FINAL ENGINEERING DESIGN REPORT WHATCOM WATERWAY CLEANUP IN PHASE 1 SITE AREAS

Prepared for

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LIST OF ACRONYMS AND ABBREVIATIONS

%	percent
Anchor QEA	Anchor QEA, LLC
ASB	aerated stabilization basin
ASCE	American Society of Civil Engineers
BMP	best management practice
BST	Bellingham Shipping Terminal
CAP	Cleanup Action Plan
CEM	Coastal Engineering Manual
City	City of Bellingham
cm	centimeters
D/F	dioxins/furans
DMMP	Dredged Material Management Program
Ecology	Washington State Department of Ecology
EDR	Engineering Design Report
ENSR	ENSR International Corporation
FRP	fiberglass reinforced pipe
FSEIS	Final Supplemental Environmental Impact Statement
GP	Georgia-Pacific
GP West	Georgia-Pacific West mill site
H:V	horizontal to vertical
hp	horsepower
HPA	Hydraulic Project Approval
IC	institutional control
kg	kilograms
KPFF	KPFF Consulting Engineers
Meridian Pacific	Meridian Pacific Highway, LLC
MHHW	mean higher high water
MHW	mean high water
MLLW	mean lower low water
MNR	monitored natural recovery
MTCA	Model Toxics Control Act

NAD 83	North American Datum of 1983
NCHRP	National Cooperative Highway Research Program
ng	nanograms
NOAA	National Oceanic and Atmospheric Association
NOS	National Ocean Survey
NPDES	National Pollutant Discharge Elimination System
NRDI	Non-remedial Design Investigation
OHW	ordinary high water
OHWM	ordinary high water mark
Over-water Walkway	Boulevard Park Over-water Walkway
PAH	polycyclic aromatic hydrocarbon
PDCR	Preliminary Design Concept Report
PLP	potentially liable parties
Port	Port of Bellingham
PRDI	Pre-remedial Design Investigation
propwash	propeller wash
RAU	Remedial Action Unit
RCW	Revised Code of Washington
RETEC	The RETEC Group
RI/FS	Remedial Investigation/Feasibility Study
SEIS	Supplemental Environmental Impact Statement
SEPA	State Environmental Policy Act
Site	Whatcom Waterway Site
SMS	Sediment Management Standards
SPT	Standard Penetration Testing
SQS	sediment quality standard
SSSMGP	South State Street Manufactured Gas Plant
SWPPP	Stormwater Pollution Protection Plan
UFC	United Facilities Criteria
UHMV	Ultra-high Molecular Viscosity
UHMW	Ultra-high Molecular Weight
USACE	U.S. Army Corps of Engineers
VST	vane shear testing

WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
Work Plan	Pre-remedial Design Investigation Work Plan
WRDA	Water Resource Development Act
WSDOT	Washington State Department of Transportation

GLOSSARY

Whatcom Waterway Site (Site)	The overall MTCA cleanup site addressed by the Whatcom Waterway Consent Decree. This area includes both Whatcom Waterway and adjacent aquatic lands impacted by historic mercury discharges from the former Georgia Pacific chlor-alkali plant wastewater discharges. The Site includes both Phase 1 and Phase 2 cleanup areas and additional areas being addressed by monitored natural recovery.
Whatcom Waterway	The physical waterway extending from Roeder Avenue to deep water. Whatcom Waterway includes both the Inner Waterway and Outer Waterway areas.
Inner Waterway	The inner portion of Whatcom Waterway, extending from Roeder Avenue to the beginning of the federal navigation channel at Waterway Station 29+00. The Inner Waterway includes Site Units 2 and 3 of the Whatcom Waterway Site.
Outer Waterway	The outer portion of Whatcom Waterway, extending from Station 29+00 into deep water. The Outer Waterway includes Site Units 1A, 1B, and 1C of the Whatcom Waterway Site. The federal navigation channel is located within the Outer Waterway.
Federal Navigation Channel	The federal navigation project as currently authorized in existing Water Resources Development Act (WRDA) legislation. The authorized project includes a 30-foot deep navigation channel extending from Station 29+00 of Whatcom Waterway into deep water. The Federal Navigation Channel is maintained by coordinated actions of the U.S. Army Corps of Engineers and the Port of Bellingham as the local sponsor.
Central Waterfront Site	The MTCA Site located on certain properties between Whatcom Waterway and I&J Waterway. The Central Waterfront Site is undergoing an RI/FS investigation under a MTCA Agreed Order.
GP West Site	The MTCA Site located on upland property on the south side of Whatcom Waterway. The GP West Site is undergoing an RI/FS investigation under a MTCA Agreed Order.

Log Pond	Site Unit 4 of the Whatcom Waterway Site. The Log Pond is located between Whatcom Waterway and the GP-West Site. The Log Pond was partially remediated in 2001 as part of an Interim Action. Additional cleanup work is to be completed as part of the final cleanup of the Whatcom Waterway Site.
Chlor-Alkali Remedial Action Unit	The Chlor-Alkali Remedial Action Unit is located within the GP West cleanup site adjacent to the Log Pond.
Pulp and Tissue Mill Remedial Action Unit	The Pulp and Tissue Mill Remedial Action Unit is located along the south shoreline (nearshore area) within the GP West cleanup site.
Project	The current Project as defined in this document. The Project includes the construction and monitoring activities necessary to complete the final remedial action in the Whatcom Waterway Phase 1 Site Areas. The Project is being designed, permitted, and constructed separately from the cleanup in Phase 2 Site Areas, consistent with the requirements of the First Amendment to the Whatcom Waterway Consent Decree.
Phase 1 Site Areas	Those portions of the Whatcom Waterway Site that are being cleaned up using dredging, capping, and institutional controls. These areas include Site Units 3B, 2A, 4, and portions of Units 1C and 2C.
Phase 2 Site Areas	Those portions of the Whatcom Waterway Site that are to be cleaned up using dredging, capping, confined aquatic disposal, and institutional controls. These areas include Site Units 1A, 1B, 2B, 5B, 6B, 6C, and 8, and portions of Unit 2C. The cleanup work in Phase 2 Site Areas will be designed, permitted, and constructed separately from the cleanup in Phase 1 Site Areas, consistent with the requirements of the First Amendment to the Whatcom Waterway Consent Decree.
Natural Recovery Areas	The portions of the Whatcom Waterway Site that are to be cleaned up using monitored natural recovery and institutional controls. These areas include Site Units 3A, 5A, 5C, 6A, 7, and 9. Long-term compliance monitoring in these areas will be implemented as part of the current Project.

Central Waterfront Area	The upland properties located between Whatcom Waterway and I&J Waterway and between Roeder Avenue and the aerated stabilization basin (wastewater treatment lagoon). The Central Waterfront Area includes the properties within and outside of the Central Waterfront Site.

EXECUTIVE SUMMARY

The Whatcom Waterway Cleanup in Phase 1 Site Areas (Project) is to be conducted by the Port of Bellingham (Port) to implement the cleanup of the Whatcom Waterway Site (Site) as required by Consent Decree (No. 07-2-02257-7) as amended (Ecology 2007a, 2011a). Permitting for the Project includes a Nationwide Permit 38 for the Cleanup of Hazardous and Toxic Waste by the U.S. Army Corps of Engineers (USACE; 2015) and a Section 408 Authorization. The Project also incorporates measures addressing the substantive provisions of Washington State Department of Fish and Wildlife (WDFW) regulations for Hydraulic Project Approvals (HPA) and of the City of Bellingham's (City) Shoreline Master Program, Critical Areas Ordinance, stormwater regulations, and other local requirements as described in Appendix N. The Project is located along the City waterfront in Whatcom County, Washington, within the Port's and City's Waterfront District master planning area.

This cleanup action is being performed in compliance with the requirements of the Model Toxic Control Act (MTCA) and Sediment Management Standards (SMS) regulations. The Project actively remediates Phase 1 site areas using dredging, upland disposal, and capping. The primary contaminants of concern at the Site are mercury and phenolic compounds. A combination of recent source control efforts and natural recovery has improved conditions such that Site cleanup levels are currently being met in surface sediment in a large portion of the Site. However, where this layer of clean sediment is subject to potential disturbance from wind and wave events, navigational traffic, and planned future maintenance dredging, active remediation is required to prevent exposure to contaminants in subsurface sediment.

Industrial activities adjacent to the Site, dating back to the late 1800s, have resulted in sediment contamination. Additionally, the shorelines are generally devoid of vegetation and over-steepened because of manmade structures (e.g., creosote-treated timber bulkheads) or armored with concrete, asphalt, or other manmade debris. The Site also contains a number of derelict structures, including creosote-treated bulkheads, piles, and dolphins and overwater structures that limit habitat conditions and connectivity. The combination of contaminated sediments, over-steepened and armored shorelines, and derelict structures has resulted in the severely degraded habitat conditions within the Site.

Implementing the Project will result in significant environmental improvements over existing conditions through removal of highly contaminated sediments, removal of existing creosote-treated and other derelict structures, and capping of dredged areas with clean materials. As an ancillary benefit of the cleanup, the final Project will result in greatly improved habitat quantity, quality, and connectivity for a variety of species.

For discussion purposes, the Project is broken out into three geographic areas: the Bellingham Shipping Terminal (BST), Log Pond, and Inner Waterway. Major activities within these areas include dredging, capping, containment wall installation, structure removal, structure replacement, and ancillary nearshore habitat improvements. All work to be performed will incorporate best management practices (BMPs) and conservation measures to minimize potential environmental impacts from construction.

Bellingham Shipping Terminal

The BST is located in the outer portion of the Waterway to the west of the Log Pond area (Plate ES-1). The Project includes work within BST Berths 1 and 2 to remove existing contaminated sediments, place a residuals management cover material, and place a transition cap to prevent potential erosion and recontamination of the remediated areas. Berths 1 and 2 of the BST represent primarily subtidal, deep-water aquatic habitat consistent with the designated federal navigation channel.

Remediation activities within Berth 1 include dredging contaminated sediments and placing residuals management cover material. Dredging and placement of residuals management cover will also be performed in the southeastern portion of Berth 2. A transition area cap will be placed on the slope area adjacent to Berth 1 to prevent potential erosion and recontamination of the remediated areas.

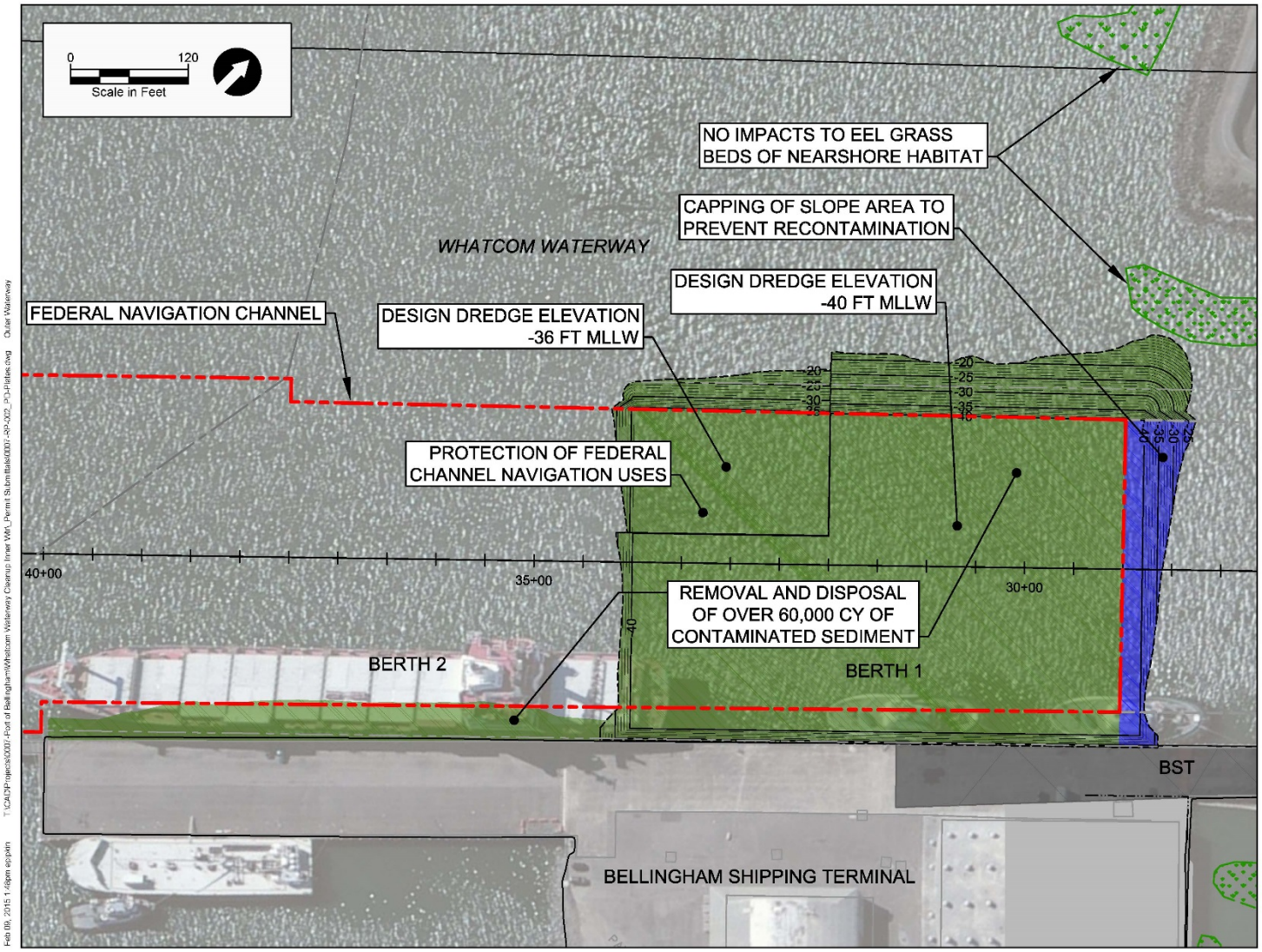

Plate ES-1
Net Environmental Benefits of Cleanup at BST
Final Engineering Design Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

Inner Waterway

The Inner Waterway area is located at the east end of the Site. Existing habitat conditions in the Inner Waterway area are highly impacted by anthropogenic factors. In addition to contaminated sediments, the area's shorelines are degraded by the presence of extensive manmade shoreline debris, including concrete waste and asphalt rubble, overwater structures, and creosote-treated timber structures including vertical bulkheads and piling. Remediation work to be performed within the Inner Waterway includes dredging contaminated sediments, installing shoreline containment walls, shoreline cutbacks in selected areas, sediment capping, and structure removal (including removal of an existing dock and creosote-treated timber piles) and replacements as necessary to accomplish remediation (Plate ES-2). The unstable shorelines along the Georgia-Pacifica West mill (GP West) cleanup site and the Central Waterfront cleanup site are potential sources of contamination. Required stabilization and source control measures are to be completed in these locations to prevent recontamination of the remediated areas.

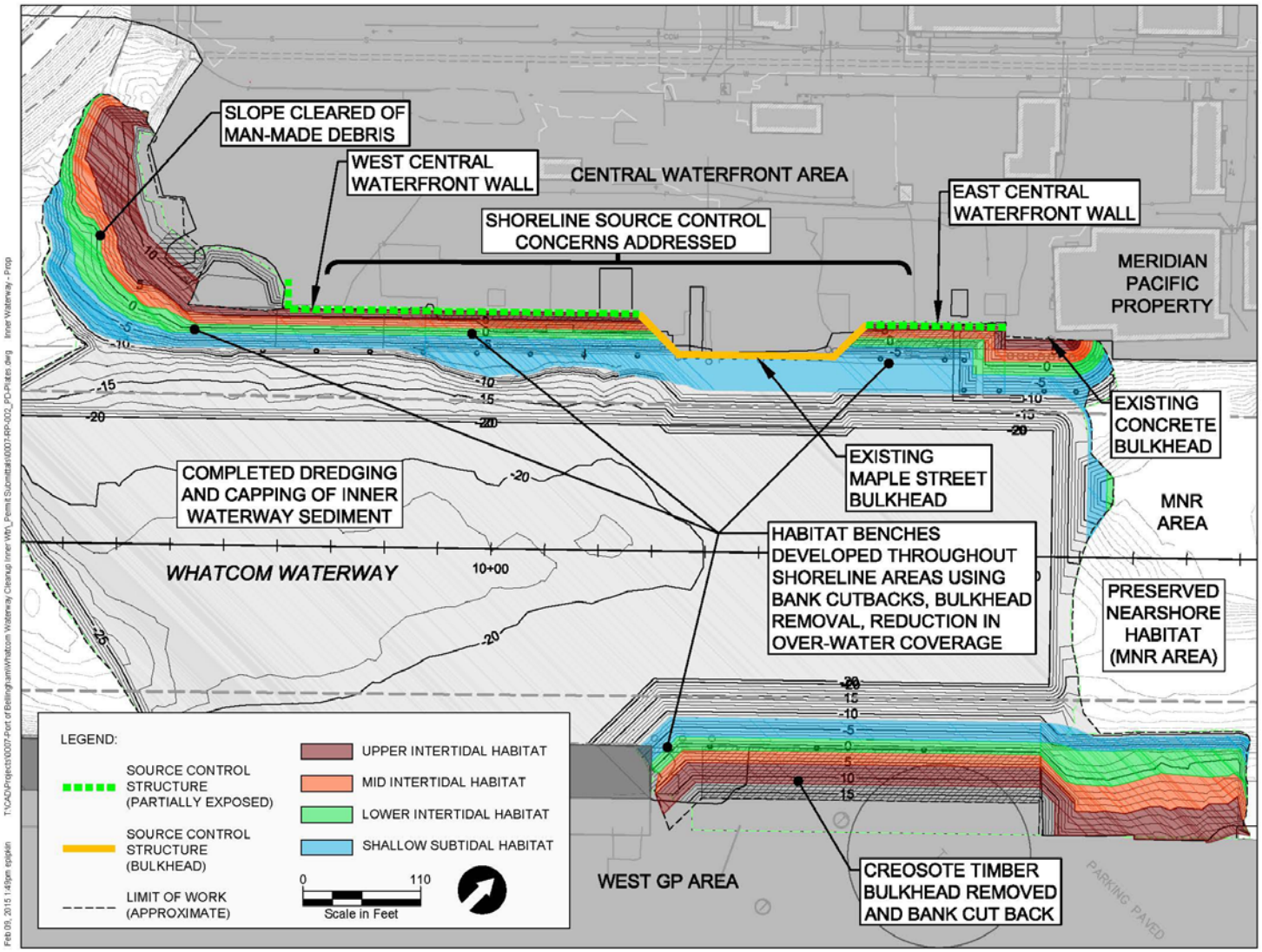

Plate ES-2
Net Environmental Benefits of Cleanup Within the Inner Waterway
Final Engineering Design Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

Log Pond

The Log Pond area is located between the BST and the Inner Waterway on aquatic land owned by the Port (Plate ES-3). The Log Pond was the site of a previous interim cleanup action and habitat enhancement project (Anchor Environmental 2001a) that isolated contaminated sediment with a clean cap.

Shoreline areas along the southeastern portion of the Log Pond are covered with manmade debris including concrete and asphalt rubble, rebar and other metal debris, and a variety of creosote-treated timbers and timber pile stubs. Under the Project, nearshore cap edges will be finished and connected to the adjacent shorelines to correct and prevent cap erosion and associated recontamination of the cap surface. Select structures (e.g., creosote-treated timber piles and portions of an existing creosote-treated timber bulkhead) and manmade debris will also be removed within the Log Pond area to facilitate the cap construction. The Log Pond is located along the northern edge of the GP West site that includes areas of contaminated soil and groundwater that are the subject of an ongoing investigation and cleanup, and the Project design includes shoreline stabilization measures to prevent recontamination of the Log Pond from these upland contamination sources.

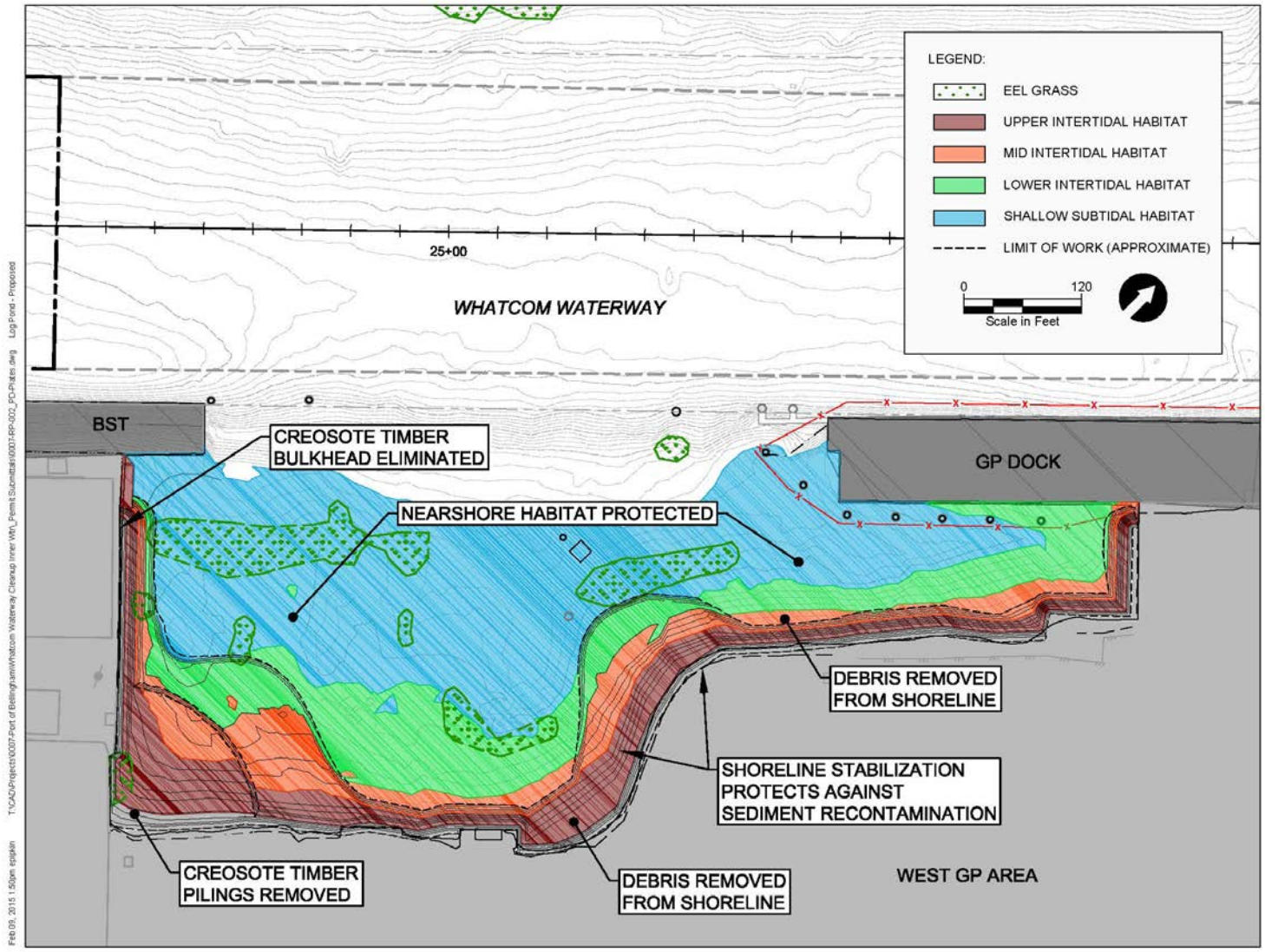

Plate ES-3
Net Environmental Benefits of Cleanup at the Log Pond
Final Engineering Design Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

Monitoring and Institutional Controls

In addition to the active remediation elements of the Project, the cleanup action includes implementation of long-term monitoring and contingency response measures throughout the Phase 1 Site areas, and also in Site areas being managed by monitored natural recovery (MNR). Institutional controls will be implemented as part of the cleanup action for all capping and natural recovery areas to ensure protection of the cleanup action.

Net Environmental Benefits

The Project will result in significant improvements in the environmental conditions within the Site through the cleanup of contaminated sediments and control and containment of upland pollution sources. As part of its cleanup decision for the Site (Ecology 2007a), the Washington State Department of Ecology (Ecology) conducted an analysis of the environmental impacts of the cleanup. That analysis, as described in the Final Supplemental Environmental Impact Statement (FSEIS; Ecology 2007b), determined that the implementation of the cleanup action would result in net environmental benefits to the environment, including benefits to fisheries resources and aquatic habitat.

Consistent with the findings of the FSEIS, the work as proposed in this Engineering Design Report is expected to result in significant habitat improvements. These benefits are associated with implementing contaminated sediment cleanup and source control; removing existing creosote-treated derelict structures and miscellaneous shoreline debris; improving intertidal habitat conditions by replacing currently over-steepened slopes that are littered with concrete, asphalt, and other debris with more gentle slopes overlain with clean materials; and reducing the overall the amount of in- and overwater cover within the Waterway. Existing structures that must be replaced will be constructed out of more environmentally friendly materials than the current structure (e.g., existing creosote-treated timber piling to be removed will be replaced by a lesser number of steel or concrete piling and the new steel piling will occupy a smaller overall footprint).

In summary, the net environmental effects of the Project include the following:

- Removing up to 158,900 cubic yards of contaminated sediment
- Placing up to 126,600 cubic yards of clean capping and residuals management materials to prevent potential erosion and recontamination
- Removing approximately 263 tons of creosote-treated timber (e.g., piling and bulkheads) from the Site
- Removing manmade debris from 46,950 square feet of shoreline and intertidal areas within the Waterway, including concrete waste, asphalt rubble, and other miscellaneous debris
- Providing a net reduction of more than 4,300 square feet of overwater cover by removing unused existing structures
- Eliminating existing vertical bulkheads and provide new slopes at slopes of 2 horizontal to 1 vertical (2H:1V) or flatter in various shoreline areas
- Increasing the quantity and quality of intertidal and shallow subtidal habitat within the Project area and significantly improving habitat connectivity for a variety of fish and invertebrate species, including Endangered Species Act-listed Chinook salmon

Ultimately, the Project will result in significant environmental improvements over existing conditions within the Site and will provide greatly improved habitat quantity, quality, and connectivity for a variety of species.

1 INTRODUCTION

This Engineering Design Report (EDR) for Phase 1 Site Areas describes the detailed engineering design for the final cleanup of certain portions of the Whatcom Waterway Site (Site) in Bellingham, Washington. The Site location and vicinity are shown in Figure 1, including Site subareas and Site units.

The cleanup in these Site areas is being performed consistent with the cleanup requirements of the Model Toxics Control Act (MTCA), Chapter 70.105D in the Revised Code of Washington (RCW), as administered by the Washington State Department of Ecology (Ecology) under the MTCA Cleanup Regulation, Chapter 173-340 of the Washington Administrative Code (WAC). The cleanup also complies with Sediment Management Standards (SMS; WAC 173-204).

Site cleanup is to be performed by the Port of Bellingham (Port) and other cooperating potentially liable parties (PLPs) under Ecology oversight, in accordance with Consent Decree No. 07-2-02257-7 (Ecology 2007a) and the First Amendment to the Consent Decree (Ecology 2011a).

1.1 Site Location and Vicinity

Figure 1 presents the Site vicinity and location features, including the overall Site boundary and the location of Site units within the Site. Figure 1 also shows the location of several other cleanup sites designated by Ecology and located in adjacent portions of Bellingham Bay. These adjacent sites include the Central Waterfront, I&J Waterway, Cornwall Avenue landfill, former South State Street Manufactured Gas Plant (SSSMGP), and R.G. Haley sites. The cleanup action for the Site is being coordinated with these separate site cleanups by the Port and Ecology.

The Site includes sediments that have been impacted by contaminants historically released from industrial waterfront activities, including mercury discharges from the former Georgia-Pacific (GP) chlor-alkali plant. The chlor-alkali plant was located on a portion of the adjacent GP West mill site (GP West) and operated between 1965 and 1999, when it was

permanently closed. The chlor-alkali plant discharged mercury-containing wastewater into the Waterway, primarily during the late 1960s and 1970s.

The Site boundary shown in Figure 1 was determined based on the extent of potentially significant surface and subsurface mercury contamination in sediments as determined during the Remedial Investigation and Feasibility Study (RI/FS) process and during subsequent pre-remedial design investigations (PRDI) conducted during 2008 (Anchor QEA 2010a).

Other site-associated contaminants include wood waste and degradation products from historical log rafting activities and phenolic compounds from pulp mill wastewater discharges. Some contaminants (hydrocarbons and boatyard metals) associated with the Central Waterfront site are commingled with subsurface contamination in shoreline areas along the northern portion of the Waterway and are being remediated as part of the Site cleanup action described in this report. Section 2 of this report provides additional detail regarding the nature and extent of contaminants located within the Site.

1.2 Overview of Site Cleanup Requirements

The *Preliminary Design Concept Report* (PDCR) (Anchor QEA 2012) provides an overall summary of Site cleanup requirements as defined in the Consent Decree (Ecology 2007a) and the First Amendment to the Consent Decree (Ecology 2011a). These actions include cleanup construction activities to be performed in Phase 1 Site areas, separate work to be performed in Phase 2 Site areas, and monitoring activities to be performed in other areas of the Site to be managed by monitored natural recovery (MNR).

The cleanup action for the Site was selected by Ecology after completion of an RI/FS, which began in 1996 and has included two supplements. It was finalized in 2006 with a Supplemental RI/FS report (RETEC 2006) describing the nature and extent of contamination, presenting the conceptual Site model, and assessing potential alternatives for cleanup of each portion of the Site. Technologies evaluated in the RI/FS included removal with upland disposal, treatment, reuse, containment (including capping, nearshore confined disposal, and confined aquatic disposal), enhanced natural recovery, MNR, and institutional controls. Potential environmental impacts associated with the cleanup alternatives were evaluated

under the State Environmental Policy Act (SEPA). Ecology's SEPA impacts analysis was documented in a Final Supplemental Environmental Impact Statement (FSEIS) issued by Ecology (Ecology 2007b).

As described in the RI/FS, the cleanup action for the Site also includes implementation of contingency actions within the portion of the Site known as the Log Pond (Figure 1). In late 2000 and early 2001, GP implemented an interim action to clean up sediment contamination in the Log Pond area. This interim action beneficially reused 43,000 cubic yards of clean dredge materials from the Swinomish navigation channel and Squalicum Waterway. The materials were used to cap contaminated sediments in the Log Pond area and to improve habitat substrate and elevations for use by aquatic organisms. Monitoring results have confirmed that the majority of the cap is meeting performance objectives; however, some erosion has occurred at the shoreline edges where the cap was the thinnest, exposing mercury-contaminated sediment. As part of the final cleanup of the Log Pond area, contingency actions will be taken to contain exposed contaminants and to correct and prevent cap erosion.

In 2007, Ecology developed a Cleanup Action Plan (CAP) for the Site. The CAP describes Ecology's selected cleanup action for the Site, consistent with MTCA and SMS requirements. In 2007, after public notice and opportunity to comment, a Consent Decree (Ecology 2007a), including the CAP, was signed by the cooperating PLPs and Ecology and entered into the records of Whatcom County Superior Court.

In 2011, after public notice and opportunity to comment, the First Amendment to the Consent Decree (including amendments to the CAP and schedule) was signed by the cooperating PLPs and Ecology and entered into the records of Whatcom County Superior Court (Ecology 2011a). The adjustments made to the original cleanup action affected certain areas of the Site as described in Section 2 of this EDR.

Consistent with the requirements of the First Amendment to the Consent Decree, the design and implementation of the cleanup will be implemented in two cleanup phases, with two separate and independent construction projects, each addressing distinct areas of the Site. The PDCR (Anchor QEA 2012) describes the cleanup work to be conducted in each area of

the Site, including the work to be conducted within the Phase 1 areas (the current Project), as well as the work to be conducted in the Phase 2 areas (separate future project). The PDCR also describes the management of the areas of the Site for which the selected cleanup action was MNR. No cleanup construction activities are planned for these MNR areas.

1.3 Purpose of Report

This EDR documents the engineering design to be used for the construction of the cleanup action in the Phase 1 Site areas. These Phase 1 Site areas include portions of Site Unit 1C near the Bellingham Shipping Terminal (BST), Site Unit 4 (the Log Pond), and portions of the Inner Waterway including Site Units 2A and 3B and portions of Unit 2C. The work to be performed in these areas utilizes dredging, upland disposal, capping, monitoring, and institutional controls to meet cleanup objectives.

Appendix G of this report describes the Compliance Monitoring and Contingency Response Plan that will be implemented following completion of construction in the Phase 1 Site areas. That monitoring program addresses both the Phase 1 Site areas and portions of the Site to be managed by MNR. These MNR areas include portions of Units 3, 5, and 6, and all of Units 7 and 9.

This report does not describe the engineering design for cleanup actions in Phase 2 Site areas. The Phase 2 Site areas are separate and distinct from those being remediated during the current Project. The work in the Phase 2 areas uses different technologies to achieve cleanup levels, including confined aquatic disposal for management of contaminated dredge materials. The engineering design for cleanup actions in Phase 2 Site areas will be provided in a separate Phase 2 EDR. That document will be developed as part of Phase 2 design and permitting, which will be initiated after completion and Ecology approval of the construction activities described in this report. The Phase 2 EDR is anticipated to be completed for public review in 2016, consistent with the schedule defined in the First Amendment to the Consent Decree (Ecology 2011a).

Consistent with the First Amendment to the Consent Decree (Ecology 2011a), this EDR for Phase 1 Site areas was updated at two points before implementing the construction work

described herein. First, the report was updated after being made available for public review and comment. Second, the report was updated where necessary to reflect adjustments required to comply with final Project permits issued for Project construction.

1.4 Report Organization

The information contained in this report has been organized in the following manner:

- **Section 2 – Background and Design Basis:** Section 2 provides background regarding the cleanup decision and the requirements that must be met by the design. The sources of data used in the design are described, along with Project design criteria.
- **Section 3 – Overview of Project Elements:** The cleanup Project for Phase 1 Areas includes many different Project elements. Section 3 provides an overview of these elements, including construction activities, as well as compliance monitoring, contingency measures, and institutional controls.
- **Section 4 – Net Environmental Effects:** Ecology's cleanup decision included review of the net environmental effects of the Project consistent with the requirements of SMS and the FSEIS (Ecology 2007b). Section 4 reviews the net environmental effects of the engineering design as proposed in this document.
- **Sections 5 to 10:** Sections 5 through 10 of the document provide a detailed discussion of the design assumptions used for each construction element composing the cleanup, including site preparation and staging (Section 5), dredging and disposal (Section 6), Waterway capping (Section 7), work along the South Shoreline (Section 8), work along the Central Waterfront shoreline (Section 9), and the Log Pond contingency actions (Section 10).
- **Section 11 – Anticipated Implementation Schedule:** The anticipated implementation schedule for the Project is provided in Section 11, including construction, institutional control, and long-term monitoring requirements.
- **Section 12 – Summary:** Section 12 provides an overall summary of the cleanup Project and its net environmental effects.
- **Section 13 – References:** This report builds on many previous documents. Applicable references cited in this report are listed in Section 13.

2 BACKGROUND AND DESIGN BASIS

This section provides additional information regarding the history of the Site and context for the EDR. Also described in this section are the sources for information used in developing the engineering design, and the design criteria applied to the construction elements of the Project.

2.1 Site Background

As described in Section 1.1, the Site includes sediments that have been impacted by contaminants historically released from industrial waterfront activities, including mercury discharges from the former GP chlor-alkali plant; wood waste and degradation products from historic log rafting activities; and phenolic compounds from pulp mill wastewater discharges. There are multiple cleanup sites located adjacent to the Waterway as shown in Figure 1, and sediment contamination from those other sites is commingled with subsurface contamination in portions of the Site. Cleanup of the Site is being coordinated with these separate actions, which are also overseen by Ecology.

The chlor-alkali plant discharged mercury-containing wastewater into the Waterway primarily during the late 1960s and 1970s. Initial environmental investigations of the Site during the 1980s and 1990s identified mercury in sediment at concentrations that exceed applicable standards, as well other contaminants from industrial releases.

The RI/FS process for the Site began in 1996 and has included two supplements to reflect updated land use within portions of the Site. The most recent 2006 Supplemental RI/FS report (RETEC 2006) described the nature and extent of contamination, presented the conceptual site model, and assessed potential alternatives for cleanup of each portion of the Site. In the RI/FS, the different portions of the Site were divided into sediment Site units as shown in Figure 1. These units were developed based on differences in the following parameters:

- Physical factors, including bathymetry, sediment particle size and texture, wood material distribution, wind and wave energies, and the characteristics of adjacent shorelines

- Land use and navigation, including upland zoning, shoreline infrastructure, navigation uses, natural resources, ongoing waterfront revitalization activities, and potential interrelationships between cleanup considerations and these factors
- Natural resources, including the types of existing aquatic habitats within the unit.
- Contaminant distribution, including patterns of surface and subsurface contamination and relative contaminant concentrations

Site cleanup technologies evaluated include removal with upland disposal, treatment, reuse, containment (including capping, nearshore confined disposal, and confined aquatic disposal), enhanced natural recovery, MNR, and institutional controls. Potential environmental impacts associated with the cleanup action were evaluated under SEPA. Ecology's SEPA impacts analysis was documented in an FSEIS issued by Ecology (Ecology 2007a).

Ecology subsequently developed a CAP for the Site. The CAP describes Ecology's selected cleanup action for the Site, consistent with MTCA and SMS requirements. The CAP included the following information:

- Summary of Project background and environmental conditions
- Cleanup requirements applicable to the Site, including cleanup standards and other federal, state, and local laws applicable to the cleanup action
- Summary description of the remedial alternatives evaluated in the RI/FS
- Rationale for selection of the proposed cleanup alternative
- A description of the cleanup action selected by Ecology, consistent with MTCA requirements, including a description of the types, levels, and amounts of hazardous substances that will remain on Site as part of the cleanup and the measures that will be used to prevent migration and contact with those substances
- Compliance monitoring, contingency action requirements, and institutional controls are also described

In 2007, after public notice and opportunity to comment, a Consent Decree (including the CAP) was signed by the cooperating PLPs and Ecology, and entered into the records of Whatcom County Superior Court.

Under the terms of the Consent Decree, the Port and the other cooperating PLPs developed a *Pre-Remedial Design Investigation Work Plan* (Work Plan) (Anchor QEA 2008) for Ecology review, which focused on filling pre-design data gaps to allow remedial design and permitting activities to move forward. Following Ecology approval of the Work Plan in June 2008, investigation activities commenced in July 2008 and were completed in May 2009. Testing activities completed as part of the PRDI were extensive and included:

- Updated surveys of Site physical conditions using bathymetric and side-scan sonar surveys and sediment probing within the aerated stabilization basin (ASB)
- Oceanographic data collection documenting current and wave behavior within Bellingham Bay
- Surface sediment testing, including both chemical and biological (i.e., bioassay) testing
- Specialized testing of sediments, including porewater and mercury speciation in surface sediments, and contaminant leachability measurements in planned dredging areas
- Testing of subsurface sediment quality using samples collected by vibracore, hollow-stem auger, and diver-deployed core methods
- Collection of geotechnical data for use in engineering design of the cleanup action
- Surveys of current habitat characteristics, including surveys of eelgrass occurrence within the proposed construction areas

Most PRDI findings were consistent with previous expectations or represented an improvement in Site environmental conditions. Information developed during the PRDI documented that surface sediment quality continued to recover naturally within most areas of the Site. No contamination exceeding Site cleanup levels was detected in planned MNR areas and no exceedances of cleanup levels were noted in surface sediments within Units 6B or 6C, which had been identified for capping. The lateral extent of surface sediment contamination within Unit 5B was determined to be smaller than previously estimated. Within Unit 8 (ASB), the thickness of the contaminated sludge was verified, and this sludge was determined to overlay a thick sequence of clean native sandy sediments. Also, with the exception of the transition sands immediately beneath the ASB sludges, no contamination was identified in the sandy materials used to construct the interior of the ASB berm or in the sediments beneath the berm.

In one area, the PRDI findings provided new information that required a substantial change to the planned cleanup as defined in the original CAP (Ecology 2007a). Specifically, updated information indicated that levels of dioxins/furans (D/Fs) in buried sediments offshore of the shipping terminal (within Units 1A and 1B) would render these sediments unlikely to meet Dredged Material Management Program (DMMP) guidelines for unconfined open-water disposal, as planned in the original CAP. Concentrations of D/Fs in these materials (expressed using the Toxic Equivalents Quotient [TEQ] method) ranged from 26 to 39.8 nanograms (ng) TEQ/kilograms (kg), with an average concentration of 33 ng/kg.

The primary effect of the D/F testing data was that a different disposal option was needed for the Units 1A/1B materials slated for unconfined open-water disposal in the original CAP. As described below, Ecology developed the First Amendment to the Consent Decree (Ecology 2011a), including changes to the cleanup action to provide a different management method for these sediments. This also presented an opportunity to manage a portion of the sediments from Units 1C and 5B differently.

In 2011, after public notice and opportunity to comment, the First Amendment to the Consent Decree (including amendments to the CAP and schedule) was signed by the cooperating PLPs and Ecology and entered into the records of Whatcom County Superior Court. The adjustments made to the original cleanup action affected specific areas of the Site.

2.2 Required Cleanup Actions

Consistent with the First Amendment to the Consent Decree, the design and implementation of the cleanup of the Site will be implemented in two cleanup phases, with two separate and independent construction projects, each addressing distinct areas of the Site. Monitoring for each of the two construction projects will be performed consistent with a Compliance Monitoring and Contingency Response Plan prepared for each project. The Compliance Monitoring and Contingency Response Plan for the cleanup in Phase 1 Site areas is provided as Appendix G.

Three primary remedial action technologies will be implemented in Phase 1 areas, including remedial dredging, engineered capping, and installation of containment wall structures. Remedial dredging is defined as the controlled removal of contaminated sediments from the aquatic environment. Remedial dredging techniques may include mechanical or hydraulic dredging methods, though mechanical dredging will be specified as the primary dredging method for the Phase 1 cleanup action. Engineered capping is the controlled, accurate placement of clean material to isolate contaminated material from the aquatic environment. An engineered cap can serve any or all of three primary functions:

- Physical isolation of the contaminated material from the benthic environment
- Physical containment of the underlying contaminated material, preventing resuspension and transport to other sites
- Reduction of the flux of dissolved contaminants into the engineered cap and overlying water column

Engineered cap composition and thickness can consist of a single layer of clean material, or multiple layers of different material types. Caps are generally constructed of sand overlain by larger size materials such as gravel or rock to protect against erosion due to hydrodynamic forces. Engineered caps proposed for Phase 1 areas fall into three types:

- **Type I:** Three-layer engineered cap (sand, gravel filter, and rock armor) used to isolate contamination and provide erosion protection from wind waves and propeller wash (propwash forces). This engineered cap design is primarily employed along shorelines and in nearshore areas.
- **Type II:** Two-layer cap (sand and gravel armor) used to isolate contamination and provide erosion protection from primarily propwash forces. This engineered cap design is primarily used in open water areas where water depths result in lower propwash velocities and wind wave forces than areas where Type I caps are used.
- **Type III:** Two-layer cap (gravel filter and rock armor) used for erosion protection along the Log Pond shoreline areas that are experiencing ongoing erosion but where no chemical recontamination has occurred.

Containment wall structures will be used to prevent uncontrolled slope movement during nearshore dredging and engineered capping operations, to contain contaminated soils and to

minimize the potential for groundwater contaminant migration from the adjacent upland cleanup areas to re-contaminate the newly placed caps.

The construction Project to be completed in Phase 1 Site areas will include cleanup actions within the Inner Waterway (Units 2A and 3B and portions of Unit 2C), the Log Pond (Unit 4), and a portion of the BST (Unit 1C). The work to be performed in these areas is shown on Figure 2, and described in detail in this EDR. The construction Project addressing these Phase 1 areas will include the following activities:

- **Inner Waterway areas (Units 2A and 3B and portions of Unit 2C):** Dredging and capping will be performed within portions of the Inner Waterway. This work will include remediation of the portion of the Waterway that overlaps with the Central Waterfront site (along the northern shoreline of the Waterway). Cleanup in the Inner Waterway will also include some structure demolition and removal, replacement or removal of bulkheads in steep shoreline areas along the northern Waterway shoreline, removal of the clarifier and associated bulkhead along the southern Waterway shoreline, and repair and replacement of some existing structures as necessary to accomplish the remediation.
- **Log Pond area (Unit 4):** A cap was placed within the Log Pond during 2000/2001 as part of an Interim Remedial Action. Contingency actions are required to repair the cap edges. Work within the Log Pond includes shoreline capping as necessary to repair these shoreline edges of the cap. Cleanup within the Log Pond will include stabilization of the shoreline located adjacent to the BST and some demolition of selected structures (e.g., timber piles) as necessary to complete the contingency actions.
- **Bellingham Shipping Terminal area (Unit 1C):** The BST is located within the Outer Waterway. This area includes sediment deposits with contaminant concentrations that are higher than those in other Unit 1C and adjacent areas. Remediation activities include dredging and upland disposal of contaminated sediments from a portion of Unit 1C.

Monitoring of portions of Units 3, 5, and 6 and all of Units 7 and 9, designated for MNR under the Consent Decree (Ecology 2007a) and First Amendment to the Consent Decree (Ecology 2011a), will also be performed following completion of the construction work in Phase 1 areas (see Figure 3). This monitoring program is defined in this EDR.

The construction Project to be completed in Phase 2 areas will address Units 1A, 1B, 2B, 2C, 5B, 6B, 6C, and 8, and a portion of Unit 1C. These activities will be performed in association with certain waterfront redevelopment activities, including development of a planned marina within Unit 8 and reconfiguration of portions of the BST. The construction Project addressing these Phase 2 areas is shown on Figure 4, and includes the following activities:

- **ASB (Unit 8):** The cleanup action will include removal of the sludge and associated contaminated sediments from the ASB. Sludge and contaminated sediments will be managed by upland disposal. Following the removal of contaminated material from Unit 8, the cleanup action will remove reusable sandy sediments, including approximately 340,000 cubic yards of clean material to be stockpiled (likely at the GP West site) for later use. This excavation will provide sufficient volume for confined aquatic disposal of sediments to be dredged from Units 1A, 1B, and 5B, and part of Unit 1C. After these materials are placed, Unit 8 will be covered with a subaqueous cap compatible with future planned marina uses. The ASB then will be opened to Bellingham Bay, including dredging of the access channel (Unit 2B). The access channel will be dredged in a location consistent with planned marina uses (to be determined as part of the final design).
- **Outer Waterway (Units 1A, 1B, and a portion of 1C):** Sediments within Units 1A and 1B and a portion of Unit 1C will be dredged and disposed of within Unit 8.
- **Shoulder of the ASB (Unit 5B):** Sediments from within a portion of Unit 5B will be dredged and disposed of within Unit 8 as described above. The excavation area will be backfilled with clean sediments to restore existing grades and maintain habitat functions in this area. Clean reusable, native sediments excavated from beneath Unit 8 are to be used for this backfill.
- **Inner Waterway (Unit 2C):** Sediments within Unit 2C are to be capped. Clean reusable, native sediments excavated from beneath Unit 8 are to be used for some of this capping material. In association with this work, the portion of the BST pier extending into the Log Pond will be removed to facilitate capping and armoring of this area. The moorage function previously provided by the pier will be replaced with new breasting and mooring dolphins placed at the opposite, offshore end of the BST.
- **Barge dock area (portion of Units 6B and 6C):** The PRDI indicated that sediments in Unit 6 have naturally recovered, though a portion of this area may be subject to

propwash and associated sediment disturbance. A layer of armoring material will be placed in this area to protect against potential disturbance.

2.3 Sediment Cleanup Levels

Sediment cleanup levels and points of compliance were defined in the CAP and Consent Decree (Ecology 2007a) for the Site. These criteria remained unchanged in the First Amendment to the Consent Decree (Ecology 2011a). Site cleanup levels and points of compliance include the following:

- **Sediment quality standard (SQS) for Site-associated contaminants:** Sediment cleanup levels for Site-associated contaminants were defined in the CAP, including mercury, phenolic compounds, and polycyclic aromatic hydrocarbon (PAH) compounds. For these compounds, the cleanup levels for benthic protection have been established at the SQS. Compliance with the SQS is to be determined using a combination of chemical testing and contingent bioassay testing. Samples that exceed the chemical SQS but pass bioassay testing are considered to comply with the SQS, consistent with Washington's SMS regulations.
- **Bioaccumulation screening level for mercury:** An additional requirement was established in the CAP and Consent Decree for mercury, to ensure that the cleanup protects against potential bioaccumulation of mercury and methylmercury compounds. This screening level is 1.2 milligrams (mg) total mercury per kg dry weight. This value was developed using area-weighted averaging, but is to be applied throughout surface sediments at the Site.
- **Sediment points of compliance:** Compliance with the sediment cleanup levels is measured based on the thickness of the sediment biologically active zone. In Bellingham Bay, this thickness is the upper 12 centimeters (cm) of the sediment bed. In addition, while cleanup levels do not directly apply to sediment below 12 cm, the SMS require that the potential risks of the current or future exposure of deeper sediments be considered and minimized through the implementation of the cleanup action.

D/Fs are known to be present in surface and subsurface sediments throughout most of Bellingham Bay and other urban bays within Puget Sound. The full range of sources for

these compounds in Bellingham Bay has not yet been determined but may include contributions from many sources throughout the Bay, including former combustion sources, former GP pulp and paper mill operations, former wood-treating facilities, historic and ongoing stormwater and wastewater discharges, and atmospheric deposition.

The First Amendment references an Ecology evaluation of D/Fs in the surface sediments of Bellingham Bay. This work was completed and a report issued in June 2009 (Hart Crowser 2009). Ecology has reviewed this D/F data, and is conducting ongoing work to determine a background concentration in Bellingham Bay. In addition, Ecology is revising the SMS regulations to include a framework for regulating widespread contaminants such as D/Fs that currently do not have defined numeric SMS cleanup levels and that typically have multiple historic and ongoing sources. This rule-making effort is ongoing.

Subject to and consistent with the provisions of the Consent Decree as amended, these Ecology efforts could result in a proposed future amendment to the CAP addressing D/Fs within the Site. Until then, reasonable and prudent measures to address D/Fs as part of the cleanup action (e.g., incorporating D/F concentrations in analysis of dredging depths and management of dredging residuals, evaluating D/F mobility as part of capping design, and incorporating D/F analysis in planned compliance monitoring) have been incorporated into engineering design as described in the PDCR (Anchor QEA 2012) and in this EDR for Phase 1 Site areas.

2.4 Existing Information Used for Phase 1 Design

The engineering design for Phase 1 areas relies on existing information developed during the RI/FS and during additional studies. Available information used in development of this EDR is described below.

2.4.1 Structural Information

The Port has compiled readily available engineering design or as-built information regarding existing Site structures that are affected by the cleanup action in Phase 1 areas. However, design and as-built information was not available for all potentially affected structures. The

following provides a summary of structural information that has been made available to the Project team by the Port or through research efforts:

- As-built and maintenance drawings of the existing GP dock within the Inner Waterway and Log Pond
- Maintenance and condition drawings of the BST dock sections in Berths 1 and 2
- Condition drawings of the existing clarifier bulkhead and subsequent repairs and modifications that have been made since initial construction
- As-built drawings of the hydraulic ramp located at Maple Street
- Condition drawings of the timber step bulkhead in the southwestern portion of the Log Pond area

No as-builts or design records were available for the existing Maple Street bulkhead or for the dock and bulkheads at the former Chevron property.

2.4.2 Site Surveys

Several surveys performed throughout the Site were used to develop the Project basemap (Figures 5a to 5c) and support the 60 percent remediation design efforts. Site surveys completed to date are summarized in the following table:

Table 2-1

Site Surveys[1]

Date	Description and Extent	Formats
May 2008	Multi-beam bathymetry of the Waterway; single-beam bathymetry of Bellingham Bay in vicinity of the Waterway	AutoCAD, PDF
May 2008	Side scan survey of the Waterway	Contract report, Geotiff, side scan data files
June 2008	Under-wharf survey (BST and GP docks)	AutoCAD, under-wharf photographs (extent of survey)
September 2008	Structural inspection (non-invasive)[2]	PDF
June 2008	Additional bathymetry survey; high-resolution single-beam bathymetry of the outer federal navigation channel	AutoCAD, PDF

Date	Description and Extent	Formats
August 2008	GP pipeline survey at pipeline crossing within the Waterway	PDF, transect plots (jpg)
October 2008	Eelgrass survey (within the Waterway and the outside perimeter of ASB)	AutoCAD and PDF
February 2009	Additional under-dock survey; extent of riprap on slope (at BST)	AutoCAD, under-dock photographs (extent of survey)
March 2009	ASB armor rock quality evaluation; outer perimeter of ASB[3]	Technical memorandum, GIS
May 2009	Stormwater survey, mill site	AutoCAD
January 2010	ASB interior survey; pole survey to determine bottom of sludge layer[4]	AutoCAD, GIS
April 2012	Targeted single-beam hydrographic survey at boat haul-out location along former City of Bellingham property	AutoCAD

Notes:
1. All surveys were completed by Wilson Engineering unless otherwise noted.
2. Structural inspection was completed by KPFF.
3. Armor rock evaluation was completed by Coast & Harbor Engineering and Anchor QEA.
4. Pole survey was completed by Anchor QEA.

2.4.3 Existing Environmental Data Sources

The *Pre-Remedial Design Investigation Data Report* (Anchor QEA 2010a) describes the findings of field investigations and testing conducted specifically to support of the engineering design and permitting for the cleanup of the Site, including both Phase 1 and Phase 2 Site areas. A companion report, the *Non-Remedial Design Investigation Data Report* (Anchor QEA 2010b) summarized additional geotechnical investigations prepared within the Project area.

Additional information regarding the Site setting and environmental conditions was available in studies previously conducted under Ecology oversight. These previous studies include the following:

- *Remedial Investigation and Feasibility Study for the Whatcom Waterway Site* (Anchor Environmental and Hart Crowser 2000)
- *Bellingham Bay Comprehensive Strategy, Final Environmental Impact Statement* (Ecology 2000)

- *Final Engineering Design Report for the Log Pond Interim Remedial Action* (Anchor Environmental 2001a)
- *Year 1 Log Pond Monitoring Report* (Anchor Environmental 2001b)
- *Draft Supplemental Feasibility Study for the Whatcom Waterway Site (*Anchor Environmental 2002a)
- *Year 2 Log Pond Monitoring Report* (Anchor Environmental 2002b)
- *Whatcom Waterway Pre-Remedial Design Evaluation Data Report* (Anchor Environmental and Landau Associates 2003)
- *Bellingham Bay Comprehensive Strategy, Draft Supplemental Environmental Impact Statement* (Ecology 2002)
- *Supplemental Remedial Investigation and Feasibility Study. Volume 1: RI Report and Volume 2: FS Report* (RETEC 2006)
- *Final Supplemental Environmental Impact Statement for the Cleanup of the Whatcom Waterway Site, Bellingham Bay Comprehensive Strategy* (Ecology 2007b)
- *Cleanup Action Plan for the Whatcom Waterway Site* (Ecology 2007a)
- *First Amendment to the Consent Decree – Whatcom Waterway Sit*e (Ecology 2011a)

2.5 Site-wide Design Criteria

The following design criteria are applicable to the engineering design for Phase 1 cleanup areas.

2.5.1 Project Datums

The horizontal datum that will be used is Washington State Plane North Zone, North American Datum of 1983 (NAD 83), measured in units of feet.

The vertical datum will be National Ocean Survey (NOS) mean lower low water (MLLW) based on National Oceanic and Atmospheric Administration (NOAA) Station No. 9449211, located in Bellingham, Washington. Table 2-2 outlines the different water levels based on the NOAA Station No. 9449211 benchmarks.

Table 2-2
Datum Elevations (Station No. 9449211)

Tide Level	Meters (MLLW)	Feet (MLLW)
Highest Observed (1/5/1975)[1]	3.177	10.4
Ordinary High Water	3.116	10.2
Mean Higher High Water	2.594	8.5
Mean High Water	2.375	7.8
Mean Tide Level	1.546	5.1
Mean Sea Level	1.510	5.0
Mean Low Water	0.718	2.4
Mean Lower Low Water	0.000	0.0
Lowest Observed (12/30/1974)[1]	-1.057	-3.5
NAVD88	0.147	0.5

Notes:
1. NOAA Station No. 9449211 was active from March 30, 1973 to July 21, 1975. Tidal predictions for the area have been higher and lower than those observed.

MLLW = mean lower low water
NAVD88 = North American Vertical Datum of 1988

2.5.2 Geotechnical Design Criteria

The geotechnical design criteria were developed based on guidance from various technical references (WSDOT 2011; Duncan and Wright 2005; NCHRP 2008; and Kramer 1996) and the American Society of Civil Engineers (ASCE) 7-10 code (ASCE 2010). Appendix B contains a detailed discussion of the soil and sediment data utilized for characterization and development of soil properties and parameters for analyses, the methodologies employed, and the results and conclusions of the geotechnical engineering evaluations.

The Maple Street bulkhead is designed in accordance with the ASCE 7-10 Code (ASCE 2010). The associated design-level seismic event, seismic site classification, and ground motion parameters for the Maple Street bulkhead were derived from the guidance, tables, and charts provided in the ASCE 7-10 code. For the non-structural remedial elements (e.g., earthen slopes and caps), seismic design criteria do not exist. Although specific seismic design criteria were not developed or applied to non-structural remedial elements, these elements were evaluated to better understand their expected performance during a seismic event. The seismic demand from the ASCE 7-10 design-level seismic event was assumed for this

evaluation. The ASCE 7-10 design-level seismic event reflects a similar demand as an earthquake with a 10 percent chance of exceedance in 50 years (i.e., the 475-year return interval earthquake), and is considered to be a suitable seismic event to support remedial design evaluations at the Site.

The other geotechnical design criteria applied to the Site are as follows:

- Site characterization and soil properties such as unit weights, strength parameters, compressibility, and modulus parameters are derived from the soil borings, sediment cores, in situ geotechnical tests such as Standard Penetration Testing (SPT) and vane shear testing (VST), and relevant laboratory data collected during the PRDI and NRDI, as well as other geotechnical investigation data that is available from other investigation efforts completed near the Site.
- Slope angles are evaluated for dredged and capped areas and bulkheads based on target static factors of safety of 1.3 and 1.5 for short-term and long-term conditions, respectively, which are consistent with Washington State Department of Transportation (WSDOT) guidance (WSDOT 2011). A target factor of safety of 1.1 was selected for global seismic slope stability of the Maple Street bulkhead.
- The seismic performance of non-structural remedial elements (e.g., earthen slopes and caps) was assessed by evaluating potential permanent seismic slope displacements for a seismic design-level event developed using the ASCE 7-10 code, which is similar to a 475-year earthquake. Seismic slope displacements of less than 3 feet are generally considered acceptable (Duncan and Wright 2005).
- Caps were evaluated based on a target factor of safety of 2.0 against bearing-capacity failure. This design criterion was used to assess the maximum lift thickness of the cap that can be placed at a given time.

2.5.3 Structural Design Criteria

The following structural design criteria apply to structural design, demolition, and improvement efforts for the Project:

- United Facilities Criteria (UFC) 4-152-01, *Design: Piers & Wharves*, 2005
- UFC 4-151-10, *General Criteria for Waterfront Construction*, 2001
- ASCE, *Minimum Design Loads for Buildings and Other Structures* (ASCE 7-02)

- *Building Code Requirements for Structural Concrete* (American Concrete Institute 318-05)
- *American Institute of Steel Construction Manual of Steel Construction, 13th Edition*, (American Institute of Steel Construction 2006)

Design life for proposed structures is 50 years, assuming completion of regular visual inspections and appropriate structure maintenance.

2.5.4 Coastal Engineering Design Criteria

Site-wide basis of design criteria for coastal engineering considerations include the following:

- A potential rise in sea level of 2.4 feet by 2100 was considered as part of remedial design. This potential sea level rise is consistent with the evaluation documented in the *Waterfront District Redevelopment Final Draft EIS* (Port of Bellingham 2010) completed by the Port in July 2010. This would result in a future predicted mean higher high water (MHHW) elevation of 11.4 feet MLLW (in comparison to the current MHHW elevation of 8.5 feet based on MLLW defined by the current tidal epoch). The ordinary high water (OHW) elevation would change from 10.2 feet MLLW to 13.1 feet MLLW.
- Wave conditions at the Site were based on results of numerical modeling for 100-year recurrence interval events. Wave modeling for 100-year wave conditions was completed using predicted 100-year winds speeds from 240-degree (southwest) and 270-degree (south) directions, which represent the most impactive angles of wave attack for the Waterway. Wave model runs were also run under both MLLW and MHHW tide conditions (based on the NOAA tidal datum at Bellingham, Washington). Additional detail regarding wave modeling can be found in Appendix C.
- Tidal and riverine currents at the Site (bed-velocities) were estimated using numerical modeling for a greater than 100-year recurrence interval event for fresh water inflow and spring tide conditions (largest elevation difference between subsequent high and low tides). The design fresh water inflow from Whatcom Creek was taken as the combination of the estimated 100-year flow (extrapolated from gage data collected upstream of Whatcom Falls) and the maximum flow out of the control structure at

Lake Whatcom (at the headwaters of Whatcom Creek). Additional detail regarding tidal circulation modeling can be found in Appendix C.

- Near-bed velocities due to vessel operations (propwash) were developed using numerical modeling based on evaluation of existing and proposed operations within the Project area. Velocities estimated a distance of 26 cm from the seabed in the model, which were used to evaluate stable sediment and rock sizes. Specific vessel and operations criteria, as well as additional detail regarding propwash modeling, can be found in Appendix D.
- Stable sediment and armor size for shoreline areas impacted by waves were calculated using guidance in the U.S. Army Corps of Engineers (USACE) Coastal Engineering Manual (CEM) (USACE 2002) assuming a no damage (no movement) condition. (See Appendix C for more detail.)
- Stable sediment and armor size for areas impacted by currents (tidal and propwash) are defined as the D_{95} size fraction of a normally distributed sediment gradation. (See Appendices C and D for more detail.)

2.5.5 In-water Work Window and Allowable Construction Work Hours

In-water construction activities will be performed consistent with allowable work windows established in coordination with state and federal resource agencies. Final work windows were specified in Project permits based on the prevalence of different fish species of concern. Most in-water construction activities will be limited to the period between August 1 and March 14. Work may also be completed below the ordinary high water mark (OHWM) in the dry (i.e., during periods of low tide) between July 16 and July 31. Work between February 15 and March 14 will be limited to placement of engineered caps (consisting of clean sand, gravel filter, and rock armor) and residuals management cover; no dredging will occur during this time period.

Based on the current land use classifications for the Site area (heavy industrial or marine industrial), there are currently no hours of work restriction, and construction activities are assumed to be allowed 24 hours per day, 7 days per week.

2.5.6 Whatcom Waterway Use Assumptions

Remedial design for dredging, capping, and shoreline stabilization within the Site addresses current and anticipated Waterway uses consistent with the Consent Decree (Ecology 2007a) and the First Amendment to the Consent Decree (Ecology 2011a). Specific uses are discussed as part of the design, including each of the following:

- **BST**: Deep draft navigation uses are expected to continue at the BST consistent with its current use as a marine terminal. The federal navigation channel is expected to be maintained, including periodic maintenance dredging. The current authorized depth for the federal project is -30 feet MLLW and typical channel maintenance dredging may include over-depth allowances resulting in dredging to elevations of -32 feet MLLW. The BST berths have historically been maintained at neat-line dredge elevations of -35 feet MLLW.
- **Log Pond**: The Log Pond is designated for continued preservation and enhancement of shallow-water aquatic habitat, including potential continuation of eelgrass seeding or other enhancement activities. Navigation uses within the Log Pond are limited to potential small boat access and securing of BST vessel mooring lines to existing dolphins located within the Log Pond. Future maintenance dredging of the Log Pond is not anticipated.
- **Inner Waterway**: The Inner Waterway is expected to be maintained as a locally managed multi-purpose navigation channel, with a functional water depth of 18 feet at MLLW. The channel is expected to be actively maintained, including periodic maintenance dredging.
- **Central Waterfront Shoreline**: Property uses within the Central Waterfront are expected to focus on marine trades (i.e., continuation of existing boatyard, barge terminal, and other marine uses) consistent with Waterfront District planning.
- **South Shoreline**: The former GP West property is to be used for mixed use development consistent with Waterfront District planning. The former wastewater clarifier and associated bulkhead are not required for these uses. The GP dock is expected to continue in use of navigation for an interim period, but could be replaced by alternative shoreline structures in the future.

Additional detail regarding Waterway use assumptions are discussed in subsequent sections of this EDR where relevant to the remedial design.

2.5.7 Construction Best Management Practices

Appropriate best management practices (BMPs) are to be used during cleanup construction activities. These BMPs will be used to minimize potential environmental impacts during Project construction. The BMPs were updated as appropriate following completion of Project permitting reviews. BMPs are provided in Appendix K.

3 OVERVIEW OF PROJECT ELEMENTS

This section provides an overview of the cleanup construction activities to be conducted within Phase 1 Site areas. This section also documents the monitoring, contingency response measures, and institutional controls to be implemented as part of the Project within Phase 1 areas and within areas of the Site to be managed by MNR. Plate 1 provides an overview of the construction activities included in the current Project. Net environmental effects of the cleanup action are then described in Section 4, and detailed design assumptions for these construction activities are described in further detail in the subsequent sections (Sections 5 through 11) of this EDR and its appendices.

3.1 Work Area Preparation, Staging, and Stockpiling Activities

Work area preparation activities are required to complete construction within the Phase 1 cleanup areas as shown in Figure 6. This primarily includes preparation of material management areas. Port-owned land at the GP West site and, to a lesser extent, the Central Waterfront site will be used for necessary stockpile, dewatering, and re-handling areas, unless the selected contractor provides an alternative suitable facility where these activities can be performed. These areas will be made available to the contractor should they elect to design, construct, and manage the facilities on the Port's property.

The final material management locations are expected to be located within portions of the areas shown on Figure 6. With the exception of soil and debris suitable for on-site reuse or recycling (see below), the contractor will be required to ultimately transport dredged sediment and debris entrained with contaminated sediment to a permitted Subtitle D landfill facility. Transportation methods may include shipment by barge, truck, or rail. Certain other materials that may be reused or recycled include the following:

- **Reuse overburden soils:** Overburden soil generated from upland excavations within the Central Waterfront site (e.g., during temporary excavations required for shoreline containment structure installation) may be temporarily stockpiled and reused as backfill. See Section 3.3.4.
- **Reuse South Shoreline cutback soils:** Soil generated during the cutback of the South Shoreline of Whatcom Waterway may be reused as backfill within the former

clarifier, or may be retained on site in a covered stockpiled for future subgrade fill within the GP West site. See Section 8.3.3.

- **Recycling concrete debris:** Clean concrete debris generated during removal of the clarifier or concrete debris along the Log Pond or Central Waterfront Area shorelines may either be crushed on site and stockpiled for on-site reuse or transported to appropriately permitted concrete recycling facilities. Concrete debris that cannot be efficiently segregated from contaminated sediments will be managed as contaminated sediments at a permitted Subtitle D landfill. Bricks, plastic, or woody debris (if present) will not be recycled for on-site reuse and will be managed by Subtitle D landfill disposal.

As shown in Figure 6, two on-site stockpile and equipment staging locations are anticipated for use during construction as provided below:

- **GP West staging areas:** A staging, stockpile, and dewatering area will be made available to the contractor at the GP West site. This area will provide a location for sediment dewatering and will create sufficient staging capacity to coordinate transloading, transport, and disposal. Potential barge offloading would occur at the GP dock, while dewatering and stockpiling would occur further south in the paved area southeast of the Log Pond (Figure 6). A smaller staging and stockpile area is located in the area near the clarifier. This area will be used for localized staging and stockpiling activities associated with the clarifier-area bank cutback and associated sediment capping and related work.
- **Central Waterfront staging areas:** A second set of staging and stockpile areas may be developed at the former Chevron property portion of the Central Waterfront site. This may be used to stage and facilitate debris removal, wall installation, and shoreline stabilization measures along the Central Waterfront site. This area may include stockpiles of construction materials or contaminated soils, debris, and sediment generated during work in this area. Equipment staging and construction work will also occur along the Central Waterfront shoreline during construction of shoreline stabilization and source control measures in these areas.
- **Other staging areas:** Depending on the final disposal site selected, the Project may utilize other sediment transload and staging facilities. In this case, the dredged material will be transported by barge to the offloading facility, and offloaded over a

spill prevention apron directly into a temporary staging area. The temporary staging area will likely be 5 to 10 acres in size, but may be larger or smaller depending on the methods utilized by the contractor. The staging area will be lined with sealed asphalt, concrete, or an impermeable liner and surrounded by perimeter containment (e.g., Ecology blocks). The sediment will be heaped by a front-end loader or similar type of equipment to promote drainage before the sediment is loaded into haul trucks or rail gondolas. The excess water (i.e., effluent) that drains from the sediment or accumulates through rainfall within the temporary staging area will be collected, filtered, and treated as necessary before being appropriately disposed. Discharges of Site water that receive effluent from the temporary staging area will comply with water quality criteria required by Ecology permits or sewer discharge authorizations applicable to the discharge location.

Stormwater and dewatering effluent associated with Project staging areas will be appropriately managed from all upland dewatering, stockpile, and re-handling areas. Upland construction areas, including those work areas within the GP West site and those in the Central Waterfront Area, will be covered by a Washington State National Pollutant Discharge Elimination System Permit (NPDES) Construction Stormwater General Permit. The contractor will be responsible for preparing a Stormwater Pollution Prevention Plan (SWPPP) that meets applicable regulatory and permit requirements. Other than stormwater covered by the stormwater permit, water generated on the GP West site will be covered by the Port's existing NPDES permit (Ecology 2007c; Ecology 2011b; Ecology 2012; Ecology 2014d). Active, existing transmission lines and a pump station will move water from the GP West site across the Inner Waterway to the ASB. This permit was modified by Ecology to specifically authorize management of water from sediment handling and remediation activities. All water discharged directly from barges will be filtered to remove suspended solids before entering the Waterway.

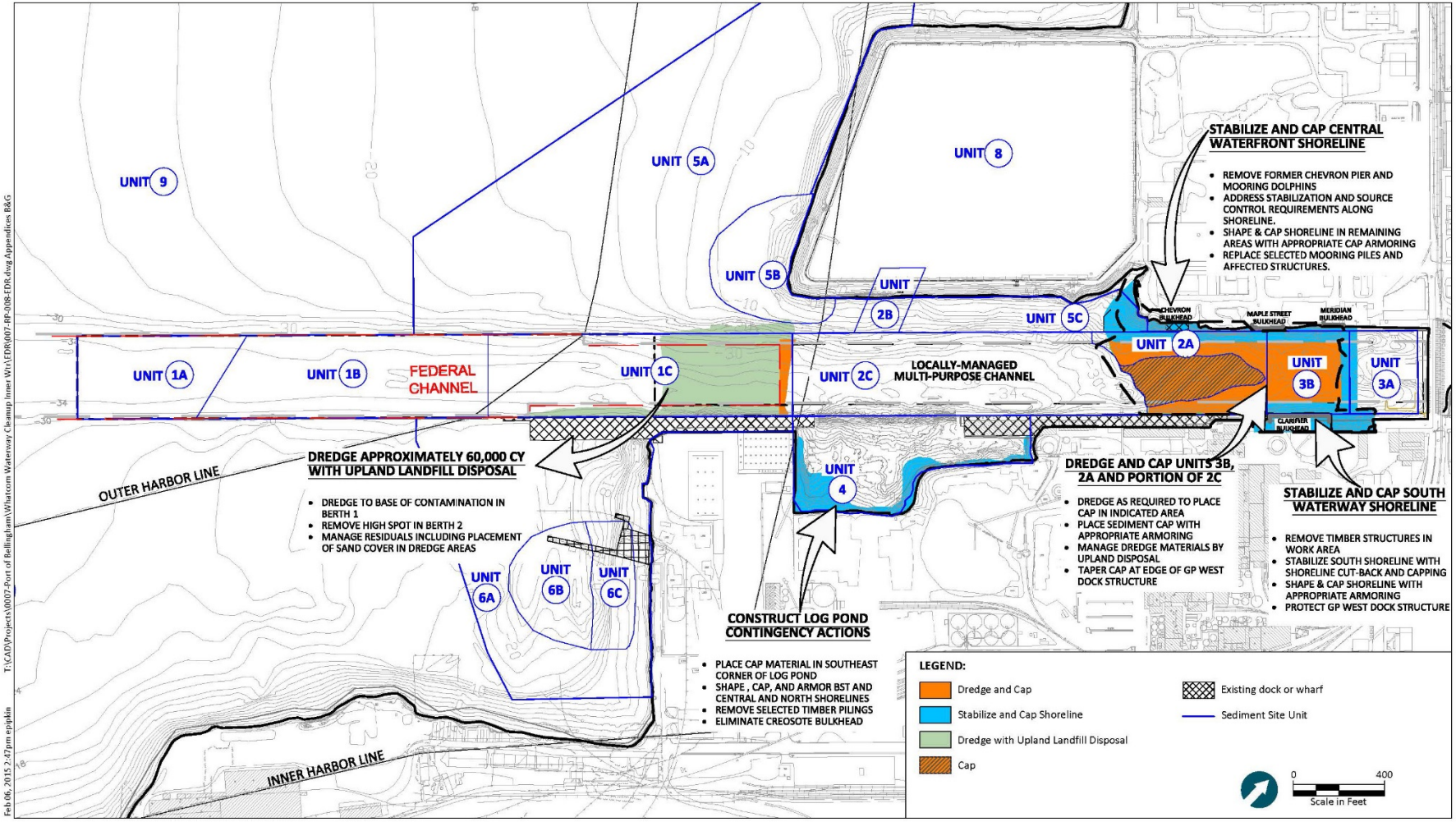

Plate 1
Construction Project for Phase 1 Areas
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Whatcom Waterway Cleanup in Phase 1 Site Areas

3.2 Cleanup near the Bellingham Shipping Terminal

The BST (Plate 2) is located within the outer portion of the Waterway and southwest of the Log Pond area.

Plate 2
Bellingham Shipping Terminal Area showing Berths 1 and 2 (where vessels are moored) and Southwestern Portion of Log Pond Area (facing southwest)

3.2.1 Existing Conditions and Cleanup Objectives

Berths 1 and 2 of the BST represent primarily subtidal, deep-water aquatic habitat consistent with a maintained navigation channel. Subsurface sediments in Berths 1 and 2 contain sediments that exceed the SQS for total mercury (0.41 mg/kg) and additionally contain elevated D/F concentrations. Shallow-water nearshore habitats are limited to riprapped under-dock engineered slope areas along the BST (Ecology 2007a). Some eelgrass areas are located near the ASB but are outside of the Project footprint. There is little to no marine or upland vegetation in the BST area.

Cleanup objectives for the BST area are focused on removing contaminated sediments from Berth 1 and a portion of Berth 2. The sediments removed during the cleanup will be managed by upland disposal. No capping will be performed within the federal channel areas,

but a transition slope cap will be placed on the adjacent sediments to prevent potential sediment resuspension and recontamination of the remediated areas.

3.2.2 Bellingham Shipping Terminal Work to Be Performed

Remediation activities within Berth 1 include dredging of contaminated sediments and placement of residuals management cover material. Dredging and placement of residuals management cover will also be performed in the southeastern portion of Berth 2. No structure removal or replacements will be performed within the BST area. A transition area cap will be placed on the slope area adjacent to Berth 1 to prevent potential erosion and recontamination of the remediated areas.

Impacted sediments in the Phase 1 portion of Unit 1C will be removed by mechanical dredging. The dredging will remove contaminated sediments from the federal navigation channel areas and berth areas adjacent to the BST pier (Figure 7). Dredge cut elevations vary in different portions of Unit 1C and are based on review of historical dredging depths and the depth of contamination as measured during the PRDI investigations.

As shown on Figures 7, 8a, 8b, and 8c, the dredging will remove all impacted sediments to the base of contamination in front of BST Berth 1. Anticipated required dredge elevations are -36 feet MLLW and -40 feet MLLW plus a 2-foot over-dredge allowance. These required dredge elevations provide for complete removal of the contamination and unencumbered use and maintenance of the federal navigation channel area (the federal channel's project depths are shallower). The dredge prism transitions to a required dredge elevation of -35 feet MLLW at the BST pier face. This elevation represents the maximum historical dredge elevation and represents the deepest dredge cut that can be safely implemented without requiring dock structural upgrades.

Verification bathymetric surveys will be used to ensure that contaminated sediments are removed to the design elevation before placing residuals management cover. As described in Appendix G, sampling will be performed after dredging to verify the thickness and composition of dredging residuals, and to verify that dredging has removed contaminated sediments. Post-dredging residual sediment management cover will then be placed over the

entire dredging area. This material will consist of a minimum placement thickness of 6 inches of clean sand with an allowable over-placement of an additional 6 inches. Chemical sampling will be performed in surface sediments following completion of dredging and residuals management, to ensure that site cleanup levels are met.

Two provisions are included to minimize risks of sediment recontamination from propwash in the remediated areas. These include removal of a sediment high spot within Berth 2 and placement of an engineered cap over the slope transition area located at the upstream boundary of the federal navigation channel.

The high-spot dredging in Berth 2 (Figures 7 and 8c) will remove sediments to a required dredge elevation of -32 feet MLLW, plus 2 feet over-dredge allowance. A layer of residuals management cover will then be placed over this dredging area. These actions will minimize the risk that propwash disturbances might result in recontamination of the Berth 1 remediation area.

The slope transition area is located beyond the limits of the federal navigation channel at the boundary between Unit 1C and Unit 2C. This transition slope area will be a Type 1 engineered cap to prevent potential scouring of contaminated sediments from Unit 2C by propwash from tugs and ships operating at the BST. That cap will include an isolation layer of sand, overlain by a gravel filter layer and a top layer of rock armor. The design of the engineered cap in this transition area (Figure 8b) ensures that the presence of the engineered cap does not encumber future federal channel maintenance activities.

Sediments removed during dredging of Unit 1C will be dewatered and barged to an offloading facility, where they will be transported by railcars or trucks to a permitted Subtitle D landfill facility. Examples of currently permitted regional landfill facilities include, but are not limited to, the Allied Waste landfill facility in Roosevelt, Washington, and the Waste Management landfill facilities located in Wenatchee, Washington, and Columbia Ridge, Oregon.

3.3 Inner Waterway Cleanup

The Inner Waterway portion of the federal navigation channel was deauthorized as part of the Water Resources Development Act (WRDA) legislation of 2007. This act deauthorized the channel between the head of the Waterway and Waterway Station 29+00 (see Figures 5a and 5b). The Inner Waterway includes aquatic lands owned by the Washington State Department of Natural Resources (WDNR), the Port, the City of Bellingham (City), and Meridian Pacific Highway, LLC (Meridian Pacific). The cleanup of these areas under the Consent Decree (Ecology 2007a) is consistent with the plan for a locally managed multi-purpose channel within the Inner Waterway. That multi-purpose channel is intended to service vessels and barges with shallow and intermediate drafts. The channel is to be actively maintained to provide functional water depths of 18 feet at MLLW (i.e., capping allows for future maintenance dredging to elevations of -18 feet MLLW with a 2-foot over-dredge allowance).

Plate 3 is an aerial photograph of the Inner Waterway clarifier tank and clarifier bulkhead located on the southeastern side of the waterway. Plate 4 is an aerial photograph of the Inner Waterway Central Waterfront located on the northwestern side of the Waterway.

Plate 3
Aerial Photograph of Clarifier Tank and Creosote-timber Clarifier Bulkhead to be Removed, South Shoreline of Inner Waterway Area (facing south)

Plate 4
Aerial Photograph of the Central Waterfront Shoreline (facing north)

3.3.1 Existing Conditions and Cleanup Objectives

Existing conditions in the Inner Waterway area are highly impacted by anthropogenic factors. In addition to contaminated sediment, the area shorelines are degraded by the presence of extensive manmade debris, creosote-treated timber structures, the presence of unnecessary vertical bulkheads, and overwater structures. These features degrade and disconnect the nearshore habitat that is so important to migrating juvenile salmonids.

Environmental quality is further threatened by source control concerns associated with unstable shorelines along the GP West cleanup site and the Central Waterfront cleanup site. Stabilization and source control measures are required in these areas to prevent potential future sediment recontamination.

Examples of manmade structures that are negatively impacting nearshore habitats within the Inner Waterway are shown on Plate 5. On the southeastern side of the Waterway, from west to east, there is an existing treated timber foam-suppression tank with pile-supported large diameter piping hangers, a catwalk supported by creosote-treated piling, creosote-treated timber dolphins, a vertical creosote-treated timber bulkhead supporting a clarifier tank, and a second vertical creosote-treated timber bulkhead. Multiple pile stubs are located waterward of the second creosote-treated timber bulkhead.

The northwestern side of the Waterway includes shoreline areas that are unstable and are covered with manmade debris including concrete waste and asphalt rubble. A nearly vertical, failing creosote-treated timber bulkhead is located at the former Chevron property. The dilapidated Chevron Pier that was used for historic bulk petroleum handling is in poor condition and shades intertidal habitat in this area. Pilings and dolphins along most of the shoreline are constructed of creosote-treated timber pilings that present a potential source of sediment recontamination and impacts to water quality. Upland areas within the Inner Waterway include contaminated soil and groundwater that are the subject of an ongoing investigation and cleanup. Source control measures are required to prevent Waterway recontamination from petroleum seepage along the former Chevron site and in areas near Maple Street. Plates 6 to 12 show the existing habitat conditions on the northwestern side of the Inner Waterway from east to west, which are generally degraded.

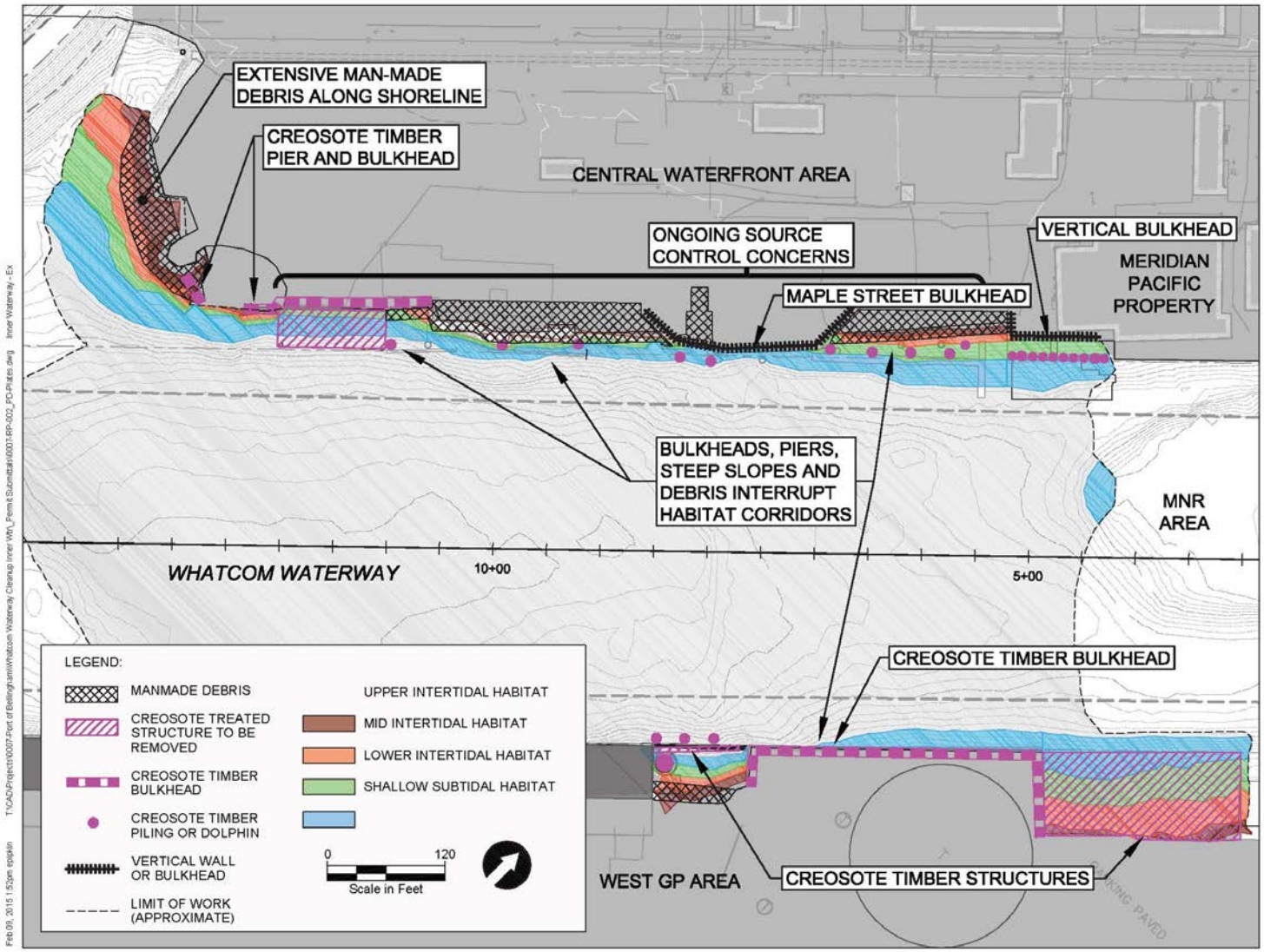

Plate 5
Existing Conditions Within the Inner Waterway
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Whatcom Waterway Cleanup in Phase 1 Site Areas

Plate 6
Existing Concrete Bulkheaded Shoreline to be Capped and Creosote-treated Piling to be Removed at Meridian Pacific Property, Inner Waterway (facing north)

Plate 7
Debris and Over-steepened Slope in Proposed Cutback Area between Maple Street and the Meridian Pacific Property, Central Waterfront Area, Inner Waterway (facing southwest)

Plate 8
Existing Barge Ramp, Creosote-treated Timber and Steel Dolphins, and Concrete Bulkhead at Maple Street, Inner Waterway Area (facing northwest)

Plate 9
Concrete and Other Shoreline Debris, Log Booms, and Creosote-treated Timber Pile Dolphins in Proposed Shoreline Cutback Area between the Former Chevron Property and Maple Street, Central Waterfront Site, Inner Waterway Area (facing northeast)

Plate 10

Chevron Pier Supported by Creosote-treated Piles, Creosote-treated Dolphins, and Creosote-treated Timber Bulkhead to be Removed, Located between Chevron Pier and Maple Street, Inner Waterway Area (facing northwest)

Plate 11

Portions of Failing Creosote-treated Timber Bulkhead to be Removed, Central Waterfront Site, Inner Waterway (facing northwest)

Plate 12
Shoreline Debris in Proposed Cutback and Capping Area, Portion of Chevron Property Located along Laurel Street, Inner Waterway (facing north)

Contaminated subsurface sediments are located throughout the Inner Waterway. These sediments are to be remediated by dredging and capping. Sediments removed by dredging will be managed by upland disposal. The caps will address the main Waterway bottom and the sloping edges of the Waterway along the South Shoreline and the Central Waterfront shoreline to the north. Stabilization and source control measures required to protect the Waterway cap from recontamination are described below.

Remediation work to be performed within the Inner Waterway includes dredging contaminated sediments, installing shoreline containment walls, shoreline cutbacks in selected areas, sediment capping, and structure removal and replacements as necessary to accomplish remediation. These measures will accomplish remediation as required by the MTCA Consent Decree. Ancillary benefits of the work include substantial improvements to nearshore aquatic habitat throughout the Inner Waterway.

3.3.2 Inner Waterway Dredging and Capping

Remediation within the Inner Waterway will include removal by dredging of sediments within the Waterway bottom to an elevation of -24 feet MLLW (Figure 9a) plus over-dredge allowance. Sediments removed during dredging will be barged to an offload facility and transported by railcars or trucks to a Subtitle D landfill facility.

The sediments remaining after dredging will be contained using a Type II engineered cap, which has a minimum sand placement layer of 2 feet (plus an over-placement allowance of 6 inches) and a minimum gravel armor placement thickness of 1 foot (plus over-placement allowance of 6 inches). Final capping contours are shown in Figures 9b, 14a, and 14b.

The dredging and engineered capping plan for the central portion of the Inner Waterway places the top of the engineered cap at or below elevation –20 feet MLLW. This elevation is 2 feet below the functional or desired operation depth for the Inner Waterway (-18 feet MLLW). This ensures that future maintenance dredging of the waterway can occur without disturbing the engineered cap.

As shown in Figures 9b, 14a, and 14b, no engineered capping will be performed in the head of the Inner Waterway. This area is to be managed using MNR, consistent with the requirements of the Consent Decree (Ecology 2007a) and First Amendment to the Consent Decree (Ecology 2011a). Dredging and engineered capping will be performed along the transition area as necessary to create a stable 3H:1V final capped side slope in the transition area between the engineered capping and MNR areas of the Inner Waterway.

The dredging and engineered capping designs in the nearshore areas of the Inner Waterway are more complex, as required to address shoreline slope transitions, existing structures, and existing navigation uses. The upper slope portions of these areas will receive a Type I engineered cap and will be armored with an additional layer of rock armor to resist wind and wave erosion and propwash. The dredging and engineered capping work in nearshore areas of the Inner Waterway is described in more detail in Section 3.3.3 (for the South Shoreline) and in Section 3.3.4 (for the Central Waterfront).

3.3.3 South Shoreline Dredging, Cutback, and Capping

Shoreline cutback and capping will occur along the South Shoreline of the Waterway, adjacent to the former GP West property. This includes cutting back soil behind an existing creosote-treated timber bulkhead and then capping the cutback slope area. The clarifier, a portion of the existing bulkhead, several creosote-treated timber dolphins, associated wooden and metal structures (catwalk, foam tank, and piping), and shoreline debris will be removed to complete the bank cutback and capping as part of the Project. The existing creosote-treated timber bulkhead that supports the inactive clarifier tank is shown in Plate 13.

Plate 13
Creosote-treated Timber Bulkhead Supporting the Clarifier Tank to be Removed, Proposed South Shoreline Cutback, Inner Waterway Area Adjacent to Clarifier (facing southwest)

Dredging along the South Shoreline will be conducted within the Waterway as necessary to achieve required dredge elevations and accommodate the placement of the engineered caps. The GP dock will remain in place and dredging cuts adjacent to the dock (Figure 12a) will be offset as necessary to protect the dock structure from damage during construction.

Before the engineered cap is placed along the South Shoreline of the Inner Waterway, the clarifier bulkhead (Figure 10) will be removed and the shoreline cut back to create a stable 3H:1V side slope. To enable this work, the aboveground portions of the existing clarifier will be removed along with the foundation elements located within the slope cutback area. As part of clarifier removal, the foam tank along the South Shoreline will be demolished and the existing operable stormwater line that is present on the South Shoreline slope will be rerouted. The portion of the bulkhead within the cutback area will be removed (Figure 10 and Section C-C' on Figure 12b). Other existing structures will be removed from the area as shown on Figure 10 to enable completion of shoreline cutback and capping. These include the removal of selected piling and dolphins and the associated catwalk and foam tank. Selected piling will be replaced following capping as shown on Figure 11 to preserve existing moorage functions.

The slope in the clarifier area will then be cut back to a stable 3H:1V side slope. This cutback creates additional open-water and nearshore habitat areas within the Site. The void created by demolishing the clarifier will be backfilled with cutback soils or other fill material to create a flat upland surface. Clean concrete debris from the clarifier removal will be recycled, and suitable cutback soils (i.e., free of bricks, plastic, or other unsuitable debris) will be used to fill the clarifier depression or will be stockpiled on site for reuse as subgrade fill within the GP West site as described in Section 8.3.3.

The South Shoreline will be capped using a combination of Type I and Type II capping designs. The engineered capping plan contours are shown in Figure 11, and cap design sections are shown in Figures 12a and 12b. Over-placement allowances for engineered cap placement are shown in Figure 12c. All South Shoreline areas will receive a Type II cap, with a sand layer and gravel armoring layer. Exposed upper slope areas (above -8 feet MLLW) will be capped using a Type I engineered cap, including a rock armoring layer to protect against wind and wave erosion. This rock armoring will not be applied in the area between the clarifier bulkhead cutback and Central Avenue (Section D-D' on Figures 11 and 12b) because this area has more gradual slopes and is sheltered from direct wave exposure. The Type I engineered cap design with rock armor layer will also be used in the lower slope areas (between -8 feet MLLW and -20 feet MLLW) near the GP dock to protect against potential propwash disturbances in this area from vessels using the dock.

3.3.4 Central Waterfront Shoreline Source Control and Capping

Along the Central Waterfront shoreline, the Project addresses dredging and engineered capping requirements for the Waterway site, and also addresses required shoreline stabilization and source control measures necessary to protect the Waterway caps from potential recontamination. Construction elements in these areas are complex and include dredging (Figure 9a), removing structures and shoreline debris (Figures 13a and 13b), installing shoreline containment walls to address shoreline stabilization and source control requirements, sediment dredging and slope cutbacks, placing engineered capping, and replacing certain existing structures removed during site remediation (Figures 14a and 14b).

Cutbacks along the Central Waterfront shoreline will be performed at three locations where it is necessary to place stable sediment caps and to remove contaminated soils and debris from nearshore areas. Partially exposed containment wall structures will be used to address contaminated soil and groundwater source control requirements as described below. After dredging and slope cutbacks, the slopes will be capped to create stable sloping caps at slopes of 2H:1V or flatter. Containment wall structures in these areas will be embedded below the final cap surface to minimize the presence of vertical structure in intertidal areas. Only the uppermost portion of the containment wall structures (above approximate elevation +9 feet MLLW) will be exposed upon completion of cap construction.

Plate 14
Aerial Photograph of Central Waterfront Shoreline Illustrating Proposed Cutback Areas Adjacent to Proposed Containment Wall (black lines) and Replacement Maple Street Bulkhead (purple line) Structures

Containment walls are required as part of source control measures to protect Waterway sediments from recontamination from Central Waterfront site contaminated soils and groundwater. These containment walls will be placed as shown in Plate 14 and Figures 14a and 14b, and will be constructed as follows:

- **New partially exposed containment wall between former Chevron property and Maple Street bulkhead:** A new steel sheetpile containment wall will be constructed along the shoreline between the former Chevron property and the Maple Street bulkhead. This wall will be used to minimize recontamination risks associated with hydrocarbon-contaminated soil and groundwater located in these areas and is intended to prevent recontamination of the newly placed sediment cap. Additional source control evaluations will be conducted as part of completing the remedial investigation of the Central Waterfront site. If further actions are required to prevent recontamination of the newly placed cap, these will be taken as part of implementing the final cleanup action for the Central Waterfront site. The wall will also be used to facilitate dredging of hydrocarbon-impacted soil and shoreline debris prior to cap placement.

- The wall will be composed of steel sheetpile and will be installed along approximately 360 linear feet of the shoreline, with a final exposed height of approximately 4 feet (transitioning between approximate elevation +9 and +13 feet MLLW).
- During installation of the wall and construction of the sediment caps, some upland soil will be temporarily removed by trenching from behind the wall to address short-term construction stability of the sheetpile. Overburden soils that are free of petroleum contamination (to be verified by testing the excavated soils for petroleum; one sample per 200 cubic yards) will be segregated and may be reused to backfill the trenches on completion of work as described below. Petroleum-contaminated soils removed from the trenches will be managed by Subtitle D landfill disposal.
- Following installation of the wall, the existing Chevron timber pier structure will be removed. Sequencing for removal of this timber structure (i.e., pier decking, pile stringers and caps, and support piling) may require that timber support piles in this area of the Site be cut off at the mudline and left in place in order to maintain stability of the existing sediment slope in this area and to minimize potential for deflection of the containment wall that could occur due to slope movement.
- After the sheetpile wall installation and site capping are completed, this temporary upland excavation will be backfilled with clean imported soil and overburden soils. Temporary tie-backs or bracing may also be required during construction to facilitate sheetpile wall installation.
- Portions of the joints in the sheetpiles will be sealed with a joint-filling compound to reduce permeability of the sheetpile wall in order to limit shallow groundwater movement. A concrete cap will be constructed on the top of the sheetpile where required to protect the exposed top of the wall. The sheetpile wall will be installed with an impact or vibratory hammer.
- Additionally, survey monitoring will be conducted during installation of the containment wall to verify that the wall is installed along the correct alignment and that the wall is not moving downslope because of vibratory installation of the sheetpiles. Results of survey monitoring will be evaluated in a daily basis and

contractor means and methods of wall installation may be changed if evidence of wall movement is observed during construction.

- **Groundwater cutoff wall and bulkhead replacement at Maple Street:** A replacement steel sheetpile bulkhead wall will be constructed waterward of the existing concrete Maple Street bulkhead to stabilize the shoreline and contain existing contaminated soil and groundwater. The sheetpile bulkhead wall will also allow for safe completion of required nearshore dredging and capping by avoiding the risk of undermining the existing bulkhead.
  - The wall will be composed of sheetpile along approximately 240 linear feet of shoreline, and will be installed using a vibratory hammer. Monitoring points will be established on the existing concrete bulkhead and the structure will be monitored (using survey techniques) during installation of the replacement bulkhead wall at Maple Street to verify that downhill creep of the existing structure is not occurring. If evidence of creep is observed during installation of the replacement bulkhead, then contractor means and methods of installation may be changed to address this issue. The wall will have a final exposed height of approximately 21 feet, similar to the existing exposed height.
  - Permanent drilled-in steel rod grouted tie-backs will be installed into the upland to help anchor the wall. The tie-backs will be connected to a continuous steel whaler beam on the face of the wall. The centerline of the whaler will be placed between elevation +6 feet MLLW and +10 feet MLLW. A fender system will be installed along the bulkhead face to protect the integrity of the bulkhead and whaler system from vessel damage. The fender system will consist of up to 12 steel fender piles placed immediately offshore of the bulkhead. The fender piles will be backed with a steel whaler beam that runs the full length of the bulkhead and a rubber energy absorption fender that connects the top of the pile to the bulkhead. These fender piles will be steel pipe piles approximately 24 inches in diameter or smaller. The steel whaler, connections, and rubber fenders will occupy approximately 400 square feet of over-water area.
  - A reinforced concrete cap will be constructed on the top of the sheetpile and will run for the full length of the wall.

- The joints in the sheetpiles will be sealed with a joint-filling compound to control groundwater seepage. The concrete paving immediately adjacent to the bulkhead will be repaired or replaced as necessary.
- Before the drilled-in tie-backs are installed, the existing 55-foot-long by 16-foot-wide steel barge ramp and barge ramp foundation will need to be removed along with contaminated soils. After removing the contaminated soil, the void that currently exists at the barge ramp will be filled with clean backfill material to create a stable soil surface for construction of the containment wall tie-backs. As described below, the ramp may be replaced with a mobile or fixed ramp system.

- **New partially exposed wall between Maple Street bulkhead and Meridian Pacific property:** A partially exposed shoreline wall will be constructed in the area extending between the Maple Street bulkhead and the Meridian Pacific property. This wall will be used to stabilize contaminated soil present in upland site areas, and to permit the dredging of contaminated sediments and debris from adjacent areas. The wall will be composed of steel sheetpile.
  - The wall will be constructed along approximately 130 linear feet, with a final exposed height of approximately 4 feet (between approximate elevation +9 and +13 feet MLLW).
  - During installation of the wall and construction of the sediment caps, some upland soil will be temporarily removed from behind the wall to address short-term construction stability of the wall. Overburden soils that are free of petroleum contamination (to be verified by testing excavated soils for petroleum; one sample per 200 cubic yards) will be segregated and may be reused to backfill the trenches upon completion of work. Petroleum-contaminated soils removed from the trenches will be managed by Subtitle D landfill disposal. After completion of wall installation and site capping, this temporary upland excavation will be backfilled with clean soil and uncontaminated overburden soils.
  - Temporary tie-backs or bracing may also be required during construction to facilitate wall installation.
  - Additionally, survey monitoring will be conducted during installation of the containment wall to verify that the wall is installed along the correct alignment and that downslope movement of the wall is not occurring due to vibratory

installation of the sheetpiles. Results of survey monitoring will be evaluated in a daily basis and contractor means and methods of wall installation may be changed if evidence of wall movement is observed during construction.

Dredging will be completed along the Central Waterfront shoreline as necessary to permit placement of sediment caps as shown in Figures 14a and 14b. Areas of required dredging are shown in Figures 9a and 15. This dredging includes slope cutbacks in the Laurel Street area of the Chevron property and in stretches of the shoreline located immediately south and north of the Maple Street bulkhead. Engineered cap designs are shown in plan view in Figure 14, and in cross-section in Figures 15a through 15d. Over-placement allowances for engineered cap placement are shown in Figure 15e. The shorelines will be capped using a combination of Type I and Type II cap designs. Most deeper shoreline areas will be capped using a Type II cap design, with a sand layer and a gravel armoring layer. Exposed upper slope areas (above -8 feet MLLW) will be capped using a Type I cap design, including an additional layer of rock armor to protect against wind and wave erosion. Rock armor consistent with the Type I cap design will also be placed in the lower slope areas (between -8 feet MLLW and -20 feet MLLW) near the Maple Street bulkhead to protect against potential propwash disturbances in this area from vessel traffic.

As noted above, some structures that must be removed to complete the remediation work will be replaced, including selected piles and dolphins and the barge ramp at the Maple Street bulkhead. Additional paving will be constructed to replace the existing crane pad east of Maple Street. These existing structures are shown in Figures 13a and 13b. After dredging and engineered capping, some of these structures will be replaced as shown in Figures 14a and 14b. These replacement structures include the following:

- **Barge ramp at Maple Street bulkhead:** The existing barge ramp at the Maple Street bulkhead will be removed to access and then remove contaminated soil present in the existing ramp location, and the ramp cavity will be backfilled and sealed to eliminate a preferential migration pathway for contaminated groundwater. The ramp may be replaced in the future with a mobile or fixed structure equivalent in function but with an alternate foundation and lifting design (one that doesn't create a preferential groundwater migration pathway). The Project design assumes that the existing ramp and foundation (including support piles) will be removed and the cavity will be

backfilled and sealed (by the installation of the replacement bulkhead wall and backfill and paving over the cavity).

- **Replacement paving - crane operation area adjacent to Meridian Pacific property:** The upland crane pad located at the existing boatyard adjacent to the Meridian Pacific property will need to be removed during the installation of the containment wall and completion of dredging and capping in this area. The crane pad structure will be replaced with pavement once these activities are complete in order to restore existing uses and to ensure that the heavy loads imposed by the crane do not damage the containment wall. The replacement paving will be constructed directly upland from the containment wall between the Maple Street bulkhead and the Meridian Pacific property.
- **Replacement piling and dolphins along the Central Waterfront and South Shoreline:** The existing timber and steel dolphins and piles along the Central Waterfront shoreline will need to be removed to allow dredging and capping operations to be completed. These existing piles and dolphins will be replaced with new steel dolphins and piles. They will be replaced with both steel mono-pile dolphins and dolphins comprised of both plumb and battered piles. Along the Central Waterfront shoreline, from the former Chevron property to the Meridian Pacific property, up to 12 dolphins will be installed. Each dolphin will consist either of a single mono-pile (30 inches in diameter or less) or a three-pile dolphin using one vertical and two batter piling of 24 inches in diameter or less. These dolphins will be fitted with an Ultra-high Molecular Weight (UHMW) or rubber-wearing surface. Up to five additional replacement pilings (24 inches in diameter or less) will be installed along the northern portion of the Central Waterfront shoreline and adjacent to the Meridian Pacific property. These pilings will be fitted with a UHMW or rubber-wearing surface. Three mooring dolphins along the South Shoreline are to be removed, along with the associated catwalk, to accommodate dredging and capping in this area. One dolphin and the associated catwalk are to be replaced in this area. The replacement dolphin will use a steel mono-pile design 30 inches in diameter or less. Appropriate cleats and mooring hardware will be reinstalled along with the replacement dolphin and piling.

Remediation will include extensive removal of existing creosote-treated structures (estimated quantity 263 tons of creosote-treated timber debris) within the Inner Waterway. These structures include existing old creosote-treated timber dolphins, timber piles, and pile stubs;

the Chevron Pier; creosote-treated timber bulkheads; the GP clarifier; a foam tank; pile-supported piping and equipment; and a catwalk. Figures 13a and 13b show existing structures and debris that will be removed to enable completion of required remediation activities. Specifically, the following structure removals will occur:

- A total of 13 creosote-treated timber and steel pile dolphins will be removed from the Inner Waterway area using a vibratory hammer. In total, the dolphin removal includes 80 creosote-treated timber piles and 9 steel piles.
- Approximately 340 creosote-treated timber piles or broken pile stubs will be cut or pulled with a vibratory hammer in various locations in the Inner Waterway.
- The 3,600-square-foot, creosote-treated timber Chevron Pier and 121 associated creosote-treated piles will be removed. Some of these pilings will be cut at the existing mudline before the sediment cap is placed.
- The creosote-treated timber bulkhead along the shoreline of the former Chevron property will be removed. The bulkhead is approximately 165 feet in length and comprised of a 6-inch timber bulkhead, steel tie rods, and approximately 25 creosote-treated piles. The super structure will be cut at the mudline, tie rods will be cut at the excavation limit, and the timber piles will be cut at or near the mudline.
- The GP clarifier creosote-treated timber bulkhead and associated steel sheetpile wall, bracing, and timber piles will be removed or cut as required to construct a new slope cutback and sediment capped. This bulkhead consists of approximately 275 linear feet of creosote-treated timber bulkhead, 90 linear feet of steel sheetpile bulkhead and steel bracing, and 120 creosote-treated timber piles.
- The concrete clarifier tank located in upland areas adjacent to the clarifier bulkhead will be removed. Removing the clarifier consists of demolishing approximately 310 cubic yards of concrete clarifier wall and approximately 115 cubic yards of the 8-inch concrete clarifier slab. The remaining slab will be core-drilled with approximately 50 holes to allow for drainage. The remaining void will be filled with bank cutback soil or crushed concrete to bring the site to grade.
- A foam tank composed of approximately 360 square feet of creosote-treated timber and 175 linear feet of large diameter fiberglass reinforced pipe (FRP) will be demolished. The timber foam tank will be demolished down to the top of an existing concrete footing (approximately elevation -2 feet MLLW) and the existing piping will be cut and capped at the shoreline and removed.

- A 390-square-foot treated timber catwalk supported by 16 creosote-treated piles will be demolished. The timber walkway will be removed with heavy equipment and the timber piles will be removed in their entirety using a vibratory hammer.
- Concrete rubble and other debris will be removed from the shoreline in certain areas as necessary to prepare the surface for capping as shown in Figures 13a and 13b.

3.4 Log Pond Contingency Action

The Log Pond area is located between the BST and the Inner Waterway. Plate 15 is an aerial photograph of the Log Pond Area and includes the northeastern portion of the BST.
The Log Pond area was previously remediated as part of an Interim Action completed in 2001 (Anchor Environmental 2001a). Results of multi-year monitoring (Anchor Environmental 2001b; Anchor Environmental 2002b; RETEC 2006) have confirmed that the majority of the cap is meeting performance objectives; however, some erosion has occurred at the shoreline edges where the cap was the thinnest, exposing or threatening to expose mercury-contaminated sediment.

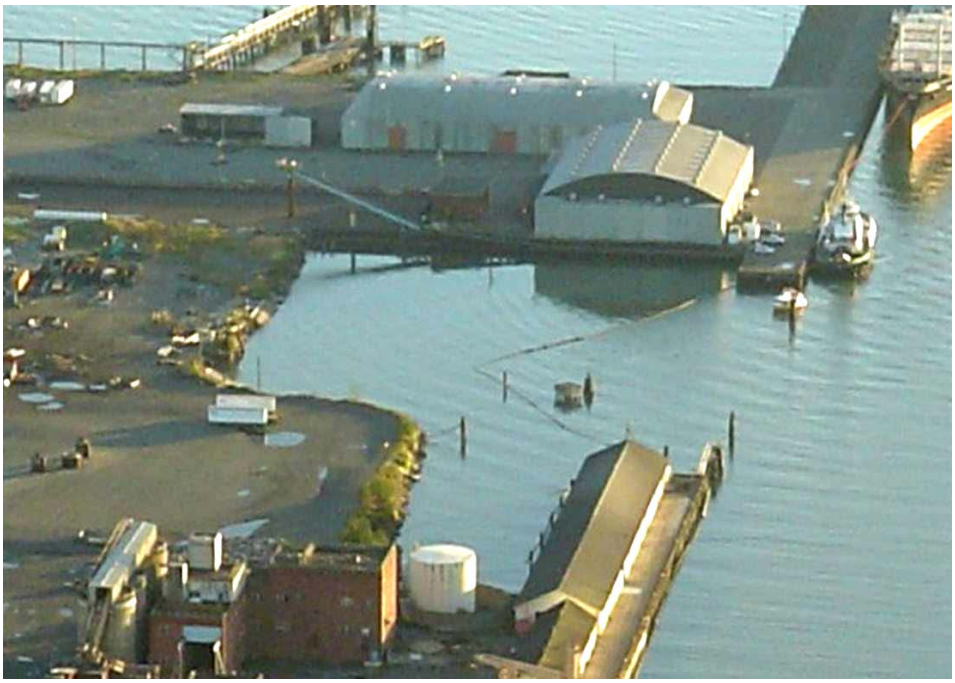

Plate 15
Log Pond Area (facing southwest)

3.4.1 Existing Conditions and Cleanup Objectives

Existing conditions within the Log Pond are summarized in Plate 16. Sediment in the Log Pond is currently capped and the Log Pond area is the location of an ongoing eelgrass seeding study. Habitat conditions within the main portion of the Log Pond area were dramatically improved during implementation of the Interim Action in 2000 (Anchor Environmental 2001a). However, that Project did not address the shoreline areas of the Log Pond, which are generally degraded due to the presence of bulkheads, debris, and creosote-treated structures.

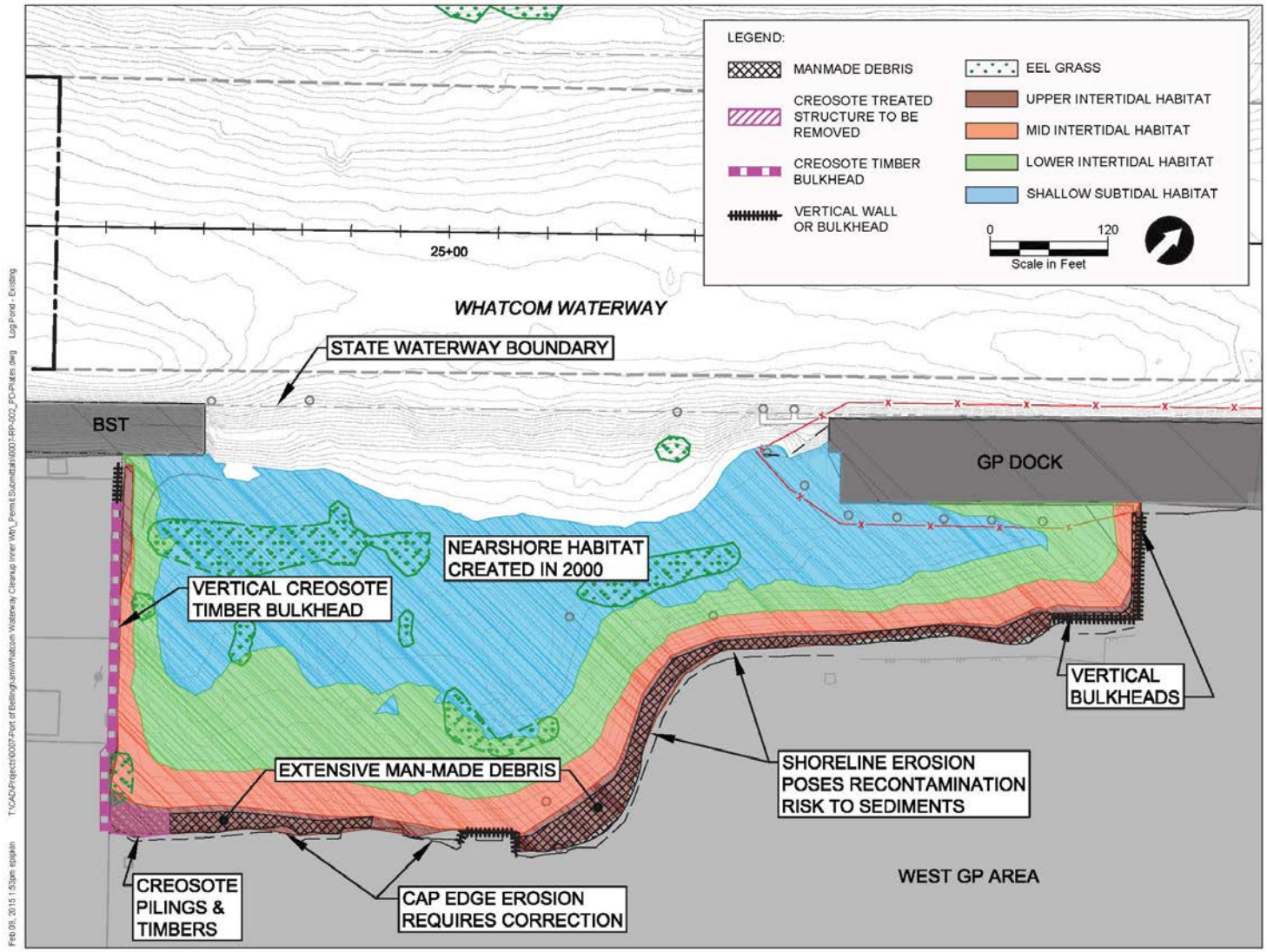

Plate 16
Existing Conditions at the Log Pond
Final Engineering Design Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

Preservation of the long-term quality of the Log Pond area also requires stabilization of shoreline cap edges and shoreline slopes and soils to prevent potential recontamination. The design for shoreline stabilization measures must consider the environmental quality of adjacent uplands, because the Log Pond is located along the northern edge of the GP West site. That site includes areas of contaminated soil and groundwater that are the subject of an ongoing investigation and cleanup. The southwestern side of the Log Pond is bounded by vertical creosote-treated piling and timber bulkhead wall associated with the BST as shown in Plate 17.

Plate 17
Creosote-treated Piling and Timber Bulkhead Wall in Shoreline Capping Area, Southwestern Edge of Log Pond Area Adjacent to BST (facing west)

Shoreline areas along the southeastern portion of the Log Pond are covered with manmade debris, including concrete and asphalt rubble, rebar and other metal debris, and a variety of creosote-treated timbers, amongst other miscellaneous debris as shown in Plates 18, 19, and 20. The Log Pond area also has numerous creosote-treated timber pile stubs located within the intertidal area. The pile stubs shown in Plate 18 are typical of the pile stubs located throughout the Log Pond area. Shoreline vegetation in the Log Pond area is limited to a small number of deciduous trees, bushes, and grasses. Much of the existing vegetation is composed of Himalayan blackberry (*Rubus discolor*).

Plate 18
Manmade Shoreline Debris and Creosote-treated Timber Pile Stubs to be Removed, Southwest Corner of Log Pond Area (facing south)

Plate 19
Concrete, Rebar, and Other Miscellaneous Manmade Debris to be Removed and Over-steepened Banks to be Capped along Central Portion of Log Pond Area Shoreline (facing east)

Plate 20
Log Boom to be Relocated, Log Pond Area (facing south)

Cleanup objectives for the Log Pond include implementation of contingency actions to stabilize the shoreline edges of the sediment cap and to prevent future cap erosion or recontamination. The capping along the Log Pond edges will be integrated with shoreline stabilization measures to prevent future erosion of over-steepened banks along the GP West site. These measures will protect against potential bank erosion that could result in recontamination of the Log Pond sediments.

3.4.2 Capping and Structure Removal

Work to be performed in the Log Pond area includes capping and structure removal activities.

Remediation activities planned for the Log Pond area include completion of shoreline capping throughout nearshore areas. This capping includes creation of stable shoreline slopes between the in-water cap and the adjacent uplands to minimize risks of cap erosion or recontamination. Fill placement and conversion of some open water areas to upland is required within the Log Pond area to safely construct these stable shoreline transitions; bank

cutbacks in this area are not practicable due to the presence of contaminated soils and existing containment structures in upland nearshore areas. Selected structures (creosote-treated timber piles and portions of an existing creosote-treated timber bulkhead) and debris will also be removed within the Log Pond area to facilitate the cap construction.

The shoreline edges of the cap will be stabilized with additional engineered capping, using Type I and Type III cap designs. The majority of the Log Pond shoreline is subject to erosion risks, but no recontamination of sediments has occurred. A Type III cap will be used in these areas to stabilize the shoreline and protect the existing sediment cap against erosion. The capping materials will extend from the existing cap surface up to the existing top-of-bank elevations. In the southwestern corner of the Log Pond where recontamination was observed, a Type I sediment cap will be used. There the engineered cap will include three material layers, including sand, gravel filter, and rock armor. The cap in this area will also extend up to the existing top-of-bank elevations. Figure 16 shows the proposed engineered capping plan for the Log Pond area. Figure 17 shows representative engineered cap sections.

Prior to engineered capping, unused timber piles will be removed from the Log Pond. These piles will be pulled or will be cut at the mudline. Additionally, the existing 800-foot log boom across the mouth of the Log Pond will be relocated and shortened to approximately 440 feet as shown on Figure 16. The boom prevents logs or floating debris from becoming trapped beneath the GP dock and causing damage to the structure.

The engineered capping design minimizes potential habitat impacts associated with fill placement, within the environmental constraints associated with the shoreline areas. Use of shoreline cutbacks is not practicable in this area because of the presence of contaminated soils and existing containment structures within the adjacent GP West site. However, prior to engineered capping, shoreline debris will be removed from the shoreline to establish a more uniform cap subgrade and minimize the necessary fill placement thicknesses.

Engineered capping slopes will vary throughout the Project area as shown on Figures 16 and 17a. Slopes vary from 2H:1V to flatter than 10H:1V. The design for most upper slope areas (i.e., above 8.5 feet MLLW) uses a 2H:1V slope to minimize habitat impacts.

Completion of the shoreline capping will include elimination of approximately 350 feet of vertical creosote-treated timber bulkhead currently located in the western portion of the Log Pond, along the BST. This will include removal of the top 4 to 6 feet of approximately 120 creosote-treated timber pilings. This shoreline will be stabilized with a sloping Type III engineered cap with a slope of 2H:1V as shown on Figures 16 and 17a to minimize potential impacts to nearby eelgrass beds. Specifically, the following structure removal actions will occur:

- Approximately 13 creosote-treated timber piles and approximately 24 broken pile stubs will be cut or pulled with a vibratory hammer in various locations in the Log Pond area.
- A two-step creosote-treated timber bulkhead approximately 350 feet long will be partially demolished. Demolition of the bulkhead will consist of cutting and removing the top 4 to 6 feet of approximately 120 creosote-treated timber piles immediately above their existing tie-back connections. The tops of these piles will be cut to allow the placement of an engineered erosion protection rock slope.
- A floating log boom approximately 800 feet long will be shortened to approximately 440 feet and will be relocated.
- Large manmade debris along the Log Pond shoreline will also be removed as necessary to support capping. The large debris consists of rock, concrete rubble, and other large debris.

3.5 Monitoring and Contingency Response Actions

Monitoring and contingency response actions are an integral part of the cleanup of the Phase 1 dredging and capping areas. Monitoring and contingency response actions are also required for the areas of the Site to be managed by MNR. These MNR site areas include Units 3A, 5A, 5C, 6A, 7, and 9, and portions of Units 5B, 6B, and 6C (no remedial construction is planned in these areas).

As part of the Site cleanup, compliance monitoring and contingency responses (if needed) will be implemented in accordance with WAC 173-340-410, Compliance Monitoring Requirements. The three types of compliance monitoring to be conducted include:

- **Protection monitoring:** This type of monitoring is used to confirm that human health and the environment are adequately protected during the construction period of the

cleanup action. As part of the Phase 1 Site cleanup activities, protection monitoring will encompass water quality monitoring to ensure water quality protection within the Site during in-water construction activities. Water quality monitoring for the cleanup construction activities in Phase 1 Site areas are described in the Water Quality Monitoring Plan attached as Appendix L.

- **Performance monitoring:** Performance monitoring is used to confirm that the cleanup action has attained cleanup standards and other performance standards. Physical, chemical, and biological performance monitoring will be conducted following completion of Phase 1 Site cleanup activities. Performance monitoring in Unit 1C will include sampling of post-dredging residuals and additional sampling to verify that dredging has achieved removal of contaminated sediments in Unit 1C. In all Phase 1 construction areas (including Unit 1C), performance monitoring will include physical integrity and sediment quality monitoring, after the completion of construction. Performance monitoring will include bathymetric surveys and surface sediment chemical analyses and will be conducted immediately after the completion of Phase 1 construction at the Site. Performance monitoring will also include crab and clam tissue monitoring and co-located porewater monitoring. Performance monitoring and associated contingency response actions for each dredging and capping area are described in Appendix G.
- **Confirmation monitoring:** Confirmation monitoring is used to confirm the long-term effectiveness of the cleanup action once performance standards have been attained and to assess compliance with cleanup levels in MNR areas. Confirmation monitoring and associated contingency response measures for Phase 1 dredging and engineered cap areas and for Site MNR areas are described in Appendix G. As part of Phase 1 Site cleanup activities, long-term confirmation monitoring will encompass physical integrity and sediment quality monitoring in the cap and porewater monitoring at two targeted locations within Unit 4 (the Log Pond). Confirmation monitoring in the MNR areas includes surface and subsurface sediment quality monitoring. Confirmation monitoring will be initiated the year after Phase 1 construction is completed and is described in more detail below. Tissue monitoring is also to be performed as part of Site confirmation monitoring as described in Appendix G.

3.6 Institutional Controls for Engineered Capping and Monitored Natural Recovery Areas

The overall remedial action for engineered capping and MNR areas includes institutional controls, which include a number of measures to protect the integrity of the remedial action. These measures include both restrictive covenants and other measures as described below.

Prior to completion of the construction Project in Phase 1 areas, an Institutional Control (IC) Plan will be developed for the Phase 1 engineered capping areas and Site MNR areas and will be prepared in consultation with the appropriate federal, state, and local agencies. The IC Plan will outline anticipated restrictive covenants to be filed for the Site engineered capping and MNR areas. It will also address such matters as Waterway signage on prohibited activities, vessel size and speed, signage regarding protection of capped areas, lease prohibitions or usage restrictions and notifications, and a plan for enforcing the Waterway restrictions. The current remedial action anticipates ongoing navigation uses, navigation maintenance dredging, and other activities in portions of the Site following completion of the remedial action. The IC Plan for the Site will include and outline the intended ongoing uses and maintenance activities.

MTCA restrictive covenants are one part of the planned institutional controls. Restrictive covenants document the nature and extent of contamination and the remedial action, as well as limit activity on the property to those activities that will not interfere with the integrity of the remedial action. For example, they limit uses of the cap and natural recovery areas to those that do not interfere with the remedial action and prohibit the modification of cap and natural recovery areas without the consent of Ecology. In addition, restrictive covenants require owners of the property to notify all lessees or property purchasers of the restrictions on the use of the properties. Finally, restrictive covenants require the owners of the properties to make provisions for continued monitoring and operation and maintenance of the remedial action prior to conveying title, easement, lease, or other interest in the property. Restrictive covenants will be subject to Ecology's approval before being recorded.

Future in-water construction activities are also subject to additional project reviews under state and federal permitting authorities (e.g., USACE Section 10/404, Washington State

Department of Fish and Wildlife [WDFW] Hydraulic Project Approval [HPA], Ecology water quality certification, and City permitting requirements).

Restrictive covenants will be filed with Whatcom County upon completion of the active cleanup measures for all capped areas that are part of the Phase 1 construction and for Site MNR areas. For state-owned aquatic lands, the restrictive covenants will be recorded in WDNR's index plates and property files used to track ownership and use activities and may include easements for constructed cap areas. These controls will remain in place indefinitely unless removal is approved by Ecology.

Restrictive covenants are expected to be placed in the engineered cap construction areas listed below. Anticipated uses in each area are described below:

- **Inner Waterway engineered capping areas:** Units 2A, 3B, and portions of 2C will be engineered capped. Navigation uses in these areas will include operations as a locally managed, multi-purpose channel with a minimum operational bed elevation of -18 feet MLLW. The federal navigation channel in this area was deauthorized by the Port, WDNR, and USACE in 2007 (WRDA 2007). Operation of the multi-purpose channel will include periodic maintenance dredging by the Port (in conjunction with other property owners along the Inner Waterway) to maintain water depths, but future deepening or widening of the channel is not anticipated. Future land uses along the Inner Waterway are expected to consist of marine trades and mixed-use redevelopment consistent with updated property zoning.
- **Log Pond engineered capping areas (Unit 4):** Sediment in the Log Pond is currently capped; however, erosion has caused breakthrough in a portion of this area and additional capping material will be placed (Figure 16). The existing restrictive covenant placed at the time the previous Interim Action was completed will be replaced or amended as necessary to address the scope of the cap modifications. The Log Pond is a Bellingham Bay priority habitat restoration area. Navigation use in the nearshore portions of the Log Pond is not anticipated, with the exception of small boat access (i.e., kayaks or hand-carry boats). Navigation within the outer portion of the Log Pond is expected to be limited to small boat access to support BST vessel-mooring activities (e.g., use of small boat to attach bow and stern lines to the mooring dolphins within the Log Pond). Public shoreline access may be provided in the future

to a portion of the Log Pond shoreline as part of planned redevelopment of the GP West site. No deepening for navigation uses is anticipated for the Log Pond area.

Restrictive covenants are also to be placed in the following MNRs. Anticipated uses in each area are described below:

- **Head of the Waterway (Unit 3A):** This portion of the Inner Waterway is located within the locally managed, multi-purpose channel. As described previously, the Port, WDNR, and USACE completed the deauthorization process in 2007 for the federal navigation channel that formerly extended into this area. Unit 3A includes emergent nearshore intertidal and subtidal habitat. Future land uses along the Inner Waterway are expected to consist of marine trades and mixed-use redevelopment consistent with updated property zoning and Waterfront District Planning. However, no navigation dredging is currently anticipated within Unit 3A. Future uses may include the implementation of habitat enhancement or public access improvements. Some docks and piles associated with existing overwater structures are also located in this area and may require repair, replacement, or removal from time to time. Such construction activities would be subject to Ecology review, and BMPs will be implemented during any in-water construction activities as appropriate to minimize potential sediment disturbance.
- **Shoulder of the ASB (Unit 5):** Other than the portion of Unit 5B that is to be managed by dredging and confined aquatic disposal during Phase 2 remediation (see Figure 4), sediments within Unit 5 are to be managed by MNR. Sediments in these areas currently comply with Site cleanup levels. These areas are located adjacent to the ASB and have relatively shallow water depths. Areas of emergent shallow intertidal and subtidal aquatic habitat are located adjacent to the ASB. With the exception of the ASB, the buried NPDES-permitted ASB outfall pipe, and the Central Waterfront area shorelines, no structures are currently located in Unit 5. Naturally shallow water depths limit navigation uses to transiting of the area by shallow-draft vessels. Future navigation dredging within Unit 5 is not currently anticipated.
- **MNR areas near barge dock (Unit 6):** A portion of Unit 6 (portions of Unit 6B and 6C) near the barge dock will be capped to resist potential propwash erosion during Phase 2 remediation (Figure 4). The remaining areas of Unit 6 are expected to continue in Port-related navigation use. No navigation dredging projects are

currently planned for this area. If uses change and navigation dredging is required, that dredging would be subject to Ecology review, and measures would be required to ensure appropriate management of dredged materials and continued compliance with Site cleanup levels. Docks and structures associated with the Port terminal are located in this area. Future construction activities could be required around these structures for maintenance, repair, or construction and demolition. Such construction activities would be subject to Ecology review, and BMPs will be implemented during any in-water construction activities as appropriate to minimize potential sediment disturbance.

- **Starr Rock (Unit 7):** Unit 7 includes the offshore sediments within and around the former USACE-authorized Starr Rock sediment disposal site. There are no structures currently located in these areas. Navigation uses in these areas are primarily limited to small-boat navigation due to the shallow water depths.
- **Remaining areas of the Site (Unit 9):** Unit 9 consists of the remaining areas of the Site (beyond the boundaries of Units 1 through 8) that contain low-level, buried subsurface mercury contamination. No exceedances of surface sediment cleanup standards have been noted within this area of the site in either the 1996 or 2002 sampling events. Most of the Unit 9 areas consist of deep-water, offshore areas. However, Unit 9 also abuts the shoreline along the northern and eastern sides of the Site. Shoreline marine structures are located within nearshore portions of Unit 9, including near I&J Waterway and Squalicum Inner Boat Basin. As described in Section 3.7 below, construction for the City's Over-water Walkway project is planned for the area between Boulevard Park and the Cornwall Avenue Landfill site, and several separate cleanup sites (I&J Waterway, R.G. Haley, Cornwall Avenue Landfill, and SSSMGP) are located within or abutting Unit 9. If navigation dredging is required in Unit 9 areas, that dredging would be subject to Ecology review, and measures would be required to ensure appropriate management of dredged materials and continued compliance with Site cleanup levels. Future construction activities (maintenance, repair, or construction and demolition associated with marine structures located in Unit 9) could be required. Such construction activities would be subject to Ecology review, and BMPs will be implemented during any in-water construction activities as appropriate to minimize potential sediment disturbances.

3.7 Coordination with Other Actions

The Site cleanup work described in this EDR is being coordinated with work at other cleanup sites located in the Site vicinity (see Figure 1). These include sites adjacent to Phase 1 construction areas and sites located adjacent to areas being managed by MNR.

Coordination measures incorporated into Phase 1 dredging and engineered capping areas include the following:

- **Central Waterfront site cleanup:** The Central Waterfront site is approximately 55 acres and shares more than 1,200 linear feet of shoreline with the Waterway. Site coordination issues considered as part of the engineering design for Phase 1 areas include the following:
  - **Remediation of co-located surface sediments:** Surface sediment contamination from historic upland boatyard activities along the southern shoreline of the Central Waterfront site includes copper, zinc, and tributyl tin. Contaminated surface sediments from the Central Waterfront site overlay buried mercury-contaminated sediment that comprises part of the Site. These surface sediments will be remediated as a consequence of the construction activities in the Phase 1 cleanup areas. Remediation of these surface sediments will require removing certain piles and dolphin structures, some of which will be replaced following sediments remediation.
  - **Shoreline stabilization and source control measures:** Areas of upland soil and groundwater contamination are located along portions of the Central Waterfront site shoreline between the former Chevron and the Meridian Pacific properties. Stabilization of these shoreline areas and installation of groundwater containment wall will be conducted as required to permit the remediation of the Waterway sediments and to prevent future cap instability and potential recontamination of Waterway sediments.
  - **Central Waterfront Interim Action:** An area of recurring petroleum seepage that was noted along a portion of the former Chevron site has been addressed by the Port and Ecology as an Interim Action, under an amendment to an existing MTCA agreed order, prior to implementation of the Waterway cleanup actions. This work included removal of petroleum-impacted soils and placement of appropriate

backfill sediments to prevent erosion of shoreline soils. The Waterway cleanup work has considered these completed Interim Action measures in designing final shoreline stabilization and control measures.

  - **Final Central Waterfront cleanup action:** Cleanup actions in upland areas of the Central Waterfront site, including any associated monitoring activities, will be implemented separately as part of the final Ecology-selected cleanup remedy for the Central Waterfront site. The final Central Waterfront site remedy is to be documented in a CAP and Consent Decree. These documents will also document the work completed in overlapping site areas as part of the Waterway construction effort, as well as any additional actions required to complete the cleanup of the Central Waterfront site.

- **GP West site cleanup:** The Phase 1 construction activities include construction along two portions of the GP West shoreline.

  - **Log Pond construction:** Construction activities within the Log Pond abut the Chlor-Alkali Remedial Action Unit (RAU) of the GP West cleanup site, which has undergone a remedial investigation and an interim action. A Feasibility Study is currently in development under an Agreed Order with Ecology. The protectiveness of the engineered capping to be implemented within the Log Pond has been evaluated in coordination with the groundwater fate and transport evaluations being conducted at the GP West site (see Appendix J). The monitoring work required for the cap within the Log Pond includes measures to monitor both sediment and porewater quality. The porewater monitoring provides ongoing data to assess cap recontamination by groundwater discharges from the adjacent Chlor-Alkali RAU. As described below, any additional remedial measures or monitoring required to address GP West site groundwater will be implemented as part of the final cleanup of the Chlor-Alkali RAU, to be documented in a future CAP and Consent Decree.
  - **Engineered capping of South Shoreline near clarifier bulkhead:** Engineered capping of the South Shoreline near the existing clarifier bulkhead requires stabilization of this shoreline. The proposed cutback and engineered capping of this area has been designed in consideration of soil and groundwater conditions present in nearshore areas of the Pulp and Tissue Mill RAU of the GP West site.

Final requirements for the Pulp and Tissue Mill RAU were defined in the Consent Decree (Ecology 2014a) for that RAU. No groundwater contamination has been detected during testing performed in the clarifier bulkhead areas as part of the GP West RI/FS activities. Soils generated from the cutback of this area will be managed within the upland GP West site areas or will be transported to appropriately permitted off-site disposal areas where required. Upland cleanup actions for soil and groundwater and associated monitoring activities within the Pulp and Tissue Mill RAU will be implemented separately consistent with the CAP and Consent Decree (Ecology 2014b).

A number of ongoing cleanup and development actions are located within or adjacent to MNR areas of the Site. Some of these ongoing activities include:

- **I&J Waterway cleanup:** The I&J Waterway site is approximately 4 acres. An RI/FS was recently finalized for this site under a MTCA agreed order with Ecology (Anchor QEA 2015). Surface sediment contamination from historic industrial activities along the southern shoreline of I&J Waterway includes but is not limited to bis(2-ethylhexyl)phthalate, PAH compounds, bioassay exceedances, and nickel. Contaminated surface sediments from the I&J Waterway site overlay buried contaminated sediment that comprise part of the Site as shown in Figure 1. Surface and subsurface contaminated sediment will be remediated as part of the cleanup selected for the I&J Waterway site. Other dredged material management activities will occur as part of future Port and USACE maintenance dredging activities for the federal channel. Project reviews conducted as part of these separate projects will include a review of potential impacts from or to the Site MNR areas.
- **Cornwall Avenue landfill cleanup:** The Cornwall Avenue landfill site is approximately 8 acres and is undergoing design and permitting to implement a MTCA Consent Decree (Ecology 2014c) between the Port, the City, WDNR, and Ecology. Surface sediment contamination from historic municipal landfill activities along the shoreline at the south end of Cornwall Avenue includes but is not limited to solid waste and associated hazardous substances. Contaminated surface sediments from the Cornwall Avenue landfill site overlay buried contaminated sediment that comprise part of the Site as shown in Figure 1. Surface and subsurface contaminated sediment will be remediated as part of the cleanup selected for the Cornwall Avenue landfill

site. Project reviews conducted as part of the Cornwall Avenue landfill cleanup will include a review of potential impacts from or to the Site MNR areas.

- **R.G. Haley site cleanup:** The R.G. Haley site as currently defined is approximately 8 acres. The site has undergone a recent interim action (GeoEngineers 2014) and is undergoing an RI/FS through a MTCA agreed order between the City and Ecology. Surface sediment contamination from historic wood treatment activities along the shoreline at the south end of Cornwall Avenue includes but is not limited to pentachlorophenol and dioxins. Contaminated surface sediments from the R.G. Haley site overlay buried contaminated sediment that comprise part of the Site as shown in Figure 1. Surface and subsurface contaminated sediment will be addressed as part of the cleanup selected for the R.G. Haley site. Project reviews conducted as part of the R.G. Haley site cleanup will include a review of potential impacts from or to the Waterway MNR areas.
- **Former SSSMGP site cleanup:** This cleanup site includes areas impacted by former operation of the SSSMGP. The site includes portions of Boulevard Park and may include adjacent aquatic lands. Contaminants at the site include PAH compounds and other hydrocarbons associated with manufactured gas plant operations. This area is undergoing an RI/FS under a MTCA agreed order between the City and Ecology. Project reviews conducted as part of the former SSSMGP site cleanup will include a review of potential impacts from or to the Site MNR areas.
- **Boulevard Park Over-water Walkway project:** The City is currently conducting engineering design and permitting for a project known as the Boulevard Park Over-water Walkway (Over-water Walkway). The Over-water Walkway is planned as a pedestrian trail between Boulevard Park and the Cornwall Avenue landfill area. The Over-water Walkway project has been included in multiple City of Bellingham planning documents between 2002 and 2010. The project includes placement of new piles and overwater walkway structures within Unit 9. Permitting and construction for the Over-water Walkway and the cleanup actions will incorporate best management practices to minimize potential sediment disturbance.
- **Removal of creosote-treated piles and dock structures:** While not proposed as part of the current Project, removal of additional creosote-treated piles and dock structures may occur within areas of the Site designated for MNR. These activities remove a potential source of PAH contamination from Bellingham Bay. Where structures

require replacement, these replacements will maximize the use of appropriate materials, such as concrete, that do not represent a potential source of water quality or sediment contamination. Permitting and construction for future removal actions and the cleanup actions will incorporate BMPs to minimize potential sediment disturbance.

4 NET ENVIRONMENTAL EFFECTS

Ecology's cleanup decision for the Site (Ecology 2007a, Ecology 2011a) included consideration of its net environmental effects, consistent with SMS requirements. As part of its FSEIS (Ecology 2007b), Ecology further evaluated appropriate mitigation measures to be used during Project implementation, and documented Ecology's expectation that the cleanup action was expected to have a beneficial impact on environmental conditions and specifically aquatic habitats within the Site. This section discusses the environmental resources and habitats within each of the Phase 1 Site areas, and discusses the expected net environmental effects associated with the cleanup construction activities as proposed in the current engineering design. Consistent with the evaluation conducted by Ecology in the FSEIS, the implementation of this cleanup and source control work will result in an overall improvement of habitat conditions within the site post-Project construction. This net improvement results from the removal of existing creosote-treated structures, reductions in overwater cover, removal of manmade shoreline debris and the reconstruction of shoreline slopes in a manner that provides expanded areas of important nearshore intertidal and shallow subtidal habitat along migration corridors for juvenile salmonids.

4.1 Fisheries and Invertebrate Resources

The Waterway has historically been occupied or used by a variety of fish and invertebrate species for various purposes (e.g., foraging, migration, and spawning). However, the current degraded habitat conditions within the Waterway limit the functions and value of that habitat for many species. This section provides information on the known species use of the Waterway and those factors that limit use of the Waterway by those species.

4.1.1 Surf Smelt and Sand Lance

Surveys by the WDFW have documented spawning beaches in Bellingham Bay. However, no surf smelt or sand lance spawning has been documented in the Inner Waterway, presumably because suitable substrates are not available (Ecology 2007b). One area documented with potential surf smelt and sand lance spawning habitat is the shoreline within the Log Pond area (WDFW 2008). Existing contaminated sediments, creosote-treated structures, over-steepened slopes, lack of suitable spawning substrates (i.e., fine-grained

materials within intertidal areas), and shoreline obstructions such as vertical bulkheads may limit the productivity of surf smelt and sand lance in the Waterway.

4.1.2 Pacific Herring

Herring are known to congregate in the deeper water of Bellingham Bay. This species deposits its eggs on marine vegetation such as eelgrass and algae in the shallow subtidal and intertidal zones between 1 foot above and 5 feet below MLLW. However, only relatively low-density spawning deposition occurs in the Bay, and none of that has been documented in the vicinity of the Waterway (Ecology 2007b). Existing contaminated sediments, creosote-treated structures, over-steepened slopes, lack of suitable spawning substrates (i.e., limited suitable marine vegetation), and shoreline obstructions such as vertical bulkheads may limit the productivity of herring in the Waterway.

4.1.3 Salmonids

The Nooksack River has the largest salmon runs in Bellingham Bay, followed by Squalicum and Whatcom creeks. Concentrations of chum, coho, and Chinook salmon along the shoreline and in offshore waters in Bellingham Bay peak annually about mid-May. Juvenile coho and Chinook salmon appear to have different migration habits. Coho remain in Bellingham Bay for approximately 30 to 35 days, while Chinook remain for about 20 days (Ecology 2007b). Existing contaminated sediments; creosote-treated structures; over-steepened slopes resulting in limited suitable intertidal habitat and increased available predator habitat; and shoreline obstructions such as vertical bulkheads may limit the productivity of salmonids in the Waterway.

4.1.4 Groundfish

Several species of groundfish occur in both shallow and deep waters in Bellingham Bay for either part or all of their life. Detailed information on groundfish species and their timing and use of Bellingham Bay is not available. Key characteristics of groundfish occurring in northern Puget Sound are generally applicable to Bellingham Bay (Ecology 2007b). Groundfish may be present in the nearshore and deep-water areas of the Waterway; however, their use of the Waterway may be limited by the over-steepened slopes resulting in

limited suitable intertidal habitat for juveniles; and shoreline obstructions such as vertical bulkheads.

4.1.5 Clams, Geoduck, and Oysters

Bellingham Bay supports a variety of marine invertebrates, ranging from infauna (worms, clams, and small ghost shrimp that penetrate benthic sediments) to epibenthic plankters (organisms such as very small crustaceans that move off the substrate surface) to larger invertebrates such as oysters, crabs, and shrimp. The predominant bivalves in Bellingham Bay are intertidal and subtidal hardshell clams (Ecology 2007b). Shellfish densities are relatively low along the eastern shore of Bellingham Bay in the vicinity of the Waterway, although bivalves are the dominant benthic organism within the Waterway (Anchor Environmental 1999, as referenced in Ecology 2007b). Scattered oysters also occur along the shoreline of the Whatcom Creek estuary (Palm 1995, as referenced in Ecology 2007b). Geoduck, which is only present in a handful of locations in the Bay, does not occur within the Waterway (Ecology 2007b). Low shellfish densities may be linked to existing habitat conditions in the Waterway.

4.1.6 Shrimp

Seven species of pandalid shrimp, including, pink, coonstripe, dock, and spot shrimp, occur in nearshore and deeper waters of Bellingham Bay. For example, coonstripe shrimp have been observed in intertidal areas immediately offshore of the Cornwall Avenue Landfill (which is just south of the Waterway), and this species is common around piers and floats. Shrimp densities in the areas surrounding the Waterway are moderate when the Bay is viewed as a whole (Ecology 2007b).

4.1.7 Crab

Crab trawls conducted for the Puget Sound Dredge Disposal Analysis investigations indicate that the predominate crab resources in Bellingham Bay are the non-edible purple or graceful crab, the edible red rock crab, and the edible Dungeness crab (Ecology 2007b).

Dungeness crab is generally abundant in most areas of Bellingham Bay and has been documented in the Waterway. The northern and eastern shorelines of Bellingham Bay serve

as nursery and rearing areas for juvenile Dungeness crab. A shell substrate is a preferred habitat for the first 8 to 10 weeks after larvae settle. However, other substrates, such as small cobbles and gravel, algae, and eelgrass, are also recognized as important rearing habitat for juvenile crab. Because the Waterway has relatively limited quantities of these habitats, its usefulness as a nursery and rearing area is likely limited (Ecology 2007b).

4.2 Types and Functions of Habitats

The 2007 Supplemental EIS for the Project described three types of habitats that can be found in the Project area. The habitats include intertidal, shallow subtidal, and subtidal. These habitat types are discussed further in the following subsections (Ecology 2007b).

There are three main types of aquatic habitat found in the Inner Waterway: intertidal, shallow subtidal, and subtidal. In general, these habitats are highly degraded due to long-term industrial use of the Waterway and associated sediment contamination, in- and overwater structures, vertical bulkheads, the presence of extensive manmade shoreline debris, and other habitat limiting factors. The features and functions of habitat types within the Waterway are discussed further below.

4.2.1 Intertidal (Elevation +11.0 feet to -4.0 feet MLLW)

Sand, mud, and cobble habitat is found in the intertidal area. This area supports rooted plants to varying degrees, with increased numbers and variety occurring at higher elevations. Premium intertidal habitat of this kind, with the appropriate substrate, energy levels, and other conditions providing maximum benefit to juvenile salmonids, is limited in the Waterway to areas at the head of the Waterway, areas along portions of the sides of the Waterway, and in portions of the Log Pond area (Ecology 2007b).

Gravel and rocky shore habitats are also found in the intertidal environment. Native eelgrass is occasionally found in pools and channels on the rocky shores at about 0 feet MLLW. Brown, green, and red algae are also found throughout this area. Armored and rocky areas of the Waterway with this type of habitat are located along the sides of the Waterway and in portions of the Log Pond area (Ecology 2007b).

4.2.2 Shallow Subtidal (Elevation -4.0 feet to -10.0 feet MLLW)

Sand, mud, and cobble habitat is also found in the shallow subtidal area. Mudflats within this substratum support epibenthic prey that is consumed by juvenile salmon migrating through the area. The substrate within this elevation can also provide suitable habitat for Dungeness crab mating and egg brooding. Shallow subtidal areas are located at the heads and along portions of the sides of the Waterway and in the Log Pond area.

Gravel and rocky shore habitats are also found in the intertidal environment. Native eelgrass is occasionally found in this area, as are a variety of brown, red, and green algae. Invertebrates common to this substratum include crabs, shrimp, sponges, sea anemones, worms, sea stars, oysters, and a variety of fish such as perch, prickle back, flat fish, and some juvenile salmon. The fish use this area for feeding, refuge, and reproduction. Rocky shallow subtidal habitats are located along portions of the Waterway and in portions of the Log Pond area (Ecology 2007b).

4.2.3 Subtidal (Below Elevation -10.0 feet MLLW)

Sand, mud, and cobble habitat is also found in the subtidal area. Native eelgrass is still relatively common between -10 and -20 feet MLLW; however, beyond -20 feet MLLW, light is limited and eelgrass and macroalgae are less prevalent. Some varieties of hardshell clams are also less abundant with increased depth, while the geoduck clam tends to be more abundant in deeper water. The substrate within this elevation can provide suitable habitat for Dungeness crab mating and egg brooding. The substrate and water column are also used for feeding by a variety of fish, including sub-adult and adult juvenile salmon. Most portions of the Project area consist of subtidal habitat with sand or mud bottom (Ecology 2007b).

Gravel and rocky shore habitats are also found in the intertidal environment. Larger-sized fish and shellfish often occur in deeper waters. Greater than 20 feet below MLLW, reduced light penetration limits the abundance and growth of macroalgae. In addition, the occurrence of some species, such as oyster, is rare. Rocky subtidal shorelines within the site predominantly occur along the developed shorelines of the Waterway (Ecology 2007b).

4.3 Priorities for Improving Habitat

The Bellingham Bay Pilot Comprehensive Strategy (Ecology 2000) provides an integrated strategy to expedite source control, sediment cleanup, and associated habitat restoration in Bellingham Bay. As part of this approach, the Comprehensive Strategy considers contaminated sediments, sources of pollution, habitat restoration, and in-water and shoreline land use from a bay-wide perspective. The Comprehensive Strategy also contained a Preliminary Draft Habitat Mitigation Framework that identifies the following objectives for sustaining habitat and aquatic resources and increasing habitat area and function in Bellingham Bay. Selected specific objectives related to the Project include:

- Provide clean sediments to support functions and species
- Restore and enhance degraded estuaries of Whatcom, Squalicum, Padden, and Little Squalicum creeks
- Restore, enhance, and protect viable habitat that provides connective corridors between estuary and open-water habitats and between other habitats in the open-water environment
- Endeavor to achieve net gains in aquatic area and habitat functions
- Maximize habitat restoration and protection opportunities (including marine buffer) with remediation and shoreline projects.
- Restore lost habitat attributes by removing shoreline fills, shoreline landfills, removing remnant structures, and removing or replacing treated timber structures where practicable

The implementation of the current cleanup Project accomplishes several of the aforementioned objectives as detailed in the following sections.

4.4 Effects of the Cleanup Project

The Project will result in significant improvements in the environmental conditions in the Waterway through the cleanup of contaminated sediments and control of upland pollution sources. As an ancillary benefit to the cleanup and source control, significant habitat improvements will be realized throughout the Waterway because of the removal of existing creosote-treated derelict structures and miscellaneous shoreline debris; improved intertidal habitat conditions by replacing currently over-steepened slopes that are covered with

concrete, asphalt, and other debris with more gentle slopes overlain with clean materials; and an overall reduction in the amount of overwater cover within the Waterway. Where existing structures must be replaced to accomplish the cleanup, the replacement structures will be constructed out of more environmentally friendly materials than the structure being replaced (e.g., existing creosote-treated timber piling to be removed will be replaced by a lesser number of steel piling and the new steel piling will occupy a smaller overall footprint than the existing creosote-treated timber piling).

Plates 21, 22, and 23 highlight the overall effects of the environmental cleanup for the BST, the Inner Waterway, and the Log Pond areas. Additional detail on the effects of the cleanup is found in the following sections.

4.4.1 Cleanup and Source Control

The Project will result in cleanup and source control actions throughout the Waterway. In the BST area, remediation activities within Berth 1 include dredging of contaminated sediments and placement of clean residuals management cover material. Dredging and placement of clean residuals management cover will also be performed in the southeastern portion of Berth 2. Additionally, a transition area cap composed of clean cap materials will be placed on the slope area adjacent to Berth 1 to prevent potential erosion and recontamination of the remediated areas. Remediation activities planned for the Log Pond area include completion of shoreline capping using clean cap materials throughout nearshore areas. This capping includes creation of stable shoreline slopes between the in-water cap and the adjacent uplands to minimize risks of cap erosion or recontamination. Remediation work to be performed within the Inner Waterway includes dredging contaminated sediments, installing shoreline containment walls, shoreline cutbacks in selected areas, and sediment capping using clean cap materials. Contaminated dredge material and clean cap volumes are provided in Table 4-1.

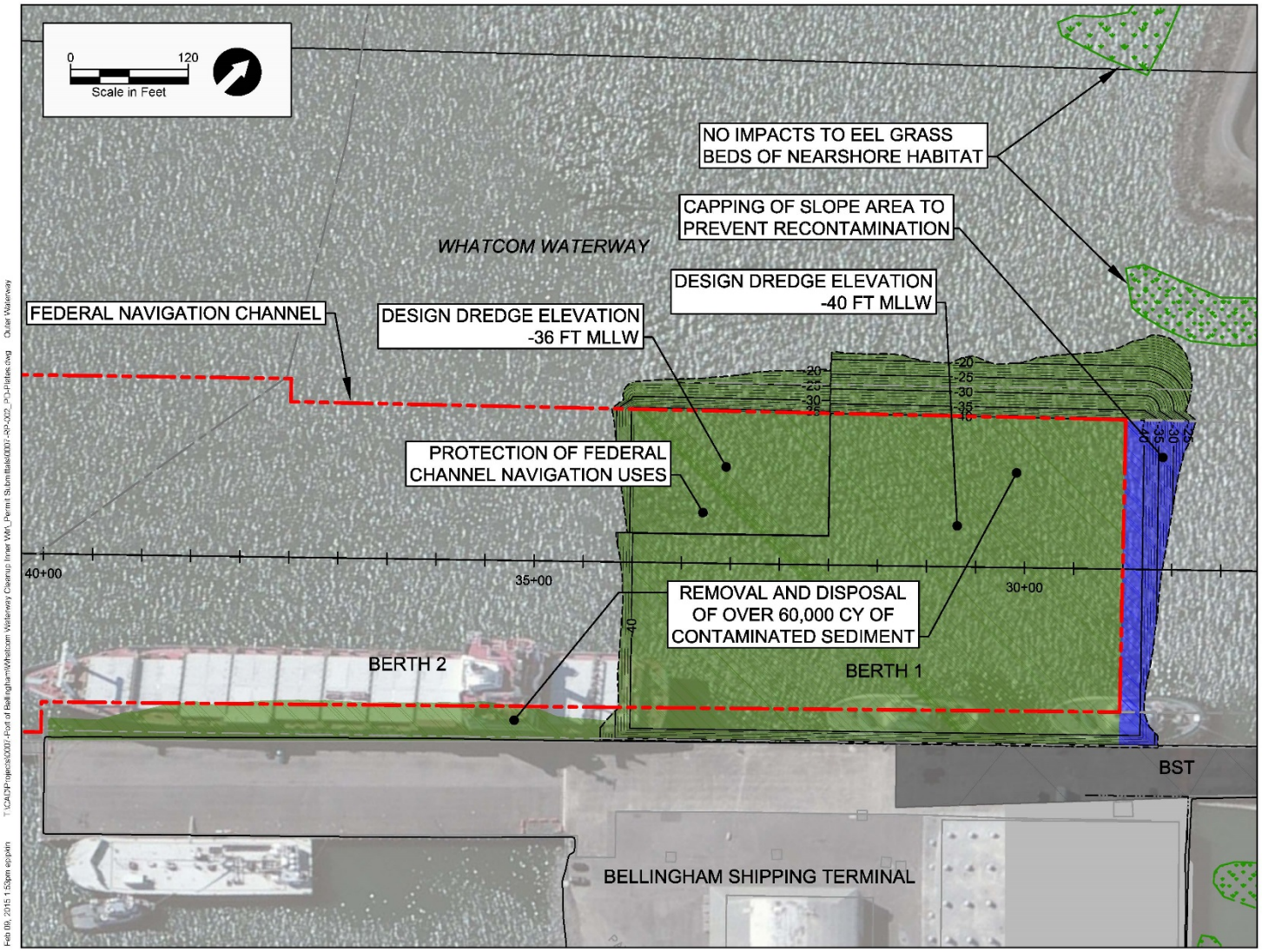

Plate 21
Net Environmental Effects of Cleanup at BST
Final Engineering Design Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

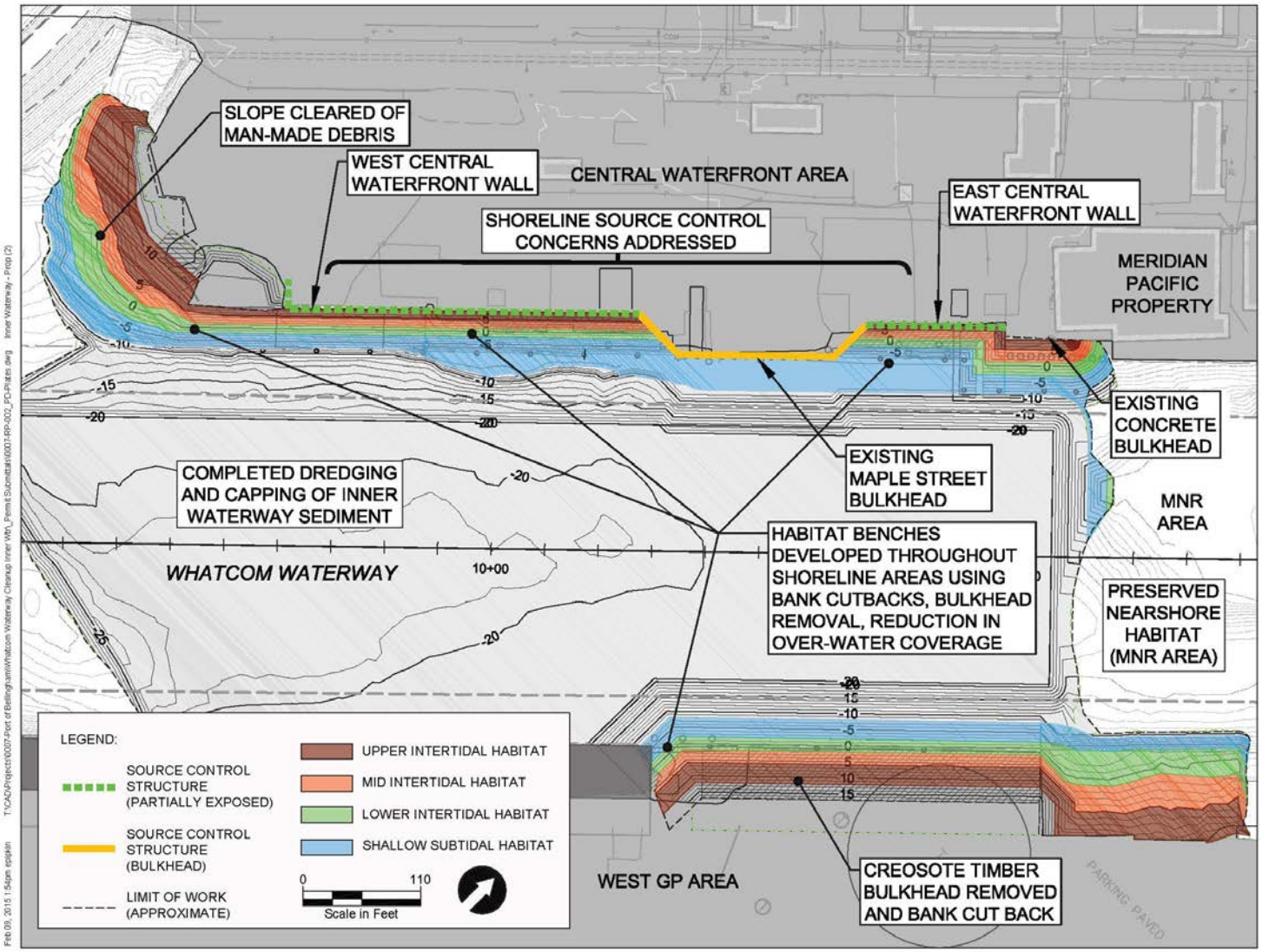

Plate 22
Net Environmental Effects of Cleanup at the Inner Waterway
Final Engineering Design Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

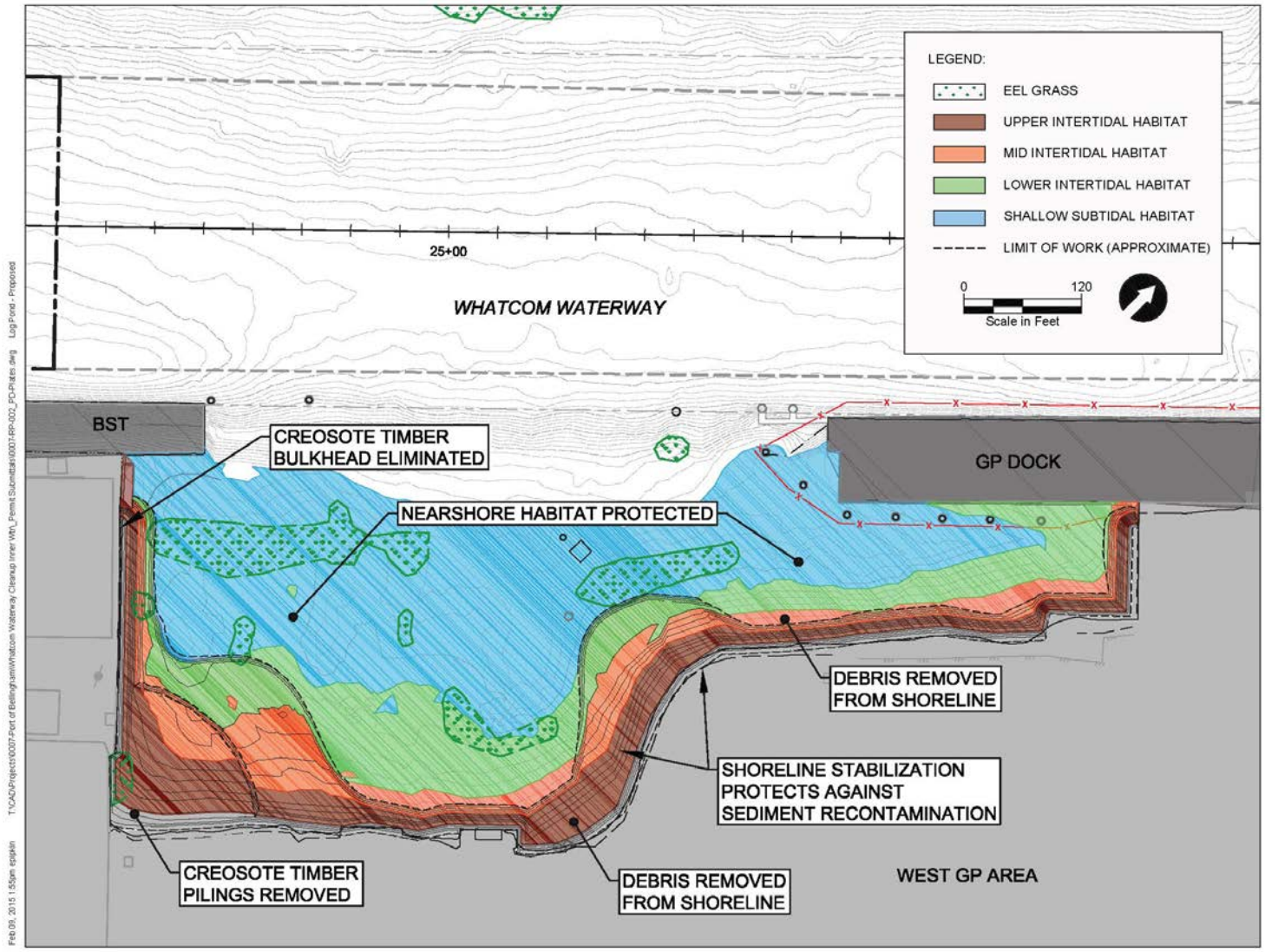

Plate 23
Net Environmental Effects of Cleanup in the Log Pond
Final Engineering Design Report
Whatcom Waterway Cleanup in Phase 1 Site Areas

Table 4-1
Contaminated Dredge Material, Clean Cap Placement, and Clean Residuals Cover
Approximate Maximum Volumes

Project Component	Inner Waterway	Log Pond Area	BST	Total
Contaminated Dredge Material Removed	76,700	0	82,200	158,900
Clean Cap and Residuals Cover Material Placed (Total)	93,600	18,200	14,800	126,600
Clean Sand	52,800	1,900	12,200	66,900
Clean Gravel	29,500	6,400	1,000	36,900
Clean Cobble	11,300	9,900	1,600	22,800

Notes:
1. All volumes are in cubic yards and include defined over-dredge and over-placement allowances. Actual quantities of dredge material removal and cap and cover placement will be lower than these maximum values assuming that the full over-dredge and over-placement allowances are not used.
2. Contaminated dredged materials will be disposed of in a permitted upland landfill. No in-water disposal is proposed.
3. The Inner Waterway is Units 2A, 3A, and 3B and portions of Unit 2C.
4. The Log Pond area is Unit 4.
5. The BST is Unit 1C.

4.4.2 Creosote and Shoreline Debris Removal

To accommodate the dredging and removal of contaminated sediments, existing in-water structures within the Waterway, including creosote-treated timber piling and dolphins, will be removed and disposed of at an approved upland landfill. Approximately 300 creosote-treated timber piles and 505 linear feet of creosote-treated timber bulkhead will be removed as part of the Project. In addition, in the Log Pond and Inner Waterway areas, manmade shoreline debris including concrete and asphalt rubble, rebar and other metal debris, and a variety of creosote-treated timbers, amongst other miscellaneous debris, will be removed. Table 4-2 details the tonnage of creosote-treated timber piling to be removed by area and includes the removal of both creosote-treated timber piles and bulkheads. Table 4-3 details the area from which manmade shoreline debris will be removed.

Table 4-2

Tonnage of Creosote-treated Timber to be Removed[1]

Project Component	Central Waterfront Area			Former GP West Property			
	Meridian Pacific Property	Former Chevron Property	Other Central Waterfront	Head of Whatcom Waterway to Clarifier Bulkhead	Clarifier Bulkhead to Log Pond	Log Pond	Total
Tons of creosote-treated wooden structures to be removed[2-7]	5 tons	81 tons	93 tons	52 tons	10 tons	22 tons	263 tons

Notes:

1. Creosote-treated timber includes creosote-treated piling, dolphins, and bulkheads.
2. Pilings were counted from the shoreline on site visits conducted on October 25 and 26, 2012; not all piling were clearly visible or accessible.
3. Piling length above water was measured, where possible, and the time was noted; other pilings were visually estimated.
4. Overall piling length above mudline was estimated using tidal predictions and available bathymetry.
5. Total estimated piling length is assumed to be twice the piling length above mudline.
6. Piling unit weight is assumed to be 32 pounds per cubic foot (pcf).
7. Piling unit weight is based on a personal communication between Derek Koellmann of Anchor QEA and Lisa Kaufman of WDNR on October 24, 2012.

GP = Georgia-Pacific Corporation

Table 4-3

Shoreline and Nearshore Debris Removal[2]

Project Component	Central Waterfront Area			Former GP West Property		
	Meridian Pacific Property	Former Chevron Property	Other Central Waterfront	Head of Whatcom Waterway to Clarifier Bulkhead	Clarifier Bulkhead to Log Pond	Log Pond
Debris Removal Area[1, 2]	0	3,150	12,000	14,700	1,180	15,920

Notes:

1. All areas are in square feet and are representative of shoreline area between top of bank and elevation +5 feet MLLW where debris will be removed.
2. Debris to be removed is a combination of concrete and asphalt rubble, derelict steel, and general shoreline debris.

GP = Georgia-Pacific Corporation

4.4.3 Reduction of Overwater Cover

To accommodate the dredging and removal of contaminated sediments, existing overwater structures within the Waterway, including existing piers, timber catwalks, and creosote-treated piling and piles stubs will be removed and disposed of at an approved upland landfill. Removal of these overwater structures will result in an overall net reduction in overwater cover in the Waterway, increasing the overall level of habitat connectivity within the Waterway by removing existing nearshore habitat obstructions. Some of the structures to be removed will be replaced with structures composed of more environmentally materials. For example, some existing creosote-treated timber multiple-pile dolphins will be replaced by dolphins or single piles constructed of concrete or steel. Table 4-4 provides a summary of the changes in overwater cover within the intertidal zone.

Table 4-4

Changes in Overwater Cover within the Intertidal Zone[1-3]

Project Component	Central Waterfront Area			Former GP West Property			Total All Areas
	Meridian Pacific Property	Former Chevron Property	Other Central Waterfront	Head of Waterway to Clarifier Bulkhead	Clarifier Bulkhead to Log Pond	Log Pond	
Chevron Pier	0	-3,550	0	0	0	0	-3,550
Barge Loading Ramp[4]	0	0	100	0	0	0	100
Vessel Floats and Gangway[8]	0	0	0	0	0	0	0
Timber Catwalk and Foam Tank[5,6]	0	0	0	0	-750	0	-750
Log boom	0	-70	-90	0	0	-270	-430
Piling and Pile Stub Removal/Replacement[7]	2	-7	10	-118	-12	-27	-152
Replacement Fender System[7]	0	0	400	0	0	0	400
Total	2	-3,627	420	-118	-762	-297-	-4,382

Notes:

1. All areas are in square feet.
2. Changes in overwater cover are only detailed for intertidal areas where the seafloor elevations range between -12 feet MLLW and +10 feet MLLW (mean higher high water [MHHW]). Overwater cover in areas deeper than -12 MLLW is not documented in this table as turbidity conditions in Bellingham Bay and the Waterway typically limit the photic zone to above -12 MLLW.

3. Positive numbers reflect an increase in overwater coverage area, and negative numbers reflect a reduction in overwater coverage area.
4. Barge loading ramp assumes no significant change in overwater coverage. An allowance for some additional shading equivalent to an area approximately 20 feet long by 5 feet wide is included in the table above pending future determinations regarding the specific type of ramp (e.g., mobile or fixed) and lifting structure to be used.
5. Timber catwalk and foam tank calculations include removal of utilities.
6. Piling removal/replacement encapsulates the net piling overwater cover. Piles that currently support the Chevron Pier and timber catwalk adjacent to the foam tank are not included.
7. All replacement piling will replace existing pilings that are being removed.
8. The vessel floats and gangway will be reinstated following completion of cleanup activities, resulting in no net change in overwater coverage within the intertidal zone for this structure.

4.4.4 Reduction of Vertical Bulkheads in Intertidal Areas

In certain areas within the Waterway, existing creosote-treated timber vertical bulkheads will be removed, including the existing creosote-treated timber bulkhead at the former Chevron property, the creosote-treated timber clarifier bulkhead, and portions of the creosote-treated timber bulkhead on the southwestern portion of the Log Pond area. After removal of these bulkheads and dredging and slope cutbacks (dependent on the given treatment for a specific area), the slopes will be capped to create stable sloping caps at slopes of 2H:1V or flatter. Removal of the creosote-treated timber vertical bulkheads will result in improved in-water habitat connectivity and an increase in the overall quality and quantity of intertidal habitat within the Waterway, in addition to removing a source of creosote from the Waterway.

4.4.5 Improving Nearshore Habitat along Salmonid Migration Corridors

Nearshore and intertidal habitat conditions will be greatly improved over existing conditions as a result of the Project, and these changes will benefit juvenile salmon through improving the quality and quantity of nearshore salmonid migration, refugia, and foraging areas. Removal of the existing creosote-treated timber bulkheads at the former Chevron property clarifier bulkhead, and Log Pond area, removal of existing overwater cover and manmade debris within intertidal and shoreline areas, and associated slope treatments resulting in slopes of 2H:1V or flatter will result in habitat conditions that are significantly more favorable to juvenile salmonid movement and migration than under current conditions. The improved habitat conditions will reduce the number of current deep-water areas and shaded areas where piscivorous predators can reside and provide connected intertidal migration and foraging corridors along large portions of the shoreline of the Waterway, allowing for

increased juvenile salmonid growth opportunities. The changes to intertidal and subtidal habitat elevations are shown in Table 4-5. Associated changes to deep subtidal habitat elevations are shown in Table 4-6.

Table 4-5

Changes in Acreage of Intertidal and Shallow Subtidal Habitat[1-4]

Habitat Elevations (MLLW)	Central Waterfront Area			Former GP West Property			BST	
	Meridian Pacific Property	Former Chevron Property	Other Central Waterfront	Head of Whatcom Waterway to Clarifier Bulkhead	Clarifier Bulkhead to Log Pond	Log Pond	Berths 1 and 2	Total
OHWM to +4	0.01	0.12	0.01	0.09	0.14	0.32	0	0.69
+4 to 0	0.02	0.01	0.02	-0.01	0.08	-0.21	0	-0.09
0 to -4	0.00	0.02	-0.01	-0.01	0.09	-0.43	0	-0.33
-4 to -10	-0.01	-0.06	0.23	-0.07	0.06	0.11	0	0.26
Total Intertidal Habitat (OHWM to -10)	0.02	0.09	0.25	0.00	0.37	-0.21	0	0.52

Notes:

1. All areas are in acres.
2. Habitat area values are rounded to the nearest one-hundredth of an acre.
3. The estimated changes in acreage assume that the Project is completed consistent with the current design, using approximately 50 percent of cap over-placement allowance in capped areas.
4. Positive numbers reflect a net gain in aquatic habitat area; negative numbers reflect a net reduction in aquatic habitat area.

GP = Georgia-Pacific Corporation
MLLW = mean lower low water
OHWM = ordinary high water mark

Table 4-6

Changes in Acreage of Deep Subtidal Habitat[1-3]

Habitat Elevations (MLLW)	Central Waterfront Area			Former GP West Property			BST	Total
	Meridian Pacific Property	Former Chevron Property	Other Central Waterfront	Head of Whatcom Waterway to Clarifier Bulkhead	Clarifier Bulkhead to Log Pond	Log Pond	Berths 1 and 2	
Total (Below -10)	-0.02	-0.13	-0.2	-0.01	-0.16	0	0	-0.52

Notes:

1. All areas are in acres.
2. Habitat area values are rounded to the nearest one hundred square feet.
3. The estimated changes in acreage assume that the Project is completed consistent with the current design, using approximately 50 percent of cap over-placement allowance in capped areas. Positive numbers reflect a net gain in aquatic habitat area; negative numbers reflect a net reduction in aquatic habitat area.

BST = Bellingham Shipping Terminal
GP = Georgia-Pacific Corporation
MLLW = mean lower low water

4.4.6 Net Change in Washington State Waters and Waters of the United States

The Project involves multiple actions that will result in favorable changes to the intertidal and subtidal elevations within the Waterway, including dredging, slope cutbacks, and capping activities. These actions will not result in a net change in the amount of Washington State waters as shown in Table 4-7. The Project will result in a net change in the amount of waters of the U.S. as shown in Table 4-8; however, the Project will also result in significantly improved environmental and habitat conditions throughout the Waterway as previously described in this section.

Table 4-7

Net Change in Washington State Waters[1-5]

Central Waterfront Area			Former GP West Property			BST	
Meridian Pacific Property	Former Chevron Property	Other Central Waterfront	Head of Whatcom Waterway to Clarifier Bulkhead	Clarifier Bulkhead to Log Pond	Log Pond	Berths 1 and 2	Total
0.00	-0.040	0.05	0.00	0.21	-0.22	0	0.00

Notes:

1. Conversion of State waters to uplands is defined as those areas that are currently below the OHWM of the Waterway that are being converted into uplands (areas above OHWM).
2. OHWM is defined as elevation +10.2 feet MLLW.
3. All areas are in acres rounded to the nearest hundredth of an acre.
4. Positive numbers reflect a net gain in area of Washington State Waters, and negative numbers reflect a net reduction in area of Washington State Waters.
5. The estimated changes in acreage assume that the Project is completed consistent with the current design, using approximately 50 percent of cap over-placement allowance in capped areas.

BST = Bellingham Shipping Terminal
GP = Georgia-Pacific Corporation
MLLW = mean lower low water
OHWM = ordinary high water mark

Table 4-8

Net Change in Waters of the United States[1-5]

Central Waterfront Area			Former GP West Property			BST	
Meridian Pacific Property	Former Chevron Property	Other Central Waterfront	Head of Whatcom Waterway to Clarifier Bulkhead	Clarifier Bulkhead to Log Pond	Log Pond	Berths 1 and 2	Total
0.00	-0.08	0.06	-0.01	0.17	-0.37	0	-0.23

Notes:

1. Conversion of the waters of the U.S. to uplands is defined as those areas that are currently below the MHHW of the Waterway that are being converted into uplands (areas above MHHW).
2. MHHW is defined as elevation +8.5 feet MLLW.
3. All areas are in acres.
4. Positive numbers reflect a net gain in area of Waters of the US, and negative numbers reflect a net reduction in area of waters of the U.S.
5. The estimated changes in acreage assume that the Project is completed consistent with the current design, using approximately 50 percent of cap over-placement allowance in capped areas.

BST = Bellingham Shipping Terminal
GP = Georgia-Pacific Corporation
MLLW = mean lower low water

5 SITE PREPARATION AND STAGING AREA DESIGN

As part of cleanup construction activities, the selected contractor will be required to bring the necessary barges, dredges, and other water-based specialized equipment to the Site. The equipment will be moored and repositioned within the Waterway as necessary to complete the work. Completion of the work will also require mobilization of land-based equipment including backhoes, shore-based cranes, pile-driving equipment, loaders, and other equipment. This section discusses potential site areas that may be used by the contractor to stage equipment, or for staging, stockpiling or loading contaminated sediments and other materials. These areas are shown on Figure 6.

5.1 Offload, Staging, and Stockpile Facility – GP West Site

Portions of the GP West site will be made available to the contractor for use in staging equipment and materials for the Project and for stockpiling and transloading dredged sediments and debris for shipment to off-site landfill facilities. The main proposed staging and stockpile area is an irregular shape that measures approximately 1,500 feet long by 750 feet wide (Figure 6). This area may be modified as necessary to coordinate construction activities with Port tenants or site users, or to coordinate construction activities with remediation activities that may be occurring at the GP West site.

A smaller staging and stockpile area is located in the area near the clarifier. This area will be used for localized staging and stockpiling activities associated with the clarifier-area bank cutback and associated sediment capping and related work.

Other locations may alternately be used by the contractor for sediment and debris offloading and staging, pending the approval of the Project engineer and the Port and Ecology. The contractor will be required to submit a Construction Work Plan that will detail operations, including set up and breakdown, stormwater management, and cleaning of the offload facility.

Based on discussions between the Port and Burlington Northern Santa Fe Railway (BNSF), the use of rail haul directly from the GP West site does not appear feasible. Neither the GP West site nor the adjacent Port terminal is currently serviced by rail spurs connected to the

BNSF main line. Rail haul may be utilized for sediment transportation and disposal, using either new temporary connections to the main line, or using off-site rail facilities for transloading sediments and debris between barges or trucks and rail.

If the contractor chooses to use the GP West site, sediments and debris would be offloaded from a selected portion of the GP dock. Spill containment measures will be required at this offloading facility to ensure that all sediment and water from offloading operations be fully contained and that water generated from upland handling of dredge materials can be captured and managed using the NPDES-permitted water treatment system.

Specific stockpile configurations within the designated work areas will be at the discretion of the contractor. However, all stockpile areas will be appropriately contained to prevent leaching of contaminants to the ground, and final methods for containing the stockpiles will be described in the Construction Work Plan and approved by the Project engineer or the Port prior to construction. An example containment scenario incorporates stacked ecology blocks with an impervious geotextile fabric, and a minimum of 2 inches of asphalt overlay beneath stockpiles.

5.2 Central Waterfront Site Staging Area

A portion of the former Chevron property at the Central Waterfront site will also be made available to the contractor, primarily to facilitate shoreline work, debris removal, structural wall construction, and capping along the Central Waterfront shorelines. Staging activities to be conducted in the Central Waterfront may include staging sheetpiles and other materials required for shoreline containment wall construction; stockpiling excavated soils, debris, and sediment generated during shoreline work; and storage and staging of engineered capping materials for use in shoreline work areas.

The area is approximately 300 feet long by 150 feet wide (Figure 6). The final boundaries area may be modified as necessary to coordinate construction activities with property uses by site tenants and users, or to accommodate remediation activities occurring at the Central Waterfront site.

5.3 Stormwater Management

A construction general stormwater permit will obtained for upland construction activities at the GP West and Central Waterfront sites. Stormwater will be managed according to permit conditions at the upland materials stockpile and staging areas. The contractor will prepare an SWPPP that meets conditions of the permit, and details BMPs to minimize generated waters and ensure compliance with applicable water quality criteria and discharge requirements. The SWPPP will:

- Identify potential sources of pollution that may be reasonably expected to affect the quality of stormwater discharge from the work area
- Describe and ensure implementation of practices that will be used to reduce the pollutants in stormwater discharge from the work area
- Ensure compliance with terms of the State of Washington general permit for construction stormwater discharges and the Port's existing NPDES permit (Permit No. WA-000109-1) as applicable
- Identify applicable BMPs for stormwater management

At both the GP West and Central Waterfront sites, the contractor will not allow stormwater to directly discharge to the Waterway. The contractor will utilize the existing stormwater collection and treatment system at the former GP West property for management of construction water generated within the GP West site during the work. As needed the contractor will use structural devices, such as hay bales, silt fences, and catch basin inserts to filter or divert stormwater from directly entering either the Waterway or any storm drains not ultimately connected to the ASB for treatment prior to discharging to the Waterway.

5.4 Other Environmental Considerations

Other environmental considerations that will be addressed associated with upland staging and stockpiling activities include the following:

- **Coordination with upland cleanup projects**: Cleanup activities at the Central Waterfront site and GP West site are ongoing. To the extent that cleanup activities at the sites occur during the work period for the Waterway Project, appropriate measures will be taken to avoid interference between these projects. Additionally, any monitoring wells or other remediation or monitoring equipment that may be

located within the work areas will either be protected or will be appropriately abandoned prior to implementation of the work. Methods for protection or abandonment will be reviewed and approved by the Ecology site manager prior to implementation.

- **Control of fugitive dust**: The contractor will control fugitive dust from the stockpile and staging areas using appropriate best management practices. The tracking of soil or dust off site to City streets will be controlled.
- **Mitigation of traffic impacts**: Traffic impacts associated with Project construction activities will be mitigated to the extent practicable. This will include using barges where appropriate to transport construction materials to and from the Site, using designated truck haul routes. Flaggers will be used if necessary to ensure traffic safety.

Additional environmental considerations based on required permit conditions are described in detail in Appendix K.

6 DREDGING AND DISPOSAL DESIGN

Dredging will be performed within the Inner Waterway and BST areas of the Site within remediation Units 1C, 2A, and 3B (Figure 2). Dredging activities will be performed using mechanical dredging equipment, and dredged sediment and debris will be handled at a transload facility for disposal at an upland landfill. This section describes the dredge prism design criteria used throughout the Project, and documents the basis for dredging equipment selection. Descriptions are then provided for dredging and associated activities for both the BST and Inner Waterway cleanup areas, including assumptions for residuals management, material staging, offloading, and disposal design.

6.1 Dredge Prism Design

Dredge prisms were designed based on the nature and extent of contamination in each area and on the target sediment removal depths. In areas to be capped, these target removal depths consider the proposed final capping design. Secondary considerations in dredge prism designs included geotechnical properties of the sediment, locations, and characteristics of adjacent structures, and the typical precision and accuracy of dredging equipment that will likely be utilized to implement the work.

Neatline elevations are specified for each of the dredge areas as shown in the Project EDR figures. The contractor will be provided with a maximum over-dredge allowance below the specified neatline depth. The maximum allowable over-dredge is 2 feet below the neatline elevation. This is the maximum deepest elevation at which the contractor will be allowed to dredge based on permit conditions. The contractor is expressly prohibited from dredging below the maximum over-dredge allowance.

Dredge prisms adjacent to the BST and former GP dock were also designed to account for sloughing of material from these under-pier areas. Material is anticipated to slough into the dredge area once the toe support has been dredged and the contractor will be required to remove the sloughed material. When dredging adjacent to the GP dock and the BST, the contractor will limit cut thickness to a maximum of 4 feet for each dredge pass, with the intent of initiating a controlled sloughing of under-pier material. The contractor will be

required to make a cleanup pass in areas where sloughing may occur prior to final approval of dredged material removal and after allowing adequate time for sloughing to occur.

To minimize water quality impacts, the contractor will be required to make each dredge pass complete with the dredge buckets and will not be allowed to stockpile sediment in the water. The contractor also will not be allowed to level the completed dredge surface by dragging a beam or the dredge bucket.

6.2 Equipment Selection

Dredging work will be conducted using a mechanical dredge. Hydraulic dredging was determined to be inappropriate for remediation in the Phase 1 areas. Dredging method selection for these areas has considered the following factors:

- Ability of mechanical dredging equipment to meet Project requirements, including compliance with applicable water quality criteria
- Presence of debris within the dredging areas (hydraulic dredging equipment is subject to fouling with such debris)
- Ability of mechanical dredging to achieve higher solids loadings in the dredged materials, without necessitating costly and area-intensive dewatering methods
- Mechanical dredging produces lesser quantities of generated waters, minimizing both risks to receiving waters and the water treatment needs necessary to address those risks
- Improved availability of equipment and expertise within the Pacific Northwest for mechanical dredging as opposed to hydraulic dredging
- Ability to use mechanical dredging equipment for other Project activities (e.g., cap placement) within the Project

The selected contractor will determine the specific pieces of mechanical dredging equipment required to perform the Project work. It is assumed that the contractor will use dredge derricks, barges, and tugs. The contractor will be required to specify equipment choices and procedures in advance as part of the Construction Work Plan. Equipment selection choices will comply with environmental controls and permit requirements associated with water

quality criteria. The Water Quality Monitoring Plan (Appendix L) will be implemented during dredging as necessary to ensure protection of water quality.

6.3 Verifying Dredge Performance

In addition to completion of water quality monitoring, the completeness of dredging will be verified as described in the Construction Quality Assurance Plan (Appendix F) and in the Compliance Monitoring and Contingency Response Plan (Appendix G). Progress surveys will verify that design dredge elevations have been met and in locations where adequate depth has not been achieved the contractor will be required to remove additional material. In addition, the contractor will be required to perform cleanup dredge passes adjacent to both the BST and the GP dock in the Outer and Inner Waterways, respectively, to remove material that has sloughed from under-pier area (see discussion in Sections 6.4 and 6.5 below).

6.4 Outer Waterway Dredging, Residuals Management, and Transition Slope Area Engineered Capping

Dredging plans for the Outer Waterway are shown on Figures 7 and 8. The design for these areas includes dredging, residuals management, and transition slope capping as described in this section.

6.4.1 Outer Waterway Dredge Design

The Outer Waterway (BST) area is located to the southwest of the Log Pond area and is used for vessel moorage and loading and unloading of large cargo and container vessels (see Figure 1). The current Project includes removal of contaminated sediments to clean bottom within the federal navigation and Berth 1 area. Dredging will also remove a shoaled area within Berth 2 that poses a risk of recontamination (from propwash disturbance) to the Berth 1 remediation area.

No structure removals or modifications are to be conducted as part of the Outer Waterway dredging. The BST pier structure is present along the entire length of the dredging prisms. The BST facility will remain operational throughout completion of the remediation activities.

The BST pier was designed to support dredging to depths of -35 feet MLLW at the pier face. Dredging to deeper depths may create geotechnical or structural instability within the structure. KPFF Consulting Engineers (KPFF) performed a structural evaluation of the dock and pier to assess the loading conditions. The analysis assessed the potential for overstressing the existing timber piles due to loading from the resulting unbalanced soil height. A supporting geotechnical evaluation of the soil conditions was performed to assess soil stratigraphy, soil modulus (i.e., stiffness), and earth pressures that would potentially be exerted on the piles after dredging. The recommendations provided to KPFF are presented in the Figures section of Appendix B. Dredge design elevations have considered this limitation.

Dredging will be performed in the Outer Waterway/BST area (Unit 1C), adjacent to the existing BST facility, to remove contaminated sediments to defined neatline elevations from within the Berth 1 area (Figures 7, 8a, and 8c). The following criteria were used as the basis of design:

- Berth 1 dredging will be completed to establish a dredge elevation of -40 feet MLLW throughout the majority of the area, with a portion in the western corner being dredged to -36 feet MLLW. These depths result in removal of all sediments exceeding the SQS (0.41 mg/kg) for total mercury, and also address sediments containing elevated D/F concentrations as defined during the PRDI investigations (Anchor QEA 2010a).
- Along the northwestern edge of the Berth 1 area, the dredge prism will slope upwards from the dredge design elevations at the edge of the federal navigation channel to meet existing bathymetry elevations (Figures 8b and 8c). Final slope grades vary on this slope in an effort to protect eelgrass bed resources to the north of the dredge prism.
- Grades along the BST dock will be completed at 2H:1V from the dredge design elevation to the pier face to accommodate sloughing from under-pier areas and facilitate berthing depths in an effort to remove as much contaminated sediment as possible while maintaining structural integrity of the docks (Figures 8a and 8c).
- Berth 2 dredging will be conducted to establish a minimum dredge elevation of -32 feet MLLW at the face of the existing BST dock. The dredge prism will be flat (i.e., no slope), with a vertical cut at the pier face, and will extend out into the Berth 2

area until it daylights with existing bathymetry (Figure 8c). As previously discussed, the contractor will be responsible for removing any slough material originating from under the BST dock from the dredge footprint.

6.4.2 Management of Dredging Residuals

Because the Outer Waterway dredging areas (with the exception of the slope transition area as described in Section 6.4.3) will not be capped, management of dredging residuals will be performed. Residuals cover material will be placed within dredge areas located in the Outer Waterway adjacent to the BST (Figure 7). Six inches of clean sand will be placed to manage anticipated dredge residuals generated by dredging activities and to address potential recontamination risks associated with resuspension and redistribution of dredged sediments during construction. Appendix A provides a detailed discussion and calculation of multiple residual management scenarios and includes recommendations for dredge production and cleanup pass requirements for different areas.

Residuals management cover material will be placed within the Outer Waterway dredge area following completion of dredging activities to manage the thin veneer of dredging residuals that are expected to remain at the sediment surface. As described in Appendix A, dredging residuals occur with all types of dredging. The quantity and quality of dredge residuals vary depending on the dredge material properties, the presence of debris and other factors. Placement of residuals management cover material will be designed to mix with the thin veneer of contaminated surface sediments to produce a sediment surface that meets cleanup objectives. The quality of the final surface will be verified with chemical testing as described in the Compliance Monitoring and Contingency Response Plan (Appendix G).

Residuals management cover material will be placed in Berth 1 (Figures 8a and 8c). The analysis of dredging residuals for Berth 1 (Appendix A) has demonstrated that a placement of 6 inches of clean sand cover material will provide final surface sediment concentrations of mercury below the SQS. Over-placement allowances of 6 inches (total placement of 12 inches) were considered as part of design, and this potential over-placement would provide further reductions in final surface concentrations. Final concentrations of D/Fs will vary depending on the concentrations of these chemicals in the sand cover material. Before

placement, the residual cover material will undergo chemical testing to determine actual contaminant concentrations and will be screened accordingly to ensure adequate environmental protection. Assuming a D/F concentration below 2 ng/kg (naturally occurring concentrations of D/Fs vary with the source of clean sand materials) in the sand cover material, average D/F concentrations in the final surface immediately after construction are expected to be below 4 ng/kg. These concentrations will tend to equilibrate with those of average Bellingham Bay surface sediments over time due to sediment transport and mixing. D/Fs in surface sediment within Bellingham Bay have been shown to be decreasing due to natural recovery processes (Hart Crowser 2009), the same natural processes that have resulted in demonstrated natural recovery for mercury.

Residuals cover materials will also be placed within the Berth 2 dredge areas (6 inches with an over-placement allowance of 6 additional inches).

6.4.3 Transition Slope Area Engineered Capping

The northeastern slope of Berth 1 (transition into the Inner Waterway) will be capped using a Type I engineered cap design including sand, gravel filter and rock armor to prevent scouring and potential recontamination of Berth 1 from contaminated sediments on the adjacent slope area of Unit 2C (Figures 8b and 8c). The engineered cap design for this area considers potential propwash forces that may be associated with vessel traffic in the Berth 1 and federal channel areas. The engineered cap design also maintains appropriate lateral and vertical offsets from the federal navigation channel project boundaries as necessary to permit future maintenance dredging of the channel without risking damage to the engineered cap.

6.5 Inner Waterway Dredge Design

The dredging design for the Inner Waterway is shown in Figures 9a, 12a, and 12b. Specific design considerations relevant to the development of those dredge prisms are described below for each area. After dredging, these areas will be engineered capped as described in Sections 7, 8, and 9.

The Inner Waterway area is utilized for various navigation activities, and navigation and berthing activities utilize both the north shoreline (Central Waterfront and Meridian Pacific

properties) and the south shoreline (former GP dock). The Consent Decree (Ecology 2007a) and First Amendment to the Consent Decree (Ecology 2011a) anticipate continuation of navigation uses in these areas, as a locally managed multi-purpose waterway. Current and anticipated future navigation uses of the Inner Waterway include the following:

- Open-water portions of the Inner Waterway area will be maintained at target elevations of -18 feet MLLW to preserve the operational use of this area for small boats, barges, and certain commercial vessels (e.g., fishing trawlers). Waterway management will include future maintenance dredging, including up to 2 feet of over-dredge allowance.
- The emergent tideflat located at the head of the Waterway will be preserved for habitat and public access, and no dredging will be conducted in this area. Navigation uses in this area will be limited, but could include use by small boats (e.g., kayaks or hand-carry boats).
- Navigation uses along the south side of the Waterway will continue, with utilization of the GP dock for barge and vessel berthing. Some existing dolphins that must be removed to accomplish sediment dredging and capping will require replacement to preserve these existing uses. The clarifier area bulkhead located along the south side of the Waterway is not required for navigation uses.
- Existing navigation uses along the Central Waterfront shoreline and along a portion of the Meridian Pacific property will continue. These properties are designated for continued marine trades uses as part of the Waterfront District planning effort. Anticipated navigation uses include continued barge and commercial vessel access for activities such as aggregate transportation, cargo transportation, and manufactured product shipping, consistent with historical uses in this area, and continued boatyard activities, including operation of a boat-lift using a shore-mounted crane. Existing features of this area, including the presence of mooring dolphins, intermediate water depths (-8 feet MLLW or deeper) within the berthing areas and a serviceable barge ramp are to be retained to support these existing uses. Some of the pilings, dolphins, and other structures that must be removed to accomplish dredging and capping will be replaced as necessary to continue these existing uses.
- Continued boat access to the Meridian Pacific property is assumed, including preservation of mooring dolphins as necessary to support continued small boat access.

Future maintenance dredging along the Meridian Pacific pier face (i.e., within the MNR area at the head of the waterway) is not anticipated.

Consistent with the requirements of the Consent Decree (Ecology 2007a) and First Amendment to the Consent Decree (Ecology 2011a), the dredging design for the Inner Waterway (Units 2A and 3B) includes removal of contaminated sediments to sufficient depths to allow placement of an engineered cap while maintaining existing operational uses and water depth requirements. The dredging and engineered capping design for this area is shown in Figures 9a and 9b.

Details of the Inner Waterway cap are provided in Section 6. The top of the engineered cap will be established at a not-to-exceed elevation of –20 feet MLLW to maintain a Waterway navigation elevation of -18 feet MLLW; this buffer provides at least 2 feet over-dredge allowance for future maintenance dredging to –18 feet MLLW. The top of cap consideration results in setting the required dredge elevation to be -24 feet MLLW in the main portion of the Inner Waterway to accommodate the total cap thickness design. An over-dredge allowance of 2 feet (down to elevation –26 feet MLLW) has been used per USACE guidance to determine maximum dredge volumes for permit application purposes. Thicknesses of dredge cuts will vary throughout the Inner Waterway and will be thickest at slope transition areas.

Dredging adjacent to the GP dock has considered the design and maintenance condition of this structure. Similar to the Outer Waterway, sloughing is expected and the contractor will be required to remove sediment that has sloughed from under-pier areas during performance of the work. Design slopes and setbacks from the pier face as necessary to protect the structure from damage are shown in Figures 9a, 11, and 12a.

Detailed design assumptions for dredging and engineered capping along the South Shoreline (i.e., clarifier bulkhead area) and along the northern shoreline (i.e., Central Waterfront and Meridian Pacific properties) are provided in Sections 8 and 9. As described in Section 8, the dredging along the South Shoreline includes cutback of the clarifier bulkhead area to create a final stable capped slope at a grade of 3H:1V. The dredging in the Central Waterfront area includes cutbacks of the slope in three areas with debris or petroleum-contaminated soils.

The dredging in the Central Waterfront areas includes considerations to protect against slope instability and to address hydrocarbon source control requirements, as described in Section 9.

6.6 Sediment Offload, Staging, Transport, and Disposal

Sediments dredged from the Outer Waterway and the Inner Waterway will be managed by upland disposal in a permitted Subtitle D landfill. The sediments should qualify for use as daily cover within this type of landfill. Final transportation to the landfill may occur by rail or truck, depending on the selected landfill facility and the transportation logistics selected by the contractor. Final landfill selection may also affect the allowable moisture content in the sediments to be disposed. Examples of permitted Subtitle D landfills that have historically managed dredged sediments include the Waste Management landfills in Wenatchee, Washington, and Arlington, Oregon, and the Allied Waste facility located in Roosevelt, Washington. Other landfills may be utilized for sediment management, provided that they meet Subtitle D permitting requirements.

With the exception of soil and debris suitable for on-site reuse or recycling (see below), the contractor will be required to ultimately transport dredged sediment and debris entrained with contaminated sediment to a permitted Subtitle D landfill facility. Transportation methods may include shipment by barge, truck, or rail. Certain other materials may be reused or recycled including the following:

- **Reuse clean overburden soils:** As described in Section 3.3.4, clean overburden soil generated from upland excavations within the Central Waterfront site (e.g., during temporary trench excavations required for shoreline containment structure installation) site may be temporarily stockpiled and reused as trench backfill within the Central Waterfront site. Specifically, during installation of the wall and construction of the sediment caps, some upland soil will be temporarily removed by trenching from behind the wall to address short-term construction stability of the sheetpile. Overburden soils that are free of petroleum contamination (to be verified by testing the excavated soil for petroleum; one sample per 200 cubic yards) will be segregated and may be reused to backfill the trenches upon completion of work.

Petroleum-contaminated soils removed from the trenches will be managed by Subtitle D landfill disposal.

- **Reuse South Shoreline cutback soils:** Soil generated during the cutback of the South Shoreline of the Whatcom Waterway may be reused as backfill within the former clarifier, or may be retained on site in a covered stockpiled for future subgrade fill within the GP West site. Specifically, soils that are free of bricks, plastic, or other unsuitable debris will be used fill the clarifier depression. Any remaining soil suitable for reuse will be stockpiled on site for reuse as subgrade fill within the GP West site. Testing of the stockpiled soil will be performed as described in Section 8.3.3.
- **Recycling concrete debris:** Clean concrete debris generated during removal of the clarifier or during removal of concrete debris along the Log Pond or Central Waterfront Area shorelines may either be crushed on site and stockpiled for on-site reuse, or transported to appropriately permitted concrete recycling facilities. Concrete debris that cannot be efficiently segregated from contaminated sediments will be managed as contaminated sediments at a permitted Subtitle D landfill. Other debris (e.g., bricks, plastic, or woody debris) will be segregated and will be managed by Subtitle D disposal.

The contractor will be required to transport dredged sediments from the Waterway to the landfill. The contractor will be responsible for providing an appropriate offload facility and the transportation logistics to move the sediments from the dredging area to the disposal site. This may include use of the staging areas as shown on Figure 6, or alternative locations. The contractor will be required to barge sediments to the designated offload point. Transloading, staging, stockpiling, and dewatering methods will comply with the requirements specified in Section 5 of this EDR. Transportation between the offload point and the final disposal site may include truck or rail transportation, or a combination thereof.

7 WATERWAY ENGINEERED CAPPING DESIGN

Engineered caps are to be placed within the bottom of the Inner Waterway, and also along the transition slope area adjacent to Berth 1 dredging as described in Section 6.4.3. This section describes the design for these caps. Engineered capping designs for the South Shoreline, the Central Waterfront shoreline, and the Log Pond are described separately in Sections 8, 9, and 10, respectively.

7.1 Engineered Cap Design Evaluation

The thicknesses of the engineered caps are based on parameters that include evaluation of contaminant mobility, bioturbation, erosion protection, future maintenance, construction tolerances, and geotechnical considerations. The following sections discuss basis of design criteria associated with open-water cap thickness design within the Inner Waterway area.

7.1.1 Contaminant Mobility

The engineered cap design addresses contaminant mobility by developing a chemical isolation or attenuation layer that is typically placed directly above the contaminated sediment surface. Design of an effective chemical isolation layer includes consideration of the movement of contaminants driven by advection and molecular diffusion. The cap thickness is designed so that the engineered cap will effectively reduce the migration of contaminants to the water column and also physically isolate the contaminants from the benthic environment.

Contaminant mobility in the open-water portions of the Inner Waterway area was evaluated using the steady-state model of Reible et al. (2009). That model estimates the chemical concentrations that may occur in the surficial sediment layer of a cap once steady-state conditions are achieved in the cap isolation and attenuation layer. This analysis was performed to ensure that the designed cap thickness would be capable of meeting performance standards for mercury (as defined using the SQS of 0.41 mg/kg). The analysis also considered D/Fs, and evaluated the performance of the cap with respect to these compounds.

Results of the contaminant mobility evaluation are described in Appendix E for new capping areas within the Whatcom Waterway. That analysis demonstrated that a minimum

attenuation layer thickness of 2 feet would provide protection at or below the mercury SQS under a range of evaluated conditions. The analysis also demonstrated that a 2-foot attenuation layer thickness would also contain D/Fs that may be present in the underlying sediments. The model evaluations were performed using conservative design assumptions, and the analysis indicates that the engineered cap design will protect sediment quality. A detailed description of the cap modeling analysis is presented in Appendix E.

7.1.2 Bioturbation

An important consideration in the long-term evaluation of engineered capping systems is the potential for bioturbation or exposure of surficial and deep-burrowing aquatic life within the cap to subsurface contaminants.

Detailed core analyses performed in Bellingham Bay suggest that the sediment bioactive zone is approximately 12 cm (5 inches) in thickness, and that bioturbation is minimal below a depth of approximately 0.5 feet (15 cm) (Officer and Lynch 1989, Anchor Environmental and Hart Crowser 2000). The engineered cap placed in the Inner Waterway area (except for the marginal boundary area) will have a minimum thickness of 2 feet and will consist of sand, with a gravel armor layer (1 foot) placed to protect against potential propwash disturbances. With the over-placement allowance, the final cap thickness will vary between 3 and 4 feet. This thickness provides robust protection of the bioactive zone and also provides protection against periodic deep-burrowing organisms such as ghost shrimp. The presence of the surface gravel armor layer will tend to limit deep bioturbators such as ghost shrimp from burrowing into the underlying sand isolation and attenuation layer.

7.1.3 Erosion Protection

Design criteria for erosion protection of engineered caps located in the open-water portions of the Outer and Inner Waterways is based on impacts due to vessel operations in these areas (propwash). Tidal and wave induced near-bed currents are significantly lower in magnitude in these areas compared to those produced by propwash (see Appendices C and D). The effects of wind and wave forces are more significant for nearshore slopes along the South Shoreline, the Central Waterfront, and the Log Pond as described in Sections 8, 9 and 10, respectively.

Propwash modeling assessed stable armor sizes associated with propwash impacts from three typical commercial vessels that use the Outer and Inner waterways. The selected design vessels include a tractor tug in the outer waterway and a Puget Sound tug boat and commercial fishing vessel, the Aleutian Falcon, in the Inner Waterway. Criteria assumed for evaluation of propwash for these vessels are summarized below (additional detail provided in Appendix D, including a discussion of potential uncertainties associated with the evaluation):

- Tractor tug (Outer Waterway)
  - Bed elevations; slope ranging from -41 to -25 feet MLLW
  - Propeller diameter of 5.89 feet
  - Propeller draft of 12.5 feet
  - Maximum horsepower (hp) at 50 percent of available power (4,000 hp)
- Puget Sound tug (Inner Waterway)
  - Bed elevation of -20 feet MLLW
  - Propeller diameter of 5.83 feet
  - Propeller draft of 11.5 feet
  - Maximum hp at 85 percent of available power (722 hp)
- Aleutian Falcon commercial fishing vessel (Inner Waterway)
  - Bed elevation of -20 feet MLLW
  - Propeller diameter of 9.67 feet
  - Propeller draft of 8.17 feet
  - Maximum hp at 50 percent of available power (1,500 hp)

Based on results of propwash modeling (Appendix D), a Type II cap design incorporating gravel armor will be used in the open-water areas of the Inner Waterway (Figure 9a). Larger rock armor consistent with the Type I cap design is required at the transition slope area between the Outer and Inner Waterways (Figure 7) and along portions of the north and south shorelines (refer to Sections 7 and 8 for these shoreline areas). The use of the Type I cap design in these areas also provides the protection necessary to address additional wind and wave and propwash forces in these areas.

Sources of uncertainty with everyday operations propwash evaluation include power level assumptions, maneuvering area assumptions, and assumptions of future operational criteria. The propwash analysis also excluded emergency operations, as emergency maneuvers are difficult to predict frequency and intensity. Therefore, there is uncertainty in the propwash results with regard to emergency conditions.

7.1.4 Geotechnical

A geotechnical analysis was conducted to evaluate several key engineered cap design parameters. The geotechnical evaluation is attached in Appendix B and includes review of the following issues:

- Stability of the engineered capped slopes
- Potential displacements during seismic events
- Bearing capacity of the capped subgrade sediments
- Settlement of the engineered cap from consolidation of the capped subgrade sediments

A detailed discussion of these analyses and the results and conclusions are provided in Appendix B. Table 7-1 presents a summary of the results and design recommendations for the capping design within the Inner Waterway region.

Table 7-1
Results and Design Criteria for the Inner Waterway Engineered Capping Design

Analysis	Results	Design Criteria
Slope Stability	Slope stability for short-term and long-term loading scenarios for 3H:1V slopes are 1.6 and 1.7, respectively	Sand layer should be placed with in-water side slopes no steeper than 3H:1V; rock armor may be placed at steeper grades, up to 2H:1V
Seismic Performance	Permanent seismic slope displacements of 0.5 to 1 foot were estimated for the capped in-water slopes	N/A
Bearing Capacity	An initial maximum lift thickness of 2.5 feet of clean sand may be placed while maintaining the target factor of safety for bearing capacity	Cap lift thickness should be limited to a maximum of 2.5 feet

Analysis	Results	Design Criteria
Settlement	Cap subgrade consolidation is estimated to range from 0.5 to 1 foot near the eastern end of the Waterway to 0.5 to 2 feet in areas adjacent to the GP dock	N/A

7.2 Waterway Engineered Cap Design

Based on results of the contaminant mobility and bioturbation evaluations (Sections 7.1.1 and 7.1.2), the sand attenuation layer within the Outer and Inner Waterway will have a minimum thickness of 2 feet thick, with a 0.5-foot over-placement allowance.

In the open-water portions of the Inner Waterway, a gravel armor layer consistent with the Type II cap design is required on top of the sand isolation cap based on impacts from vessel operations (propwash velocities). The gravel layer will be 1 foot thick, with a 0.5-foot over-placement allowance and will consist of poorly sorted gravel with a D_{50} of 3 inches. The total cap thickness in this area will range from 3 feet to 4 feet. Detail 1 on Figure 12c illustrates the construction of the Type II cap in this area and Figure 9b illustrates the spatial extent and elevations of the top of the cap in plan view. Refer to Sections 8 and 9 for design of the nearshore engineered caps along the South Shoreline and Central Waterfront areas.

In the Outer Waterway, a Type I cap design will be used along the dredged slope at the transition between the Outer and Inner Waterways (northeast of the dredged area in front of the BST). The cap in this area will consist of the sand layer overlain by a gravel filter layer and an armor rock layer to protect the cap from potential erosion. The transition slope cap will be constructed at a grade of 3H:1V. The gravel filter layer will consist of the same 3-inch gravel material used as armor material in the Inner Waterway with a thickness of 1 foot and a 0.5-foot over-placement allowance. The rock armor layer will be placed at a 1.5-foot thickness with a 1-foot over-placement allowance. The total cap Type I thickness in this area will range from 4.5 feet to 6.5 feet depending on the degree of over-placement. Section B on Figure 8b and Detail 6 on Figure 8c illustrate the composition of the Type I cap in this area and Figure 7 illustrates the spatial extent and elevations of the top of engineered cap in plan view.

8 SOUTH SHORELINE ENGINEERED CAPPING DESIGN

This section summarizes the basis of design criteria for the work to be conducted in the South Shoreline areas of the Site. As described in this section, this work includes placement of engineered caps along the South Shoreline of the Inner Waterway from toe of the slope to the approximate top of bank or pier face (depending on location) as part of planned remediation activities. Work to be performed in this area also includes removal of the existing clarifier bulkhead and cutback of the shoreline, as shown in Figure 10. The cap design in this area is shown on Figures 11, 12a, 12b, and 12c. The engineered caps are designed to contain underlying contaminated sediment and to isolate the contaminants from biological receptors.

8.1 South Shoreline Use Assumptions

The GP West property is located on the southeastern side of the Inner Waterway and consists of shoreline with variable slopes. Waterway navigation uses occur primarily at the GP dock, which remains in use for navigation.

The upland properties adjacent to the South Shoreline are part of the Pulp and Tissue Mill RAU of the GP West site. These properties are to be redeveloped for mixed uses consistent with the Waterfront District land use planning. The remediation plan for the South Shoreline includes removal of the clarifier and associated bulkhead, and cutback of the bank to create a stable final engineered cap slope.

Structures that must be removed to implement site cleanup include the clarifier bulkhead, the clarifier tank, stormwater piping, and timber foam tank, as well as several timber dolphins with the associated wooden catwalk. After remediation, only the dolphins require replacement; these are used to secure mooring lines from vessels moored at the GP dock.

8.2 Engineered Cap Design Evaluation

The thicknesses of the engineered caps are based on parameters that include evaluation of contaminant mobility, bioturbation, erosion protection, future maintenance, construction tolerances, and geotechnical considerations. The following sections discuss basis of design criteria associated with shoreline cap thickness design for the South Shoreline area.

8.2.1 Contaminant Mobility

Engineered cap thicknesses and considerations for potential contaminant mobility, physical isolation of contaminants, and erosion protection are the same as those described in Section 7.1.1. Cap modeling analysis details are provided in Appendix E. This analysis addresses both mercury and D/Fs.

Areas of soil and groundwater contamination exist within the Pulp and Tissue Mill RAU of the GP West site. Available data were contained in the final RI report (Aspect 2013) and in the completion report for the Bunker C Interim Action (Aspect 2012b). Data for soils and groundwater in the South Shoreline and clarifier cutback area are provided in Appendix I. These data demonstrate that soil contaminant levels are low, and that no groundwater contamination is present in nearshore areas. No additional measures (beyond those described elsewhere in this section) are required to address soil and groundwater conditions adjacent to the South Shoreline.

8.2.2 Bioturbation

Engineered cap thicknesses and considerations for bioturbation are the same as those described in Section 7.1.2.

8.2.3 Erosion Protection

Design criteria for erosion protection of engineered caps located along the southern shoreline is based on a combined of impacts from breaking waves on the upper portions of the slope (at and above -8 feet MLLW) and vessel operations (propwash) on lower portions of the slope (below -8 feet MLLW) (Figure 11). Design wave conditions were based on 100-year (based on wind data) recurrence internal storm events (see Appendix C). Design vessels for this area consist of the Puget Sound tug and Aleutian Falcon, a commercial fishing vessel, as discussed in Section 7.1.3.

Capping in the South Shoreline area will use both Type I and Type II engineered cap designs. Based on results of the wave and propwash modeling, a Type II cap with gravel armor is appropriate for most areas below -8 feet MLLW. Use of a Type I cap design with larger rock armor is required at and above -8 feet MLLW along the majority of the shoreline to protect

against wind and wave erosion. The exception to this is the small pocket beach located to the east of the clarifier bulkhead. This area is sheltered from direct wind and wave exposure and use of a Type II cap design with gravel armor is appropriate in this area.

Adjacent to the GP dock, propwash forces associated with navigation uses are more significant than in other areas of the South Shoreline. To protect against these forces, a Type I capping design incorporating rock armor will be used on lower slope adjacent to the dock. In these areas, the Type I cap will extend down to the toe of the slope (-20 feet MLLW), as shown on Figures 11 and 12c, to protect against propwash impacts from vessels operating at the GP dock (Figure 11).

8.2.4 Geotechnical

As proposed, the engineered capping along the South Shoreline includes removal of the clarifier and cutback of the slope, followed by creation of a stable cap grade of 3H:1V. The engineered cap thickness will be 3 to 4 feet (including armor) in Type II capping areas without rock armor, and will be approximately 4.5 to 6.5 feet thick in Type I capping areas requiring rock armor. The geotechnical analysis for the South Shoreline included review of the following:

- Slope stability of the engineered cap
- Bearing capacity of the engineered cap
- Seismic performance of engineered cap
- Settlement of the engineered cap from consolidation of the subgrade sediments

A detailed discussion of these analyses and the results and conclusions is provided in Appendix B. Table 8-1 presents a summary of the results and design recommendations for the engineered capping design at the South Shoreline.

Table 8-1

Results and Design Criteria for the South Shoreline Engineered Capping Design

Analysis	Results	Design Criteria
Slope Stability	Slope stability for short-term and long-term loading scenarios have factors of safety of 1.3 and 1.5, respectively, for shorelines with sand and gravel caps placed on side slopes of 3H:1V and armoring at grades of 2H:1V	Sand cap slopes will be stable at slopes of 3H:1V; rock armor may be placed steeper, at slopes up to 2H:1V
Seismic Performance	Permanent seismic slope displacements of 0.3 to 1.3 feet were estimated for the shorelines	N/A
Bearing Capacity	An initial maximum lift thickness of 2.5 feet of clean sand may be placed while maintaining the target factor of safety for bearing capacity	Cap lift thickness should be limited to a maximum of 2.5 feet
Settlement	Cap subgrade consolidation is estimated to range from 0 to 1 foot near the eastern-most end of the South Shoreline to 2 to 3 feet in areas immediately waterward of the old clarifier bulkhead.	N/A

8.3 Structure Removal and Bank Cutback

Select structures have been identified for removal as part of cleanup of the South Shoreline. Removal of these structures is necessary to allow for completion of remediation work. The existing GP dock will remain in place.

8.3.1 Removal of Clarifier, Stormwater Lines, and Foam Tank

Removal of the concrete clarifier tank consists of the demolition of the entire aboveground clarifier wall (approximately 310 cubic yards of concrete) and demolition of the portion of the 8-inch concrete clarifier slab within the projected cutback slope (approximately 115 cubic yards) and removal of the timber foundation piling within this area. The remaining slab will be core drilled with approximately 50 holes to prevent the remaining structure from obstructing stormwater infiltration. The remaining void of the clarifier will be backfilled using soils from the South Shoreline cutback, provided that the soil is geotechnically suitable and does not contain extensive debris. Previous testing data (Appendix I) indicates that the soil in this cutback area complies with MTCA industrial direct-contact cleanup levels and is suitable for on-site subgrade fill.

The existing foam tank consists of approximately 360 square feet of creosote-treated timber and 175 linear feet of large diameter FRP piping in the area. The timber foam tank will be removed down to the top of an existing pile-supported concrete footing (approximately elevation -2 feet MLLW) and the existing piping will be cut and capped at the shoreline and removed, along with the pile supports and pipe hangers. Prior to work in this area, existing utilities and stormwater lines will be rerouted as part of the clarifier removal.

8.3.2 Timber Pile and Dolphin Removal

Between the clarifier bulkhead and the GP dock is a treated timber walkway supported by approximately 16 creosote-treated piles. Three timber dolphins protect the area. The timber walkway will be removed with heavy equipment and the timber piles and dolphins will be removed in their entirety using a vibratory hammer. One of the dolphins will be replaced following completion of the dredging and capping in this area. That dolphin will be replaced with a steel mono-pile (30-inches in diameter or less) or a three-pile dolphin with a single mono-pile and two batter piles. A short section of catwalk will be replaced between the GP Dock and the dolphin.

Existing timber piling in the beach area between the clarifier bulkhead and Central Avenue will be cut off at ground surface prior to cap placement.

8.3.3 Removal of Clarifier Bulkhead and Bank Cutback

The clarifier timber bulkhead consists of approximately 275 linear feet creosote-treated timber bulkhead, 90 linear feet of steel sheet pile bulkhead and steel bracing, and 120 creosote-treated timber piles. The timber bulkhead, steel sheetpile wall, bracing, and timber piles will be cut as required to construct the new capped slope. Bank cutback elevations are shown on Section C of Figure 12b.

Soil from the bank cutback (from areas inshore of the existing bulkhead) consists primarily of sand and gravel. Chemical concentrations measured in 16 soil samples collected from five soil borings placed within the footprint of the bank cutback (Appendix I) were consistently below MTCA Method C industrial direct contact cleanup levels. Three of these soil samples exceeded MTCA Method B direct contact cleanup levels for unrestricted land use.

Provided that it is geotechnically suitable and does not contain brick or plastic debris, cutback soil will be used to fill the clarifier foundation to grade. Soils with brick, plastic, or woody debris (if encountered) will be segregated and managed by Subtitle D landfill disposal.

Excess suitable cutback soil (estimated volume of approximately 3,000 cubic yards) will be stockpiled, covered, and evaluated for reuse as subgrade fill within the GP West site. Samples of the stockpiled soil will be tested for petroleum (one sample per 200 cubic yards), PAH, and mercury (one sample per 500 cubic yards). Soils from cutback areas containing brick and plastic debris (if encountered) will not be retained for reuse unless tested for D/F concentrations (one sample per 500 cubic yards). Final disposition of the reuse soils will be conducted under Ecology oversight and will be consistent with cleanup requirements for the GP West site. Soil that is not geotechnically suitable for subgrade fill application or that contains extensive debris will be managed by off-site disposal using a Subtitle D landfill facility.

8.4 South Shoreline Engineered Cap Design

The cap design for the South Shoreline incorporates the results of contaminant mobility and bioturbation evaluations (Sections 8.2.1 and 8.2.2 and Appendix E), coastal engineering evaluations (Appendix C), and propwash evaluations (Appendix D). Based on these evaluations, both Type I and Type II capping designs will be used. In general, a Type I cap design incorporating a gravel filter layer and rock armor layer will be used in upper slope areas above -8 feet MLLW. In most areas below -8 feet MLLW, a Type II cap design will be used, including a gravel armor layer.

The typical shoreline engineered cap will range in thickness between 4.5 to 6.5 feet in Type I cap areas and 3 to 4 feet in Type II cap areas. The engineered cap will be thicker in some areas as necessary to accommodate grade transitions. Figure 11 illustrates the spatial extent and elevations of the top of engineered cap in plan view. The sections on Figures 12a to 12b and the details on Figure 12c illustrate the composition of the engineered cap along each portion of the South Shoreline.

In both Type I and Type II capping areas, the sand attenuation layer along the South Shoreline will be a minimum of 2 feet thick, with a 0.5-foot over-placement allowance.

Thicker sequences will be used in selected areas as necessary to develop smooth final grade transitions as shown on Figures 11, 12a, and 12b.

Throughout the clarifier slope cutback area, the sand cap will be placed with a final 3H:1V slope from the toe of the slope at -20 feet MLLW to an elevation of approximately +12 feet MLLW as shown on Figure 12a. A Type II cap design will be used in most areas below -8 feet MLLW. These areas will incorporate a gravel armor layer 1 foot thick, with a 0.5-foot over-placement allowance (Figure 12b). This gravel material will consist of poorly sorted gravel with a D_{50} of 3 inches.

The Type II cap design will also be used on the intertidal beach area located between the clarifier bulkhead cutback and Central Avenue. In this area, the Type II cap with sand layer and gravel armor will be placed up to the existing bulkhead, resulting in a final grade of approximate 6H:1V. The cap will extend to the existing wooden bulkhead, with a top of slope elevation of between approximately +8 and +9 feet MLLW.

The Type I cap design will be used in two areas of the south shoreline. First, the Type I cap will be used in the upper portions of the clarifier bulkhead cutback areas, above elevation -8 feet MLLW. The three-layer Type I design (Figure 2c) incorporating sand, gravel filter, and rock armor protects against wind and wave erosion forcers occurring in these upper slope areas. Along these upper shoreline areas, breaking waves require a rock armor with a D_{50} of 7.5 inches. However, a material with a slightly larger D_{50} of 9 inches has been specified to fit closer to a standard specification.

The Type I cap design will also be used in one portion of the lower slope adjacent to the GP dock as shown in Figure 11. Use of rock armor in this area protects against potential propwash forces from vessels using the dock. The rock armoring in this Type I cap area will have a D_{50} of 9 inches and will be placed with a minimum thickness of 1.5 feet, and 1-foot over-placement allowance.

9 CENTRAL WATERFRONT SHORELINE SOURCE CONTROL AND CAPPING DESIGN

This section describes the work to be conducted along the Central Waterfront shoreline, including sediment dredging and capping. It also includes additional measures to address shoreline stabilization and source control requirements. Work in this area is complex and includes removing existing structures, constructing source control structures (containment walls), dredging, constructing slope cutbacks, placing engineered cap, and replacing certain structures that must be removed temporarily to accomplish these source control and cleanup actions.

9.1 Central Waterfront Use Assumptions

As described in Section 6.5, the properties within the Central Waterfront area have been designated for continuation of marine trade uses during Waterfront District land use planning. The design for dredging, engineered capping, and shoreline stabilization activities in the shoreline portions of the Central Waterfront and adjacent Meridian Pacific property supports continuation of existing uses, including the following:

- Continued vessel moorage activities are expected at the Meridian Pacific property formerly occupied by New West Fisheries. The other Meridian Pacific properties are located within the shallow-water habitat areas being managed with MNR.
- Anticipated navigation uses for the Central Waterfront properties include continued barge and commercial vessel access for activities such as aggregate transportation, cargo transportation and manufactured product shipping, consistent with historical uses in this area. Continued boatyard uses are also anticipated, including operation of a boat-lift using an existing shore-mounted crane.
- The emergent tideflat located at the head of the waterway will be preserved for habitat and public access, and remediation in this area is limited to MNR and institutional controls. Navigation uses in this area will be limited, but could include use by small boats (e.g., kayaks or hand-carry boats).

9.2 Upland Source Control Considerations

In addition to considerations of the mobility of sediment contaminants, the shoreline stabilization and source control measures being taken along the Central Waterfront shoreline

consider the presence of petroleum and associated contaminants (e.g., benzene) in area soils and groundwater.

A supplemental shoreline investigation was conducted in this area and is included in Appendix H. These data supplement data previously collected during several rounds of environmental testing performed at area properties and during the development of the draft Central Waterfront RI/FS (AECOM 2009).

Results of environmental testing at the Central Waterfront site demonstrate that upland soils and groundwater between the former Chevron property and the Maple Street bulkhead are impacted by petroleum hydrocarbons. Existing conditions and the measures that have been incorporated into the Project design to address these conditions include the following:

- **Former Chevron property:** At the former Chevron property, the Port has completed an interim action, with Ecology oversight, to remove soils and intertidal sediments impacted by seepage of petroleum hydrocarbons. However, petroleum-impacted soils and groundwater will remain in upland Site areas, including behind the existing Chevron bulkhead, and in areas along Laurel Street. Based on the types and levels of contaminants remaining at the property, a containment wall structure is being installed along the shoreline behind the existing Chevron dock and bulkhead (these existing timber structures are to be removed as described below) to prevent potential petroleum seepage from occurring in this area and impacting the newly placed Waterway caps. The walls will be constructed using a cantilever sheetpile design with grouted joints. This design allows for potential future remediation activities such as groundwater treatment or soil excavations to be conducted upland of the containment wall if necessary as part of the Central Waterfront site cleanup. The wall will be installed along the future MHHW line to minimize the presence of vertical structure within nearshore habitat areas.
- **Shoreline between Chevron property and Maple Street:** The shoreline between the Chevron property and Maple Street consists primarily of debris and rubble armor placed offshore of the historical bulkhead alignment in this area. Petroleum hydrocarbons are present in upland soils and groundwater and within this debris fill. An area of benzene-impacted porewater was identified in sediments along the shoreline near Maple Street. As a result, a containment wall structure will be

installed along the historic bulkhead alignment in this area, and the petroleum-impacted soil and debris located offshore of this alignment will be removed. The wall design will be similar (i.e., cantilever sheetpile design) to that used at the Chevron property so as to not preclude potential future upland cleanup actions near the wall. The wall will be installed along the future MHHW line to minimize the presence of vertical structure within nearshore habitat areas.

- **Maple Street bulkhead:** Soil and groundwater near the existing Maple Street bulkhead are impacted by petroleum hydrocarbons and benzene. The contamination extends into the soils located beneath the existing barge ramp located in this area. The geometry of the current ramp system appears to create a preferential contaminant migration pathway between the uplands and the shoreline. The existing bulkhead includes tie-back structures but is in poor overall condition. The bulkhead has required several previous repairs, including installation of new tie-backs and anchor systems and the use of soil amendments (i.e., concrete injection) to repair sinkholes. This bulkhead system requires replacement to ensure long-term stability of this shoreline and to contain areas of existing soil and groundwater contamination. As part of this replacement, the existing barge ramp will be removed and replaced by an updated ramp system that does not create a preferential migration pathway. The barge ramp and foundation will be removed, along with exposed petroleum-impacted soil, which is described in detail in Section 9.4.3 below. It is not practicable to remove all impacted soils behind the existing bulkhead because of the geotechnical and structural instability of the existing bulkhead and the presence of extensive in-ground structures (e.g., tie-backs, pilings, and soil anchors), but those within the barge ramp footprint will be accessible after ramp removal. The ramp may be replaced in the future with a mobile or fixed structure equivalent in function but with an alternate foundation and lifting design (one that doesn't create a preferential groundwater migration pathway). The Project design assumes that the existing ramp and foundation (including support piles) will be removed and the cavity will be backfilled and sealed by installation of the replacement bulkhead structure and filling and paving of the ramp cavity. To accommodate planned dredging and capping and to meet structural and geotechnical design requirements, the replacement bulkhead will require the use of drilled soil anchors. These soil anchors will pose some encumbrance to future remediation activities behind the wall, similar to the soil

anchors and other subsurface structures currently in place in this area. The soil anchor system does not preclude groundwater treatment activities such as air sparging.

- **Shoreline between Maple Street and Meridian Pacific:** This stretch of shoreline includes an existing rubble-armored slope. No petroleum hydrocarbon contamination has been detected in soil or groundwater in this area. However, some heavy metal impacts have been detected in subsurface soils. Stabilization of the shoreline is required to contain this contaminated soil and support required dredging and engineered capping activities. A containment wall system will be installed for this area consisting of a cantilever sheetpile design. The wall will be installed along the future MHHW line to minimize the presence of vertical structure within nearshore habitat areas.

9.3 Engineered Cap Design Evaluation

The thicknesses of the engineered caps are based on parameters that include evaluation of contaminant mobility, bioturbation, erosion protection, future maintenance, construction tolerances, and geotechnical considerations. The following sections discuss basis of design criteria associated with shoreline cap thickness design for the Central Waterfront area.

9.3.1 Contaminant Mobility

Engineered cap thicknesses and considerations for potential contaminant mobility and isolation of sediment contaminants are the same as those described in Section 7.1.1. Engineered cap modeling analysis details are provided in Appendix E.

9.3.2 Bioturbation

Engineered cap thicknesses and considerations for bioturbation are the same as those described in Section 7.1.2.

9.3.3 Erosion Protection

Design criteria for erosion protection of engineered caps located along the Central Waterfront shoreline are the same as those used for the Southern Shoreline as described in

Section 8.2.3, although the Aleutian Falcon was not included as a design vessel for this part of the Waterway. Additional information regarding specific vessel operations used to evaluate erosion potential in this area can be found in Appendix D.

Armor requirements along this shoreline are similar to those developed for the Southern Shoreline and incorporate both Type I and Type II engineered cap designs. The Type I cap design with both gravel filter and rock armor layers will be used in upper slope areas, above elevation -8 feet MLLW. Use of the Type II cap design with a gravel armor layer is appropriate for most shoreline areas below elevation -8 feet MLLW. This design protects against anticipated wind and wave, current and propwash forces. The shallow area in front of the Maple Street bulkhead is subject to higher risks of propwash disturbance due to the geometry of the area and the anticipated type and frequency of tug and barge activity in this area. A Type I cap design incorporating both gravel filter material and rock armor layer will be required along approximately 180 linear feet of this shoreline, between elevations -8 feet MLLW and the toe of the slope (-20 feet MLLW; see Figures 14b and 15c).

9.3.4 Geotechnical

Geotechnical evaluations conducted for the Central Waterfront area included analysis of shoreline dredging and engineered capping activities, and evaluations for the design of the replacement Maple Street bulkhead and the other partially exposed containment walls required to address shoreline source control issues as described in Section 9.2. The geotechnical analysis performed for the Central Waterfront shoreline includes:

- Design parameters for the Maple Street Bulkhead, including static and seismic stability, lateral earth pressures for short-term and long-term loading conditions, and recommended pull-out resistance of grouted tie-backs
- Design parameters for other containment wall systems to be constructed using a cantilever design approach
- Slope stability for capped shorelines
- Seismic performance of capped shorelines
- Bearing capacity of the capped subgrade sediments
- Settlement of the capped subgrade sediments

- Design recommendations for piling and dolphin replacements to be implemented after shoreline capping and for replacement paving for crane operations, which will be damaged during shoreline dredging and engineered capping

A detailed discussion of these analyses and the results and conclusions are provided in Appendix B. Tables 9-1, 9-2, and 9-3 summarize geotechnical results and design recommendations for the remediation along the Central Waterfront shoreline.

Table 9-1
Geotechnical Design Criteria for the Central Waterfront Engineered Capping Areas

Analysis	Results	Design Criteria
Slope Stability	Slope stability for short-term and long-term loading scenarios have a factor of safety of 1.3 and 1.5, respectively, for shorelines with nearshore caps and hanging walls with the proposed dredging slope of 3H:1V and final top of cap slope of 2H:1V	Dredge side slopes should be no steeper than 3H:1V; slopes with armored cap should have final grades no steeper than 2H:1V
Seismic Performance	Permanent seismic slope displacements of 0.3 to 1 foot were estimated for the shoreline caps	N/A
Bearing Capacity	An initial maximum lift thickness of 2.5 feet of clean sand may be placed while maintaining the target factor of safety for bearing capacity	Cap lift thickness should be limited to a maximum of 2.5 feet
Settlement	Cap subgrade consolidation is estimated to range from 1 to 2.5 feet near the northeastern end of the Central Waterfront shoreline to 2 to 3.5 feet in areas near at the Chevron Property	N/A

Table 9-2

Geotechnical Design Criteria for the Replacement Bulkhead at Maple Street

Analysis	Results	Design Criteria
Static and Seismic Bulkhead Stability	Stability for short-term, long-term, and seismic loading scenarios have a factor of safety of 1.3, 2.2, and 1.1, respectively, for the currently proposed design of the Maple Street bulkhead	The factor of safety for global stability should be equal to or greater than 1.3, 2.0 and 1.0, respectively, for short-term, long-term and seismic loading scenarios
Ultimate Tie-back Anchor Pull-out Resistance	N/A	Ultimate pull-out resistance of 1,000 pounds per square foot is recommended for the design of grouted tie-back anchors (see Appendix B for further details)
Lateral Earth Pressures	N/A	See Appendix B for recommended earth pressure diagrams

Table 9-3

Geotechnical Design Criteria for the Partially Exposed Containment Walls

Analysis	Results	Design Criteria
Static Bulkhead Stability	Stability for short-term loading has a factor of safety ranging from 1.3 to 1.4, and the long-term loading scenario factor of safety is approximately 1.6	The factor of safety for global stability should be equal to or greater than 1.3 and 1.5, respectively, for short-term and long-term loading scenarios
Lateral Earth Pressures	N/A	See Appendix B for recommended earth pressure diagrams

9.4 Structure Removal and Replacements

Figures 13a and 13b show a number of structures that must be removed in order to conduct remediation activities along the Central Waterfront Shoreline. Some of these structures will be removed permanently and others replaced to preserve existing uses. Replacement structures will serve the same function as the removed structures, but will be constructed with appropriate materials to address current design and permitting requirements (e.g., creosote-treated timber piles will be replaced with metal piles rather than treated wood to eliminate potential ongoing sources of PAH-contamination).

9.4.1 Removal of Former Chevron Pier and Bulkhead

The existing pier is an approximately 3,600-square-foot treated timber pier comprised of heavy timber superstructure supported by approximately 121 creosote-treated piles. The entire superstructure will be removed with heavy equipment and the timber piles will be removed. Piles will be removed by a combination of pulling where this can be conducted safely and by cutting piles off at the mudline in other areas. The pier removal will be sequenced with containment wall installation to minimize risks of bulkhead failure during pier removal.

The existing timber bulkhead behind the former Chevron pier is approximately 165 linear feet and is comprised of creosote-treated timbers with steel tie rods and approximately 25 creosote-treated piles. The bulkhead removal will be sequenced with containment wall installation and capping to minimize risks of bulkhead failure. Specifically, the new containment wall will be installed before the existing bulkhead and pier structure are removed. The soils immediately behind the wooden bulkhead will be partially excavated to expose the existing tie-backs and reduce the load on the bulkhead. The new containment wall will then be installed immediately upland of the existing bulkhead. The bulkhead super-structure will then be cut at the mudline. Tie rods will be cut and the portions within the excavation will be removed. Timber piles will be cut at or near the mudline. Portions of a failed timber bulkhead located south of the former Chevron pier will also be removed. Excavation of soil on the upland side of the wall will be performed to access the tie rods for cutting and to relieve surcharge loading on the new wall as dredging and capping activities are performed. The excavated area will be backfilled with clean material following completion of capping activities and any contaminated soils will be removed from the Site for disposal at a Subtitle D landfill facility.

The Chevron pier will not be replaced following completion of remediation. However, dolphins will be replaced along the former pier alignment to preserve the moorage function provided by the former pier and associated pilings.

9.4.2 Removal and Replacement of Pilings and Dolphins

All of the existing piling, dolphins, and log booms (see Figures 13a and 13b) located between the Chevron property and the Meridian Pacific property will be removed to enable completion of shoreline stabilization, dredging, and capping. In addition to the treated timber piling associated with the Chevron pier and bulkhead (see above), these include creosote-treated timber dolphins located along the Central Waterfront site and additional timber pilings located adjacent to the Meridian Pacific property. Each dolphin consists of roughly five creosote-treated piles approximately 14 inches in diameter. Approximately 80 pilings will be removed (excluding those pilings located within the Chevron pier and bulkhead structures). In addition, the existing log booms along the shoreline between the Chevron Property and the Maple Street bulkhead will be removed.

Some of the piles and dolphins removed during remediation will be replaced after completion of dredging and capping activities. All replacement piles will be constructed of steel and no treated wood will be used. Replacement dolphins and piles are shown in Figures 14a and 14b, including 12 replacement dolphins and 5 individual piles. The dolphins will consist either of steel mono-piles of 30-inch diameters or less, or three-piling dolphins with one plumb and two battered piles of 24-inch diameters or less. The individual piles will be mono-piles of 24-inch diameter or less. The mono-piles and plumb piles will have either a UHMW or rubber-wearing surface. Pilings are also included within the fender system of the Maple Street bulkhead, as described in Section 9.4.3 below.

9.4.3 Replacement of Maple Street Bulkhead

A replacement steel sheetpile bulkhead wall will be constructed in front of the existing concrete bulkhead at Maple Street to stabilize the shoreline, contain existing contaminated soil and groundwater, and allow safe completion of required nearshore dredging and capping.

The wall will be composed of sheetpile along approximately 240 linear feet of shoreline and will have a length of approximately 60 feet. The face of the wall will have a final exposed height of approximately 21 feet, between the existing upland grade of +13 feet MLLW and

the future offshore cap elevation of -8 feet MLLW. The joints in the sheetpiles will be sealed with a joint-filling compound to control groundwater seepage.

The existing 55-foot-long by 16-foot-wide steel barge ramp and barge ramp foundation will be removed, along with exposed petroleum-impacted soil. The ramp cavity will then be filled with clean soil backfill. The ramp will be replaced in the future as described in Section 9.2 with a mobile or fixed ramp structure serving the same function. The ramp that will serve the same purpose as the existing ramp (loading and unloading of materials) will be constructed with a foundation that does not create a preferential migration pathway for contaminated groundwater. Permanent drilled-in steel rod grouted tie-backs will be installed into the upland to help support the wall. The tie-backs will be connected to a continuous steel whaler beam on the face of the wall. The centerline of the whaler will be placed between elevation +6 feet MLLW and +10 feet MLLW. A fender system will be installed along the bulkhead face to protect the integrity of the bulkhead and whaler system from vessel damage. The fender system will consist of up to 12 steel fender piles placed immediately offshore of the bulkhead and connected to each other by a steel whaler beam running the full length of the bulkhead. The fender piles will be backed with rubber energy absorption fenders that connect the top of each pile to the bulkhead.

A reinforced concrete cap will be added to the top of the sheetpile and will run for the full length of the wall. The concrete paving immediately adjacent to the bulkhead will be repaired or replaced as necessary.

9.4.4 Temporary Relocation of Existing Ramp and Float System

An existing ramp and float system is located along the Central Waterfront shoreline and services the active boatyard facility as shown in Figure 13b. This existing float system will be temporarily removed during completion of shoreline remediation work. Following completion of dredging and capping, the ramp and float system will be returned to the approximate location shown in Figure 14b.

9.4.5 Repaving in Crane Operation Area

An existing crane pad is located in the uplands, adjacent to the shoreline as shown in Figure 13b. The crane pad will need to be removed to permit completion of dredging, wall installation, and capping in this area. Replacement pavement will be constructed in the upland upon completion of this work to provide a location for continued crane operations.

9.5 Design of Partially Exposed Containment Walls

Figures 14a and 14b show the locations of partially exposed containment walls to be located along the shoreline to address soil and groundwater source control issues identified in Section 9.2. Construction of these walls will be conducted as follows:

- **Groundwater containment wall (Chevron to Maple Street):** As part of shoreline source-control measures, a new steel sheetpile containment wall system will be constructed along the shoreline between the Chevron property and the Maple Street bulkhead. This wall will be used to minimize risks of recontamination associated with contaminated soil and groundwater, consistent with cleanup and source control requirements and to permit safe completion of shoreline dredging and capping. The wall will be composed of 40-foot lengths of sheetpile and will be installed along approximately 360 linear feet of the shoreline, with a final exposed height of approximately 4 feet (transitioning between maximum cap elevations of +9 feet to +13 feet MLLW). During installation of the wall and construction of the sediment caps, some upland soil will be temporarily removed from behind the wall to address geotechnical and structural design requirements. After completion of wall installation and site capping, this temporary excavation will be backfilled with clean soil and overburden soils. Temporary tie-backs or bracing may also be required to facilitate wall installation. The portions of the sheet-pile joints installed within the layer of permeable soils (i.e., within the shallow fill and sandy native soils) will be sealed with a joint-filling compound to prevent groundwater flow through the wall at these elevations. A concrete cap will be added to the top of the sheetpile and will run for the full length of the wall.
- **Containment wall between Maple Street Bulkhead and Meridian Pacific property:** A partially exposed shoreline wall will be constructed in the area extending between the Maple Street bulkhead and the Meridian Pacific property (Figure 14b). The wall

in this area is required to contain contaminated soils associated with the Central Waterfront site and to allow completion of dredging and capping in adjacent areas. Groundwater containment is not required in this area. The wall will be composed either using 40-foot lengths of sheet piling. The wall will be constructed along approximately 130 linear feet of shoreline, with a final exposed height of approximately 4 feet (between a maximum cap elevation of +9 feet and +13 feet MLLW). During installation of the wall and construction of the sediment dredging and capping, some upland soil will be temporarily removed by trenching from behind the wall to address geotechnical and structural design requirements. Petroleum-contaminated soil (if encountered) that is removed during this trenching will be managed by Subtitle D landfill disposal. The existing crane pad located in this area will be removed during wall installation, and replaced with pavement to support continued crane operations (see Section 9.4.5). Clean soils that have been tested (1 sample per 200 cubic yards) and that do not contain petroleum contamination may be reused as backfill of the temporary trenches. After completion of wall installation and site capping, this temporary excavation will be backfilled with clean imported soil and overburden soils and the working surface will be replaced with concrete or asphaltic concrete paving.

9.6 Central Waterfront Dredging and Engineered Capping Design

The dredging design for the Central Waterfront shoreline is shown on Figure 9a. This dredging includes slope cutbacks in the Laurel Street area of the Chevron property and in stretches of the shoreline located immediately west and east of the Maple Street bulkhead.

Dredging in nearshore areas may include use of land-based equipment to remove oversized shoreline debris. Debris removal areas are shown in Figures 13a and 13b. Where debris consisting of uncontaminated concrete or asphalt can be segregated from contaminated soils and sediments, the debris may be either crushed for future reuse at the Central Waterfront or GP West site, or managed by recycling or disposal at a permitted construction debris recycling or disposal facility.

Contaminated sediments and soils dredged from offshore areas will be disposed of at an approved Subtitle D facility along with other sediments dredged from the Inner Waterway. Sediment removal will be conducted to the contours shown in Figure 9a and in the sections on Figures 15a through 15d. These design elevations achieve removal of sediments as necessary to construct the shoreline caps to the Project design elevations as indicated below.

The engineered cap design for the Central Waterfront shoreline addresses the contaminant mobility and bioturbation evaluations (Sections 7.1.1 and 7.1.2). The engineered cap design for the Central Waterfront shoreline will use a combination of Type I and Type II cap designs. Figures 14a and 14b illustrates the spatial extent and elevations of the top of engineered cap in plan view. Sections on Figures 15a through 15d and details on Figure 15e illustrate the composition of the engineered cap in this area.

The Type I cap design, incorporating a layer of sand with gravel filter and rock armor layers, will be used in upper slope areas (above elevation -8 feet MLLW) of Site Units 2A and 3B. This design includes a minimum sand placement thickness of 2 feet with a 0.5-feet over-placement allowance. The sand layer will be placed on slopes 3H:1V or flatter. A gravel filter layer consisting of a poorly-sorted gravel with a D_{50} of 3 inches will be 1 foot thick with a 0.5-feet over-placement allowance. The rock armor layer in Type I cap areas will be sized to resist the impact of breaking waves. This requires a 7.5-inch D_{50} rock armor to be placed on top of the 3-inch gravel layer. However, a D_{50} of 9 inches has been specified to fit closer to a standard specification. The minimum thickness of the rock armor layer is 1.5 feet with a 1-foot over-placement allowance. The rock armor will be placed on slopes of 2H:1V or flatter. The rock armor will extend either to the top of the bank or to the face of containment wall or bulkhead structures. Along the new containment wall structures, the armor layer will extend up to a maximum design elevation of +9 feet MLLW to minimize vertical structure within the intertidal areas. The top of the Type I cap will vary along the Maple Street bulkhead as shown in Figures 14a and 14b.

Use of the Type II cap design with a gravel armor layer is appropriate for most shoreline areas below elevation -8 feet MLLW. The cap in these areas will be placed at grades of 3H:1V or flatter. The Type II cap design protects against anticipated wind and wave, current, and propwash forces in most lower-slope areas. However, the habitat bench area in

front of the Maple Street bulkhead (Figure 14b) is subject to higher risks of propwash disturbance due to the geometry of the area and the anticipated type and frequency of tug and barge activity in this area. A Type I cap design incorporating both gravel filter material and rock armor layer will be required along approximately 180 linear feet of this between elevations -8 feet MLLW and the toe of the slope at -20 feet MLLW (see Figure 14b).

10 LOG POND CONTINGENCY ACTION DESIGN

This section describes the engineering design for the engineered cap that will be placed in the Log Pond nearshore areas. This work fulfills Log Pond contingency action requirements and addresses nearshore erosion that has occurred in certain areas. The engineered cap will also provide a stable, long-term connection between the existing cap surface and the top of bank throughout the Log Pond. In addition to addressing sediment cap erosion, this shoreline stabilization will protect against potential future erosion of contaminated soils from adjacent upland areas.

10.1 Log Pond Use Assumptions

Sediment in the Log Pond is currently capped and uses of the Log Pond are limited by restrictive covenants to those that are compatible with the existing sediment cap. The Log Pond is a Bellingham Bay priority habitat restoration area and is the location of an ongoing eelgrass seeding study. Navigation use in the nearshore portions of the Log Pond is not anticipated, with the exception of small boat access (i.e., kayaks or hand-carry boats). Navigation within the outer portion of the Log Pond is expected to be limited to small boat access to support BST vessel-mooring activities (e.g., use of small boat to attach bow and stern lines to the mooring dolphins within the Log Pond). In the future, public shoreline access may be provided to a portion of the Log Pond shoreline as part of planned redevelopment of the GP West site. No deepening for navigation uses is anticipated for the Log Pond area.

10.2 Upland Source Control Considerations

The Long Pond is located along the northern edge of the Chlor-Alkali RAU of the GP West site. This area includes areas of contaminated soil and groundwater that are the subject of an ongoing investigation and cleanup. Extensive work has been performed at the property, including a completed Interim Action. A feasibility study is under development by the Port and Ecology under an existing Agreed Order. The FS will define alternatives for final Site cleanup.

With respect to the Long Pond capping area, two source control issues were considered. These include bank stabilization to prevent potential exposures of contaminated soil, and

evaluations to address potential sediment recontamination from discharges of contaminated groundwater.

The distribution of soil contamination within the Chlor-Alkali RAU of the GP West site has been evaluated as part of the site-wide RI report (Aspect 2013). The RI builds on a previous RI/FS study completed in 1994 (ENSR 1994) and a draft FS conducted in 2004 (Anchor Environmental 2004). As described in those previous RI/FS documents, the upland areas near the Log Pond include a former settling basin constructed in 1971 for pre-treatment of wastewaters and a confined upland disposal site constructed in 1974 for the containment of dredged materials generated during targeted dredging of the Waterway by GP. Both areas were constructed behind containment berms authorized under federal USACE permits. Protecting these upland areas from shoreline erosion ensures that the containment berms remain intact and that the contaminated soils present in upland areas are not released to the Log Pond. The protection of the shoreline against soil erosion has been incorporated into the design for the Log Pond contingency action as described below.

The second source control consideration included the evaluation of whether upland groundwater is likely to recontaminate sediments within the Log Pond. In particular, a localized area of groundwater mercury contamination was identified in the upland near the southwest corner of the Log Pond. This nearshore area includes a portion of the caustic plume subarea, specifically the area near well Law-1. This area has been the subject of numerous studies and was specifically evaluated during the development of the Log Pond interim action (Anchor Environmental 2001a). At that time, the mercury concentration present in groundwater in the Law-1 area was not expected to pose a recontamination risk to sediments. In 2001, 2002, and 2005, after implementation of the Log Pond cap, sediment porewater monitoring (Anchor Environmental 2001b, Anchor Environmental 2002b, RETEC, 2006) demonstrated that sediment mercury concentrations were well below the levels that could pose a risk of sediment recontamination. These empirical data supported the evaluations that had been developed during engineering design (Anchor Environmental 2001a).

A separate evaluation was conducted as part of the Chlor-Alkali RAU Interim Action and the site-wide RI study process (Aspect 2013). That work included additional groundwater and well point investigations targeted at the Law-1 nearshore area, development of a site-specific

mercury partitioning coefficient, and development of groundwater model to evaluate nearshore groundwater mixing processes and how those might be impacted by implementation of the Log Pond contingency actions (Appendix J).

Empirical data collected during the groundwater and well point studies demonstrated that groundwater mercury concentrations attenuated along the flow path between nearshore groundwater wells, deep well points, and shallow porewater samples collected just below the sediment bioactive zone. Empirical data demonstrated attenuation factors of 54-fold between the groundwater wells and the deep well points, and 290-fold between the groundwater well and the porewater samples collected just below the bioactive zone. Empirically measured porewater concentrations were below the levels at which mercury recontamination above the SQS (0.41 mg/kg) could occur. These empirical measurements incorporate both groundwater and subsurface sediment sources and demonstrate that groundwater migration from the Law-1 area or from capped subsurface sediments is unlikely to cause recontamination of the Log Pond sediments.

With respect to future site conditions, the groundwater modeling evaluation (Appendix J) provided an estimate of the difference in attenuation that occurs due to placement of the sediment cap. The evaluation was conservative in that it did not take into account bioturbation or any geochemical processes that occur within sediment caps. Only tidally induced groundwater mixing and dispersion were considered. Nevertheless, the placement of the nearshore cap materials as contemplated with the Log Pond contingency actions resulted in marked improvements in protectiveness, as measured by increases in predicted attenuation factors. The model predicted attenuation factors increased between 4-fold and 8-fold over existing conditions. Therefore, the placement of the nearshore capping materials can be expected to provide further protection against potential groundwater-related recontamination of Log Pond sediments, protection that has already been empirically demonstrated through direct porewater verification testing. Additional porewater verification monitoring has been incorporated into the long-term monitoring program for the Log Pond as described in Appendix G, which will provide further verification regarding the protectiveness of the cap and the status of groundwater source control measures.

In addition to those actions that will be taken within the Log Pond, source removal work has been conducted at the Chlor-Alkali RAU as part of a completed Interim Action and additional cleanup actions will be taken following completion of the Chlor-Alkali RAU FS and selection of a final cleanup remedy by Ecology. At a minimum, the site cleanup would include a long-term groundwater monitoring program to ensure protectiveness of the upland cleanup remedy.

10.3 Engineered Cap Design Evaluation

The thicknesses and locations of the engineered caps to be placed in the Log Pond are based on parameters that include evaluation of contaminant mobility, bioturbation, erosion protection, future maintenance, construction tolerances, and geotechnical considerations. The following sections discuss basis of design criteria associated with shoreline cap thickness design for the Log Pond area.

10.3.1 Contaminant Mobility

Engineered cap thicknesses and considerations for potential contaminant mobility were conducted as part of the engineering design report for the Log Pond Interim Action (Anchor Environmental 2001a). These evaluations indicated that a sediment cap of 2 feet was sufficient to control potential mercury mobility. This is consistent with the findings of sediment capping evaluations performed for the final cleanup action in the Inner Waterway areas as described in Appendix E.

Additionally, the behavior of mercury in groundwater and sediment porewater has been empirically monitored during Log Pond cap monitoring in 2001, 2002, and 2005 and during the GP West RI/FS investigations completed in the Law-1 nearshore area and the Log Pond between 2009 and 2011. As described in Section 10.2, these evaluations demonstrate empirically that groundwater is not a current source of recontamination to the Log Pond sediments and that the placement of additional cap materials as contemplated to address nearshore erosion potential will provide further protection.

10.3.2 Bioturbation

For identified recontamination areas within the southwestern corner of the Log Pond, engineered cap thicknesses and considerations for bioturbation and erosion protection are the same as those described in Section 7.1.2. In these areas, the cap newly placed engineered cap material will consist of a Type 1 cap design and will include placement of a minimum of 2 feet of sand cap, 1 foot of gravel filter, and a 1.5-foot layer of rock armor. These thicknesses are sufficient to prevent exposure of contaminated sediments to deep-burrowing bioturbators.

10.3.3 Erosion Protection

Hydrodynamic and wave modeling were conducted for the Log Pond area. These evaluations demonstrated that wind-driven waves have the largest impact on potential sediment mobility in this area. Model predictions of 100-year wave heights in the Log Pond (see Appendix C) were used to evaluate the size of rock armor necessary to remain stable (i.e., no rock movement) in nearshore slope and transition areas. This rock armor will be used in both Type I and Type III cap design areas.

Additional factors considered as part of erosion protection included the following:

- **Behavior of habitat layers over existing cap**: The Log Pond interim action included both placement of an isolation cap and placement of additional materials to raise bed elevations to support development of eelgrass and intertidal and shallow subtidal habitat. Sediment movement within these incremental habitat layers does not pose a risk of recontamination and no need for armoring was specified for these areas.
- **Stabilization of Log Pond shorelines**: Because the goal of armoring is not only to stabilize the existing sediment cap, but also to stabilize the existing shoreline against potential soil erosion and associated contamination, all armoring is to extend to the top of the existing slope. This ensures long-term protection of the shoreline within which contaminated soil could otherwise be exposed.
- **Elimination of creosote-treated bulkhead**: A vertical bulkhead constructed of creosote-treated timbers is present along the shoreline of the Log Pond at the BST. This bulkhead represents a potential source of PAH-contamination to sediments and also represents a long-term slope stability concern. The cap design includes material placement as necessary to enable elimination of the treated timber bulkhead.

10.3.4 Geotechnical

Significant remedial elements for the Log Pond include the elimination (by partial removal, capping, and buttressing) of the existing timber bulkhead and placement of a varying cap thickness along the shoreline. The geotechnical analysis performed for the Log Pond area includes the following;

- Slope stability of the rock buttressed bulkhead and caps
- Bearing capacity of the capped subgrade sediments
- Seismic performance of the engineered cap
- Settlement of the engineered cap from consolidation capped subgrade sediments

A detailed discussion of these analyses and the results and conclusions is provided in Appendix B. Table 10-1 presents a summary of the results and design recommendations for the engineered capping design at the Log Pond.

Table 10-1
Results and Design Criteria for Log Pond Contingency Action

Analysis	Results	Design Criteria
Static Slope Stability	Slope stability for short-term and long-term loading scenarios have a factor of safety of 1.4 to 1.5, respectively, for shorelines with final grades (of sand cap) no steeper than 3H:1V	Dredge side slopes for sand cap placements should be no steeper than 3H:1V; slopes of rock armor should have final grades no steeper than 2H:1V
Seismic Performance	Permanent seismic slope displacements of 0.3 to 1 foot were estimated for the shoreline caps	N/A
Bearing Capacity	An initial maximum lift thickness of 2.5 feet of clean sand may be placed while maintaining the target factor of safety for bearing capacity	Cap lift thickness should be limited to a maximum of 2.5 feet
Settlement	Cap subgrade consolidation is estimated to range from 0.5 to 1 foot near the bulkhead and 1.5 to 3 feet in areas adjacent to the GP dock	N/A

10.4 Structure Removals

As part of the work in the Log Pond, certain structures will be removed. Some existing mooring and timber dolphins will be preserved. Structures to be removed from the Log Pond include the following:

- **Partial removal of timber bulkhead**: The existing bulkhead along the southwestern edge of the log pond is a two-step timber structure and is approximately 350 linear feet. The timber piles above the tie-back connections will be cut and removed. This will result in removal of the top portions (4 to 6 feet) of approximately 120 creosote-treated timber piles.
- **Removal of treated pile stubs**: Approximately 13 pilings or broken creosote-treated timber pile stubs will be cut or pulled from the shoreline and open-water in several different locations in the Inner Waterway and Log Pond area.
- **Relocation and shortening of log boom**: The existing 800 lineal feet of floating log boom will be relocated and shortened to approximately 440 lineal feet.

10.5 Design of Engineered Cap and Shoreline Stabilization Measures

The capping design for the Log Pond contingency actions is based on the results of the contaminant mobility and bioturbation evaluations, a coastal engineering evaluation (Appendix C), and an evaluation of the remaining thickness of the existing sand cap (Appendix C). Figure 16 shows the spatial extent of the Type I and Type III caps to be placed along the Log Pond shoreline. Sections on Figures 17a and 17b and Details on Figure 17c show the composition of Log Pond slopes as proposed.

The placement of Type I and Type III caps along the Log Pond shoreline requires some offshore movement of the existing shoreline topography and high water lines (including adjustments to both the OHWM and MHHW lines). To minimize this required movement and to minimize the quantity of capping material required, over-sized debris will be removed from the shoreline prior to cap placement. This will occur along most of the southern and eastern shorelines of the Log Pond. The use of bank cutbacks in these areas to further reduce the required adjustments to the OHWM and MHHW lines is not practicable, because an existing shoreline containment berm located in the upland portions of the Chlor-Alkali RAU must be preserved to avoid potential exposure of contaminated soils contained in this area.

A Type I engineered cap will be placed in the southern corner of the Log Pond where previous erosion has caused cap recontamination (Figure 16). In this area, the sand layer will be 2 feet thick and will be placed at a grade of 3H:1V or flatter, with a 0.5-foot over-placement allowance. Over this sand layer, a gravel filter layer (D_{50} of 3 inches) will be placed with a thickness of 1 foot. This gravel layer will also be placed on a slope of 3H:1V or flatter, with an over-placement allowance of 0.5 feet. On top of the filter layer, an armor layer (D_{50} of 9 inches) with a thickness of 1.5 feet will be placed with an over-placement allowance of 1 foot.

A Type III cap will extend into the Log Pond area beyond the Type I cap (in the southern corner) to prevent further erosion of the existing cap due to impacts from waves. Figure 16 shows the spatial extent of both Type I and Type III engineered caps in this area, and Section B on Figure 17a and Detail 3 on Figure 17c show the composition of these engineered caps.

Shoreline stabilization measures will be implemented throughout the remaining edges of the Log Pond. A Type III engineered cap will be used in these areas. The Type III cap will include placement of a sloping layer of rock armor (D_{50} of 9 inches) extending from the existing sand cap all the way to the top of bank (+14 to +16 feet MLLW). The rock armor layer will be placed at a slope of 2H:1V or flatter. A filter layer will be placed beneath the armor layer. The filter layer will include either a gravel filter layer (D_{50} of 3 inches) at least 1-foot thick, or where a full gravel filter layer cannot be placed, filter fabric will be included as part of the filter layer.

11 ANTICIPATED IMPLEMENTATION SCHEDULE

This section provides an overview of the anticipated implementation schedule for cleanup construction activities within Phase 1 Site areas, including associated monitoring and institutional controls. Also described are the schedules for implementing monitoring and institutional controls within areas of the site to be managed by MNR.

The dredging, capping, and shoreline stabilization activities described in this EDR are anticipated to be completed within a single construction season. The targeted start date for construction is during summer 2015. Construction activities will be conducted in a manner that achieves the following goals:

- Provides for a safe work environment
- Protects existing facilities from damage
- Maintains reasonable access and operation for shoreline businesses
- Minimizes the potential for recontamination
- Accomplishes the work in a timely manner
- Accomplishes the in-water work during the permitted work windows
- Accomplishes the work in a cost-effective manner

The Project work windows, as defined by final Project permits (see Section 2.5.5 and Appendix K), will govern most in-water work activities. However, some work within the Phase 1 areas may be appropriately initiated prior to the opening of these in-water work windows. Likewise, some work activities may continue after closure of these in-water work windows. These activities may include some or all of the following:

- Preparation or removal of upland staging and stockpile areas
- Removal of nearshore structures located within Project work areas
- Removal of nearshore vegetation, debris, or structures during in-the-dry tidal conditions, subject to applicable permit conditions
- Installation of groundwater containment walls along the Central Waterfront shoreline, including associated soil excavations and debris removals
- Removal of overwater structures

- Upland excavations and backfill, including preparatory activities such as groundwater dewatering, trenching, shoring, or installation of temporary tie-backs or bracing structures
- Upland staging or transportation and disposal of dredged materials, soil, debris and other construction materials

Work activities that will generally be restricted to the in-water work windows include the following:

- In-water debris or structure removal
- In-water dredging or shoreline excavations
- Sheetpile driving or re-installing structures below the OHWM
- Engineered capping or residuals management cover materials placement

The Construction Quality Assurance Plan (Appendix F) defines measurement and verification steps that will be performed to monitor the completion of work activities. These include the following:

- Pre-construction submittal reviews prior to any contractor work activities
- Pre-dredge bathymetric surveys to document conditions immediately prior to construction
- Post-dredge bathymetric surveys to verify achievement of target design elevations
- Inspections of materials to be used for engineered capping, armoring, residuals cover, and structure replacements
- Progress surveys to verify the placement of engineered capping materials within Project design tolerances
- Project engineer inspections and additional profiling (as necessary) prior to reuse of soils or debris within the Site or adjacent Port-owned properties
- Inspections of installed containment walls and other structures to verify compliance with Project design criteria
- Water quality monitoring consistent with the Project Water Quality Monitoring Plan (Appendix L)
- Sediment quality verification testing consistent with the Compliance Monitoring and Contingency Response Plan (Appendix G)

A Sampling and Analysis Plan defining the specific sampling and analysis procedures to be used during implementation of the Compliance Monitoring and Contingency Response Plan (Appendix G) will be developed and submitted to Ecology for review and approval.

The IC Plan will be submitted for Ecology review before construction activities are completed in Phase 1 areas, consistent with the requirements of the Consent Decree (Ecology 2007a) and the First Amendment to the Consent Decree (Ecology 2011a). The institutional controls as outlined in that plan will be filed within 60 days of receiving final Ecology comments on the IC Plan.

The Project as-built report will be prepared for Ecology review 120 days after completion of required construction activities, consistent with the requirements of the First Amendment to the Consent Decree (Ecology 2011a).

Long-term monitoring will be implemented consistent with the schedule as outlined in the Compliance Monitoring and Contingency Response Plan (Appendix G). Contingency response measures, if required, will be implemented as outlined in that document.

12 SUMMARY

The Project is being conducted by the Port to implement cleanup actions required by the Waterway Site Consent Decree (Ecology 2007a) as amended (Ecology 2011a). Permitting for the Project includes a Nationwide Permit 38 for the Cleanup of Hazardous and Toxic Waste (USACE 2015) and a Section 408 Authorization. The Project also incorporates measures addressing the substantive provisions of WDFW regulations for HPAs and of the City's Shoreline Master Program, Critical Areas Ordinances, stormwater regulations and local approvals as described in Appendix N.

This cleanup action is being performed in compliance with the requirements of the MTCA and SMS regulations. The current Project completes final cleanup actions within the Phase 1 Site areas using dredging, upland disposal, and capping. Most areas of the Site currently comply with Site cleanup levels for mercury, phenolic compounds, and PAHs in surface sediments, and the final cleanup action required for the site addresses subsurface mercury-impacted sediments that have the potential to be exposed through natural (e.g., wind and wave erosion) or anthropogenic (e.g., propwash or maintenance dredging) forces.

Implementing the Project will result in significant environmental improvements over existing conditions within the Site through the removal of highly contaminated sediments, removal of existing creosote-treated and other derelict structures, and capping of dredged areas with clean materials. As an ancillary benefit of the cleanup, the cleanup action will result in greatly improved habitat quantity, quality, and connectivity within the Waterway for a variety of species.

The Project will include actions in the BST, Inner Waterway, and Log Pond. Major cleanup activities within these areas include dredging, capping, containment wall installation, structure removal, structure replacement, and ancillary intertidal habitat improvements. All work to be performed will incorporate BMPs and conservation measures to minimize potential environmental impacts from construction.

12.1 Bellingham Shipping Terminal

The current Project includes work within BST Berths 1 and 2 to remove existing contaminated sediments, place a residuals management cover material, and place a transition cap to prevent potential erosion and recontamination of the remediated areas. Berths 1 and 2 of the BST represent primarily subtidal, deep-water aquatic habitat consistent with ongoing use of the federal navigation channel in this area.

Remediation activities within Berth 1 include dredging of impacted sediments and placement of residuals management cover material. Dredging and placement of residuals management cover will also be performed in the southeastern portion of Berth 2. A transition area cap will be placed on the slope area adjacent to Berth 1 to prevent potential erosion and recontamination of the remediated areas.

12.2 Inner Waterway

Existing habitat conditions in the Inner Waterway area are highly impacted by anthropogenic factors. In addition to the impacts of contaminated sediments, the area's shorelines are degraded by the presence of extensive manmade shoreline debris, including concrete waste and asphalt rubble, overwater structures, and creosote-treated timber structures including vertical bulkheads and piling.

Remediation work to be performed within the Inner Waterway includes dredging contaminated sediments, shoreline containment wall installation, shoreline cutbacks in selected areas, sediment capping, and structure removal (including removal of an existing dock and creosote-treated timber piles), and replacements as necessary to accomplish remediation. The Project design includes shoreline stabilization and source control measures to address recontamination of the Inner Waterway from upland contamination sources associated with the Pulp and Tissue Mill RAU of the GP West site and the Central Waterfront site.

12.3 Log Pond

The Log Pond was the site of a previous interim cleanup action and habitat enhancement Project that resulted in sediment in the Log Pond being currently capped. Shoreline areas

along the southeastern portion are covered with manmade debris, including concrete and asphalt rubble, rebar and other metal debris, and a variety of creosote-treated timbers and timber pile stubs. Under the Project, nearshore cap edges will be finished and connected to the adjacent shorelines to prevent cap erosion and associated recontamination of the cap surface. Select structures (e.g., creosote-treated timber piles and portions of an existing creosote-treated timber bulkhead) and manmade debris will also be removed within the Log Pond area to facilitate the cap construction. The Project design includes shoreline stabilization measures to prevent recontamination of the Log Pond from upland contamination sources associated with the Chlor-Alkali RAU of the GP West site.

12.4 Monitoring and Institutional Controls

The cleanup action includes implementation of long-term monitoring and contingency response measures throughout the Phase 1 Site areas, and also in Site areas being managed by MNR. Institutional controls will be implemented as part of the cleanup action for all capping and natural recovery areas to ensure protectiveness of the cleanup action.

12.5 Net Environmental Benefits

The Project will result in significant improvements in the environmental conditions in the Site through the cleanup of contaminated sediments and control of upland pollution sources. As part of its cleanup decision for the Site (Ecology 2007a), Ecology conducted an analysis of the environmental impacts of the cleanup. That analysis, as described in the FSEIS (Ecology 2007b), determined that the implementation of the cleanup action would result in net environmental benefits to the environment, including benefits to fisheries resources and aquatic habitat.

Consistent with the findings of the FSEIS, the work as proposed in this engineering design is expected to result in significant habitat improvements throughout the Site. These benefits are associated with implementation of contaminated sediment cleanup and source control, the removal of existing creosote-treated derelict structures and miscellaneous shoreline debris, improving intertidal habitat conditions by replacing currently over-steepened slopes that are littered with concrete, asphalt, and other debris with more gentle slopes overlain with clean materials, and reducing the overall the amount of in- and overwater cover within

the Waterway. Existing structures that must be replaced will be constructed out of more environmentally friendly materials than the current structure (e.g., existing creosote-treated timber piling to be removed will be replaced by a lesser number of steel or concrete piling and the new steel piling will occupy a smaller overall footprint than the existing creosote-treated timber piling).

In summary, the net environmental effects of the Project include:

- Removing up to 158,900 cubic yards of contaminated sediment
- Placing up to 126,600 cubic yards of clean capping and residuals management materials to prevent potential erosion and recontamination
- Removing approximately 263 tons of creosote-treated timber (e.g., piling and bulkheads) from the Waterway
- Removing manmade debris from 46,950 square feet of shoreline and intertidal areas within the Waterway, including concrete waste, asphalt rubble, and other miscellaneous debris
- Providing a net reduction of more than 4,300 square feet of overwater cover by removing unused existing structures
- Eliminating existing vertical bulkheads and provide new slopes at slopes of 2H:1V or flatter in various areas within the Waterway
- Increasing the quantity and quality of intertidal and shallow subtidal habitat within the Project area and significantly improving habitat connectivity for a variety of fish and invertebrate species, including ESA-listed Chinook salmon

Ultimately, the Project will result in significant environmental improvements over existing conditions within the Site and provide greatly improved habitat quantity, quality, and connectivity within the Waterway for a variety of species.

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