 in Public Involvement and Education money from the Puget Sound Water Quality Action Team. The "Only Rain in the Drain" nonpoint source pollution education program, which targeted one area of the City that drains into the Thea Foss Waterway, focused messages on the way residents wash and maintain their cars through doorbelling, direct mail, Web, workshops, community events and school lessons. The City evaluated results with a baseline and end survey of resident knowledge, attitudes and behavior, as well as monthly monitoring at the outfall for contaminants associated with cars. Results were compared with surveys and monitoring of an adjacent outfall area used as a control group. As the City and CHB evaluated results at various points in the year-long campaign, methods and messages were refined to better meet the needs of the participants. The City plans to use final results to replicate successful campaign elements to other parts of the City and extend the messages to other everyday citizen behaviors that might contribute to nonpoint source pollution.

As a key partner in the proposed Urban Waters marine research center, the City also provided community relations support to secure contributions from the Port of Tacoma and SSA Marine to endow an environmental science chair at the University of Washington. The City also is considering a research grant that will mark the capstone in the endowment, making urban marine research a reality. Even before a facility is built, as envisioned on the east side of the Thea Foss Waterway, research planning has begun. Initial research will focus on stormwater technologies, sediment bioremediation and other marine biotechnology, as well as aquaculture and the invasive species that sometimes travel in ballast water.

11.0 OPERABLE UNIT CONTACT INFORMATION

Contact Information for representatives for the various involved organizations are as follows:

City of Tacoma: Project Manager	Mary Henley City of Tacoma Public Works Department Environmental Services Science and Engineering 2201 Portland Avenue Tacoma, WA 98421-2711 253-502-2113
KPFF: Construction Manager	Bill Conley KPFF Consulting Engineers 101 Stewart Street, Suite 800 Seattle, WA 98101 206-382-0600
EPA: Remedial Project Manager	Piper Peterson Lee U.S. EPA, Region 10 1200 Sixth Avenue Seattle, WA 98101 206-553-4951
Corps: EPA Contractor	Kym Takasaki U.S. Army Corps of Engineers 4735 E. Marginal Way S. P.O. Box 3755 Seattle, WA 98124-3755 206-764-3322
URS: EPA Contractor	Kara Steward URS Corporation 1501 Fourth Avenue, Suite 1400 Seattle, WA 98110 206-438-2700
Contractor:	Bruce Gordon Manson Construction Company 5209 E. Marginal Way S. P.O. Box 24067 Seattle, WA 98124 206-762-0850

Property Owners:

Alber's Mill:	Sara Bartels Alber's Mill 1821 Dock Street Tacoma, WA 98402 253-627-5200
City of Tacoma:	Bill Iyall City of Tacoma Public Works - Engineering 747 Market Street, Room 520 Tacoma, WA 98402 253-591-5864
Colonial Fruit:	Kevin Trucco Colonial Fruit and Produce 1179 Dock Street Tacoma, WA 98402 253-272-2102
Department of Natural Resources:	Lindie Schmidt Department of Natural Resources 950 Farman St. N. P.O. Box 68 Enumclaw, WA 98022-0068 360-825-1631
Foss Landing:	Mike Norman Foss Landing 1940 E. D Street Tacoma, WA 98421 253-627-4344
Foss Waterway Development Authority:	Don Meyer Foss Waterway Development Authority 535 Dock Street, Suite 204 Tacoma, WA 98402 253-597-8122
Foss Waterway Marina:	Tracy McKendry 821 Dock Street Tacoma, WA 98402 253-272-4404
Globe Machine Manufacturing:	Cal Bamford Globe Machine Manufacturing 701 E. D Street Tacoma, WA 98421 253-383-2584

Johnny's Dock Restaurant & Marina:	Dave Bingham Johnny's Dock Restaurant 1900 E. D Street Tacoma, WA 98421 253-627-3186
Johnny's Seafood:	Gary Gerontis Johnny's Seafood 1199 Dock Street Tacoma, WA 98402 253-627-2158
Martinac Shipbuilding:	Joe Martinac, Jr. J.M. Martinac Shipbuilding Corp. 401 E. 15th Street Tacoma, WA 98421 253-572-4005
Museum of Glass:	Julie Pisto Museum of Glass 1801 Dock Street Tacoma, WA 98402 253-284-2129
Olympic Chemical Corp.:	Jerry Delcamp Olympic Chemical Corp. 1002 E. D Street Tacoma, WA 98421 253-872-5007
Petrich Marine Dock:	Clare Petrich Petrich Marine Dock 1118 E. D Street Tacoma, WA 98421 253-272-1005
St. Paul:	Dave McEntee Simpson Tacoma Kraft 917 E.11th Street Tacoma, WA 98421 253-680-6894
Thea's Landing:	Vivian Burks Thea's Landing 1705 Dock Street Tacoma, WA 98402 253-572-8432

Thea's Park:	Steve Knauer Metro Parks Tacoma 4702 S. 19th Street Tacoma, WA 98405 253-305-1000
Totem Marine Services:	LeRoy "Red" Westgard Totem Marine Services 820 E. D Street Tacoma, WA 98421 253-272-4404
Wheeler-Osgood:	Craig Wattles The Wattles Company 1203 E, D Street Tacoma, WA 98421 253-272-7205
	Bruce Sheppard Burlington Northern Santa Fe 2454 Occidental Ave. S. Seattle, WA 98134 206-625-6035
Woodworth & Company:	John Woodworth Woodworth & Company 1200 E. D Street Tacoma, WA 98421 253-383-3585

12.0 CERTIFICATION

The construction for the remedial action activities required by the SOW and as described in this report has been completed in full satisfaction of the requirements of the Consent Decree.

To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for known violations.

Wade Watson, P.E.
KPFF Consulting Engineers

Mary L. Henley, P.E.
City of Tacoma

Tables and Figures

Table 1
Cleanup Objectives and Performance Standards

CLEANUP OBJECTIVES AND PERFORMANCE STANDARDS	REMEDIAL ACTION OUTCOME
Commencement Bay Nearshore/Tideflats Record of Decision (ROD) – September 1989	
Relationship to Sediment Quality Objectives (see Sec 7.2.4, p.51) "As part of the remedial investigation/feasibility study, sediment quality objectives were required that could be used to: a) Identify problem chemicals in sediments b) Identify sources associated with problem chemicals c) Establish spatial designations of problem areas, especially in areas where site-specific biological testing results were not available."	Sediment Quality Objectives (SQOs) were developed as part of the Commencement Bay Nearshore / Tideflats Remedial Investigation / Feasibility Study that are utilized to identify problem chemicals, identify sources of problem chemicals, and define problem areas. The SQOs are the compliance criteria for remedial action surfaces including final dredge and capping surfaces per the Construction Quality Assurance Project Plan (CQAP) and project plans and specifications. The SQOs are presented in Table B-2 of Appendix B.
Relationship to Sediment Quality Objectives (see Sec 7.2.4, p.51) "Based on consideration of management and technical criteria and on results of a verification exercise with field-collected data, the AET approach was selected and confirmed as the preferred method for developing sediment quality values in the CB/NT area. An AET is the sediment concentration of a chemical above which statistically significant ($P \leq 0.05$) biological affects are always observed in the data set used to generate AET values."	SQOs based on the Apparent Effects Threshold (AET) are used as compliance criteria for remedial action surfaces including final dredge and capping surfaces per the CQAP and project plans and specifications. The final dredge and cap surfaces met the SQOs upon completion of remedial actions. See Sediment Verification Sampling and Analysis section for each RA in Section 3.0.
Sediment Cleanup Objectives and Extent of Contamination (see Sec 8.1, p.62) "The long-term sediment quality goal for Puget Sound, defined by PSWQA (1988) as the absence of acute or chronic adverse effects on biological resources or significant human health risk, was translated into a set of sediment quality objectives for the CB/NT site… As such, sediment quality objectives form the basis for both source control and sediment remedial actions."	The SQOs are the compliance criteria for remedial action surfaces including final dredge and capping surfaces per the Construction Quality Assurance Project Plan (CQAP) and project plans and specifications. The final dredge and cap surfaces met the SQOs upon completion of remedial actions. See Sediment Verification Sampling and Analysis section for each RA in Section 3.0.
Sediment Cleanup Objectives and Extent of Contamination (see Sec 8.1, p.62) "Sediment Quality objectives were also translated into sediment remedial action levels and source control levels. Sediment remedial action levels incorporate technical feasibility and cost considerations by incorporating mitigating factors such as natural recovery. The sediment remedial action level differentiates areas that exceed the sediment quality objective, but are predicted to recover naturally, from those that are more significantly contaminated and therefore require active remediation to achieve the sediment quality objectives. If natural recovery is predicted to be effective in achieving the cleanup objectives in a reasonable timeframe (10 years), then no sediment remediation would be required."	Sediment Remedial Action Levels (SRALs) were used to identify areas for active remediation during remedial design. Remedial actions were identified for areas that exceeded the SQO(s) and were predicted to exceed the SQO(s) in 10 years (i.e., reasonable timeframe) so that natural recovery was not an option.

CLEANUP OBJECTIVES AND PERFORMANCE STANDARDS	REMEDIAL ACTION OUTCOME
Sediment Cleanup Objectives and Extent of Contamination (see Sec 8.1, p.62) "…the long-term overall project cleanup objective was to attain sediment quality objectives."	The SQOs are the compliance criteria for remedial action surfaces including final dredge and capping surfaces per the CQAP and project plans and specifications. The final dredge and cap surfaces met the SQOs upon completion of remedial actions. See Sediment Verification Sampling and Analysis section for each RA in Section 3.0. Monitoring and compliance of natural recovery areas with the SQOs will be performed and evaluated as part of Operation, Maintenance, and Monitoring Plan (OMMP) activities.
Cleanup Objectives (see Sec 10.1, p.97) "The objective of the selected remedy is to achieve acceptable sediment quality in a reasonable timeframe… Because the objective of the selected remedy is to achieve the sediment quality goal in a reasonable timeframe, natural recovery is integrated into the overall remedy. Natural recovery considerations are used to identify sediment remedial action levels that delineated sediments that are allowed to recover naturally from those that require active sediment cleanup."	SRALs were used to identify areas for active remediation during remedial design. Remedial actions were identified for areas that exceeded the SQO(s) and were predicted to exceed the SQO(s) in 10 years (i.e., reasonable timeframe) so that natural recovery was not an option. Monitoring and evaluation of natural recovery areas will be performed as part of OMMP activities.
Cleanup Objectives (see Sec 10.1, p.97) "Habitat function and enhancement of fisheries resources will also be incorporated as part of the overall project cleanup objectives. For example, the physical characteristics and placement of material used for capping contaminated sediment in the marine environment will be required to provide a suitable substrate and habitat for aquatic organisms that may utilize that environment."	Approved capping materials were used to construct caps in the Thea Foss and Wheeler-Osgood Waterways.
Explanation of Significant Differences (ESD) – August 2000	
Commencement Bay Nearshore/Tideflats Record of Decision (see Sec B., p.3) "The cleanup objective for the remedial action, as described in Section 10 of the 1989 ROD, states that "the selected remedy is to achieve acceptable sediment quality in a reasonable time frame." "Acceptable sediment quality: is defined as "the absence of acute or chronic adverse effects on biological resources or significant human health risks". The ROD designated biological test requirements and associated sediment chemical concentrations referred to as sediment quality objectives (SQOs) to attain the cleanup objective for the CB/NT site. The PCB SQO was subsequently updated in the 1997 ESD. Habitat function and enhancement of fisheries resources were also identified as overall project cleanup objectives."	The SQOs were the compliance criteria for remedial action surfaces including final dredge and capping surfaces per the CQAP and project plans and specifications. The final dredge and cap surfaces met the SQOs upon completion of remedial actions. See Sediment Verification Sampling and Analysis section for each RA in Section 3.0. Habitat mitigation and enhancement areas were constructed as specified in the approved project plans and specifications.
Performance Requirements for Remedial Actions - Cap Requirements (see Sec IV A, p.11) "Caps will have a minimum thickness of three feet and will be constructed to address adverse impacts through four primary functions: 1. Physical isolation of the contaminated sediments for the ecological receptors; 2. Stabilization of the contaminated sediments, preventing resuspension and transport to other locations within the waterway	Caps consisting of approved materials were placed to a minimum thickness of 3 feet as part of remedial actions (except for enhanced natural recovery areas; i.e., thin capping).

CLEANUP OBJECTIVES AND PERFORMANCE STANDARDS	REMEDIAL ACTION OUTCOME
3. Reduction of contaminants transported through the groundwater pathway to levels that will that will not recontaminate surface sediments above the SQOs or adverse biological effect levels, or contaminate surface water at levels exceeding background concentrations or marine chronic water quality criteria; 4. Provide a cap surface that promotes colonization by aquatic organisms."	
Performance Requirements for Remedial Actions - Dredging and Confined Disposal (see Sec IV B, p.11) "Performance standards for dredging and confined disposal will be consistent with Clean Water Act and Rivers and Harbors Act requirements….Both the remediated waterways and the disposal sites will be subject to long-term monitoring to ensure that the selected remedy remains protective, including monitoring to ensure that surface sediments do not become recontaminated in the remediated waterways, and that marine chronic water quality standards or background concentrations are not exceeded in the surface water outside of the confined disposal sites."	The long-term monitoring of the Thea Foss and Wheeler-Osgood Waterways and St. Paul CDF will be performed as part of OMMP activities.
Performance Requirements for Remedial Actions - Natural Recovery and Enhanced Natural Recovery (see Sec IV C, p.11) "Natural recovery or enhanced natural recovery is an acceptable remediation approach at locations where sediment are marginally contaminated and are likely to recover to cleanup levels within the 10 year time frame specified in the ROD. At the CB/NT site, EPA considers marginally contaminated sediments as those with chemical concentrations less than the second lowest Apparent Effects Threshold (AET) value (the SQO is set at the lowest AET) or biological test results that do not exceed the minimum cleanup level (MCUL) value under Washington State Sediment Management Standards…Areas selected for natural recovery (including enhanced natural recovery) will require: (1) monitoring plans, (2) triggers for initiating contingent actions if the monitoring indicates natural recovery will not succeed in the 10 year time frame, and (3) contingent plans for active remediation if monitoring in interim years indicates natural recovery will not occur by year 10."	Areas were identified for natural recovery and enhanced natural recovery as part of design. Six inches of channel sand cap material was placed in RA 7A as enhanced natural recovery in accordance with the approved project plans and specifications. The Second Lowest Apparent Effects Threshold (2LAET) criteria are presented in Table B-2 in Appendix B. Monitoring and contingency actions for natural recovery and enhanced natural recovery areas will be performed as part of the OMMP activities.
Performance Requirements for Remedial Actions – Subsurface Contamination (see Sec IV D, p.12) "In order to meet SQOs in the long term, subsurface sediments must either meet SQOs or be isolated from the surface. Exposure of contaminated subsurface sediments may occur during the cleanup by dredging adjacent areas, through physical processes, such as storms or ship scour, or through future dredging or excavation. In order for subsurface contamination to remain in place, it must either be present at such low levels that it would not present a risk if it were exposed, or it must have a very low potential for exposure. These criteria have been applied in selecting the cleanup construction phases of the remediation."	Subsurface contamination was either removed so that the remaining sediment surface was less than the SQOs, in the case of "dredge to clean" remediation areas, or subsurface sediment with contaminant concentrations that exceed the SQOs was confined (i.e., isolated) by three feet of cap material, in the case of capped remedial areas, as part of remedial actions. Potential for erosion and scour were taken into account in selecting capping materials for various slope areas.

CLEANUP OBJECTIVES AND PERFORMANCE STANDARDS	REMEDIAL ACTION OUTCOME
Performance Requirements for Remedial Actions – Mitigation (see IV F, p.13) "All appropriate measures will be taken during remedial design, construction, and site maintenance to continue to avoid and minimize adverse impacts. Such measures that will be required by EPA include, but are not limited to, avoidance of fish-critical activity periods for in-water work, incorporation of "best-design" features and/or materials into remedial and compensatory mitigation plans that protect or enhance ESA-listed species, and creation or restoration of critical salmonid habitat. Additionally EPA will require compensatory mitigation plans to offset loss and other impacts to aquatic habitat and meet ESA responsibilities."	Appropriate measures were taken during construction to avoid and minimize adverse impacts to the Commencement Bay aquatic environment including water quality monitoring to monitor and control impacts from in-water construction activities, use of Best Management Practices (BMPs) (control of dredging and material placement speed, containment of debris with debris booms, use of oil absorbent booms, etc.) during construction, avoidance of construction during fish critical activities periods or use of BMPs and fish monitoring during construction when a work was performed during the fish window. Additionally, all planned habitat mitigation and enhancement areas were constructed in accordance with the approved project plans.
Statement of Work (SOW) – August 2002	
Cleanup Objectives (see Sec II B., p.3) "The cleanup objectives for the remedial action, as described in Section 10 of the 1989 ROD, state that "the selected remedy is to achieve acceptable sediment quality in a reasonable time frame" (CB/NT ROD, P. 97). Habitat function and enhancement of fisheries resources are also project cleanup objectives."	See response to ROD cleanup goals and performance standards provided above.
Acceptable Sediment Quality in a Reasonable Time Frame (see Sec II B. 1., p.3) "Acceptable sediment quality" is defined as "the absence of acute or chronic adverse effects on biological resource or significant human health risk" (CB/NT ROD, p. 62). The ROD designated biological test requirements and associated sediment chemical concentrations referred to as sediment quality objectives (SQOs) to attain cleanup objectives for the CB/NT site… A "reasonable time frame" incorporates the ROD's selection of natural recovery for sediment in the CB/NT site that are minimally contaminated and are predicted to naturally recover within 10 years from implementation of the remedial action in any given problem area."	The SQOs were the compliance criteria for remedial action surfaces including final dredge and capping surfaces per the CQAP and project plans and specifications. The final dredge and cap surfaces met the SQOs upon completion of remedial actions. See Sediment Verification Sampling and Analysis section for each RA in Section 3.0. Monitoring of natural recovery areas will be performed as part of OMMP activities.
Habitat Function and Enhancement of Fisheries Resources (see Sec II B. 2., p.4) "Habitat function and enhancement of fisheries resources have also been incorporated as part of the overall project cleanup objectives and remedial design. For example, the physical characteristics and placement of material used for capping contaminated sediments in the marine environment will be required to provide a suitable substrate and habitat for aquatic organisms that may utilize that environment."	Habitat mitigation and enhancement were constructed as specified in the approved project plans. Construction of habitat areas was performed using the approved materials specified in the project plans.

CLEANUP OBJECTIVES AND PERFORMANCE STANDARDS	REMEDIAL ACTION OUTCOME
Cap Requirements (see Sec III A., p.6) "Performing Defendant shall demonstrate that all capped areas are completed in accordance with the performance standards identified in the Final Design… As-builts shall be provided for each capped RA in the Remedial Action Construction Report."	All caps were completed in accordance with the performance standards identified in the Final Design. Capping activities and subsequent verification monitoring performed in each area are described in Section 3.0. Figures showing the as-built conditions in each RA are presented in Figures 4 through 7.
Dredging and Confined Disposal (see III B. p.6) "Performance standards for dredging and the confined disposal site shall be consistent with the CB/NT ROD and ARARs including the Clean Water Act, Rivers and Harbors Act, and Endangered Species Act Requirements… Performing Defendant shall implement the dredging of Remedial Action areas necessary to achieve SQOs for those areas EPA has determined will not naturally recover within 10 years. Contaminated sediment shall be dredged and disposed of in the St. Paul confined disposal facility… As-builts of all dredged surfaces shall be provided to EPA in the Remedial Action Construction Report. Performing Defendant shall document to EPA quantities (in-place volumes), and disposal location (e.g., St. Paul or other appropriate disposal option identified in the ESD) for each RA dredged from the Thea Foss and Wheeler Osgood Waterways. The Final Design shall identify the following specific criteria. ▪ Excavate sufficient existing material from the St. Paul Waterway to optimize the disposal capacity relative to use of the site for disposal of dredged material from the Thea Foss and Wheeler Osgood Waterways; ▪ Place contaminated sediments dredged from the Foss and Wheeler Osgood Waterways in the St. Paul Confined Disposal Facility; ▪ Determine the volume of sediments suitable for open-water disposal or beneficial reuse. …Verification that performance standards, including SQOs, have been achieved shall be documented in the pre-final construction reports, and in documentation required by the OMMP, as appropriate."	The design for remedial action for the Thea Foss and Wheeler-Osgood Waterways remediation project, including construction and disposal of contaminated sediment in the St. Paul CDF, were developed based on the considerations identified in the SOW. Figures presenting the as-built conditions are presented in Figures 4 through 11, Figure 13, and Figure 15. Verification that performance standards have been achieved is documented in Section 3.0 and in the Final Inspection Reports presented in Appendix D. Monitoring of habitat areas will be performed in accordance with the project OMMP.
Natural Recovery (see III C. p.7) "For those areas selected for natural recovery Performing Defendant has (1) prepared monitoring plans, (2) identified triggers for initiating additional response actions if the monitoring indicates natural recovery will not succeed in the ten (10) year time frame, and (3) specified additional response actions for active remediation if monitoring in interim years indicates natural recovery will not occur by year ten (10). These elements primarily addressed in the OMMP for the Site and other deliverables, as appropriate."	Areas were identified for natural recovery as part of design. Monitoring and contingency actions for natural recovery areas will be performed as part of the OMMP activities.

CLEANUP OBJECTIVES AND PERFORMANCE STANDARDS	REMEDIAL ACTION OUTCOME
Subsurface Contamination (see III D. p.7) The Final Design includes dredging or containing all areas of subsurface contamination that EPA determined had a high to moderate potential for future exposure… Exposure of contaminated subsurface sediments may occur during the cleanup by dredging adjacent areas, through physical processes, such as storms or ship scour, or through future dredging or excavation. In order for subsurface contamination to remain in place, it must either be present at such low levels that it would not present a risk if it were exposed, or it must have a very low potential for exposure. The Performing Defendant shall implement the remedial action to ensure that contaminated subsurface sediment is not exposed and that SQOs are achieved at the surface of every dredge cut, either by dredging to uncontaminated sediments, or by capping over dredge cuts with SQO exceedences."	Subsurface contamination was either removed so that the remaining sediment surface was less than the SQOs, in the case of "dredge to clean" remediation areas, or subsurface sediment with contaminant concentrations that exceed the SQOs was confined (i.e., isolated) by three feet of cap material, in the case of capped remedial areas, as part of remedial actions. Potential for erosion and scour were taken into account in selecting capping materials for various slope areas.
Habitat Mitigation (see III E. p.7) "Performing Defendant shall take all appropriate measures during construction, and site maintenance to avoid and minimize adverse impacts to the aquatic environment. Such measures required by EPA include, but are not limited to, avoidance of fish-critical activity periods for in-water work, incorporation of "best-design" features and/or materials into remedial and compensatory mitigation plans that protect or enhance EPA-listed species, or protect, create or restore critical salmonid habitat. Additionally, Performing Defendant shall implement compensatory mitigation plans to offset unavoidable loss and other impacts to aquatic habitat and meet ESA responsibilities… Under this SOW, the Performing Defendant shall implement the final compensatory mitigation plan included in the Final Design as well as a long-term monitoring plan for the habitat mitigation.	Appropriate measures were taken during construction to avoid and minimize adverse impacts to the Commencement Bay aquatic environment including water quality monitoring to monitor and control impacts from in-water construction activities, use of Best Management Practices (BMPs) (control of dredging and material placement speed, containment of debris with debris booms, use of oil absorbent booms, etc.) during construction, avoidance of construction during fish critical activities periods or use of BMPs and fish monitoring during construction when a work was performed during the fish window. Additionally, all planned habitat mitigation and enhancement areas were constructed in accordance with the approved project plans.
Explanation of Significant Differences (ESD) – August 2004	
Placement of dredged sediment on the Puyallup River Delta (see Sec 1, p.4) "Placing 246,000 cubic yards (CY) of dredged sediments from the St. Paul CDF 500 feet back from the north-western edge of the delta would potentially increase the size and reduce the overall depth of the delta by several feet in this area… Additional sediment placed on the Puyallup delta would provide an environmental benefit to out-migrating juvenile salmonids and returning salmon… It also maintains the capacity of the DMMP site for disposal of better suited materials (e.g., those that could not be beneficially reused). Sediments were placed on the north-western side of the delta, as opposed to the more north-eastern side, to minimize or eliminate any potential sediment migration and deposition on adjacent Port of Tacoma properties. Surveys taken during and after sediment placement are located in the Administrative Record."	Placement of material dredged from the St. Paul CDF was performed between November 2003 and February 2004.

CLEANUP OBJECTIVES AND PERFORMANCE STANDARDS	REMEDIAL ACTION OUTCOME
Alternative Sources of Capping Material (see Sec 2, p.6) "This ESD identifies two additional sources that would be acceptable for the City to use as capping material and/or material to augment or create habitat mitigation sites; (a) sediments from the Puyallup River Delta or (b) sediments from the mouth of the Puyallup River…"	Material from these sources were not used as part of remedial actions.
Capacity of the St. Paul CDF and Sediments Dredged from the Thea Foss and Wheeler-Osgood Waterways (see Sec 3, p.7) The City's remedial action contractor determined that consolidation of the foundation soils and the consolidation of the dredge material, plus excavating the CDF slightly steeper and deeper (to -60 ft MLLW) would increase the capacity which is necessary to accommodate the temporary increase in sediment volume created by using hydraulic dredging. "	The capacity of the St. Paul CDF was increased by steepening the shoreline slopes and dredging to -60 feet MLLW.
Habitat Mitigation Projects for the Thea Foss and Wheeler-Osgood Waterways Remediation (see Sec 4, p.7) "The habitat mitigation includes creation of 11.4 acres of new aquatic habitat in the Puyallup River Side Channel, North Beach Habitat Area, and Middle Waterway Tideflat areas. This created habitat compares to net loss of aquatic habitat of 12.0 cares of aquatic habitat in the St. Paul waterway and Thea Foss Waterway… Therefore, the City is required to provide, at a minimum, an additional 0.58 acres of aquatic habitat. At this time, the City is developing the design for the Hylebos Creek (referred to as the Bunker Mitigation project) to provide this habitat."	Habitat mitigation sites were constructed in accordance with the approved project plans.
Clarification of Selected Remedy and Consideration of Federal Deauthorization of the Navigation Channel in the Thea Foss Waterway (see Sec 5, p.9) "The City and Corp have an agreement regarding the encroachment between the set of stations above and if in the future the Corps needs to conduct navigational dredging of these locations, the City may have to modify the remedy based on this future use. "	The City and Corps have established an Memorandum of Agreement concerning encroachment that is provided in Appendix F.
Institutional Controls (see Sec 6, p.10) "As a component of remedial design and remedial action planning, the basic elements of institutional control plans have been identified and will be memorialized in final Institutional Control Plans for both the City of Tacoma and Utilities."	The City has prepared an Institutional Controls Plan that meets EPA requirements. The Institutional Controls Plan is provided in Appendix G of the OMMP.

Table 2
Summary of Construction Quantities

Task	Quantity	Units
Quantity of Sediment Dredged to Construct Confined Disposal Facility (CDF)	402,650	CY
Quantity of Sediment Placed on Puyallup River Delta as Beneficial Reuse as Part of CDF Construction	246,315	CY
Quantity of Sediment Disposed of at the Commencement Bay Open Water Disposal Site as Part of CDF Construction	138,485	CY
Quantity of Sediment Dredged from Thea Foss and Wheeler-Osgood Waterways	422,535	CY
Quantity of Capping Material Placed in Thea Foss and Wheeler-Osgood Waterways	282,359	Ton
Number of Timber Piling Removed as Part of Thea Foss and Wheeler-Osgood Waterway Remediation Project[1]	1,653	Each
Number of Piling Installed as Part of Thea Foss and Wheeler-Osgood Waterway Remediation Project[2]	436	Each
Quantity of Material Excavated to Construct Habitat Sites	266,764	CY
Quantity of Material Disposed of Offsite	152,816	Ton
Quantity of Material Used to Cap the CDF	177,100	CY

Notes:
CY Cubic yards
1 Comprised of treated (i.e., creosote) and untreated timber piling.
2 Comprised of steel and concrete piling.

Table 3
Remedial Action Summary

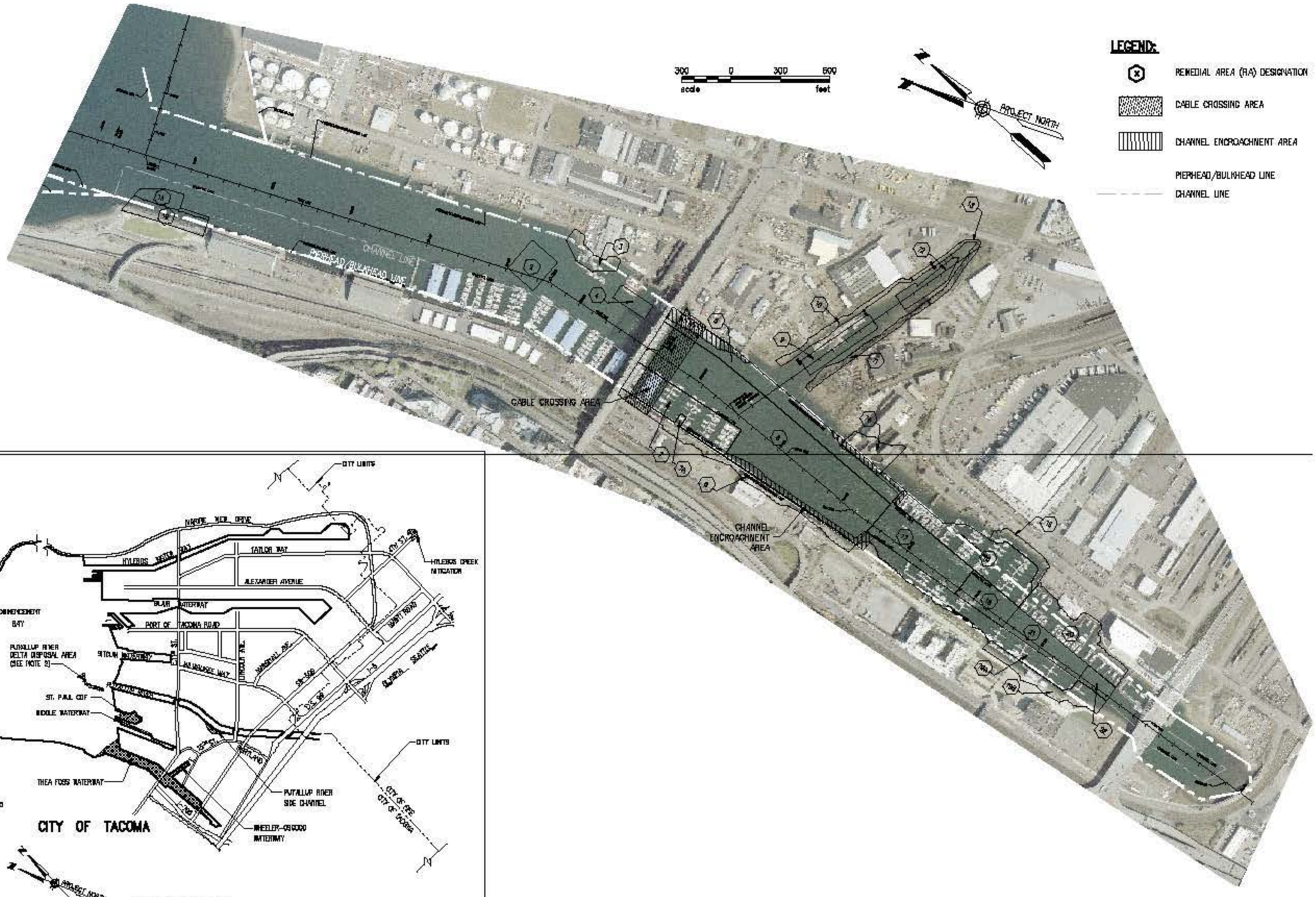
Activity Area	Action Completed	Construction Completion Date
RA 2	Dredge and Backfill	8/18/05
RA 4	Dredge and Backfill	8/11/05
RA 5	Dredge to Clean, Slope Cap between Stations 37+00 and 39+80 (Petrich), Natural Recovery, and Quarry Spall Backfill along northern boundary of RA	10/23/05
RA 6	Dredge to Clean, Slope Cap between Stations 43+50 and 52+30 on the western side of RA 6, and Natural Recovery along northern boundary of RA	1/21/06
RA 7	Enhanced Natural Recovery (six inches of channel sand cap material)	12/7/05
RA 7A	Dredge and Channel Sand Cap	11/5/05
RA 8	Slope Cap and Habitat Enhancement	12/5/05
RA 9	Dredge and Channel Sand Cap	11/10/05
RA 12	Dredge and Backfill and Channel Sand Cap in adjacent sheen source area	10/25/05
RA 14	Slope Cap	1/4/06
RA 15	Slope Rehabilitation and Dredge to Clean	8/18/05
RA 16	Dredge to Clean and Channel Sand Cap between the northern RA boundary and Station 55+30 and from Stations 57+00 to 58+90	1/19/05
RA 17	Dredge to Clean and Channel Sand Cap between Station 54+70 and southern boundary of the RA	2/4/06
RA 18	Dredge and Channel Sand Cap	1/20/06
RA 19A&B	Channel Sand, Grout Mat, and Slope Cap	12/17/05
RA 20	Dredge, Channel Sand and Slope Cap, and Habitat Enhancement	1/18/06
RA 21	Dredge and Channel Sand Cap	1/13/06
RA 22	Dredge and Channel Sand Cap	12/17/05

Table 4
Sources of Import Cap Material Summary

Import Material Type	Material Source	Placement Locations	EPA Approval Date	Characterization Submittal Number
Slope Cap Filter Material	Glacier NW DuPont Pit (#B-335)	RA 5, RA 8, RA 14, RA 15, RA 19A, RA 19B, and RA 20	December 9, 2003	63
	Miles Sand and Gravel, Auburn Pit (#A-41)		December 11, 2003	87
Riprap	WA Rock Quarry Kapowsin Pit (#QSB-332)	RA 5, RA 8, RA 14, RA 15, RA 19A, RA 19B, RA 20, and RA 22	December 9, 2003	63
	Glacier NW, White River Quarry Pit (#A-487)		December 9, 2003	88
Quarry Spalls	WA Rock Quarry Kapowsin Pit (#QSB-332)	RA 5, RA 6, RA 8, RA 14, and RA 20	December 9, 2003	63
Habitat Mix	Miles Sand and Gravel, Auburn Pit (#A-41)	RA 8, RA 14, RA 15, RA 19A, RA 19B, RA 20, and RA 22	December 22, 2004	87
Channel Sand Cap	Glacier NW DuPont Pit (#B-335)	RA 2, RA 4, RA 6, RA 7, RA 9, RA 12, RA 16, RA 17, RA 18, RA 19A, RA 19B, RA 20, RA 21, and RA 22	December 26, 2004	63

Table 5
Summary of Quality Assurance Plans, Reports and Addendums

Plans / Reports	Date	Addendums	Date
Sediment Verification Quality Assurance Project Plan	October 2003	NA	NA
Contaminated Sediment / Soil Management Plan	July 2003	NA	NA
Stockpile Sampling Quality Assurance Project Plan	July 2003	Addendum to Stockpile Quality Assurance Project Plan - Waste Sampling and Analysis at Martinac Shipyard	April 19, 2004
		Addendum to Stockpile Quality Assurance Project Plan - Revised Soil Sampling and Analysis at 16th Street Waterline Excavation	May 13, 2004
		Addendum to Stockpile Quality Assurance Project Plan - Revised Soil Sampling and Analysis at Marina Parking Lot	May 21, 2004
Water Quality Field Sampling Plan	July 2003	NA	NA
Pre-Construction Characterization Quality Assurance Project Plan	July 2003	Request for Change 22 (RFC-022), Thea Foss and Wheeler-Osgood Waterways Remediation Project, Puyallup River Side Channel Habitat Request for Change	March 18, 2005
Data Validation Report for Sediment / Cap Verification Samples, Construction Correspondence 2330 (CR-2330)	April 2006	Responses to USACE Comments on Data Validation, Construction Correspondence 2341 (CR-2341)	June 2, 2006
		Reply to USACE / EPA Comments on Data Validation, Construction Correspondence 2344 (CR-2344)	June 26, 2006
		Data Validation Documentation, Construction Correspondence 2345 (CR-2345)	July 12, 2006



FLOYD | SNIDER
strategy • science • engineering

kpff

DRAWN BY: JKH
DATE: 9/7/06

Thea Foss and Wheeler-Osgood Waterways Remediation Project

Figure 1

Vicinity Map

CDF CONTAINMENT BERM

TACOMA KRAFT MILL
(SIMPSON TACOMA KRAFT COMPANY)

ST. PAUL CDF OFFSET BERM

ST. PAUL CDF SITE

STORM WATER COLLECTION

SIMPSON FUEL DOCK

TACOMA SAW MILL
(SIMPSON TIMBER COMPANY)

SIMPSON LOG HAUL ROAD

ST. PAUL BEACH HABITAT **

ST. PAUL HABITAT BERM

PENINSULA HABITAT **

MIDDLE WATERWAY
CORRIDOR HABITAT

STORM WATER
DISCHARGE

MIDDLE WATERWAY
TIDEFLAT HABITAT

SIMPSON LOG HAUL OUT

MIDDLE WATERWAY

** NOTE:
PENINSULA HABITAT AND ST. PAUL BEACH HABITAT ARE COLLECTIVELY KNOWN AS THE NORTH BEACH HABITAT

SHEEN SOURCE REMOVAL AREA

PROJECT NORTH

COMMENCEMENT BAY

THEA FOSS WATERWAY

WHEELER-OSGOOD WATERWAY

CITY MARINA / DELIN DOCKS

JOHNNY'S DOCK MARINA NORTH

JOHNNY'S DOCK MARINA SOUTH

FOSS LANDING MARINA

FOSS WATERWAY MARINA

17TH ST. MARINA *

CITY VIEW MARINA *

ALBER'S WHARF MARINA *

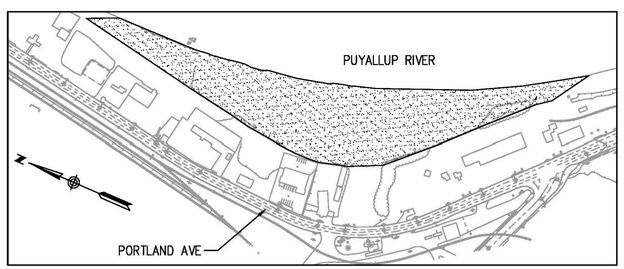
* NOTE:
17TH STREET, CITY VIEW, AND ALBER'S WHARF MARINAS ARE COLLECTIVELY KNOWN AS DOCK STREET MARINA.

REMEDIAL AREA
BY OTHERS

LEGEND:

- (X) REMEDIAL AREA (RA) DESIGNATION
- REMEDIAL WORK PREVIOUSLY COMPLETED UNDER SEPARATE CONTRACT
- REMEDIAL WORK ACCOMPLISHED BY UTILITIES

300 0 300 600
scale feet



PUYALLUP RIVER SIDE CHANNEL
SCALE: 1"=300'

FLOYD | SNIDER
strategy • science • engineering

kpff

DRAWN BY: JKH
DATE: 6/2/06

Thea Foss and Wheeler-Osgood Waterways Remediation Project

Figure 2

Project Site Plan

Legend

Completed Remediation Actions
- No Action
- Natural Recovery
- Enhanced Natural Recovery
- Slope Rehabilitation
- Habitat Enhancement
- Backfill
- Cap
- Dredge to Clean
- Grout Mat
- Additional Cap Material Placement in Utilities Area
- Transition Slope
- Quarry Spalls
- Area Containing Subsurface Utilities
- Remediation Areas

Thea Foss and Wheeler-Osgood Outfalls
- City of Tacoma (No.)
- Private

NOTES

- Base map generated from CAD drawings supplied by Walker and Associates, based on a March 2006 aerial survey.
- Outfall locations provided by City of Tacoma. Outfall numbers provided by City of Tacoma or Tacoma-Pierce County Health Department Figure E-1 (1995).

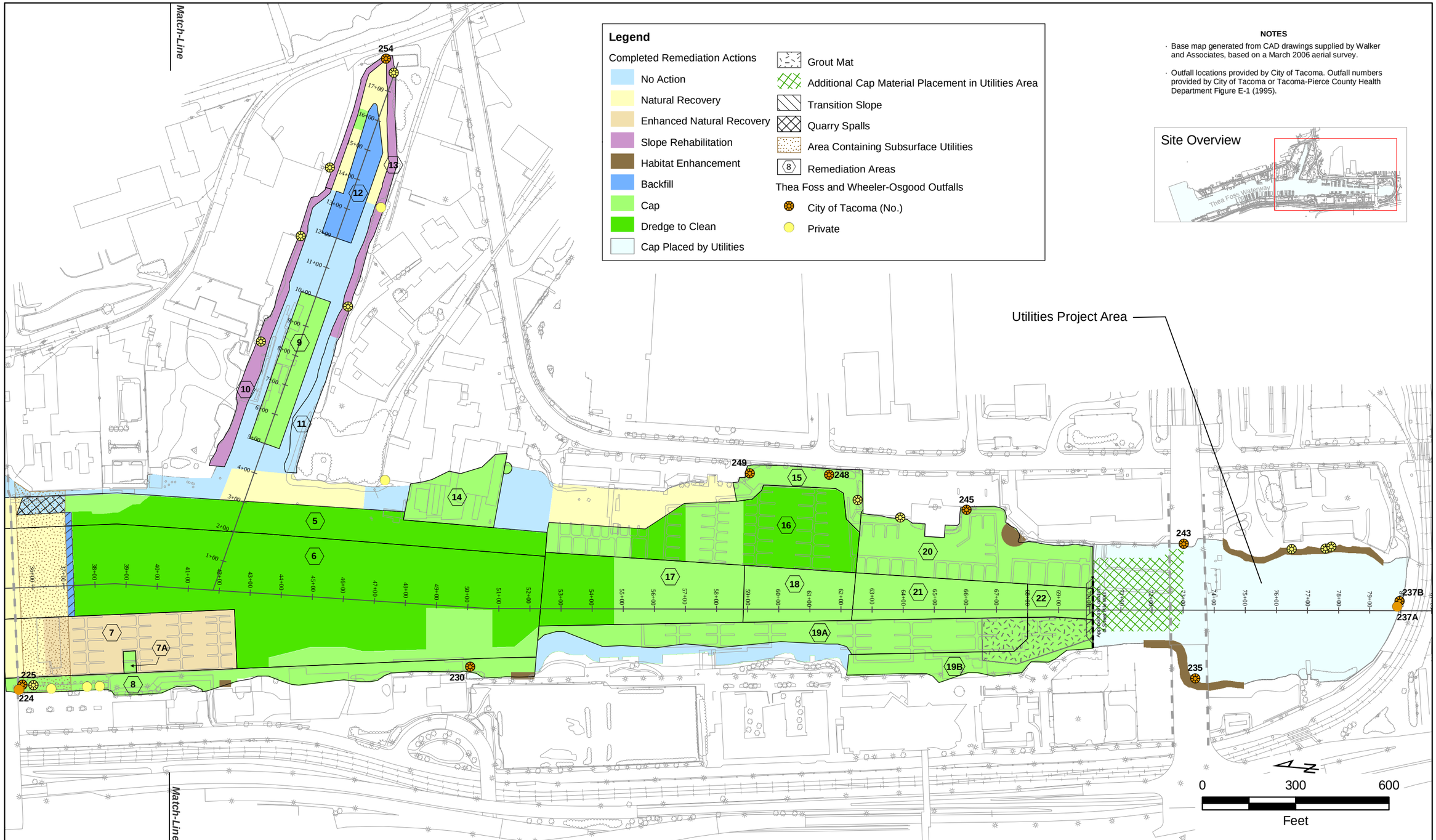
FLOYD | SNIDER
strategy ▪ science ▪ engineering

kpff

Thea Foss and Wheeler-Osgood Waterways Remediation Project

Figure 3 (1 of 2)
Completed Remedial Actions

DATE: 6/22/2006 4:57:05 PM
MXD NAME: \\Sam\Data\projects\KPFF Foss\GIS\RACR\Fig 3 - Completed Actions 1 of 2.mxd



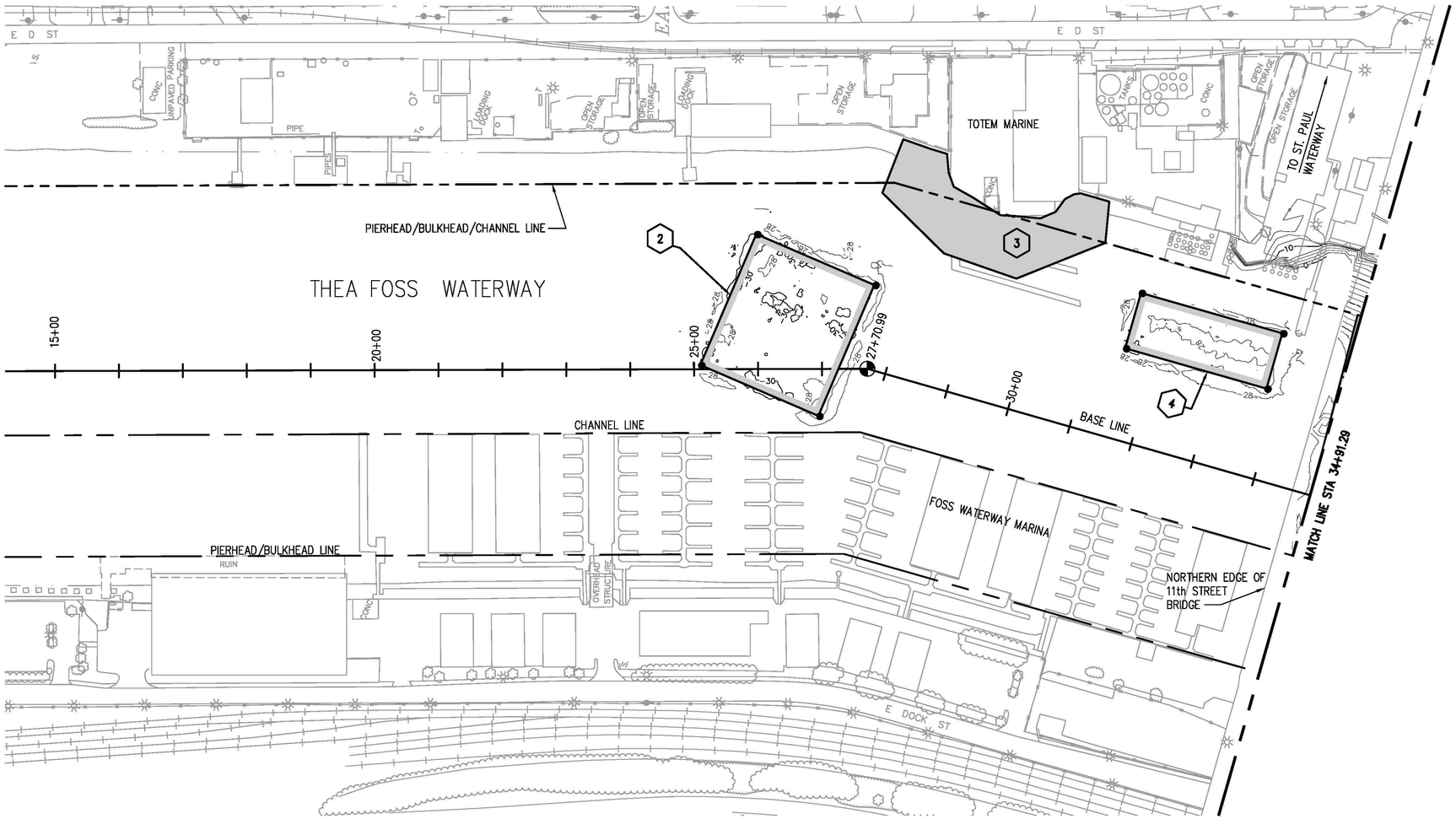
FLOYD | SNIDER
strategy ▪ science ▪ engineering

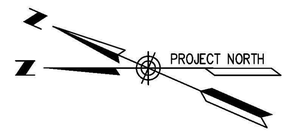
kpff

Thea Foss and Wheeler-Osgood Waterways Remediation Project

Figure 3 (2 of 2) Completed Remedial Actions

DATE: 6/22/2006 4:54:59 PM
MXD NAME: \\Sam\Data\projects\KPFF Foss\GIS\RACR\Fig 3 - Completed Actions 2 of 2.mxd

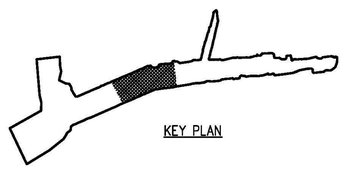




SCALE: 1"= 100'

LEGEND:

- BOUNDARY OF REMEDIAL AREA
- (X) REMEDIAL AREA (RA) DESIGNATION
- REMEDIAL WORK PREVIOUSLY COMPLETED UNDER SEPARATE CONTRACT
- -xx- FINAL SURVEY CONTOUR



100 0 100 200
scale feet

Tacoma

FLOYD | SNIDER
strategy ▪ science ▪ engineering

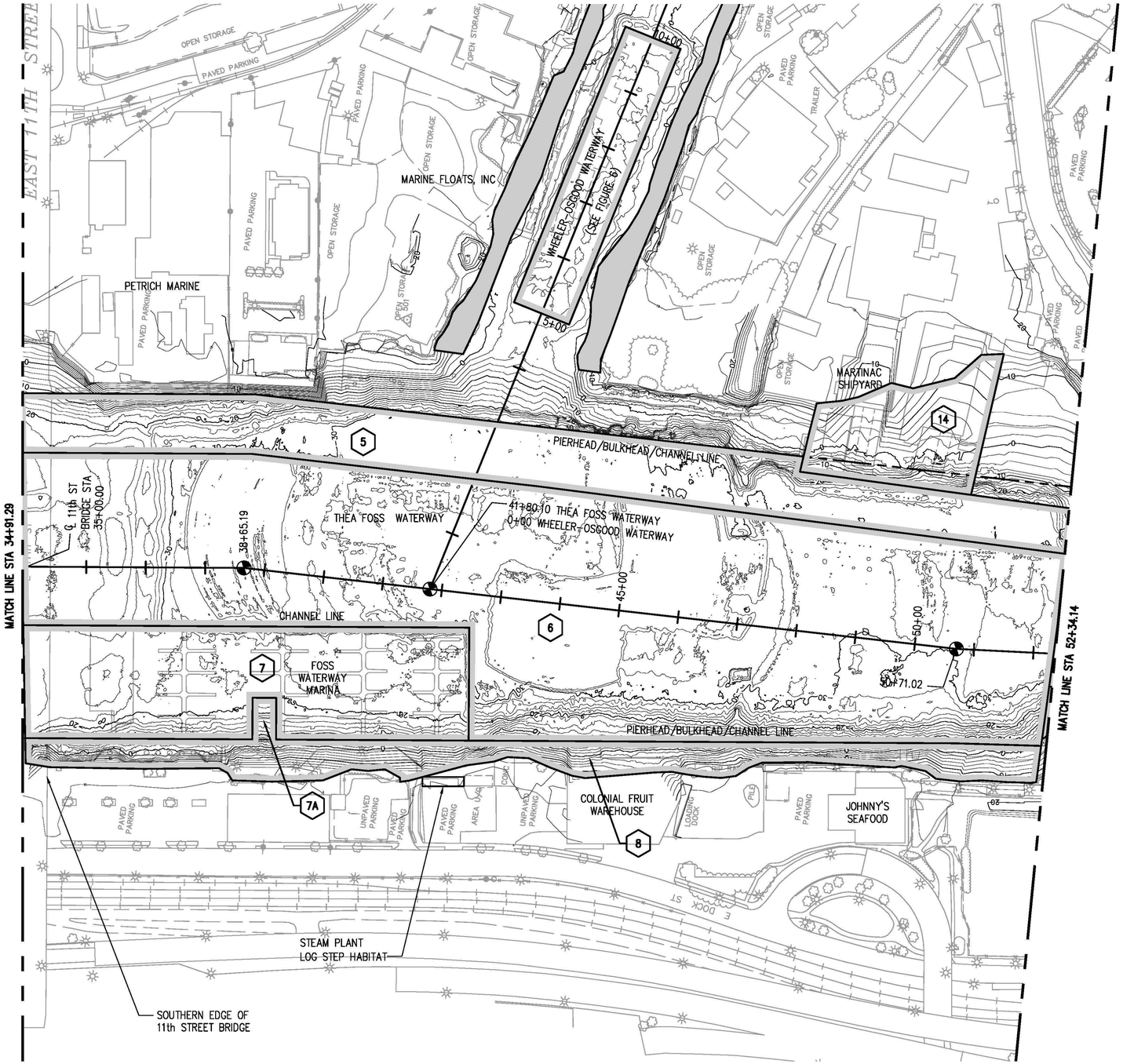
kpff

DRAWN BY: JKH
DATE: 6/2/06

Thea Foss and Wheeler-Osgood Waterways Remediation Project

Figure 4

RA2 and RA4

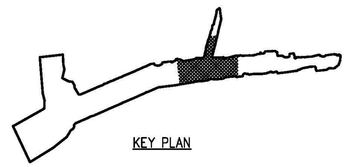


PROJECT NORTH

SCALE: 1"= 100'

LEGEND:

- BOUNDARY OF REMEDIAL AREA
- (X) REMEDIAL AREA (RA) DESIGNATION
- REMEDIAL WORK PREVIOUSLY COMPLETED UNDER SEPARATE CONTRACT
- -xx- FINAL SURVEY CONTOUR



KEY PLAN

100 0 100 200
scale feet

Tacoma

FLOYD | SNIDER
strategy • science • engineering

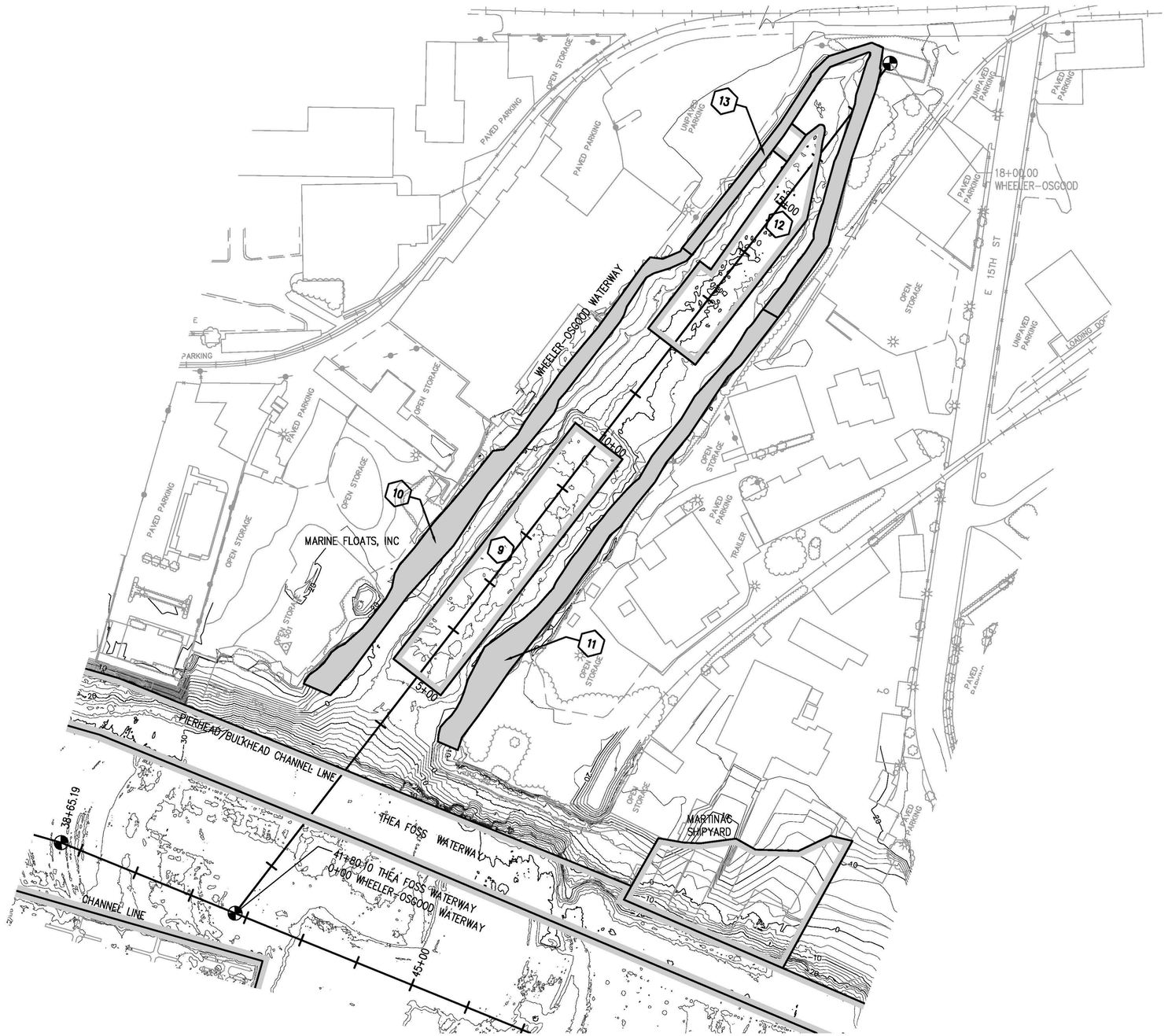
kpff

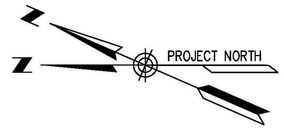
DRAWN BY: JKH
DATE: 6/2/06

Thea Foss and Wheeler-Osgood Waterways Remediation Project

Figure 5

RA5, RA6, RA7, RA7A, RA8, and RA14

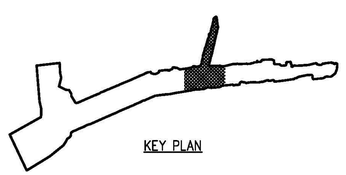




SCALE: 1"= 100'

LEGEND:

- BOUNDARY OF REMEDIAL AREA
- X — REMEDIAL AREA (RA) DESIGNATION
- REMEDIAL WORK PREVIOUSLY COMPLETED UNDER SEPARATE CONTRACT
- xx — FINAL SURVEY CONTOUR



KEY PLAN

100 0 100 200
scale feet

Tacoma

FLOYD | SNIDER
strategy ▪ science ▪ engineering

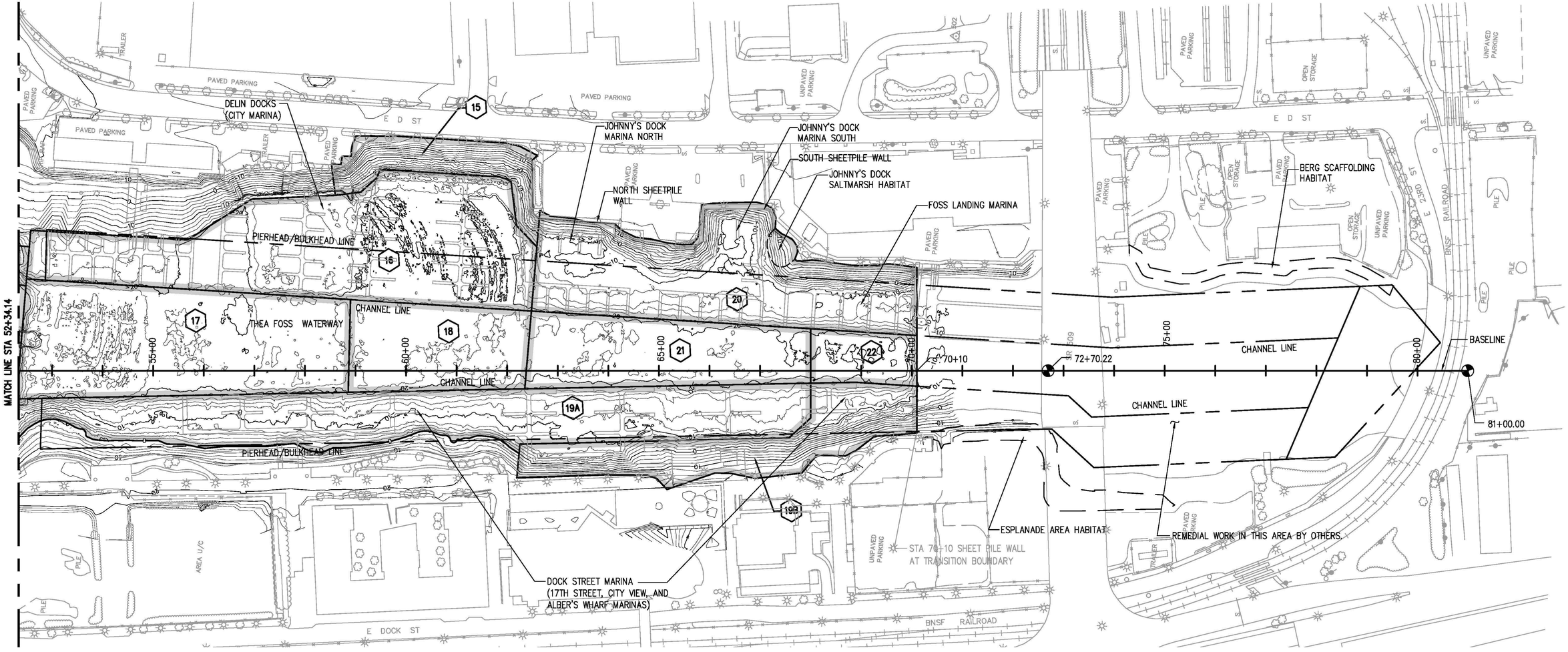
kpff

DRAWN BY: JKH
DATE: 6/2/06

Thea Foss and Wheeler-Osgood Waterways Remediation Project

Figure 6

RA9 and RA12



LEGEND:

- BOUNDARY OF REMEDIAL AREA
- (X) REMEDIAL AREA (RA) DESIGNATION
- -xx- FINAL SURVEY CONTOUR

PROJECT NORTH

SCALE: 1"= 100'

KEY PLAN

100 0 100 200
scale feet

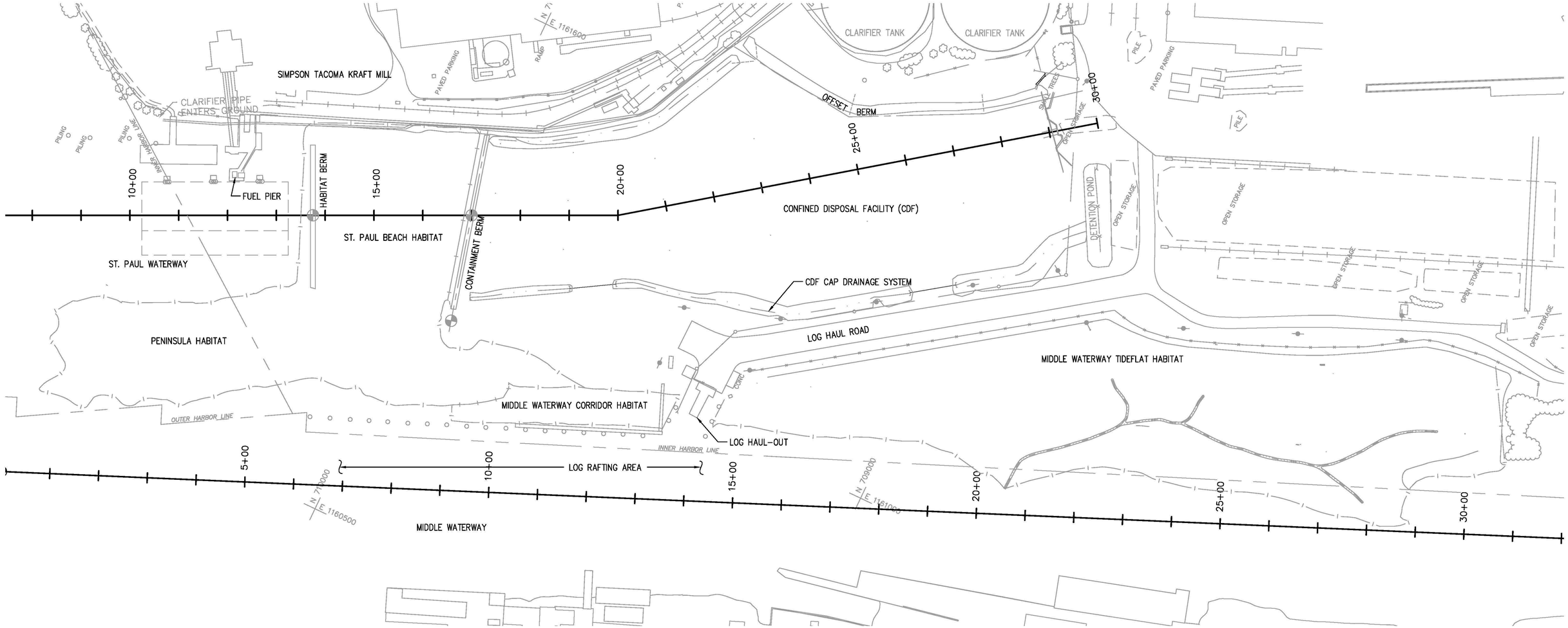
FLOYD | SNIDER
strategy ▪ science ▪ engineering

kpff

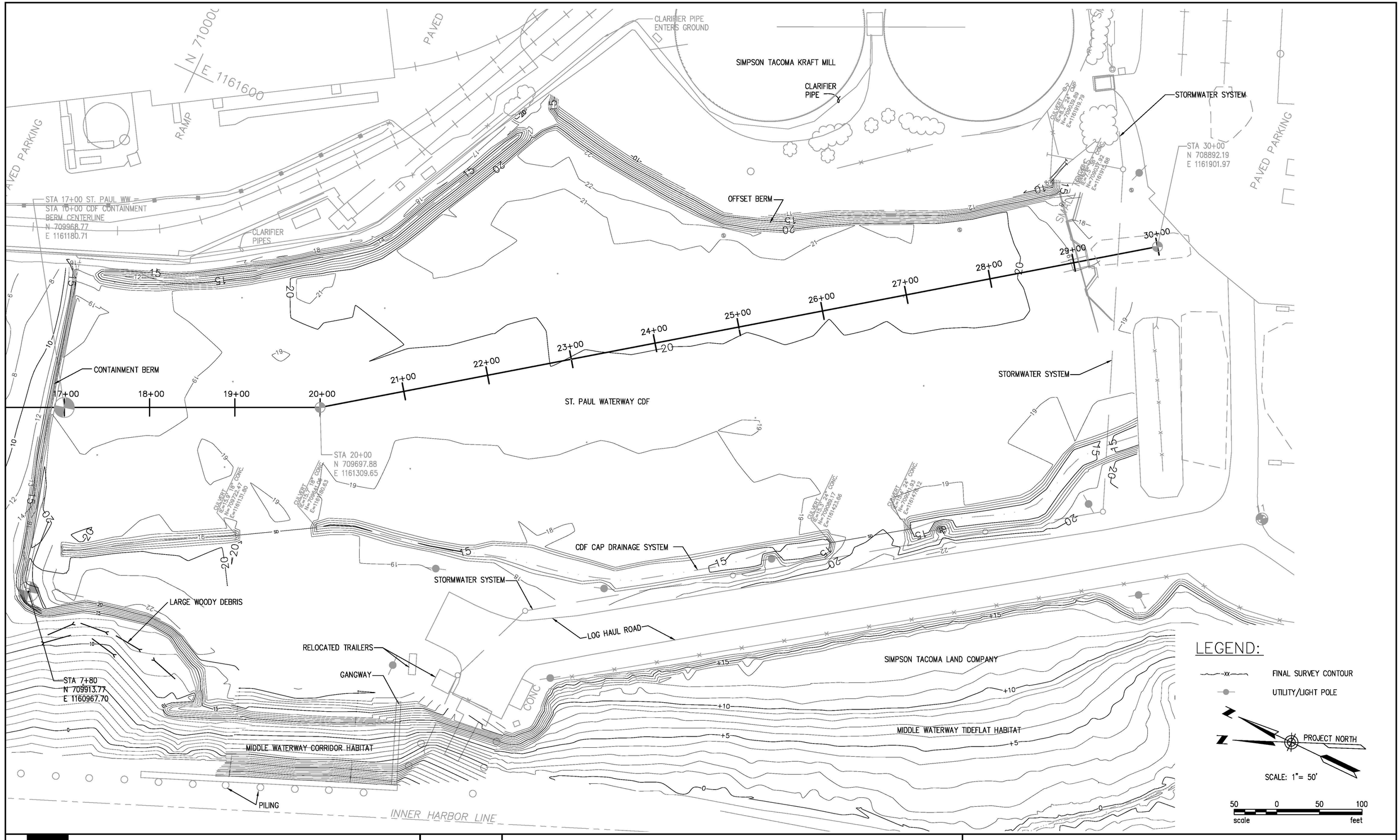
DRAWN BY: JKH
DATE: 6/2/06

Thea Foss and Wheeler-Osgood Waterways Remediation Project

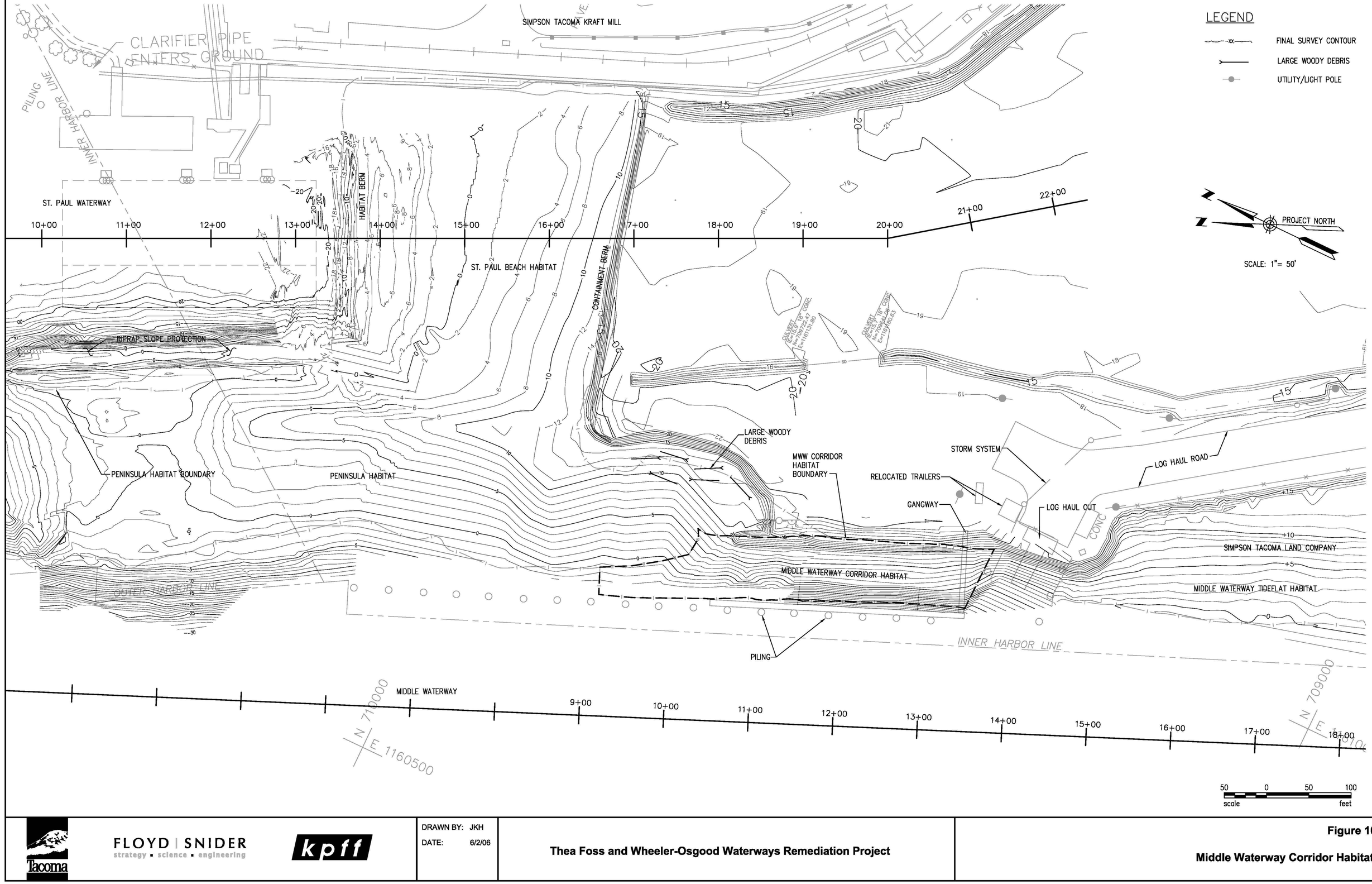
Figure 7
RA15, RA16, RA17, RA18, RA19A, RA19B, RA20, RA21, and RA22



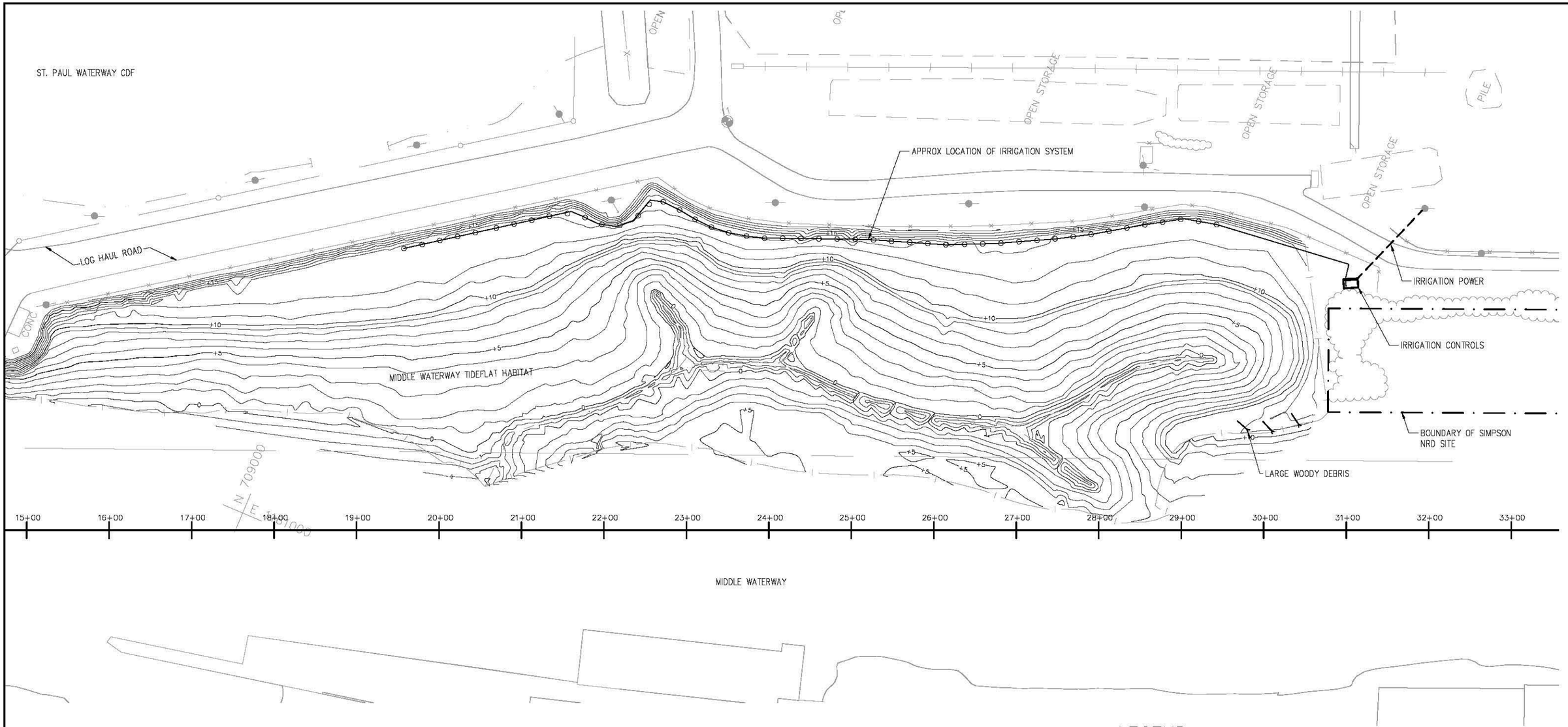
Tacoma · FLOYD | SNIDER strategy ▪ science ▪ engineering · kpff	DRAWN BY: JKH DATE: 6/2/06	**Thea Foss and Wheeler-Osgood Waterways Remediation Project**	**Figure 8** **St. Paul / Middle Waterway Site Plan**



FLOYD | SNIDER strategy ▪ science ▪ engineering; kpff	DRAWN BY: JKH DATE: 6/2/06	**Thea Foss and Wheeler-Osgood Waterways Remediation Project**	**Figure 9** **St. Paul Waterway CDF**



Tacoma · FLOYD | SNIDER strategy ▪ science ▪ engineering · kpff	DRAWN BY: JKH DATE: 6/2/06	**Thea Foss and Wheeler-Osgood Waterways Remediation Project**	**Figure 10** **Middle Waterway Corridor Habitat**



Tacoma

FLOYD | SNIDER
strategy • science • engineering

kpff

DRAWN BY: JKH
DATE: 9/7/06

Thea Foss and Wheeler-Osgood Waterways Remediation Project

Figure 11

Middle Waterway Tideflat Habitat

ST PAUL CDF

LOG HAUL ROAD

MW-007

MW-005

MW-003

MW-010

MW-009B

MW-009A

MW-008

MW-006

MW-004

UST

BOUNDARY OF SIMPSON NRD SITE

MIDDLE WATERWAY TIDEFLAT HABITAT

MIDDLE WATERWAY

N 709000

E 1163000

23+00 24+00 25+00 26+00 27+00 28+00 29+00

15+00 16+00 17+00 19+00 20+00 21+00 22+00 23+00 24+00 25+00 26+00 27+00 28+00 29+00 30+00 31+00 32+00 33+00

Legend

- Manson/Parametrix Pre-Construction Characterization Station
- Post-Excavation Confirmation Station
- UST Removal Confirmation Station

N

0 125 250

Feet

FLOYD | SNIDER
strategy ▪ science ▪ engineering

kpff

Thea Foss and Wheeler-Osgood Waterways Remediation Project

Figure 12
Middle Waterway Tideflat Habitat Sample Stations

DATE: 9/5/2006 12:02:58 PM
MXD NAME: F:\projects\KPFF Foss\GIS\RACR\Figure 12 - Middle Waterway Sample Stations rev 090506.mxd

LEGEND:

XX FINAL SURVEY CONTOUR

PROPERTY LINE

W.S. 5.3

FLOW

PUYALLUP RIVER

LEVEE BREACH

FLOW

PUYALLUP RIVER

NEW LEVEE ROAD

TOE OF SLOPE, TYP

POST#08

18.4

NEW LEVEE ROAD

TEMPORARY CONTAINMENT UNIT

FORMER TACOMA METALS PROPERTY

18TH STREET ROW

PORTLAND AVENUE

ST. PAUL AVENUE

PROJECT NORTH

SCALE: 1"= 50'

50 0 50 100

scale feet

Tacoma

FLOYD | SNIDER

strategy ▪ science ▪ engineering

kpff

DRAWN BY: JKH

DATE: 6/2/06

Thea Foss and Wheeler-Osgood Waterways Remediation Project

Figure 13

Puyallup River Side Channel Site

FLOW

PUYALLUP RIVER

LEVEE BREACH

PR008

PR007

PR006-E1

PR006-N1

PR006A

PR006

PR006A2

PR006-W1

PR006-S1

PR006-S2

PR006-S3

PR005A

PR005

PR004

HC-MW-2

PR003-N1

PRC-006

PR003

PR003A

PR003-S1

PR003-W1

PR003-W2

PR003-W3

HC-MW-1

HC-MW-3D

HC-MW-3S

PR002

PRC-001

PRC-002

PRC-005

PRC-004

PR001

PRC-003

NEW LEVEE ROAD

NEW LEVEE ROAD

HC-MW-4

18th STREET ROW

PORTLAND AVENUE

Legend

- Confirmational Sample Station
- Hart Crowser Pre-Construction Characterization Station
- Manson/Parametrix Pre-Construction Characterization Station
- Manson/Parametrix Delineation Station

N

0 100 200

Feet

Tacoma

FLOYD | SNIDER

strategy ▪ science ▪ engineering

kpff

Thea Foss and Wheeler-Osgood Waterways Remediation Project

Figure 14
Puyallup River Side Channel Sample Stations

DATE: 6/20/2006 4:43:15 PM
MXD NAME: \\Sam\Data\projects\KPFF Foss\GIS\PRSC\Figure 14 - PRSC Sample Stations.mxd

FLOYD | SNIDER
strategy ▪ science ▪ engineering

kpff

DRAWN BY:	JKH
DATE:	6/2/06

Thea Foss and Wheeler-Osgood Waterways Remediation Project

FIGURE 15

Hylebos Creek/Bunker Habitat