Interim Action Plan

Port Angeles Rayonier Mill Study Area
Port Angeles, Washington

Prepared by:

Washington State Department of Ecology

Toxics Cleanup Program
Southwest Regional Office

February 2025

DEPARTMENT OF ECOLOGY
State of Washington

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Cross-referenced or relevant documents

Interim Action Report Volume I: Upland Data Summary Report[2]
Interim Action Report Volume I: Appendices[3]
Interim Action Report Volume I: Plates[4]
Interim Action Report Volume II: Marine Data Summary Report[5]
Interim Action Report Volume III: Alternatives Evaluation[6]

[1] https://ecology.wa.gov/research-data/data-resources/environmental-information-management-database
[2] https://apps.ecology.wa.gov/cleanupsearch/document/10404
[3] https://apps.ecology.wa.gov/cleanupsearch/document/10407
[4] https://apps.ecology.wa.gov/cleanupsearch/document/10527
[5] https://apps.ecology.wa.gov/cleanupsearch/document/42416
[6] https://apps.ecology.wa.gov/cleanupsearch/document/85323

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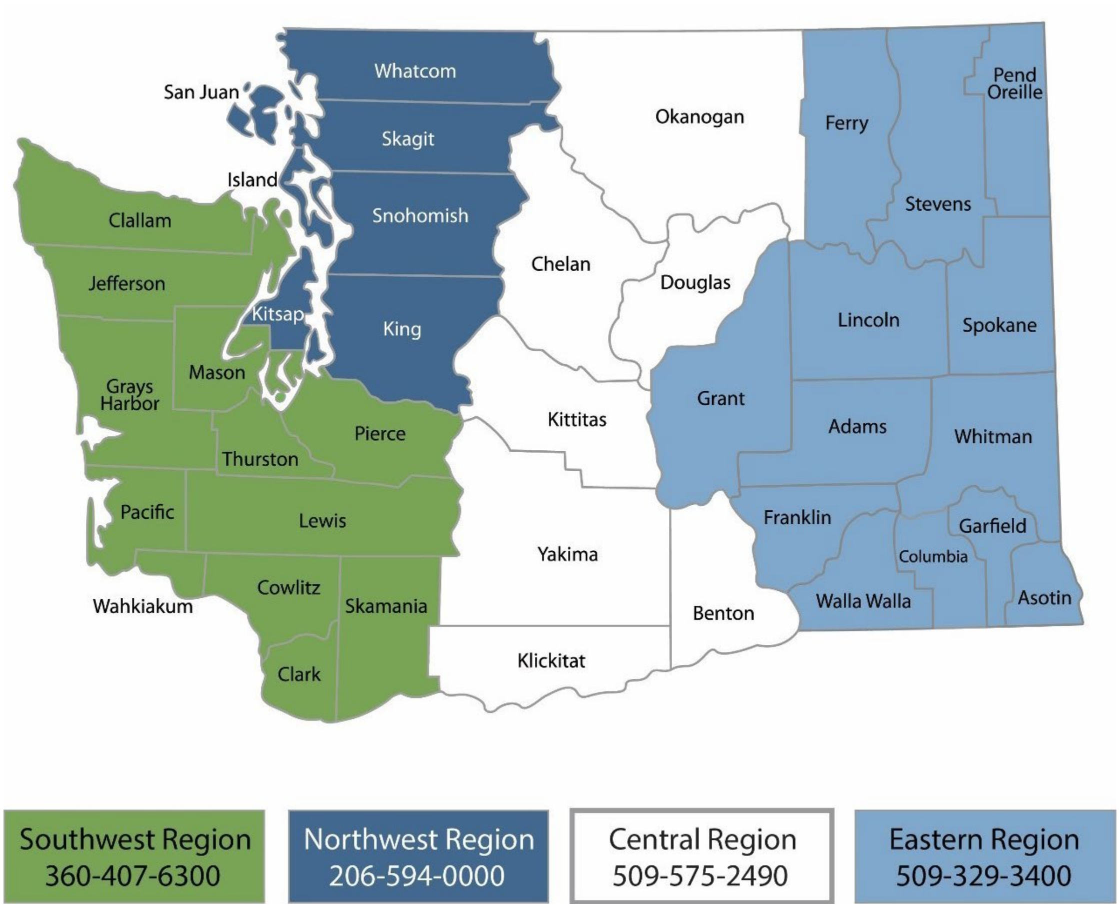

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Port Angeles Rayonier Mill Study Area

Port Angeles, WA

Facility Site ID: 19

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List of Abbreviations

ARAR	applicable or relevant and appropriate requirement
BAZ	biologically active zone
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeters
CMP	construction monitoring plan
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbons
CSL	cleanup screening level
CSM	conceptual site model
CSO	combined sewer overflow
CUL	cleanup level
cy	cubic yards
DCA	disproportionate cost analysis
DNR	Washington State Department of Natural Resources
EDR	engineering design report
EIM	Environmental Information Management System database
EJScreen	Environmental Protection Agency's Environmental Justice Screening and Mapping Tool
EMNR	enhanced monitored natural recovery
ERA	ecological risk assessment
ESI	expanded site inspection
HHRA	human health risk assessment
HSP	health and safety plan
IAP	interim action plan
IC	institutional control
IHS	indicator hazardous substance
LEKT	Lower Elwha Klallam Tribe
MMP	materials management plan
MTCA	Model Toxics Control Act
OMMP	operations, maintenance and monitoring plan
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl

PLP	potentially liable person
POC	point of compliance
PRDWP	pre-remedial design work plan
QAPP	quality assurance project plan
RAMP	Rayonier A.M. Properties LLC
Rayonier	Rayonier, Inc.
RCW	Revised Code of Washington
RDWP	remedial design work plan
REL	remediation level
RI	remedial investigation
SAP	sampling and analysis plan
SCL	sediment cleanup level
SCO	sediment cleanup objective
SCU	sediment cleanup unit
SMA	sediment management area
SMS	Sediment Management Standards
SRS	Sediment Remediation Subarea
SSL	spent sulfite liquor
SVOCs	semi-volatile organic chemicals
SWAC	surface weighted average concentration
TEQ	toxic equivalent
TPH	total petroleum hydrocarbons
Trustee Council	Port Angeles Harbor Trustee Council
USEPA	United States Environmental Protection Agency
VOCs	volatile organic chemicals
WAC	Washington Administrative Code

Executive Summary

The former Rayonier Mill Site (Site) is located on the eastern side of Port Angeles Harbor in Clallam County, Washington. The Site is largely within the limits of the city of Port Angeles on the north side of the Olympic Peninsula on the shoreline of the Strait of Juan de Fuca.

The Site is where contamination from the Rayonier Mill has come to be located. The Site boundaries have not been defined. This Interim Action Plan (IAP) describes the cleanup actions proposed for the Port Angeles Rayonier Mill Study Area. The Study Area is a portion of the Site and includes the former mill property and the marine environment next to the former mill (**Figure 1-1**). While titled an Interim Action Plan, the remedial actions for the Study Area are expected to be the Final cleanup actions for the Study Area.

Historical operations at the former Rayonier Mill resulted in contamination of the upland and marine portions of the Study Area. Under Agreed Order DE6815, Rayonier A.M. Properties LLC (RAMP) conducted a remedial investigation and feasibility study of the Study Area. The remedial investigation describes the nature and extent of contamination in soil, groundwater, and sediment. The Final Upland Data Summary (Volume I)[9] and the Final Marine Data Summary (Volume II)[10] summarize the results of the remedial investigation. The Final Cleanup Alternatives Evaluation (Volume III)[11] describes and evaluates several cleanup alternatives for soil, groundwater, and sediment.

This IAP was prepared by the Washington State Department of Ecology (Ecology) in collaboration with RAMP. This IAP meets the requirements of the Model Toxics Control Act (MTCA), chapter 173-340 of the Washington Administrative Code (WAC), and the Sediment Management Standards (SMS), chapter 173-204 WAC.

Port Angeles Harbor (Harbor) is located on the northern coast of Washington's Olympic Peninsula and along the southern shoreline of the Strait of Juan de Fuca. The Harbor has been identified as a priority environmental cleanup and restoration project by Ecology. The Harbor is located within the traditional territory of the Lower Elwha Klallam Tribe (LEKT), a federally recognized Tribe with treaty fishing, hunting, and gathering rights in the Harbor, whose people have lived throughout the northern Olympic Peninsula, including the Harbor, for thousands of years.[12]

Corporate predecessors of RAMP owned and operated a dissolving sulfite pulp mill on a portion of the Site from 1930 until early 1997, when the company closed the mill and dismantled the mill buildings.

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9 GeoEngineers 2021. Interim Action Report Volume I: Upland Data Summary Report for the Study Area, Port Angeles Rayonier Mill site, Port Angeles, Washington. Final.

10 Windward 2021. Former Rayonier Mill in Port Angeles, Interim Action Report Volume II: Marine Data Summary Report. Final.

11 Tetra Tech 2021. Agreed Order Task 4e Deliverable Interim Action Repot Volume III: Alternatives Evaluation. Final.

12 Two other federally recognized Klallam/S'Klallam Tribes also have an interest in the harbor, the Jamestown S'Klallam Tribe and the Port Gamble S'Klallam Tribe, who also hold treaty rights.

During its operation, the mill stacks, machinery used at the mill Site, the mill wastewater outfalls, the log storage pond, and treated timbers and pilings released hazardous substances.

As a result of historical mill activities, hazardous substances at the Site and in Port Angeles Harbor pose risks for both human health and the environment. There are risks for human health and ecological receptors from contaminants in soil, and risk of contaminants migrating through groundwater to the marine environment. There are risks for human health associated with the consumption of fish, shellfish, and sediments. Benthic invertebrates living within harbor sediments may also be at risk. For each potential exposure pathway, hazardous substances that drive human health or environmental risks have been identified, and cleanup standards have been developed to protect the receptors for those pathways.

To evaluate cleanup options that address human health and environmental risks, investigations were conducted within the Rayonier Mill Study Area. Cleanup alternatives were evaluated for soil, groundwater, and sediment.

Ecology has selected cleanup actions that protect human health and the environment, are permanent to the maximum extent practicable, achieve the cleanup levels (CULs)within a reasonable time frame, anticipate the potential discovery and protection of cultural resources, and are consistent with current and anticipated future uses of the Site. The selected remedy includes the following cleanup actions:

- All soil exceeding unrestricted land use soil CULs will be excavated or capped in an approximately 10-acre consolidation area in the west mill portion of the property (**Figure 6-2**). All excavated areas will be backfilled with clean soil. A 2-foot-thick cap will isolate the consolidated contaminated soil from human and ecological receptors (**Figure 6-3**). Institutional controls including an environmental covenant, will protect the integrity of the capped area. The environmental covenant will require notice and approval by Ecology of any proposal to use the in a manner that is inconsistent with the environmental covenant. If Ecology, after public notice and comment approves the proposed change, the environmental covenant shall be amended to reflect the change. All other areas of the property will meet unrestricted land use soil CULs and will not require an environmental covenant.
- Air sparging will be used as an in-situ treatment of contaminated groundwater and will prevent discharge to surface water at concentrations above CULs (**Figure 6-4**). The conditional point of compliance for this remedy is in the groundwater as close as possible to the surface water discharge location as measured by an Ecology-approved network of shoreline monitoring wells. No additional attenuation factor is allowed between the well and the groundwater/surface water contact point due to the existence of preferential migration pathways.

- Air sparging will affect the redox conditions of the subsurface, resulting in oxidation of ammonia to nitrite/nitrate, and oxidation of metals to form precipitates (e.g., manganese oxides and other oxides) that will attenuate other dissolved metals due to the adsorption capacities and scavenging capabilities of the manganese oxides. Air sparging will also promote the aerobic biodegradation of dissolved organic contaminants, such as carcinogenic polycyclic aromatic hydrocarbons (cPAHs), to less toxic substances.
- Remaining in-water structures (i.e., dock, jetty, treated timbers and pilings) are expected to be removed as part of the Washington State Department of Natural Resources (DNR) lease closeout. If not removed under the DNR lease closeout agreement, any treated timbers and pilings in contact with marine water or sediment are considered a source of contamination and are required to be removed as part of this IAP.
- The selected remedies for contaminated sediments and shoreline soils must be completed in conjunction with the removal of in-water structures and shoreline recontouring as required by the DNR lease closeout.
- Contaminated sediment from the intertidal and nearshore portion of sediment management area (SMA)-2 (the log pond) and the shoreline portion of SMA-1 (the Mill Dock Landing on the shoreline adjacent to the dock) will be excavated or dredged (**Figure 6-5**). Excavation and dredging will be conducted to achieve the sediment CULs. The excavated and dredged areas will be backfilled to stabilize the substrate and control any residuals, followed by gravel beach placement to restore the shoreline. Excavated and dredged materials will be sent off-site for disposal or placed in the Upland Study Area soil consolidation area, to be determined in the remedial design.
- A contingent remedy is selected for the SMA-3 and SMA-4 (**Figure 6-5**). The remedy to be implemented is contingent on the pre-remedial design data and hydrodynamic/sediment transport modeling to be completed per the Port Angeles Rayonier Mill Site: Under-dock and Nearshore Areas Pre-Remedial Design Analysis and Decision Framework (Decision Framework). The Decision Framework is an integral part of this IAP and is included as Appendix A. The pre-remedial design data collection and modeling must be complete before any structures are removed. The data and modeling results will be used to determine the appropriate remedies for SMA-3 (Under-dock) and SMA-4 (Nearshore) based on the decision matrix tables in the Decision Framework (**Tables 6-1** and **6-2**). The SMAs may be further subdivided into sediment remediation subareas (SRS) as determined by Ecology to be warranted and practicable, based on the hydrodynamic modeling and chemistry results to support remedy selection within the Decision Framework. The contingent remedies include enhanced monitored natural recovery (EMNR), thin-layer cap, dredging, and/or no action. Information gained from the hydrodynamic/sediment transport modeling may support design decisions for other sediment remediation areas within the sediment cleanup unit during remedial design.

- EMNR will be the remedy utilized in non-dredged areas of SMA-2 (the former log pond) and the offshore, non-berth areas of SMA-1. Following the removal of the dock, the deepened berth and approach areas will be filled with clean material to restore these historically dredged areas to the surrounding substrate depth gradient. A clean EMNR layer in the berth and approach areas and in the remainder of the sediment remediation area (except the Under-dock SMA and Nearshore SMA) will be placed to address sediment contamination and to provide suitable habitat for the benthic community.
- Under the remedy for the SMA-1 and SMA-2, approximately 20,200 cubic yards (cy) of sediment will be removed and sent off-site for disposal or consolidated under the cap described in the soil remedy. The total volume and disposal of dredged material, including any material dredged within the contingent remedy of SMA-3 and SMA-4 will be determined during remedial design. Placement of EMNR in the remaining sediment areas will effectively remediate sediment to below Sediment Cleanup Levels (SCLs) within a 10-year timeframe. Upon completing the construction, the remediation goals for sediment will be achieved and long-term monitoring will be implemented.

1.0 Introduction

This Interim Action Plan (IAP) describes the cleanup actions proposed by the Washington State Department of Ecology (Ecology) for the Port Angeles Rayonier Mill Study Area (the Study Area), a portion of the Rayonier Mill Site (Site). The Site is where contamination from the Rayonier Mill has come to be located. The Site boundaries have not been defined. While titled an Interim Action Plan, the remedial actions for the Study Area are expected to be the Final cleanup actions for the Study Area.

The Site is located on the eastern side of Port Angeles Harbor in Clallam County, Washington. It is largely within the limits of the city of Port Angeles (the City) located on the northern shoreline of the Olympic Peninsula and the Strait of Juan de Fuca (**Figure 1-1**). Most of the upland portion of the Study Area is owned by Rayonier A.M. Properties LLC (RAMP)[13] and they are the named potentially liable person (PLP).

The proposed cleanup actions are based on a remedial investigation and feasibility study (RI/FS) completed for the Study Area pursuant to Agreed Order No. DE6815 between Ecology and Rayonier Properties LLC (now known as RAMP), executed March 25, 2010. The remedial investigation describes the nature and extent of contamination in soil, groundwater, and sediment. The Final Upland Data Summary Report (Volume I)[14] and the Final Marine Data Summary Report (Volume II)[15] summarize the results of the remedial investigation. The Final Alternatives Evaluation (Volume III)[16] describes and evaluates several cleanup alternatives for soil, groundwater, and sediment. Ecology approved Volumes I-III as final on August 19, 2021, (Ecology 2021a).

Ecology has determined that the cleanup actions described herein comply with the Model Toxics Control Act (MTCA), chapter 70A.305 Revised Code of Washington (RCW), the MTCA Cleanup Regulation, chapter 173-340 of the Washington Administrative Code (WAC) (Ecology 2013a), and the SMS, chapter 173-204 WAC (Ecology 2013b). This determination is based on Volumes I-III, and other relevant documents in the administrative record.

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[13] Rayonier A.M. Properties LLC (formerly known as Rayonier Properties LLC) is the current owner of most of upland the property. In this document, "Rayonier" refers to Rayonier A.M. Properties LLC and its corporate predecessors who owned or operated the facility.

[14] GeoEngineers 2021. Interim Action Report Volume I: Upland Data Summary Report for the Study Area, Port Angeles Rayonier Mill site, Port Angeles, Washington. Final.

[15] Windward 2021. Former Rayonier Mill in Port Angeles, Interim Action Report Volume II: Marine Data Summary Report. Final.

[16] Tetra Tech 2021. Agreed Order Task 4e Deliverable Interim Action Repot Volume III: Alternatives Evaluation. Final.

1.1 Report Purpose

The purpose of this IAP is to present the proposed cleanup actions for the Study Area. This IAP includes the following:

- Description of the preferred cleanup actions.
- Summary of the rationale for selection of these cleanup actions.
- Summary of the other alternatives evaluated.
- Cleanup Standards for the Study Area.
- Schedule for implementation of the proposed cleanup actions.
- Summary of institutional controls required by the proposed cleanup actions.
- Applicable state and federal laws for the proposed cleanup actions.
- Descriptions of the types, levels, and amounts of hazardous substances that will remain in the Study Area.

1.2 Preliminary Determination

Ecology has made a preliminary determination that the cleanup actions described in this IAP comply with the requirements for selection of interim actions under WAC 173-340-430 and comply with the requirements for the selection of cleanup actions under WAC 173-340-360 for the portion of the Site within the Study Area. Specifically, Ecology has determined that the selected remedy is protective of human health and the environment, complies with applicable or relevant and appropriate requirements (ARARs), complies with cleanup standards, provides for compliance monitoring, uses permanent solutions to the maximum extent practicable, provides for a reasonable restoration timeframe, and addresses public concerns received to date. This IAP will be provided for public review, and Ecology will consider public comments and concerns prior to finalizing the IAP.

1.3 Regulatory Framework

Rayonier, Inc. owned and operated a dissolving sulfite pulp mill on a portion of the Site from 1930 until early 1997, when Rayonier, Inc. closed the mill and dismantled the mill buildings. In 2004, Rayonier, Inc. conveyed all of its ownership interest in the property to Rayonier Properties LLC. Ecology named Rayonier, Inc. and Rayonier Properties LLC potentially liable for the release of hazardous substances at the Site. In June 2014, Rayonier Advanced Materials Inc. was spun-off from Rayonier, Inc., and in connection with the spin-off, Rayonier Properties LLC changed its name to Rayonier A.M. Properties LLC (RAMP).

During its operation, the mill stacks, machinery used at the mill Site, the mill wastewater outfalls, the log storage pond, treated timbers and pilings released hazardous substances. Hazardous substances released to the environment include, but are not limited to, total petroleum hydrocarbons (TPH), cPAHs, polychlorinated biphenyls (PCBs), lead, dioxins/furans, and arsenic.

In 1997 and 1998, Ecology and the United States Environmental Protection Agency (USEPA) conducted an Expanded Site Inspection (ESI) at the Site. USEPA's ESI report (Ecology and Environment, 1998) identified areas of marine sediment, soil, and groundwater contamination that exceeded applicable state criteria for the protection of human health and the environment at the Site.

The following hazardous substances were identified during the ESI at concentrations measured above applicable State of Washington criteria:

- Dioxins/furans
- cPAHs
- PCBs
- Metals

USEPA determined that the Site was eligible for inclusion on the National Priorities List (NPL). Ecology suggested that USEPA defer the listing of the Site. USEPA, LEKT, and Ecology then entered into a Deferral Agreement (Ecology 2000), under which USEPA agreed to defer listing of the Site on the NPL, subject to various conditions, including an ongoing role for LEKT.

In 2002, Rayonier and Ecology entered into Agreed Order No. DE 02SWFAPSR-4570 (Marine Order) (Ecology 2002) under which Rayonier agreed to conduct remedial investigation (RI) activities in the marine portion of the Site.

In 2004, Rayonier and Ecology entered into Agreed Order No. DE 04SWFAPSR-6025 (Uplands Order) (Ecology 2004) under which Rayonier agreed to conduct additional RI and feasibility study (FS) activities in the upland portion of the Site. In addition to the 2002 Marine Order and 2004 Uplands Order, there have been other agreed orders for interim actions on the Site. Rayonier removed over 30,000 tons of contaminated soil under these interim actions. Section 3.2 of Volume I details the interim actions (GeoEngineers, 2021).

Results of the marine RI and upland RI/FS provided significant data but not sufficient data to determine the Site boundaries. Under MTCA, the Site is defined by the extent of contamination caused by the release of hazardous substances at the Site. By 2010, Ecology and Rayonier Properties LLC (now known as RAMP) mutually agreed to focus on developing an interim action for cleanup of a portion of the Site defined as the Study Area. RAMP remains responsible for conducting future remedial actions at the Site, outside of the Study Area, if and to the extent required under MTCA.

The Study Area refers to the former Rayonier Mill property and the adjacent marine environment, as shown in **Figure 1-2**. The upland portion of the Study Area includes the Rayonier Mill property owned or leased by RAMP, and is generally located at 700 North Ennis Street, Port Angeles, Washington 98362. The marine portion of the Study Area is bounded by a line drawn from the shoreline on the eastern edge of the Rayonier Mill property to sediment sampling station OF-08 to OF-06 to OF-07 to OF-01 to SD-69 to SD-28, then perpendicular to the shoreline, as shown in **Figure 1-2**. Based upon factors currently known to Ecology, the Study Area is only a portion of the Site and its boundaries do not reflect the boundaries of the Site as defined by MTCA.

In 2010, Rayonier Properties LLC (now known as RAMP) and Ecology entered into Agreed Order No. DE6815 (Order) to complete the first four volumes of an Interim Action Report to assist with developing an IAP to address groundwater, freshwater and marine sediments, as well as upland soils in the Study Area (**Figure 1-1**) within the Site (Ecology, 2010).

The 2010 Order supersedes all previous orders.

Pursuant to the 2010 Order, RAMP has prepared the following documents:

- Interim Action Report Volume I: Upland Data Summary Report (Volume I [GeoEngineers, 2021])
- Interim Action Report Volume II: Marine Data Summary Report (Volume II [Windward, 2021])
- Interim Action Report Volume III: Alternatives Evaluation (Volume III [Tetra Tech, 2021])
- Interim Action Report Volume IV: Draft Interim Action Plan (Volume IV [EHS Support, 2021])

Volumes I, II, and III were approved by Ecology on August 19, 2021, (Ecology, 2021). This IAP is Ecology's revision of the Volume IV report.

RAMP and Rayonier Advanced Materials Inc. have negotiated a consent decree with Ecology under which RAMP will implement this IAP.

2.0 Site Description

2.1 Site History and Setting

The Port Angeles Rayonier Mill property, located at 700 North Ennis Street in Port Angeles, Washington, comprises approximately 80 acres on the northern coast of Washington's Olympic Peninsula bordering the Strait of Juan de Fuca. The Study Area has been divided into the Upland Study Area and the Marine Study Area (**Figure 1-1**). The Current Study Area Conditions are shown in **Figure 2-1 and Figure 3-2**. The Upland Study Area is bounded on the south by high, tree-covered bluffs that rise to a plateau above the property. The Upland Study Area is mostly flat between the bluffs and Port Angeles Harbor to the north. Residential and commercial properties, including Olympic Memorial Hospital, are located on the plateau to the south of the Upland Study Area. Ennis Creek flows from the Olympic Mountains through the Upland Study Area and discharges into Port Angeles Harbor.

Before the arrival of Europeans in the late 1850s, the Port Angeles area was home to LEKT (Wegmann et al., 2010), including the tribal village of I'e'nis along Ennis Creek. The arrival of the Puget Sound Co-operative Colony in 1887 initiated one of the earliest periods of population growth in Port Angeles. The colony was established on the western bank of Ennis Creek, next to the I'e'nis village, and was home to nearly 400 people at its peak.

In 1917, the United States Government Spruce Production Corporation constructed a spruce sawmill to support aircraft construction during World War I. A large portion of the sawmill was constructed on pilings. The sawmill was never operated and sat idle until Olympic Forest Products purchased it in 1929. From 1929 to 1930, the spruce mill was renovated, and a pulp mill was constructed. The pulp mill was operated by Olympic Forest Products from 1930 to 1937. In 1937, Olympic Forest Products merged with two other independent Olympic Peninsula companies to form Rayonier, Inc. The mill ownership shifted to ITT Rayonier, Inc. from 1968 to 1994, after which it returned to Rayonier, Inc. In 1997, Rayonier, Inc. permanently ceased pulp production at the mill and dismantled the mill facilities between 1997 and 1999. The mill decommissioning was complete by October 1999.

A variety of marine aquatic species currently reside in the Harbor, including a functional benthic community, macroalgae, seagrass, and more than 60 species of fish, shellfish, birds, and marine mammals. The Harbor is fished recreationally but has been closed to tribal treaty commercial and subsistence harvest targeting Dungeness crab due to the contaminant-based moratorium imposed by LEKT in 2007.

Five long-standing health advisories related to seafood consumption apply to Port Angeles Harbor, including a 2006 Washington State Department of Health Puget Sound-wide fish advisory for mercury and polychlorinated biphenyls (PCBs)[17] a 2016 Harbor-wide Dungeness crab tissue and hepatopancreas consumption advisory,[18] and the Harbor-wide closure of shellfish harvesting[19] due to the presence of bacterial pollution and the periodic presence of paralytic and diarrhetic shellfish biotoxins.

2.2 Upland Study Area

Much of the Upland Study Area contains remnant building foundations and support pilings. Soil from the excavation and installation of the City's combined sewer overflow (CSO) project is stockpiled to the west of Ennis Creek (GeoEngineers, 2013). Preliminary stockpile sampling results include detections of dioxins and furans above the unrestricted land use soil CULs. Some metals were detected but below the unrestricted land use soil CULs (GeoEngineers, 2013). Much of the area west of Ennis Creek is covered with several feet of crushed concrete.

The Olympic Discovery Trail, a pedestrian pathway constructed along the former Seattle and North Coast Railroad right-of-way, is located at the foot of the bluff in the southern portion of the Upland Study Area (trail easement shown in **Figure 2-1**). The trail is located on an access easement granted to the City by Rayonier Properties LLC. The pedestrian pathway is separated from the majority of the Upland Study Area by a fence; it includes a bridge that crosses Ennis Creek near the northeastern corner of the former mill parking lot.

A municipal wastewater treatment plant owned by the City is located east of, and adjacent to, the southern portion of the Upland Study Area. In 2011, the City purchased a portion of the Upland Study Area immediately northwest of the wastewater treatment plant. The parcels comprising the purchased property are referred to as the City Purchase Area (**Figures 2-1 and 2-2**). An easement for a new sanitary sewer pipeline that connects to the City's wastewater treatment system was granted to the City by Rayonier Properties LLC.

A zoning map for the Upland Study Area is shown on **Figure 2-2**. The majority of the Upland Study Area is currently zoned Heavy Industrial. Areas south of the footprint of the historical industrial activities are zoned for non-industrial uses. The largest of these is zoned Public Buildings and Parks. Smaller portions of the Upland Study Area are zoned Light Industrial, Commercial Arterial, and Residential Single Family.

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[17] Washington State Department of Health. 2006. Human Health Evaluation of Contaminants in Puget Sound Fish. https://doh.wa.gov/sites/default/files/legacy/Documents/Pubs/334-104.pdf?uid=64f7bce71aa30. October.

[18] Washington State Department of Health. 2016. Human Health Evaluation of Contaminants in Puget Sound Dungeness Crab (Metacarcinus magister) and Spot Prawn (Pandalus platyderos). https://doh.wa.gov/sites/default/files/legacy/Documents/Pubs/334-378.pdf?uid=64f7bfca81395. May.

[19] Washington State Department of Health. Shellfish Safety Information. https://fortress.wa.gov/doh/biotoxin/biotoxin.html

2.3 Marine Study Area

The Marine Study Area, located in the eastern portion of Port Angeles Harbor, is where Ecology and RAMP agreed that there are aquatic impacts from the Rayonier Mill and to focus on developing an interim action for cleanup of that portion of the Site. The Marine Study Area includes the intertidal and shallow submerged lands offshore west of the mill known as the log pond; the estuary and shallow water environment offshore of Ennis Creek; and an area offshore of the eastside of the mill. The Marine Study Area also includes deeper subtidal habitat that includes the area around the Site's former deep-water outfall and dock (**Figure 2-3)**.

The Sediment Cleanup Unit (SCU) is a subunit of the Marine Study Area (**Figures 2-3 and 2-4**) that includes all areas that exceed the Site-specific cleanup standards meeting the definition of a SCU in the Sediment Cleanup User's Manual (SCUM) (Ecology 2021b). The boundaries where individual chemicals or groups of chemicals exceed the Site-specific cleanup standards were initially determined using the list of bioaccumulative indicator hazardous substances (IHSs) for Port Angeles Harbor, including dioxin/furan toxicity equivalence (TEQ), cPAH TEQ, and total PCBs (NewFields 2014). The SCU boundary formed by the overlapping chemical-specific boundaries was modified further when Ecology made a site-specific determination to use Total TEQ which combines dioxin/furan TEQ and PCB TEQ (Ecology 2016b). The preliminary SCLs were modified by regional background values published in 2016 (Ecology 2016a). In addition, one selenium data point (SD-67) was excluded because of the uncertainty associated with this selenium result in the context of the remainder of the selenium data for the Site. The final SCU is 137 acres.

The SCU includes a dock and a jetty on land owned by DNR and leased to Rayonier, Inc (lease agreement now managed by RAMP) (**Figure 2-1**). The dock extends north into Port Angeles Harbor and is constructed with treated timbers and pilings. The jetty is constructed of rock, pilings, and timbers and extends northwest into the harbor from the northwestern corner of the property. RAMP began deconstructing the dock in 2020 by removing the warehouse structure located on the dock and the majority of the concrete deck panels.

For purposes of remedial planning, the SCU is divided into four separate Sediment Management Areas (SMAs) (**Figure 2-4**). The SMAs require staging the work sequentially to implement the cleanup action in a safe and environmentally protective manner that is consistent with site conditions, including weather, exposure, and in-water work windows.

Potential remedial alternatives for SMA-1 and SMA-2 were assessed as part of the Volume III Alternatives Evaluation (Tetra Tech 2021). However, the available data did not support the recommended remedy for under the dock (originally part of SMA-1) and supported further evaluation of the remedy for nearshore areas. Therefore, two contingent SMAs (SMA--3 and SMA-4) were delineated for further investigation to determine an appropriate remedy, as discussed in the Port Angeles Rayonier Mill Site: Under-dock and Nearshore Areas Pre-Remedial Design Analysis and

Decision Framework (Decision Framework). The Decision Framework is an integral part of this IAP and is included as Appendix A.

SMA-1 includes the deeper subtidal offshore habitat and former berth areas.

SMA-2 includes the area offshore of the West Mill Area (i.e., the log pond) and up to the jetty located to the northeast of the log pond.

SMA-3 includes the area under the dock where the large number of pilings affect offshore currents and wave energy therefore creating a different depositional regime than the adjacent berths and undisturbed offshore sediments.

SMA-4 includes the nearshore areas to the west and east of the main dock that may be subjected to increased erosion and sediment transport post-remediation due to changes in shoreline transport or increased wave energy following the removal of the jetty and dock structures.

2.4 Cultural Resources

Historically, a portion of the Upland Study Area was used by Native Americans of the Lower Elwha Klallam Tribe. A Klallam village, called I'e'nis, was located on the eastern bank of Ennis Creek, and supported a population of hunter-fisher-gatherers before Euro-American contact. I'e'nis was one of more than 30 known Klallam villages in the region. The total population of the tribe was as high as 10,000 in the early 1800s. After introduced diseases swept through the tribe in the 1850s, only a few residents of I'e'nis remained. Some of the survivors continued to live on the beaches of Port Angeles Harbor until the 1930s (Integral, 2007).

In 1937, the United States purchased and took into trust status, land for what would become LEKT's Reservation at the mouth of the Elwha River, and tribal members were relocated from the Harbor to these trust lands. Since then, LEKT has maintained a strong presence at the Harbor, harvesting aquatic resources under its treaty rights, restoring the shoreline and other aquatic habitat, and protecting cultural resources and remains of its ancestors at I'e'nis and Tse-whit-zen, another major historical Klallam village located at the base of Ediz Hook.

Information on the historic Klallam village of I'e'nis, suggests a moderate to high probability of prehistoric to historic period Native American cultural resources in some portions of the mill property (Cascadia, 2010). The I'e'nis village was located on the eastern bank of Ennis Creek. These areas will receive additional attention—including consultation under Section 106 of the National Historic Preservation Action and preparation of an Inadvertent Discovery Plan. This represents a special site condition that may affect the manner of remediation in some areas.

3.0 Human Health and Environmental Concerns

This section provides a summary of the Site environmental conditions, sources of contamination, the nature and extent of contaminants in affected media, potential exposure pathways, as well as human health and environmental concerns resulting from this contamination. A brief summary of the Conceptual Site Model (CSM) is also provided. A more detailed evaluation of Site related contamination and the associated risk is provided in the Interim Action Reports Volumes I through III: (GeoEngineers, 2021; Windward, 2021; and Tetra Tech, 2021).

3.1 Site Geology and Hydrogeology

Near-surface soil within the Upland Study Area consists of fill, alluvium deposited by Ennis Creek, beach deposits, and glacial deposits including till and outwash. Based on an evaluation of historical information, the majority of the fill material beneath the mill property was likely placed before construction of the pulp mill began in the 1930s, with smaller amounts placed before 1917 for construction of the spruce sawmill. The location of the shoreline and the Ennis Creek channel changed over the development history of the property. Before construction of the pulp mill, the shoreline was located farther south, and the majority of the Upland Study Area was below the mean higher high-water elevation. Fill material beneath the mill property consists of sand and gravel with varying amounts of concrete rubble and other construction debris from the mill demolition. The thickness of fill ranges from 3 feet in the southern portion of the Upland Study Area to 25 feet in the northwestern portion.

The depth to groundwater beneath the Upland Study Area ranges from approximately 2 to 15 feet below ground surface (bgs) based on groundwater level measurements obtained between August 2010 and June 2011. In general, groundwater is shallower in monitoring wells located near the shoreline, and deeper in monitoring wells located further inland. The inferred groundwater flow direction beneath the Upland Study Area is generally to the north towards Port Angeles Harbor, with flow components toward Ennis Creek in the vicinity of the creek. Shallow groundwater flow is likely influenced locally by subsurface structures remaining from the past mill operations, such as building foundations. The groundwater flow direction does not appear to vary substantially on a seasonal basis.

3.2 Contaminant Sources, Release Mechanisms, Transport Mechanisms

3.2.1 Historical Contaminant Sources

The industrial processes associated with the historical pulp manufacturing operations used petroleum and used or produced other chemical products and byproducts that were sources of some of the contaminants of concern (COCs) identified in the Study Area.

The following are the three major categories of historical mill operations that were sources of COCs:

- Power and steam generation
- Pulp production
- Support operations

These historical sources were discussed in detail in the Volume I Report (GeoEngineers, 2021). In addition, many of the mill structures, such as buildings, piping, tanks, and utility raceways, were constructed of various metals, including iron and steel. These metal structures were exposed to corrosive and/or reactive environments through the use of steam and caustic materials (e.g., acids, bases, oxidizers). Consequently, these metal structures may have been a historical source of diffuse metals contamination.

An important component of operations at the Rayonier Mill was the management of process wastewater and stormwater. From the 1930s to 1972, process wastewater and stormwater generated at the mill were discharged without treatment into Port Angeles Harbor through five nearshore outfalls distributed along the shoreline between the former log pond area and Ennis Creek (**Figure 2-3**) (Shea et al., 1981). In 1972, an extensive wastewater and stormwater drainage system and primary wastewater treatment plant were constructed at the Rayonier Mill, and the five nearshore outfalls were removed from service. Treatment plant effluent and stormwater were routed to a new deep-water outfall, which extended 7,900 feet into the Strait of Juan de Fuca (**Figure 2-3**). A secondary wastewater treatment plant was constructed at the mill in 1979 to provide additional treatment of wastewater prior to discharge through the deep-water outfall.

Another potential source of COCs is the naturally occurring metals in soil and/or fill beneath the mill property. Under certain geochemical conditions (e.g., anoxic and reducing and/or acidic or alkaline pH), which may have been created as a result of the pulp manufacturing process, naturally occurring metals in the soil matrix may have leached to groundwater.

Pulp production ended in 1997 when the mill closed. The primary historical sources of contaminants associated with the active mill operations were removed when the mill was decommissioned. Discharge from outfalls along the shoreline ended in the early 1970s, and discharge from the deeper outfall ended in 1997. Some of the residual contamination present at the Site at the time of the decommissioning was addressed in prior interim remedial actions.

3.2.2 Release Mechanisms

During pulp mill operations, the following mechanisms may have released COCs from the sources identified in Section 3.2.1:

- Stack emissions from power and steam generation may have resulted in releases of COCs such as dioxins/furans into the air as a result of burning salt-laden wood. Fallout and settling of airborne particulates from the stack emissions may have resulted in deposition to surface soil and surface water bodies.
- Wastewater discharge through outfalls to Port Angeles Harbor may have resulted in releases of COCs such as ammonia, dioxins/furans, and metals to the harbor.
- Leaks, spills, and drips from process machinery, equipment, and petroleum/chemical product storage and conveyance facilities may have resulted in releases of COCs such as petroleum products, semi-volatile organic chemicals (SVOCs), cPAHs, and PCBs to soil, groundwater, and surface water bodies.
- Direct deposition of residues and byproducts such as boiler ash and wood/pulp residue may have resulted in releases of COCs such as metals and dioxins/furans to surface and subsurface soil.
- Corrosion and flaking of aboveground metal process or support structures may have resulted in releases of metals to surface soil and surface water bodies.
- Leaching of cPAHs from treated timbers and pilings at the dock and jetty locations.

Except for continued leaching of cPAHs from treated timbers and pilings, these release mechanisms would have acted only during the time of active mill operations; the primary contaminant sources and release mechanisms associated with mill operations were eliminated with the mill's decommissioning in 1997-1999.

3.2.3 Transport Mechanisms

Under current conditions, the primary physical and chemical transport mechanisms that may contribute to the migration of COCs in the environment include the following:

- Erosion of contaminated soil and/or fill.
- Leaching of COCs from soil to groundwater via stormwater infiltration, percolation, and diffusion.
- Migration of COCs in groundwater via advection and diffusion, including possible discharge of contaminated groundwater to marine surface water and sediment.
- Erosion and transport of contaminated marine sediment via scouring and/or currents.

These transport mechanisms are identified in **Figure 3-1**. The Volume I and II Reports (GeoEngineers, 2021; Windward, 2021) included detailed discussions of contaminant transport mechanisms and the physical and chemical conditions in the Study Area that may affect the mobility of COCs.

3.3 Nature and Extent of Contamination

3.3.1 Soil

Mill-related COCs detected in soil in the Upland Study Area include:

- Metals
- Dioxins/furans
- TPH
- cPAHs
- PCBs

These COCs are generally assumed to be associated with historical releases to the ground surface or shallow subsurface soil.

Several interim actions have been completed in areas of the mill property where past releases occurred and contaminants such as hydraulic oil, PCBs, Bunker C, hog fuel waste, and residual spent sulfite liquor (SSL) were present in soil and/or shallow groundwater. As of 2006, the interim actions removed approximately 34,000 tons of contaminated soil and contaminated wood residue, and limited quantities of affected groundwater, from known areas of concentrated past releases.

Between September 2012 and June 2013, as part of the City's CSO project, a total of approximately 28,200 cy of soil was excavated within the Port Angeles Rayonier Mill Study Area along the CSO pipeline. The excavated materials were placed in stockpile areas shown in **Figure 3-2**. Preliminary stockpile sampling results include detections of dioxins above the unrestricted land use soil CULs. Some metals were detected but below the unrestricted land use soil CULs (GeoEngineers, 2013). The soil stockpiles are covered with grass to protect against erosion. The final disposition of the stockpiles will be determined during development, evaluation, and design of the selected soil remedy.

The concentrations of COCs remaining in soil are generally present at lower concentrations (e.g., most detections are below unrestricted land use soil CULs, a few are two-three times CULs, a very few are at ten times CULs) and are more widely distributed across the mill property. The concentrations of COCs are generally highest in shallow soil, and concentrations decrease with depth.

The soil and groundwater analytical data suggest that PCBs and select metals may have leached from soil to groundwater in some localized areas at concentrations that could present a risk via the groundwater-to-surface water pathway. However, in general, the concentrations of PCBs and metals detected in soil beneath the mill property are relatively low (e.g., most detections are below unrestricted land use soil CULs, a few are two-three times CULs, a very few are at ten times CULs) and the areas where PCBs and metals may have leached to groundwater appear to be limited in spatial extent. No significant areas of other potential COC leaching to groundwater (i.e., TPH, VOCs, SVOCs, dioxins/furans, or pesticides) were identified in soil.

3.3.2 Groundwater

Mill-related COCs detected in groundwater in the Upland Study Area include:

- Metals
- cPAHs
- PCBs
- Ammonia
- Dioxins/furans

Dioxins/furans also were detected in many monitoring wells. However, the dioxin/furan detections in groundwater appear to be associated with suspended solids in the unfiltered groundwater samples analyzed for these constituents based on a strong correlation between dioxin/furan concentrations and sample turbidity for 11 of 15 wells.

Similar to the distribution of COCs in soil, COCs have been detected at relatively low (e.g., most detections are below CULs, a few are two-three times CULs, a very few are at ten times CULs) concentrations in groundwater in many areas of the mill property. There are no well-defined contaminant plumes with spatially distinct areas of relatively higher (i.e., source area) and lower (i.e., downgradient) concentrations. Groundwater contamination is spatially dispersed.

Inferred historical releases of high and/or low pH solutions from pulp mill operations likely created conditions favorable for mobilizing naturally occurring metals present in soil beneath the mill. Small quantities of metals also may have been released by the corrosion of metal infrastructure at the mill. Changes in subsurface geochemical conditions caused by the pulp manufacturing process are thought to be the primary mechanism responsible for the elevated metals concentrations detected in groundwater beneath the mill property.

3.3.3 Sediment

Mill-related COCs detected in sediment in the Marine Study Area above sediment cleanup objectives (SCO) for protection of the benthic community include:

- Metals: mercury
- PAHs: acenaphthene, benzo(g,h,i)perylene, chrysene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, total high-molecular-weight PAH (HPAH), and total low-molecular-weight PAH (LPAH)
- Phthalates: bis(2-ethylhexyl) phthalate (BEHP)
- Other SVOCs: 2,4-dimethylphenol, 2-methylphenol, 4-methylphenol, and phenol
- Total PCBs

COCs detected in sediment and tissue that are considered human health risk drivers include:

- Dioxins/furans
- PCBs
- cPAHs
- Arsenic
- Mercury

The highest contaminant concentrations were generally detected in the eastern portion of the log pond area (SMA-2), with decreasing concentrations away from the shoreline and toward the west. In the mill dock area (SMA-1 and SMA-3), concentrations in surface sediment were generally highest in closer proximity to the dock in part due to the presence of treated timbers and pilings.

Contaminant concentrations were generally low or not detected outside the designated SMAs. Subsurface sediment samples from SMA-2 had higher contaminant concentrations than did the subsurface samples from other portions of the Study Area. In SMA-2, the samples from the deeper intervals (i.e., 1 to 2 and 2 to 3 feet) generally had lower concentrations than those in the shallower intervals.

3.4 Exposure Pathways

3.4.1 Soil

Exposure pathways of potential concern for the residual COCs that remain in soil in the Upland Study Area include:

- Direct contact with affected soil by visitors, workers, future residents, and other property users, primarily via incidental ingestion of soil and/or dermal contact (human health exposure pathway).
- Exposure of soil biota, terrestrial plants, and wildlife to affected soil (terrestrial ecological exposure pathway). Wildlife may be exposed via ingestion of soil biota or terrestrial plants that contain COCs, or incidental ingestion and/or dermal contact with affected soil.
- Exposure of aquatic organisms and humans (via consumption of aquatic organisms) to marine surface water affected by leaching of COCs from soil to groundwater and subsequent discharge of groundwater to surface water (soil-to-groundwater exposure pathway).

3.4.2 Groundwater

In accordance with WAC 173-340-720(2)(d), due to the availability of municipal water and the proximity of the mill property to marine surface water that is not suitable as a domestic water supply, groundwater beneath the property or potentially affected by the property is not a current or reasonable future source of drinking water. Consequently, human ingestion of groundwater containing COCs is not an exposure pathway of potential concern at the mill property. However, based on the inferred northerly groundwater flow direction in the Upland Study Area, groundwater likely discharges to the marine environment of Port Angeles Harbor. Accordingly, exposure pathways of potential concern for COCs in groundwater beneath the Upland Study Area include exposure of aquatic organisms and humans (via consumption of aquatic organisms) to marine surface water and/or sediments affected by discharge of groundwater to surface water (groundwater-to-surface water and groundwater-to-sediment exposure pathways.

3.4.3 Sediment

COC concentrations in marine sediment are generally higher adjacent to the former upland mill property and decrease with distance from the shoreline. The sediment exposure pathways associated with human health risks include both direct contact with COCs in sediment (i.e., dermal contact or incidental ingestion) and indirect contact through the consumption of aquatic organisms (i.e., seafood) that contain COCs due to bioaccumulation. Populations that may come into direct contact with sediment include tribal treaty shellfish harvesters, other fishers, and recreational users. Seafood consumers include subsistence and recreational fishers. Exposure pathways to the benthic invertebrate community include direct contact with, or uptake of, COCs in sediment. The primary exposure pathway for fish, birds, and mammals is the ingestion of aquatic organisms that contain COCs due to bioaccumulation.

3.5 Conceptual Site Model

The nature and extent of contamination, identification of the COCs, fate and transport, and exposure assessment were all completed and detailed in the Volume III Report (Tetra Tech, 2021). These inputs were used to develop a CSM that is summarized in **Figure 3-1**.

The CSM is a qualitative description of the contaminant sources, release and transport mechanisms, and exposure pathways of potential concern. The nature and extent of contamination and the components of the CSM specific to the Upland and Marine Study Areas were described in detail in the Volume I and II Reports (GeoEngineers, 2021; Windward, 2021).

4.0 Cleanup Standards

The cleanup standards have been established as defined in the MTCA (WAC 173-340-700(3)). Cleanup standards consist of the following:

- CULs for hazardous substances present at the Site.
- The location where these CULs must be met (point of compliance [POC]).
- Other regulatory requirements that apply to the Site because of the type of action and/or location of the Site ("applicable state and federal laws").

According to WAC 173-340-700(2), "A cleanup level is the concentration of a hazardous substance in soil, water, air or sediment that is determined to be protective of human health and the environment under specified exposure conditions. CULs, in combination with POCs, typically define the area or volume of soil, water, air, or sediment at a site that must be addressed by the cleanup action."

4.1 Cleanup Action Objectives

Cleanup action objectives have been developed for the Study Area and are summarized in **Table 4-1**. Cleanup action objectives are established to specify the results that a proposed remedy is expected to accomplish.

The cleanup action objectives include protection of the following:

- Humans who could be exposed to contaminated sediment or exposed indirectly through the consumption of seafood.
- The benthic invertebrate community and higher-trophic-level organisms that could be exposed to contaminated sediment.
- Aquatic life and humans that could potentially be exposed to contaminated groundwater via the discharge of groundwater to fresh and marine surface water and sediment, and direct contact during construction.
- Humans and terrestrial wildlife that could potentially come into contact with contaminated soil in the Upland Study Area.

For each exposure pathway, indicator hazardous substances (IHSs) that drive potential human health or environmental risks were identified.

4.2 Soil Cleanup Levels and Points of Compliance

Eleven soil IHSs were identified for the Study Area. Under MTCA, soil CULs are set to protect human health and terrestrial ecological receptors from direct contact, and to protect groundwater from leaching. The CULs are based on estimates of the reasonable maximum exposure expected to occur under both current and future site use conditions.[20] The majority of the property is zoned industrial. The City Purchase Area is zoned industrial, continues to be used for industrial purposes, and will continue to be used for industrial purposes for the foreseeable future. Therefore, the soil CULs for direct contact in the City Purchase Area are set at industrial land use CULs.

The foreseeable future use of the remainder of the property has not yet been determined. Therefore, at this time, the soil CULs for direct contact for that portion of the property are set at unrestricted land use CULs. If, prior to implementation of soil cleanup actions, RAMP provides sufficient information (e.g., executed purchase and sale agreement) to demonstrate that the future use of the property will be industrial, application of unrestricted land use CULs shall be re-evaluated.

Site data do not identify a specific source area of soil contamination where leaching to groundwater needs to be addressed as part of the cleanup action; therefore, CULs were not established for leaching of contaminants from soil to groundwater. The soil CULs are protective of human health and terrestrial ecological receptors (**Table 4-2**).

Figure 4-1 shows the area exceeding at least one soil CUL and is the basis for evaluating soil cleanup alternatives. Additional soil data will be collected throughout the Upland Study Area during remedial design to refine the remediation footprint.

For the protection of human health and ecological receptors, the standard POC is throughout soil from 0 to 15 feet below ground surface (ft bgs). For soil CULs based on the protection of terrestrial ecological receptors, a conditional POC from 0 to 6 ft bgs may be applied,[21] based on the MTCA-defined biologically active zone (BAZ) for soil. MTCA stipulates that soil cleanup actions using this conditional POC for the protection of terrestrial ecological receptors must include institutional controls (ICs) to ensure that the cleanup action remains protective. The selected remedy (Section 6) includes ICs and assumes a conditional POC from 0 to 6 ft bgs for terrestrial ecological receptors for the Site.

[20] WAC 173-340-740(1)(a)
[21] WAC 173-340-7490(4)(a)

4.3 Groundwater Cleanup Levels and Points of Compliance

Eight groundwater IHSs were identified for the Study Area. The groundwater CULs are protective for discharge to the marine surface water and sediment (**Table 4-3**).

Figure 4-2 shows the area exceeding at least one groundwater CUL.

Under MTCA, the standard POC is all groundwater at all depths throughout the site.[22] At sites where the groundwater CULs are based on the protection of surface water, beneficial uses, and the site directly abuts surface water, MTCA allows a conditional POC to be established that is located either within the surface water, as close as technically possible to the point or points where groundwater flows into the surface water, or in the groundwater near the surface water discharge location. The conditional POC is set in the groundwater near the surface water discharge location and will be measured at existing shoreline monitoring wells and/or new shoreline monitoring wells that monitor groundwater before discharge to the surface water.

4.4 Sediment Cleanup Levels and Points of Compliance

The cleanup screening levels (CSL) are used as the SCLs for the human health pathway. This is based on consideration of technical possibility and net adverse environmental impacts[23] of remediating the Site to the SCO (NewFields 2014). The SCOs are used as the SCLs for the benthic community pathway.

For sediment, a screening-level ecological risk assessment (ERA) and a screening-level human health risk assessment (HHRA) were conducted for Port Angeles Harbor by Ecology as part of the sediment characterization study (Ecology, 2012). The ERA and HHRA were used to establish IHSs for both exposure pathways.

Ten IHSs were identified for human health based on the HHRA. The SCLs are protective for human health direct contact with sediments and consumption of fish and shellfish potentially contaminated by sediment contamination (**Table 4-4**).

Eighteen IHSs were identified for the benthic community. The SCLs are protective for the benthic community (**Table 4-5**).

The Rayonier Mill SCU boundary (**Figures 2-3 and 2-4**) includes all areas that exceed the SCL within the Rayonier Mill Study Area boundary.
Under the SMS rule, the POC is defined as the location within a site or SCU where sediment CULs must be met.[24] The POC is established in accordance with these requirements.

[22] WAC 173-340- 720(8)(b)
[23] WAC 173-204-560(2)(a)(ii)
[24] WAC 173-204-560(6)

For benthic invertebrates, which are evaluated on a station-by-station basis, the POC depth is the biologically active zone (BAZ). In marine environments, the BAZ is generally set at 10 centimeters (cm) (**Table 4-6**).

For human health, protection from exposure to bioaccumulative chemicals (via seafood consumption) is evaluated on a surface weighted average concentration (SWAC) basis. Therefore, the depths to which seafood (fish and shellfish) may be exposed are relevant. Fish and crabs are exposed through direct or indirect (diet) exposure pathways, which apply to the top 10 cm of sediment. Smaller bivalves (e.g., littleneck clams) are also exposed to the upper 10 to 15 cm of sediment. Larger bivalves, such as geoducks and horse clams, which can be harvested by hand from the lower edge of the intertidal area, exist deeper (i.e., up to 3 feet) in the sediment. Therefore, the POC for protection of fish and mobile shellfish is the top 10 cm throughout the SCU, and the POC for protection of sessile shellfish is the top 45 cm throughout the intertidal area.

5.0 Evaluation of Alternatives Considered

This section summarizes the remediation alternatives considered for soil, groundwater, and sediment. These alternatives represent a range of remedial actions that meet MTCA threshold criteria and have been developed using the technologies identified and retained in Volume III (Tetra Tech, 2021). Volume III recommended alternatives based on a benefit-to-cost ratio. For soil and sediment, Ecology is selecting a different alternative (see Section 6) than the recommended alternatives of Volume III report.

5.1 Cleanup Alternatives

5.1.1 Soil

Five soil cleanup alternatives were evaluated in Volume III. All soil remediation alternatives involve excavation of soil exceeding unrestricted land use soil CULs in the potential Ennis Creek Restoration Area as shown on **Figure 6-2**.

- **SL-1: Cover.** A 2-foot cap would be placed over areas where shallow soil exceeds the unrestricted land use soil CULs. Contaminated soil in the potential Ennis Creek Restoration Area would be excavated and placed in the west mill area, then capped.
- **SL-2: Consolidate and Cover with Remediation Levels (RELs).** All soil exceeding direct-contact RELs protective of occasional site visitors/trespassers in the upper 15 feet would be addressed through excavation or cover. The RELs are described in Volume III.
- **SL-3: Consolidate and Cover.** All soil exceeding the unrestricted land use soil CULs (Section 4.2) in the upper 15 feet would be addressed through excavation or cover.
- **SL-4: Excavation with RELs.** All soil exceeding direct-contact RELs in upper 15 feet or ecological RELs in upper 6 feet would be excavated and disposed off-site. The RELs are described in Volume III.
- **SL-5: Excavation.** All soil exceeding the unrestricted land use soil CULs (Section 4.2) would be excavated and disposed off-site.

5.1.2 Groundwater

Three groundwater cleanup alternatives were evaluated in Volume III.

- **G-1: Sparging.** Applies on-site treatment of groundwater using air-sparging in a network along the shoreline before groundwater discharges to the marine environment.
- **G-2: Funnel and Gate with Permeable Reactive Barrier.** Applies in-situ treatment of groundwater using a funnel and gate system that incorporated a permeable reactive barrier in a network along the shoreline before groundwater discharges to the marine environment.

- **G-3: In-Situ Chemical Treatment.** Applies in-situ treatment of groundwater using in-situ chemical oxidation (ISCO) and/or in-situ chemical fixation (ISCF) throughout the Upland Study Area.

5.1.3 Sediment

Five sediment cleanup alternatives were evaluated in Volume III.

- **S-1: Excavate/Dredge Intertidal Log Pond, EMNR in Remainder.** Contaminated sediment from the intertidal/nearshore portion of the log pond and dock landing would be excavated from the shoreline using upland-based excavation equipment. The excavated area would be backfilled to stabilize the area and control any residuals, followed by gravel beach placement to restore the shorelines. EMNR would be used in the remainder (i.e., subtidal portion) of the log pond and in other sediment remediation subareas.
- **S-2: Excavate/Dredge Intertidal Log Pond, Fill and EMNR Berth Areas, EMNR in Remainder.** Alternative S-2 is the same as Alternative S-1, with the following differences:

  The berth and approach areas would be addressed by filling with clean material to restore these historically dredged areas to an elevation similar to the surrounding area. The fill material would consist of a mix of clean sand, silt, and gravel. Filling the berth and approach areas would be sufficient to contain underlying sediment contamination and would achieve a bathymetry less prone to the accumulation of fine particulates and potential contaminants from off-site. A clean EMNR sand layer in the berth and approach areas and in the remainder of the sediment remediation area would be placed to address sediment contamination and to provide suitable habitat.

- **S-3: Dredge Intertidal and Cap Subtidal Log Pond, Dredge under Dock, Fill and EMNR Berth Areas, EMNR in Remainder.** This alternative consists of the same actions and technologies as those described for Alternative S-2, except that the subtidal portion of the log pond would be capped, and dredging would be conducted under the mill dock (assumed 2-foot cut). The berth areas would be filled to match the post-dredge elevations under the mill dock area and would achieve a bathymetry less prone to the accumulation of fine particulates and potential contaminants from off-site. ICs would be established to protect capped areas.
- **S-4: Full Log Pond Dredge, Fill and ENR around Dock, ENR in Remainder.** This alternative consists of the same actions and technologies as those described for Alternative S-2, except that the subtidal portion of the log pond would be dredged (assumed 3-foot cut).
- **S-5: Dredge all Subareas.** Under Alternative S-5, all the SRSs would be excavated/dredged (assumed 3-foot cut in all dredge areas), including the entire log pond, the berth, approach, under the mill dock, and the mill dock subtidal area.

The sediment alternatives included either dredging or EMNR for the Under-dock Area (SMA-3), and no action for the Nearshore Area (SMA-4). There is uncertainty in the effectiveness of these actions for these areas due to limited sediment chemistry characterization (both lateral and vertical) and limited modeling of the sediment bed movement post removal of in-water structures (i.e., dock, jetty, treated timbers and pilings).

Any remedy for SMA-3 and SMA-4 is contingent on additional data to make a decision on the appropriate remedy. Pre-remedial design data will be used to determine whether dredging, thin layer capping, EMNR, or no action will be a sufficiently protective remedy for SMA-3 and SMA-4. The data needs, subsequent data evaluation, and decision matrix are discussed in the Decision Framework (**Appendix A**).

5.2 Alternative Analysis

A summary of the alternatives evaluated is included in **Table 5-1** (Soil), **Table 5-2** (Groundwater), and **Table 5-3** (Sediment). Each table includes a summary of the alternative and the scoring of the alternative using the MTCA threshold requirements for the following criteria:

- Protect human health and the environment.
- Comply with cleanup standards.
- Comply with applicable state and federal laws.
- Provide for compliance monitoring.
- Use permanent solutions to the maximum extent practicable.
- Provide for a reasonable restoration time frame.
- Consider public concerns.

MTCA also provides a mechanism to consider cost and rank alternatives to determine whether remedial options that comply with MTCA requirements have a disproportionate cost in relation to the remedial benefit. For each alternative, an overall benefit score was developed by scoring and weighting each criterion, then summing the scores. Then a benefit-to-cost ratio was developed, and Volume III recommended those alternatives with the highest benefit-to-cost ratio. The scores and ratios are summarized in **Table 5-4** (Soil), **Table 5-5** (Groundwater), and **Table 5-6** (Sediment).

6.0 Selected Remedy

This section details the selected remedy for each media (i.e., soil, groundwater, and sediment), the rationale for the selected remedy, and the schedule for implementation of the soil, groundwater, and sediment remedies. While titled an Interim Action Plan, the selected remedies for each media in the Study Area are expected to be the Final cleanup actions for the Study Area.

6.1 Coordination of Remedy, Removal of In-Water Structures, and Potential Restoration

6.1.1 Removal of In-Water Structures

RAMP has certain obligations under DNR Aquatic Lands Lease No. 22-002356 for the in-water structures (i.e., dock, jetty, treated timbers and pilings) and other fill that is located on DNR leasehold. To close the lease, DNR requires the removal of improvements on state-owned lands. RAMP has initiated discussions with DNR about the removal of the dock and jetty and shoreline recontouring.

The dock consists of approximately 4000 creosote pilings, and the approximately 700-foot long jetty consists of creosote wood cribbing that are an on-going source of cPAHs. Creosote-treated pilings and structures have harmful effects on cornerstone aquatic animals in the nearshore that can impact the health of higher trophic-level species. Ecology generally recommends completely removing creosote-treated pilings and creosote-treated derelict structures.[25]

The dock is no longer functional due to decay and RAMP has removed the decking of the dock in preparation for its removal. Removal of the dock is a necessary element of the remedy for the marine portion of the Study Area. **Ecology is including the removal of the treated timbers and pilings as part of the selected remedy. In addition, removal of the in-water structures and recontouring of the shoreline are expected to be a part of the DNR lease closeout.**

The selected remedies for contaminated sediments and shoreline soils must be completed in conjunction with the dock and jetty removal and restoration of the shoreline.

6.1.2 Potential Restoration of Ennis Creek

In a suite of four agreements in 1998-2000, USEPA deferred supervision of the remedy for the Rayonier Mill Site to Ecology, subject to certain provisions, including that, “Cleanup activities must not preclude physical and biological restoration of Ennis Creek and its estuary.” LEKT 1999 (Preliminary Agreement between Ecology and LEKT).

[25] Sediment Cleanup User’s Manual (SCUM), Chapter 16.2 – Policy for Removal of Creosote-Treated Pilings

In 2010, Rayonier, Inc. and LEKT developed an Ennis Creek Restoration Conceptual Plan (Ennis Technical Team, 2010), fulfilling a provision of the June 1999 Cooperative Agreement between LEKT and Rayonier, Inc. (LEKT 1999), another of the four agreements. In 2012, the Port Angeles Harbor Trustee Council (Trustee Council) was formed to pursue resolution of claims for injury to natural resources arising under MTCA, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and other laws. The Trustee Council includes Ecology, the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, LEKT, the Jamestown S'Klallam Tribe, and the Port Gamble S'Klallam Tribe.

Rayonier and RAMP engaged in multi-year substantive discussions with the Trustee Council to develop a project to restore Ennis Creek as a way to resolve potential natural resource damage (NRD) claims. A settlement has thus far not been reached. If, in the future, RAMP and the Trustee Council reach a settlement of the NRD claims approved by a court of competent jurisdiction, the approved restoration work could involve undertaking activities within the Study Area that are independent of MTCA cleanup.

The alternatives evaluated in Volume III provide for MTCA-compliant cleanup actions that assume future restoration actions. The selected remedies support and would not preclude restoration in accordance with the Ennis Creek Restoration Conceptual Plan. Ecology, RAMP, and the Trustee Council recognize that there are often benefits to conducting restoration and remediation activities simultaneously.

6.2 Description of the Selected Remedy

To implement the cleanup actions with removal of the dock and jetty and shoreline recontouring, and to preserve the ability to restore Ennis Creek within the area depicted in **Figure 6-1**, a phased approach is necessary due to the size of the , complexity and interrelated nature of the construction work, short in-water season (typically July 15 to February 15), remote location, and prevailing weather conditions. However, none of the phased activities may be permitted to produce conditions of increased risk to human health or the environment between scheduled activities. For example, each phase should be completed in a manner that leaves the area of active work cleaner than when the respective phase was initiated and protected from erosion-related forces in the interim period between phases.

To date, RAMP has dismantled and removed the warehouse and most of the deck panels from the top of the dock and has started planning for the next steps in removing the superstructure and pilings of this very substantial marine structure.

6.2.1 Soil Selected Cleanup Action

All soil exceeding the unrestricted land use soil CULs listed in **Table 4-2** at the respective points of compliance will be excavated. The management of the contaminated soil will be detailed in a Materials Management Plan (MMP) developed during engineering design. Much of the contaminated soil will be consolidated and capped in the west mill area. Soil in the Upland Study Area will be sampled during remedial design to refine the remediation footprint both laterally and vertically.

Figure 6-2 shows a preliminary remediation footprint based on current data. The contaminated soil will be excavated in the potential Ennis Creek Restoration Area, the areas east of Ennis Creek, and west of Ennis Creek surrounding the consolidation area. In most of these areas, shallow excavation of 1-foot deep or less below existing surface grade, as shown in yellow on **Figure 6-2**, will likely be sufficient. Deeper excavation greater than 1 foot, as shown in orange on **Figure 6-2**, will be required in some areas and will be determined during remedial design. Excavated areas will be restored with clean backfill. The Engineering Design Report (EDR) will define the amount of clean backfill required.

Soils exceeding the unrestricted land use soil CULs in the potential Ennis Creek Restoration Area (at any depth) will be excavated. Excavated soils will be managed in accordance with the approved MMP. Final grading of the remediated potential Ennis Creek Restoration Area will be defined in the EDR. If a separate restoration plan, as part of a judicially approved NRD settlement, is available prior to the cleanup, the EDR shall integrate the cleanup and restoration. If a restoration plan is not available, the EDR must not preclude the physical and biological restoration of Ennis Creek. If backfill is needed within potential restoration areas, clean materials, suitable for restoration, will be used.

The appropriate management of structure materials such as treated timbers and concrete rubble, will be determined during remedial design and will be consistent with solid waste management requirements. The appropriate management will be documented in the MMP that will be developed during the remedial design and included in the EDR.

To be detailed in an Ecology-approved MMP, excavated soil will be consolidated to an inner area of the Site west of Ennis Creek, and the consolidated soil will be capped to prevent exposure to humans and ecological receptors, or the excavated soil will be disposed off-site at an appropriate disposal facility. The cap will consist of woven geotextile overlain by clean, compacted aggregate material (e.g., crushed rock, or sand and gravel) and a surface layer of clean soil (see **Figure 6-3**). The cap design will include measures to prevent burrowing animals (e.g., geogrid). The cap will be approximately 2-feet thick. The final cap design will be detailed in the EDR.

ICs will be required to preserve the integrity of the cap. An Operations, Maintenance, and Monitoring Plan (OMMP) will be developed during remedial design and construction. The OMMP will detail the inspection and maintenance of the cap. Fencing and signs may be installed to prevent damage of the cap by human activities. The cap will be monitored and maintained to include elimination of deep-rooting plants and the removal of burrowing animals.

An environmental covenant will include documentation of the contamination remaining under the cap, and detail prohibited activities that may interfere with the cleanup action, operation and maintenance, monitoring, or other measures necessary to assure the integrity of the cleanup action and continued protection of human health and the environment. The environmental covenant will require notice and approval by Ecology of any proposal to use the Site in a manner that is inconsistent with the environmental covenant. If Ecology, after public notice and comment approves the proposed change, the environmental covenant shall be amended to reflect the change.

Under this remedy, all soils that exceed the unrestricted land use soil CULs will be consolidated under a cap (**Figure 6-2**) or disposed at an appropriate disposal facility. The final volume of impacted soil that will remain in the capped area will be refined during the design investigations and remedial design. The current estimate of impacted soil to be excavated and consolidated under the cap is approximately 55,000 cy. This includes the 28,200 cy of stockpile soil and 27,000 cy excavated outside of the capped area. The estimated total amount of soil that will be consolidated or capped in place is 128,000 cy. The capped area will be setback from the shoreline (approximately 200 feet) as required under the Shoreline Master Plan. The capped area will be approximately 10 acres in the west mill area. Consolidating 55,000 cy of soil excavated (or stockpiled) from other areas of the Upland Study Area plus 20,200 cy of sediment dredged from the Marine Study Area and placing within the 10 acres of the west mill area will raise the surface of the area approximately 5 feet. A cap, currently estimated to be 2-feet thick, will be placed over this. The cap design and thickness will be refined during the remedial design.

6.2.2 Groundwater Selected Cleanup Action

The groundwater selected cleanup action includes air sparging for in-situ treatment of groundwater contamination to prevent discharge to surface water at concentrations above CULs as listed in **Table 4-3**. The conditional POC for this remedy is in the groundwater as close as possible to the surface water discharge location as measured by an Ecology-approved network of shoreline monitoring wells. No additional attenuation factor is allowed between the well and the groundwater/surface water contact point due to the existence of preferential migration pathways.

Air sparging will affect the redox conditions of the subsurface, resulting in oxidation of ammonia to nitrite/nitrate, and oxidation of metals to form precipitates (e.g., manganese oxides and other oxides) that will attenuate other dissolved metals due to the adsorption capacities and scavenging capabilities of the manganese oxides. Air sparging will also promote the aerobic biodegradation of dissolved organic contaminants, such as cPAHs, to less toxic substances.

Air sparging will be applied in a phased manner beginning near shoreline well MW-56 (**Figure 6-4**) where the highest concentrations of contaminants were found. The phased approach allows for the evaluation of sparging effectiveness and need during the remedial design and implementation phases, leading to a more optimized approach. Additional study of the groundwater plume and its discharge to surface water will be conducted during the remedial design which could lead to a modified extent of the full-scale sparging system.

Under this remedy, groundwater that is above the CULs will be treated by air sparging before discharging at the POC. The total area of impacted groundwater needing treatment is expected to be 35 acres; however, this area may be refined during remedial design.

6.2.3 Sediment Selected Cleanup Action

The selected cleanup action for sediments includes different remedial actions for each SMA within the SCU as shown in **Figure 6-5**.

Remaining in-water structures (i.e., dock, jetty, treated timbers and pilings) are expected to be removed as part of the DNR lease closeout. If not removed under the DNR lease closeout agreement, any treated timbers and pilings in contact with marine water or sediment are considered a source of contamination and are required to be removed as part of this IAP.

Contaminated sediment from the intertidal and nearshore portion of SMA-2 (the log pond) and the shoreline portion of SMA-1 (the Mill Dock Landing on the shoreline adjacent to the dock) will be excavated or dredged. Excavation and dredging will be conducted to achieve the SCLs as listed in **Tables 4-4** and **4-5**. The lateral extent of removal will be determined in remedial design based on achieving the SCLs. The excavated and dredged areas will be backfilled to stabilize the substrate and control any residuals, followed by gravel beach placement to restore the shorelines. Excavated and dredged materials will be sent off-site for disposal or placed in the Upland Study Area soil consolidation area to be determined in the remedial design.

A contingent remedy is selected for the SMA-3 and SMA-4 (**Figure 6-5**). The remedy to be implemented is contingent on the pre-remedial design data and hydrodynamic/sediment transport modeling to be completed per the Decision Framework (Appendix A). The pre-remedial design data collection and modeling must be complete before any structures are removed. The data and modeling results will be used to determine the appropriate remedies for the SMA-3 (Under-dock) and SMA-4 (Nearshore) based on the decision matrix tables in the Decision Framework (**Tables 6-1 and 6-2**). The SMAs may be further subdivided into sediment remediation subareas (SRS) as determined by Ecology to be warranted and practicable, based on the hydrodynamic modeling and chemistry results to support remedy selection within the Decision Framework. The contingent remedies include: EMNR, thin-layer cap, dredging, and/or no action. Information gained from the hydrodynamic/sediment transport modeling may support design decisions for other sediment remediation areas within the sediment cleanup unit during remedial design.

EMNR will be the remedy utilized in non-dredged areas of SMA-2 (the former log pond) and the offshore, non-berth areas of SMA-1. Following the removal of the dock, the deepened berth and approach areas will be filled with clean material to restore these historically dredged areas to the surrounding substrate-depth gradient or an elevation determined by Ecology to be appropriately stable based on modeling conducted as part of design. The appropriate placement methods for fill material will be determined during the remedial design. A clean EMNR layer in the berth and approach areas and in the remainder of the sediment remediation area (except the Under-dock SMA and Nearshore SMA) will be placed to address sediment contamination and to provide suitable habitat for the benthic community. The thickness and composition of the EMNR layer will be determined during the remedial design phase.

Under the remedy for the SMA-1 and SMA-2, approximately 20,200 cy of sediment will be removed and disposed of off-site or consolidated under the cap described in the soil remedy. The total volume and disposal of dredged material, including any material dredged within the contingent remedy of SMA-3 and SMA-4 will be determined during remedial design.

Placement of EMNR in the remaining sediment areas will effectively remediate sediment to below SCLs within a 10-year timeframe. The Rayonier Mill SCU is the designated area for which the SWAC of bioaccumulative IHS within the SCU boundary must meet the SCL at the end of a 10-year recovery period for the protection of human health. If the sediment SWAC still exceeds the SCL after a 10-year timeframe, active remediation (e.g., removal) of the highest sediment concentrations may be needed to reduce the SWAC in sediment to meet the SCL. Upon completing the construction, the remediation goals for sediment will be achieved and long-term monitoring will be implemented.

6.3 Rationale for Selecting the Remedies

MTCA prescribes how to evaluate and select cleanup actions.[26] The rules also set forth expectations for cleanup actions[27] and for institutional controls.[28] The selected cleanup action must meet the "threshold"[29] and "other"[30] requirements, including using permanent solutions to the maximum extent practicable. The cleanup action also must not rely primarily on institutional controls when it is technically possible to implement a more permanent action for all or a portion of the site.[31]

[26] WAC 173-340-360
[27] WAC 173-340-370
[28] WAC 173-340-440
[29] WAC 173-340-360(2)(a)
[30] WAC 173-340-360(2)(b)
[31] WAC 173-340-440(6)

Only one of the evaluated alternatives can satisfy the requirement to use permanent solutions to the maximum extent practicable. MTCA requires using a disproportionate cost analysis (DCA) to determine which alternative uses permanent solutions to the maximum extent practicable.[32] This involves comparing the alternatives against the evaluation criteria:[33]

- Protectiveness
- Permanence
- Cost
- Effectiveness over the long term
- Management of short-term risks
- Technical and administrative implementability
- Consideration of public concerns

Volume III evaluated the alternatives presented against these criteria, calculated benefit-to-cost ratio, and recommended those alternatives with the highest benefit-to-cost ratio as the preferred alternatives.

The comparison of benefits and costs may be quantitative (i.e., a benefit-to-cost ratio), but will often be qualitative and require the use of best professional judgement. In particular, Ecology has the discretion to favor or disfavor qualitative benefits and use that information in selecting a cleanup action.[34] **When determining which cleanup action alternative "uses permanent solutions to the maximum extent practicable,"[35] MTCA requires Ecology to select the most permanent alternative whose incremental cost is not disproportionate to the incremental benefit it would achieve compared to the lower cost alternatives.[36]** Thus, the alternative with the highest benefit-to-cost ratio is not necessarily the same as the alternative that is "permanent to the maximum extent practicable."

In addition, the MTCA rules and the SMS require that the cleanup action shall not rely primarily on institutional controls and monitoring where it is technically possible to implement a more permanent cleanup action for all or a portion of the site.[37]

Ecology reviewed the Volume III DCA, evaluated the incremental change in benefit versus cost, and applied best professional judgement to determine which alternative is permanent to the maximum extent practicable.

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[32] WAC 173-340-360(3)(b), (e)
[33] WAC 173-340-360(3)(f)
[34] WAC 173-340-360(3)(e)(ii)(C)
[35] WAC 173-340-360(3)(b)
[36] WAC 173-340-360(e)
[37] WAC 173-340-440(6) and WAC 173-204-570(3)(h)

6.3.1 Upland Soil Remediation

All the soil alternatives meet the MTCA threshold requirements. The results of the Volume III DCA for the soil remediation alternatives are summarized in **Table 5-1** and **Table 5-4** and shown in **Figure 6-6**. Volume III recommended alternative SL-2 as it has the highest benefit-to-cost ratio.

As mentioned above, under a DCA, the comparison of benefits and costs may be quantitative, but will often be qualitative and require the use of best professional judgement.[38] Ecology reviewed the Volume III DCA, evaluated the incremental change in benefit versus cost, and applied best professional judgement to determine which alternative is permanent to the maximum extent practicable.

Ecology selects Alternative SL-3 as the Selected Cleanup Action for soil. Alternative SL-3 is permanent to the maximum extent practicable and does not rely primarily on institutional controls for large portions of the property.

Review Overall Benefit and Cost

Volume III presented the Overall Benefit and Cost, and the benefit-to-cost ratio in **Figure 6-6**.

Alternative SL-5 scores the highest on Overall Benefit but is the most costly alternative. The benefit-to-cost ratio is low at 2.4.

Alternative SL-2, the recommended preferred alternative of Volume III, scores the lowest on Overall Benefit, but is the least costly alternative. The benefit-to-cost ratio is high at 8.3.

Alternative SL-3 scores second highest on Overall Benefit and is the second least costly alternative. The benefit-to-cost ratio is also high at 7.7.

While the benefit-to-cost ratio for Alternative SL-3 is slightly less than Alternative SL-2, it provides a higher overall benefit with a cost that is not disproportionate to the cost of Alternative SL-2. Alternative SL-3 provides the best overall benefit while being one of the least costly alternatives. **Alternative SL-3 would achieve more benefit than Alternative SL-2 from a quantitative and qualitative standpoint without being disproportionately more costly. As such, it is the alternative that "uses permanent solutions to the maximum extent practicable."**

Incremental change in Overall Benefit versus incremental change in Cost

To look at the incremental change in Overall Benefit versus incremental change in Cost, Ecology plotted the Overall Benefit versus Cost (**Figure 6-7**).

[38] WAC 173-340-360(e)(ii)(C)

The inflection point in the curve is at Alternative SL-3. This is the point where the incremental change in Cost of the alternatives grows faster than the incremental change in Overall Benefit. The incremental benefit gained between Alternatives SL-5 and SL-3 is 1.1 (i.e., 8.9-7.8) at a cost of $27 million (M) which is disproportionate. The incremental benefit gained between Alternatives SL-3 and SL-2 is 1.6 (i.e., 7.8-6.2) at a cost of $2.7M. This cost is not disproportionate. **Thus, Alternative SL-3 is permanent to the maximum extent practicable**.

MTCA requires that the cleanup action shall not rely primarily on institutional controls and monitoring where it is technically possible to implement a more permanent cleanup action for all or a portion of the site.[39] Institutional controls include physical measures like fences, use restrictions, and educational programs like signs and postings. Engineered controls include containment or treatment systems designed and constructed to prevent or limit the movement of, or exposure to, hazardous substances. Institutional controls are less protective than engineered controls as they are not very effective or reliable at preventing exposure to hazardous substances in the long term. People may ignore signs, cut through fences, and set up camps on vacant land. In comparison, an engineered cap is far more reliable and likely to endure, especially over the long term, as a means of preventing people from being exposed to hazardous substances at levels MTCA deems unsafe for unrestricted exposure scenarios. This is also why Ecology concludes, from a qualitative standpoint, that Alternative SL-3 would achieve substantially greater benefit over SL-2 than the purely quantitative analysis might indicate.

It is technically possible (i.e., capable of being designed, constructed, and implemented regardless of cost) to use an engineering control (containment) for the contaminated soil exceeding unrestricted land use CULs. After considering the alternatives presented in Volume III, it is clear that it is technically possible to implement a more permanent cleanup action than Alternative SL-2, which relies primarily on institutional controls for portions of the Upland Study Area cleanup. **Alternative SL-3 consolidates and contains all contaminated soil above the unrestricted land use soil CULs and does not rely primarily on institutional controls.**

6.3.2 Groundwater Remediation

All the groundwater alternatives meet the MTCA threshold requirements. The results of the Volume III DCA for the groundwater remediation alternatives are summarized in **Table 5-2** and **Table 5-5** and shown in **Figure 6-8**. **Figure 6-8** includes the estimated cost, the total (weighted) overall benefits score, and the benefits-to-cost ratio for each alternative. The Volume III DCA results indicate that the alternative with the highest benefit-to-cost ratio is Alternative G-1: Sparging.

Evaluation of Alternative G-3 showed that meeting CULs at the standard POC (all locations in groundwater) would be impractical at this Site. Alternative G-2 has a similar benefit as Alternative G-1, but the cost is substantially higher. Alternative G-1 is the selected cleanup action for groundwater. Air

[39] WAC 173-340-440(6)

sparging will be applied in a phased manner, allowing for evaluation of sparging effectiveness during the remedy implementation phase, leading to a more optimized approach. It is envisioned that additional study of the groundwater plume and its discharge to surface water will be conducted during the design phase, which may lead to a modified extent of the full-scale sparging system.

Ecology selects Alternative G-1 as the Selected Cleanup Action for groundwater. Alternative G-1 is permanent to the maximum extent practicable.

6.3.3 Sediment Remediation

All five of the sediment alternatives (S-1 through S-5) meet the MTCA threshold requirements for SMA-1 and SMA-2. The results of the Volume III DCA for the sediment remediation alternatives are summarized in **Table 5-3** and **Table 5-6** and shown in **Figure 6-9**. **Figure 6-9** includes the estimated cost, the total (weighted) overall benefits score, and the benefits-to-cost ratio for each alternative. The Volume III DCA results indicate that the alternative with the highest benefit-to-cost ratio is Alternative S-2. Volume III recommends Alternative S-2 as the preferred alternative.

Alternative S-2 includes EMNR for sediments in SMA-3 (Under-dock) and no action in SMA-4 (Nearshore). There is uncertainty in the effectiveness of these recommended actions due to limited sediment chemistry characterization (both lateral and vertical) and limited modeling of sediment bed movement post removal of in-water structures (i.e., dock, jetty, treated timbers and pilings). The Under-dock sediments have been contaminated by the long-term presence of treated timbers and pilings. These sediments could erode or otherwise mobilize once the structures, timbers, and pilings are removed. **Figure 6-10** shows the Volume III recommended alternative and the limited extent of sampling data. Ecology developed SMA-3 for the Under-dock and SMA-4 for the Nearshore area, where contingent remedies will be developed to provide practicable remedial alternatives once additional sampling data is developed.

The Decision Framework is an integral part of this IAP and is included as Appendix A. It details the pre-remedial design data collection needs and hydrodynamic/sediment transport modeling to be completed before remedial design and before any structures are removed. The Decision Framework (Appendix A) will determine the remedies for SMA-3 and SMA-4 using the modeling results and collected data and the decision matrix tables (**Tables 6-1** and **6-2**). Contingent remedies include: EMNR, thin-layer cap, dredging, or no-action. The additional information collected for the SMA-3 and SMA-4 may also be used in refining the boundary conditions of the selected remedies during remedial design. The SMAs may be further subdivided into sediment remediation subareas (SRS) as determined by Ecology to be warranted and practicable, based on the hydrodynamic modeling and chemistry results to support remedy selection within the Decision Framework.

Ecology selects Alternative S-2 with the modification of adding a contingent remedy for SMA-3 (Under-dock) and SMA-4 (Nearshore). The remedial actions for different areas of the sediment cleanup unit include:

- Remove any treated timbers and pilings in contact with marine water or sediment.
- Dredge intertidal and nearshore portion of SMA-2 (the log pond).
- Dredge shoreline portion of SMA-1 (the Mill Dock Landing on the shoreline adjacent to the dock).
- Contingent remedy for SMA-3 and SMA-4 will include EMNR, thin-layer cap, dredge, no-action, or a combination of these remedial options.
- Fill previously dredged berth and approach areas with clean fill to surrounding substrate depth gradient or an appropriately stable elevation as determined by Ecology based on modeling conducted as part of design to create suitable benthic habitat and eliminate prominent bottom features that could affect localized deposition (i.e., suppressions) or erosion (i.e., slopes or mounds).
- EMNR in the non-dredged areas of SMA-2 (the log pond) and outside of the dock berths and approaches of SMA-1

Alternative S-2 is permanent to the maximum extent practicable for SMA-1 and SMA-2. SMA-3 and SMA-4 will also require remedies that are permanent to the maximum extent practicable.

6.4 Compliance with Applicable Laws

The selected cleanup actions must comply with the MTCA Cleanup Regulations (chapter 173-340 WAC), the SMS (chapter 173-204 WAC), federal laws, and substantive requirements of applicable local and state laws. Together, these requirements, regulations, and laws are identified as ARARs. Under WAC 173-340-350 and WAC 173-340-710, the term "applicable requirements" includes regulatory cleanup standards; standards of control; and other environmental requirements, criteria, or limitations established under state or federal law that specifically address a cleanup action, location, IHSs, or other circumstance at a site. The "relevant and appropriate requirements" include regulatory requirements and guidance that have been determined to be appropriate for use by Ecology.

The selected cleanup actions will comply with all ARARs pursuant to MTCA and the SMS under the terms of the implementing agreement. Chemical-specific ARARs will be met by compliance with applicable MTCA CULs and SMS SCLs. The cleanup actions will comply with location-specific ARARs by compliance with all applicable state, federal, and local regulations in place for the upland and in-water remediation.

Applicable action-specific ARARs will be met by implementation of construction activities in compliance with all applicable construction-related requirements, such as health and safety requirements, site use and other local permits, and disposal requirements for excavated material.

The individual ARARs and expected substantive compliance of the selected cleanup actions are summarized in **Tables 6.3** through **6.5**. ARAR compliance will be further refined during the remedial design process.

6.5 Environmental Justice

WAC 173-340-380(5)(c) requires that cleanup action plans summarize how impacts on likely vulnerable populations and overburdened communities were considered when selecting the cleanup action. Ecology's Implementation Memorandum No. 25: Identifying Likely Vulnerable Population and Overburdened Communities under the Cleanup Regulations (Publication No. 24-09-044, Ecology 2024) provides a process for evaluating whether the population threatened by a contaminated site includes likely vulnerable populations or overburdened communities. Vulnerable populations and overburdened communities are indicated by a Washington State Department of a Health's Environmental Health Disparities[40] rank of 9 or 10 or by a Demographic Index or Supplemental Demographic Index from the Environmental Protection Agency's Environmental Justice Screening and Mapping Tool (EJScreen)[41] at or above the 80th percentile.

There are three census tracks near or adjacent to the Site (53009001300, 53009001200, 53009001000). The overall Health Disparities rank for the three census tracks surrounding the Rayonier Mill Site (53009001300, 53009001200, and 53009001000) site **ranked 1, 5, and 4,** respectively. This is below the rank of 9 or 10 defined to indicate vulnerable populations or overburdened communities using Publication No. 24-09-044.

Using EJScreen, the potentially exposed population within the three census tracts around the Rayonier Mill Study Area boundary are summarized as:

EJScreen Summary

Census Tracts	53009001000	53009001200	53009001300
Demographic Index (percentile in state)	57	53	40
Supplemental Demographic Index (percentile in state)	72	66	70

These are below the 80th percentile defined to indicate vulnerable populations or overburdened communities using Publication No. 24-09-044. **Based on this evaluation, the cleanup plan is unlikely to impact any vulnerable populations or overburdened communities**.

40 https://doh.wa.gov/data-and-statistical-reports/washington-tracking-network-wtn/washington-environmental-health-disparities-map

41 https://www.epa.gov/ejscreen

6.6 Tribal Engagement

Tribal engagement is an integral part of Ecology's responsibilities under chapter 70A 305 RCW and WAC 173-340-380(5)(d)(ii) and 173-340-620. Ecology's goal is to provide Indian tribes with timely information, effective communication, continuous opportunities for collaboration, and, when necessary, government-to-government consultation, as appropriate for each site.

For the Rayonier Mill Site, tribal engagement has been integral to the cleanup work since 1999. Ecology, USEPA, LEKT, and Rayonier, Inc. negotiated and agreed to several deferral and cooperative agreements. The agreements acknowledge the importance of cultural and natural resources to LEKT—including treaty fisheries and aquatic habitat in Port Angeles Harbor, the health of tribal members, and ancestral burial sites and ensure LEKT a role in Site cleanup, including consultation and concurrence in all major decisions. The agreements also highlight the importance of restoration and that cleanup activities must not preclude the restoration of Ennis Creek and its estuary. In addition to LEKT's role under these agreements, Ecology has provided opportunities for updates and consultation with the Port Gamble S'Klallam Tribe and the Jamestown S'Klallam Tribe.

6.7 Restoration Timeframe

The restoration timeframe is the period of time needed to achieve the required CULs at the points of compliance established for the site. The restoration timeframe includes design, permitting, contracting and construction of the remedy, and implementation of ICs. The soil remedy restoration timeframe is expected to take no more than 7 years, and the groundwater and sediment remedy restoration timeframes are expected to take no more than 10 years. These timeframes are expected to run essentially concurrently so the restoration timeframe for the entire project is expected to be no more than 10 years. The remedial design data will be used to refine the estimated restoration timeframes.

6.8 Compliance Monitoring

The compliance monitoring requirements associated with implementation of the selected cleanup actions to ensure their protectiveness will be implemented in accordance with WAC 173-340-410, Compliance Monitoring Requirements.

Three types of compliance monitoring will be performed: protection, performance and confirmational:

- Protection monitoring will be conducted during construction to ensure permit requirements are met, and that human and environmental health is protected.
- Performance monitoring will be conducted at the end of the construction period to confirm that design specifications (e.g., final slopes, grades, cap thickness, areal coverage) and cleanup standards are achieved.

- Confirmational monitoring collects information that allows the performance of the remedy to be evaluated over time to ensure the protectiveness and integrity of the remedy is maintained. Confirmational monitoring is also used to assess rates of recovery in EMNR areas and to assess recontamination, if any.

Detailed monitoring elements will be described in the Construction Monitoring Plan (CMP) and Operations, Maintenance and Monitoring Plan (OMMP) to be prepared for Ecology review and approval as part of the EDR.

The CMP will detail the protection and performance monitoring to be conducted during construction. It will describe quality assurance protocols and methods to be used for ensuring that the cleanup actions are implemented in accordance with the cleanup design and associated permitting requirements. Detailed contingency response actions and adaptive management, as needed, will also be described in the CMP.

The OMMP will describe postconstruction confirmational monitoring as well as an overall framework for contingency actions and adaptive management to ensure the long-term protectiveness of the cleanup actions.

Compliance monitoring activities are described in the sections that follow.

6.8.1 Protection Monitoring

Protection monitoring is conducted during implementation of the remedy to assure that permit and contract requirements are met and to provide intermittent quality control checks. It is specific to the work area and adjacent areas potentially subject to construction impacts. Protection monitoring will occur throughout the construction period and may include the following elements:

- Air quality monitoring in, upwind of, and downwind of the immediate work area during construction to protect workers, visitors, and local residents.
- Water quality monitoring in the vicinity of shoreline bank and in-water construction activities (e.g., removal of debris, excavation and dredging, placement of cap material, dewatering of dredged material) to address requirements of CWA Section 401 water quality certification.
- Visual inspection of physical best management practices (BMPs) (e.g., silt curtain) and construction stormwater management facilities (e.g., for retention, control, or treatment) on a regular basis for as long as the BMPs are in place, or the temporary stormwater facility is in operation.
- Quality control (QC) checks to confirm that location, areal extent, depth, elevation, thickness, design elements, and other performance requirements are being met; details on type and frequency of the QC checks will depend on the technology.

6.8.2 Performance Monitoring

Performance monitoring will be conducted to confirm that the design specifications and cleanup standards are met. Similar to QC checks conducted during construction, performance monitoring will include final location, areal extent, depth, elevation, and thickness of various remedy components following construction. Bathymetric and topographic surveys will be used to establish final elevations and slopes.

Additional sampling will be conducted at the end of construction to determine compliance with the cleanup standards and to describe baseline conditions for areas where EMNR is an element of the remedy.

- Surface and subsurface samples (e.g., coring) will be collected within the sediment SMAs for chemical and physical testing. Testing will focus on sediment IHSs, organic carbon, and grain size. Compliance with the cleanup standards will be based only on sediment IHSs.
- Surface and subsurface samples (e.g., coring) will be collected within the upland soils outside of the capped area for chemical and physical testing. Testing will focus on soil IHSs to ensure compliance with the soil cleanup standards.
- Surface and subsurface samples (e.g., coring) will be collected within the areas of various cap types for observation and/or physical testing to evaluate cap placement effectiveness and that cap specifications are met.
- Surface sediment samples may be collected adjacent to the SCU for chemical and physical testing immediately outside areas of remediation if data within the SCU indicates performance criteria have not been met.
- Groundwater samples will be collected within and downgradient of the area of in-situ treatment to evaluate treatment performance. Samples will be collected during and after the active treatment period. The OMMP will include plans specific to the in-situ groundwater treatment to direct future performance monitoring.

6.8.3 Confirmational Monitoring

Confirmational monitoring assesses three general areas of the cleanup action performance over time:

- Physical integrity of the remedy elements such as the caps.
- Performance of the enhanced natural recovery.
- Compliance with the cleanup standards and goals.

Bathymetric surveys will be repeated periodically to monitor the degree of post-construction elevation change that may adversely affect remedy performance. Visual inspections (actual or remote) will be conducted to assess the integrity of remedy elements over a broader area (e.g., video surveys to identify areas of scour).

Areas of the SCU utilizing EMNR to achieve CULs will be subject to periodic monitoring to evaluate the rate of contaminant reduction. Enhanced natural recovery monitoring will consist of sediment sampling and chemical testing and is assumed to be conducted at years 1, 3, and 5 following completion of construction. Longer term monitoring is proposed to be conducted at 5-year increments, but this frequency may be modified based on earlier monitoring results.

In areas where contaminants will be left in place beneath caps, long-term monitoring will be conducted to evaluate continued compliance with cleanup standards. Monitoring will include continued physical and chemical monitoring of soil or sediment at sampling frequencies sufficient to evaluate continued performance trends. Monitoring will initially be conducted Site-wide; however, the data parameters, extent, and frequency may change over-time depending on results. Special monitoring could be undertaken after severe storms or other events that could potentially damage a cap.

6.8.4 Contingency Response Actions

In addition to the monitoring information described above, the CMP and OMMP will include contingency actions and adaptive management strategies that may be applicable in response to monitoring observations. The EDR will provide additional details regarding the contingency response actions for the proposed cleanup action.

6.9 Institutional Controls

ICs are included as a component of the proposed cleanup action to ensure its long-term protectiveness under anticipated land and navigational uses; these controls will limit or prohibit activities that may interfere with or impair the integrity of the cleanup action and provide notification of these limitations. As noted in WAC 173-340-440(4), ICs are required where contamination is left in place or conditional points of compliance are used. Following construction of the proposed cleanup action for the Study Area, ICs will be implemented and are expected to include:

- **Use restrictions.** For parceled properties, use restrictions will be described in environmental covenants and recorded with Clallam County. For unparcelled state-owned property managed by DNR, Ecology and DNR are currently developing an alternative system to environmental covenants to be used by DNR.

  The environmental covenants, or alternative system for state-owned property, will protect the cleanup action by limiting incompatible uses and activities that may affect the integrity of the cleanup action, and by requiring coordination with Ecology for proposed future actions that may impact the cleanup action.

- **Maintenance requirements.** The OMMP will provide direction for the requirements and schedule for post cleanup monitoring and maintenance, including long-term inspection, performance monitoring, and maintenance of the soil and sediment caps and long-term groundwater monitoring. The OMMP will also include guidance for conducting contingent actions or otherwise modifying the cleanup action in the future if elements of the cleanup become damaged or are not performing as designed.
- **Financial assurances.** The implementing agreement to which this draft IAP is an exhibit, requires the PLP to maintain sufficient and adequate financial assurance mechanisms to fund all costs associated with the operation and maintenance of the cleanup action for the Study Area.

Institutional controls for the proposed cleanup action will be refined as part of the remedial design activities and confirmed by Ecology following completion of construction.

6.10 Periodic Review

Because the selected cleanup actions for the Study Area will result in hazardous substances remaining in the Study Area at concentrations exceeding the CULs/SCLs (e.g., beneath caps), Ecology will review the selected cleanup actions described in this IAP at least every 5 years to ensure protection of human health and the environment. Consistent with the requirements of WAC 173-340-420, the periodic review will include, but is not limited to, the following:

- A review of available monitoring data to verify the effectiveness of the completed cleanup actions, including engineered caps, in limiting exposure to hazardous substances remaining in the upland and SCU.
- A review of monitoring data for EMNR areas to confirm effective recovery of these areas.
- A review of current and projected future land and resource uses in the upland and SCU.
- A review of new scientific information for individual hazardous substances or mixtures present at the Site.
- A review of new applicable state and federal laws for hazardous substances present at the Site.
- A review of the availability and practicability of more permanent remedies.
- A review to verify that any environmental covenants are properly recorded.

Ecology will publish a notice of all periodic reviews in the site register and provide an opportunity for public review and comment by the potentially liable person and the public. If Ecology determines that substantial changes in the cleanup action are necessary to protect human health and the environment at the Site, a revised IAP will be prepared and provided for public review and comment in accordance with WAC 173-340-380 and 173-340-600.

7.0 Next Steps and Schedule

After the IAP has been finalized, RAMP will proceed with the remedial design for the selected cleanup actions. This section summarizes the deliverables and schedule for completion of the cleanup action.

7.1 Project Deliverables

The following deliverables will be developed as part of the remedial design and construction processes. All final versions of deliverables will address and incorporate Ecology's comments on the previous draft deliverables. The following are the anticipated major project deliverables:

Draft and Final Pre-Remedial Design Work Plan (PRDWP). The PRDWP will detail the hydrodynamic modeling and sampling approach to meet the sediment data needs identified in the Decision Framework (Appendix A). The PRDWP will include a Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HSP) that meet the requirements of the MTCA Cleanup Regulations (chapter 173-340 WAC) and the SMS (chapter 173-204 WAC). All data collection and analyses will be in accordance with the requirements of chapter 173-340 WAC, chapter 173-204 WAC, and Ecology's Toxics Cleanup Program Policy 840: Data Submittal Requirements. Laboratory data will be included in reports and must have met the quality assurance and quality control procedures outlined in the associated SAP and QAPP. The sediment sampling will take place in SMA-3 (Under-dock) and SMA-4 (Nearshore area).

Draft and Final Summary of Pre-Remedial Design Sediment & Hydrodynamic Modeling Results Report (Sediment Report). The Sediment Report will summarize the results of all pre-remedial design data, including sediment data collection and the hydrodynamic modeling. The results and modeling will be used with the decision matrix in the Decision Framework (Appendix A) to select appropriate remedies for SMA-3 (Under-dock) and SMA-4 (Nearshore area). The Sediment Report will document the selected remedies for SMA-3 and SMA-4.

Draft and Final Master Plan and Schedule (Master Plan). The Master Plan is a conceptual plan for the upland and marine remediation with structure removal and shoreline re-contouring. The Master Plan will identify the phases of work (e.g., design, permitting, contracting, and construction) for each media or task (e.g., sediment remediation, shoreline re-contouring, structure removal, upland soil remediation, groundwater remediation, and restoration). The Master Plan shall be reviewed and revised each year based on new information that may be available.

For each phase as identified in the Master Plan:

- **Draft and Final Remedial Design Work Plan (RDWP).** The RDWP will identify project milestones, work products, details on predesign sampling and analyses, plans and specifications, and schedules that meet the requirements of the MTCA Cleanup Regulations (chapter 173-340 WAC) and the SMS (chapter 173-204 WAC). All data collection and analyses will be in accordance with the requirements of chapter 173-340 WAC, chapter 173-204 WAC, and Ecology's Toxics Cleanup Program Policy 840: Data Submittal Requirements, which include Ecology's prior review and approval of a Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) that are attached to the RDWP. Laboratory data will be included in reports and must have met the quality assurance and quality control procedures outlined in the associated SAP and QAPP. The RDWP will also include a Health and Safety Plan (HSP). The RDWP will include, but is not limited to, the detailed sampling approach to refine remedial areas in the upland, evaluate contaminant levels in soil stockpiles, and refine sediment management areas in the sediments.

- **Draft and Final Summary of Remedial Design Results Report(s) (Summary Report(s)).** The Summary Report(s) will summarize the sampling design, sampling methods, field activities, deviations from the plan, and will include all sampling results or other data collected under the RDWP.
- **Draft and Final Engineering Design Report (EDR).** A draft and final EDR will be submitted to Ecology, in compliance with the requirements of WAC 173-340-400(4)(a) and chapter 173-204 WAC. The EDR will provide engineering concepts and design criteria for major components of the selected cleanup actions. It will include evaluation of and adaptation to reduce potential impacts from climate change and sea level rise with inclusion of green remediation best management practices and institutional control language. The EDR will include an MMP, piling removal plan, CMP, and OMMP.
- **Draft and Final Materials Management Plan (MMP).** The MMP will be developed during the engineering design phase and will comply with the requirements of WAC 173-340-400(4) and chapter 173-204 WAC. The MMP will detail the management of material generated during construction including the management of any removed treated timbers, concrete rubble, or other structure materials which will be taken off-site and recycled, reused, or disposed of in an appropriate disposal facility.
- **Draft and Final Piling Removal Plan (PRP).** The PRP will be developed during the engineering design for the sediment remediation phase and will comply with the requirements of chapter 173-204 WAC. The PRP will detail the removal of the treated timbers and pilings incorporating the results of the pre-remedial sediment sampling. The PRP will include best management practices as recommended in SCUM, chapter 16.2 – Policy for Removal of Creosote-Treated Pilings.
- **Draft and Final Construction Monitoring Plan (CMP).** The compliance monitoring requirements, which will be developed during the engineering design phase, will comply with the requirements of WAC 173-340-410 and chapter 173-204 WAC. The CMP will propose sampling and documentation required to ensure the remedial action meets the cleanup action objectives in accordance with WAC 173-340-410 and meets the design criteria established in the EDR. The CMP will include, but not be limited to, specific monitoring objectives, scope and

frequency, duration, and contingency responses and triggers. The documents will include methods for the following:

  - Protection monitoring to ensure permit requirements are met, and that human and environmental health is protected during construction.
  - Performance monitoring to confirm that design specification (e.g., final slopes, grades, cap thickness, areal coverage) and cleanup standards are achieved.

- **Draft and Final Operations, Maintenance, and Monitoring Plan (OMMP).** The compliance monitoring requirements, which will be developed during the engineering design phase, will comply with the requirements of WAC 173-340-410 and chapter 173-204 WAC. The OMMP will provide direction for the requirements and schedule for post cleanup monitoring and maintenance, including long-term inspection, monitoring, and maintenance of the soil and sediment caps and long-term groundwater monitoring. The OMMP will also include guidance for conducting contingent actions or otherwise modifying the cleanup action in the future if elements of the cleanup become damaged or are not performing as designed. The OMMP will include, but not be limited to, specific monitoring objectives, scope and frequency, duration, and contingency responses and triggers. The documents will include methods for the following:
  - Confirmational monitoring to confirm the long-term performance of the remedy including cap integrity, over time to ensure the protectiveness and integrity of the remedy is maintained. Confirmational monitoring is also used to assess rates of recovery in EMNR areas and to assess recontamination, if any.
- **30%, 60%, 90%, and 100% Construction plans and specifications (CPS).** The CPS will be developed in compliance with the requirements of WAC 173-340-400(4)(a) and chapter 173-204 WAC. Each subsequent version will address Ecology's comments on the previous version. The CPS will detail how the Ecology-approved engineering design is to be constructed by the contractor. The CPS shall be prepared in conformance with currently accepted engineering practices and techniques.
- **Progress Reports.** Unless otherwise directed by Ecology, monthly progress reports will be developed during design and construction of the cleanup action that describe the actions taken during the previous month to implement the IAP and the implementing order. Following completion of construction of the cleanup action, and unless directed otherwise by Ecology, quarterly progress reports will be submitted. The Progress Reports shall include the following:
  - A list of on-site activities that have taken place during the reporting period.
  - Description of any sample results which deviate from the norm.
  - Detailed description of any deviations from required tasks not otherwise documented in project plans or amendment requests.

  - Description of all deviations from the scope of work and schedule during the current reporting period and any planned deviations in the upcoming reporting period.
  - For any deviations in schedule, a plan for recovering lost time and maintaining compliance with the schedule.
  - All raw data (including laboratory analyses) received during the previous reporting period (if not previously submitted to Ecology), together with a detailed description of the underlying samples collected.
  - A list of planned activities for the upcoming reporting period.
- **Annual construction progress reports.** Following the completion of the construction work season each year, an annual progress report will be developed and submitted to Ecology including a summary of the work completed with a graphical representation of the work performed and progress on the entire project. Annual reports should summarize activities completed during the last construction season which may be determined by in-water windows or based on calendar year. The annual reports should discuss construction issues and resolution and recommend changes for next construction season.
- **Draft and Final Cleanup Action Report (CAR).** A CAR will be developed and submitted in accordance with WAC 173-340-400 (6)(b) and chapter 173-204 WAC after the completion of the cleanup action construction. The CAR will be submitted with graphical representations of the work performed and provide documented evidence that the cleanup action was constructed as designed and that institutional controls have been implemented. In accordance with WAC 173-340-400(6)(b)(ii) the report shall include as built drawings and document all aspects of the construction. The report shall contain an opinion from the engineer, based on testing results and inspections, the cleanup action has been constructed in substantial compliance with the plans and specification and related documents.
- **Periodic Review Data Submittal.** Submit monitoring data, as required, to support periodic reviews every five years while contamination remains at the Site. See Section 6.8.

7.2 Schedule for Actions and Deliverables

Given the complexity of implementation, this schedule (**Table 7-1**) forms a general list of milestones based on the cleanup action. Detailed implementation schedules will be submitted as part of the work plans and reports. Days refers to calendar days.

Table 7-1 Schedule for Actions and Deliverables

	Actions and Deliverables	Due Date
Decision Framework – Sediment	Develop Modeling Approach, Submit Basis of Modeling Memo	60 days after execution of AO Amendment
	Submit Draft Pre-Remedial Design Work Plan (PRDWP) including SAP, QAPP and HSP for review and comment	90 days after execution of AO Amendment
	Submit Final PRDWP incorporating Ecology's comments on the draft PRDWP for review and approval	Within 30 days of comment resolution meeting, but not more than 60 days after receipt of Ecology comments on Draft PRDWP
	Implement Final PRDWP	Within 30 days of approval of PRDWP submit JARPA. Begin sediment data collection within 60 days of permit issuance or as soon as practicable under permit-designated in-water work windows. Complete field work within 60 days.
	Submit final validated data collected during PRDWP implementation to Ecology's Environmental Information Management system	Within 60 days of receipt of final validated data package
	Submit Draft Summary of Pre-Remedial Design Sediment & Hydrodynamic Modeling Results Report (Sediment Report) for review and comment	Within 60 days of receipt of final validated data package
	Submit Final Sediment Report incorporating Ecology's comments on the draft Sediment Report for review and approval	Within 30 days of comment resolution meeting, but not more than 60 days of receipt of Ecology's comments on Draft Sediment Report
Master Plan	Submit Draft Master Plan and Schedule (Master Plan) for review and comment	Within 60 days of Ecology approval of Final Sediment Report
	Submit Final Master Plan incorporating Ecology's comments on the draft Master Plan for review and approval	Within 30 days of receipt of Ecology's comments on Draft Master Plan
	For each phase of work	
Design sampling	Submit **Draft Remedial Design Work Plan (RDWP)** including SAP, QAPP and HSP for review and comment	Within 60 days of Ecology approval of Final Master Plan
	Submit **Final RDWP** incorporating Ecology's comments on the draft RDWP for review and approval	Within 30 days of receipt of Ecology's comments on Draft RDWP
	Implement **Final RDWP**	Begin within 90 days of approval of RDWP or as soon as allowed under permit-designated in-water work windows
	Submit final validated data collected during RDWP implementation to Ecology's Environmental Information Management system	Within 60 days of receipt of final validated data package
	Submit **Draft Summary of Remedial Design Results & Hydrodynamic Modeling Results Report (Summary Report)** for review and comment	Within 60 days of receipt of final validated data package
	Submit **Final Summary Report** incorporating Ecology's comments on the draft Sediment Report for review and approval	Within 30 days of receipt of Ecology's comments on Draft Summary Report

	Actions and Deliverables	Due Date
Design	Submit **Draft Engineering Design Report (EDR)** including **Draft Material Management Plan (MMP), Draft Piling Removal Plan, Draft Construction Monitoring Plan (CMP)**, and **Draft Operations, Maintenance and Monitoring Plan (OMMP)** for review and comment	Within 90 days following Ecology's approval of the Final Summary Report
	Submit **Final EDR** including **MMP, PRP, CMP,** and **OMMP** incorporating Ecology's comments on the draft EDR, CMP, and OMMP for review and approval	Within 60 days of receipt of Ecology's comments on the Draft EDR, MMP, CMP, and OMMP
	Submit **Draft 30%, 60%, and 90% Construction Plans/Specs (CPS)** for Ecology's review and comment. Each subsequent draft must incorporate Ecology's comment on the previous draft	The Draft 30% CPS are due within 60 days of Ecology's approval of the Final EDR. Each subsequent draft is due within 45 days of receipt of Ecology's comments on the previous draft.
	Submit **Final 100% CPS** incorporating Ecology's comments on 90% CPS for Ecology's review and approval	Within 30 days following receipt of Ecology's comments on the 90% CPS
Construction	Construct the remedy according to the EDR and CPS	Within 90 days of Ecology's approval of Final EDR and Final CPS or as soon as in-water work window opens if more than 90 days.
	Progress Reports	Monthly during design and construction. Quarterly after construction completion.
	Annual Construction Progress Summary	Annually within 30 days following the end of the in-water work window for sediment work and October 1 each year for upland work
Post-construction	Submit **Draft Cleanup Action Report (CAR)** for Ecology's review and comment	90 days after completion of construction
	Submit **Final CAR** incorporating Ecology's comments on the Draft CAR for review and approval	30 days after receipt of Ecology's comments on the Draft CAR
	Implement **Institutional Controls (ICs)**.	90 days after completion of construction
	Periodic Review Data Submittal	Submit monitoring results, as required, to support periodic reviews every 5 years following completion of construction as long as contamination remains

8.0 References

Blake A.C., D.B. Chadwick, P.J. White, C.A. Jones. 2007. User's guide for assessing sediment transport at Navy facilities. SSC San Diego, San Diego, CA.

Cascadia Archaeology, 2010. Archaeological Monitoring Plan for Proposed Subsurface Investigation Activities at the Former Rayonier Mill, Port Angeles, Clallam County, Washington. Appendix D of Supplemental Upland Data Collection Work Plan, prepared by GeoEngineers for Rayonier. July 20, 2010.

Prepared for EPA Region 10 Superfund Technical Assessment and Response Team (START). Ecology and Environment, Inc., Seattle, WA.

Ecology. 2000. Deferral Agreement, Rayonier Mill Site. Washington State Department of Ecology, Olympia, WA.

Ecology. 2002. Agreed Order No. DE02SWFAPSR-4570 in the matter of remedial action by Rayonier, Inc, Port Angeles Mill Site. Washington State Department of Ecology, Olympia, WA.

Ecology. 2004. Agreed Order No. DE04SWFAPSR-6025 in the matter of remedial action by Rayonier Properties, LLC, Port Angeles Mill Site. Washington State Department of Ecology, Olympia, WA.

Ecology. 2010. Agreed Order No. DE 6815 in the matter of remedial action by Rayonier Properties LLC, Port Angeles Mill Site. Washington State Department of Ecology, Olympia, WA.

Ecology. 2012. Port Angeles Harbor sediment characterization study, Port Angeles, Washington: sediment investigation report. Washington State Department of Ecology, Lacey, WA.

Ecology. 2013a. Model Toxics Control Act Regulation and Statute. Publication No. 94-06. Washington State Department of Ecology, Olympia, WA.

Ecology. 2013b. Sediment management standards. chapter 173-204 WAC. Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA

Ecology. 2016a. North Olympic Peninsula Regional Background Sediment Characterization Port Angeles – Port Townsend, Washington Data and Evaluation Report. Publication no. 16-09-142. Washington State Department of Ecology, Olympia, Washington.

Ecology. 2016b. Port Angeles Harbor: Total TEQ, Site-Specific Rationale Memo. November 29, 2016. Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA.

Ecology. 2016c. Port Angeles Harbor: Compliance for Bioaccumulative Chemicals Using Sediment Data in Port Angeles Harbor Memo. November 29, 2016. Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA.

Ecology. 2017a. Developing Conditional Points of Compliance at MTCA Sites Where Groundwater Discharges to Surface Water. Implementation Memorandum No. 16. July 25, 2017. Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA.

Ecology. 2017b. Ecology Comments on the Agency Review Draft Interim Action Report Volume III. September 18, 2017. Washington State Department of Ecology, Olympia, Washington.

Ecology. 2021a. Approval of Interim Action Reports: Volumes I, II, and III for the Study Area, Port Angeles Rayonier Mill Site as Final Versions. August 19.

Ecology. 2021b. Sediment cleanup user's manual. Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, chapter 173-204 WAC. December 2021. Pub. no. 12-09-057. Toxics Cleanup Program, Washington State Department of Ecology, Olympia, WA.

Ecology. 2024. Implementation Memorandum No. 25: Identifying Likely Vulnerable Populations and Overburdened Communities under the Cleanup Regulations. Publication 24-09-044. January.

EHS Support. 2021. Agreed Order Task 5 Deliverable, Interim Action Report Volume IV: Draft Interim Action Plan, Port Angeles Rayonier Mill Study Area, Port Angeles, Washington. Agency Review Draft.

Ennis Technical Team. 2010. Ennis Creek & Estuary Restoration Conceptual Plan: A synopsis of the Ennis Technical Team's Planning Efforts. March 15.

EPA. 2014. Record of Decision. Lower Duwamish Waterway Superfund Site. US Environmental Protection Agency.

GeoEngineers. 2013. Materials Management Completion Report, City of Port Angeles Combined Sewer Overflow, Phase I Upgrade Project, Port Angeles Rayonier Mill Site, Port Angeles, Washington. September 6.

GeoEngineers. 2021. Interim Action Report Volume I: Upland Data Summary Report for the Study Area, Port Angeles Rayonier Mill site, Port Angeles, Washington. Final. September 1.

Integral Consulting Inc. (Integral), 2007. Remedial Investigation for the Uplands Environment of the Former Rayonier Mill Site, Port Angeles, Washington (Draft). March 2007.

Kamermans, P. 1994. Similarity in food sources and timing of feeding in deposit- and suspension-feeding bivalves. Marine Ecology Progress Series, Vol 104: 63-75.

Lin and Hines. 1994. Effects of Suspended Food Availability on the Feeding Mode and Burial Depth of the Baltic Clam, Macoma balthica. Oikos, 69(1), 28–36. https://doi.org/10.2307/3545280

LEKT. 1998. Memorandum of Understanding Between the Lower Elwha Klallam Tribe and the United States Environmental Protection Agency Regarding the Rayonier Port Angeles Paper Mill Site. February 1998.

LEKT. 1999. Preliminary Agreement Between the Lower Elwha Klallam Tribe and State of Washington Department of Ecology. March 1999.

LEKT. 1999. Lower Elwha Klallam Tribe and Rayonier Inc. Investigation and Cleanup of the Rayonier Port Angeles Mill Facility Cooperative Agreement. June 1999.

LEKT. 2000. Deferral Agreement Rayonier Mill Site. May 2000.

NewFields. 2014. Port Angeles Harbor--Cleanup Scenarios, Technical Memorandum. Prepared for Washington State Department of Ecology, Lacey, WA. Prepared by NewFields, Edmonds, WA. August 5, 2014.

SAIC. 1999. Port Angeles Harbor wood waste study, Port Angeles, Washington. Final. Science Applications International Corporation, Bothell, WA.

Shea, G.B., C. Ebbesmeyer, Q.J. Stober, K. Pazera, J. Cox, J.M. Helseth, and S. Hemingway, 1981. History, Dispersion and Effects of Pulpmill Effluents on Receiving Waters: Port Angeles, Washington – Final Report. Submitted to U.S. Department of Justice and U.S. Environmental Protection Agency.

Tetra Tech. 2021. Agreed Order Task 4e Deliverable Interim Action Report Volume III: Alternatives Evaluation. Final. September 1.

Wegmann, K.W., J.A. Homburg, D.R. Bohnenstiehl, J.D. Bowman, J.D. Windingstad, E.K. Huber. 2010. Geomorphology of the City of Port Angeles Waterfront. Technical Report 10–82, Statistical Research, Inc.: Tucson.

Windward. 2021. Former Rayonier Mill in Port Angeles, Interim Action Report Volume II: Marine Data Summary Report. Final. September 1.

Tables

Table 4-1. Cleanup Action Objectives

Medium	Objectives
Sediment	Eliminate, reduce, or otherwise control to the extent practicable risks to benthic organisms through exposure to sediments that exceed benthic organism-based sediment quality standards or result in benthic toxicity. Eliminate, reduce, or otherwise control to the extent practicable risks to humans from dermal contact or incidental ingestion of intertidal sediments containing contaminants that exceed human-health based CULs. Eliminate, reduce, or otherwise control to the extent practicable risks to humans from exposure through seafood ingestion to sediment-derived contaminants that exceed human-health based CULs on an area-averaged basis. Eliminate, reduce, or otherwise control to the extent practicable risks to higher-trophic-level organisms from exposure through direct contact or seafood ingestion to sediment-derived contaminants on an area-averaged basis.*
Soil	Eliminate, reduce, or otherwise control to the extent practicable risks to humans from direct contact with soil containing contaminants exceeding human-health based CULs. Eliminate, reduce, or otherwise control to the extent practicable risks to terrestrial ecological receptors from direct contact with soil containing contaminants exceeding ecological-based CULs. Eliminate, reduce, or otherwise control to the extent practicable leaching of constituents to groundwater that would lead to an exceedance of groundwater CULs.
Groundwater	Eliminate, reduce, or otherwise control to the extent practicable risks to aquatic life and humans from the migration of upland groundwater to marine surface water and sediment. Prevent potable uses of groundwater. Upland groundwater is considered non-potable due to the proximity and hydraulic connection to marine surface water.

* Because risks for fish and wildlife were low (Ecology 2012a), NewFields (2013) concluded that the risk-based levels derived for human seafood consumption are protective of fish and wildlife. Therefore, CULs were not derived for higher-trophic-level species.

CUL – cleanup level

Table 4-2. Soil Cleanup Levels and Points of Compliance

IHS	CUL (mg/kg)	Basis	POC
Arsenic	20	Unrestricted (Method A) (background)	0 to 15 feet bgs
Iron	56,000	Unrestricted (HH – non cancer)	0 to 15 feet bgs
Lead	250	Unrestricted (Method A) (Prevent unacceptable blood lead levels)	0 to 15 feet bgs
Zinc	302	Unrestricted (Ecological)	0 to 6 feet bgs
Thallium	0.8	Unrestricted (HH – non cancer)	0 to 15 feet bgs
cPAHs TEQ	1.0	Unrestricted (HH – carcinogen)	0 to 15 feet bgs
Pentachlorophenol	2.5	Unrestricted (HH – carcinogen)	0 to 15 feet bgs
Dioxin TEQ	0.000013	Unrestricted (HH – carcinogen)	0 to 15 feet bgs
PCB – total	0.5	Unrestricted (HH – carcinogen)	0 to 15 feet bgs
TPH – Diesel range	200	Unrestricted (Ecological)	0 to 6 feet bgs
TPH – Heavy oil range	2000	Unrestricted (Method A) (Prevent free product on GW)	0 to 15 feet bgs

bgs –below ground surface
cPAHs – carcinogenic polycyclic aromatic hydrocarbons
GW – groundwater
HH – human health
mg/kg – milligrams per kilogram
PCB – polychlorinated biphenyl
TEQ – toxic equivalent
TPH – total petroleum hydrocarbons

Table 4-3. Groundwater Cleanup Levels

IHS	CUL (µg/L)	Basis
pH	7.0-8.5 (unitless)	Protection of marine surface water aquatic life
Ammonia (un-ionized)	35	Protection of marine surface water aquatic life
Arsenic	5	Natural background
Copper	3.1	Protection of marine surface water aquatic life
Manganese	910	Protection of marine surface water – human health
Nickel	8.2	Protection of marine surface water aquatic life
cPAHs (TEQ)	0.015	PQL
Acenaphthene	3.3	Protection of marine sediment

cPAHs – carcinogenic polycyclic aromatic hydrocarbons
PQL – practical quantitation limit µg/L– micrograms per liter

Table 4-4. Sediment Cleanup Levels Protective of Human Health

IHS	Unit	CUL – CSL	Basis
Arsenic	mg/kg	14	Regional background
Cadmium	mg/kg	2.4	Regional background
Copper	mg/kg	35	Natural background
Selenium	mg/kg	0.6	PQL
Zinc	mg/kg	77	Natural background
Total mercury	mg/kg	0.13	Regional background
alpha-BHC	µg/kg	1.3	PQL
cPAH TEQ	µg/kg	64	Regional background
Total TEQ	ng/kg	5.2	Regional background

alpha-BHC – alpha-benzenehexachloride
cPAH – carcinogenic polycyclic aromatic hydrocarbon
CSL – cleanup screening level
CUL – cleanup level
mg/kg – milligrams per kilogram
ng/kg – nanograms per kilogram
PQL – practical quantitation limit
µg/kg – micrograms per kilogram

Table 4-5. Sediment Cleanup Levels Protective of Benthic Community

IHS	Unit	CUL	Basis
Mercury	mg/kg dw	0.41	SCO
Acenaphthene	mg/kg OC	16	SCO
Benzo(g,h,i)perylene	mg/kg OC	31	SCO
Chrysene	mg/kg OC	110	SCO
Dibenzofuran	mg/kg OC	15	SCO
Fluoranthene	mg/kg OC	160	SCO
Fluorene	mg/kg OC	23	SCO
Indeno(1,2,3-cd)pyrene	mg/kg OC	34	SCO
Phenanthrene	mg/kg OC	100	SCO
Pyrene	mg/kg OC	1000	SCO
Total HPAH	mg/kg OC	960	SCO
Total LPAH	mg/kg OC	370	SCO
bis(2-ethylhexyl)phthalate	mg/kg OC	47	SCO
2,4-dimethylpenol	µg/kg dw	29	SCO
2-methylphenol	µg/kg dw	63	SCO
4-methylphenol	µg/kg dw	670	SCO
phenol	µg/kg dw	420	SCO
Total PCBs	mg/kg OC	12	SCO

HPAH – high molecular weight polycyclic aromatic hydrocarbon
LPAH – low molecular weight polycyclic aromatic hydrocarbon
mg/kg dw – milligrams per kilogram of dry weight
mg/kg OC – milligrams per kilogram of organic carbon
PCB – polychlorinated biphenyl
SCO – Sediment Cleanup Objectives
µg/kg dw – micrograms per kilogram of dry weight

Table 4-6. Sediment Points of Compliance

Area	Area Definition	Exposure Route	Point of Compliance	Applicable IHS	Comparison to Standards
Entire SCU	MHHW to boundary defined by COCs > SCL	Protection of human health – ingestion of fish and mobile shellfish (crab, shrimp)	10 cm	All	SWAC
Entire SCU	MHHW to boundary defined by COCs > SCL	Protection of aquatic life (benthic organisms)	10 cm	All	Station by station
Intertidal Area	MHHW to MLLW	Protection of human health – Ingestion of sessile shellfish (bivalves)	45 cm	Includes All (cPAHs and metals) except Total TEQ[a]	SWAC (SWAC beach segments separately if applicable)
Intertidal Area	MHHW to MLLW	Protection of human health – direct contact (contact with and ingestion of sediment)	45 cm	All	SWAC

* Total TEQ combines dioxin/furan and PCB TEQs.
cm – centimeter
COC – constituent of concern
cPAH – carcinogenic polycyclic aromatic hydrocarbon
IHS – indicator hazardous substance
MHHW – mean higher high water
MLLW – mean lower low water
PCB – polychlorinated biphenyl
SCL – sediment cleanup level
SCU – sediment cleanup unit
SMA – sediment management area
SWAC – spatially weighted average concentration
TEQ – toxic equivalent

Table 5-1. Summary of the Soil Remediation Alternatives Evaluation

Criteria	Alternative SL-1 Cover	Alternative SL-2 Consolidation with RELs	Alternative SL-3 Consolidation	Alternative SL-4 Excavation with RELs	Alternative SL-5 Excavation
Alternative components	• Clear and grub upland excavation and cover areas. • Demolish concrete pads within the excavation area for repurposing onsite or for offsite disposal. • Excavate Ennis Creek area to meet CULs; place material in area to be covered. • Backfill excavation to design grade. • Install an aggregate cover (permeable geotextile covered by 1 ft of crushed rock). • Place and hydroseed topsoil (1-ft layer) in the capped areas. • Install fence and/or signs as needed to protect cover. • Conduct post-construction cover monitoring for 30 years. • Record an environmental covenant for the property.	• Clear and grub upland excavation and cover areas. • Demolish concrete pads within the excavation area for repurposing onsite or for offsite disposal. • Remove soil in excavation areas to meet RELs; place material in consolidation area to be covered. • Backfill excavations to design grade. • Install an aggregate cover (permeable geotextile covered by 1 ft of crushed rock). • Place and hydroseed topsoil (1-ft layer) in the capped areas. • Install fence and/or signs as needed to protect cover and limit site trespassing. • Conduct post-construction cover monitoring for 30 years. • Record an environmental covenant for the property.	• Clear and grub upland excavation and cover areas. • Demolish concrete pads within the excavation area for repurposing onsite or for offsite disposal. • Remove soil in excavation areas to meet CULs; place material in consolidation area to be covered. • Backfill excavations to design grade. • Install an aggregate cover (permeable geotextile covered by 1 ft of crushed rock). • Place and hydroseed topsoil (1-ft layer) in the capped areas. • Install fence and/or signs as needed to protect cover and limit site trespassing. • Conduct post-construction cover monitoring for 30 years. • Record an environmental covenant for the property.	• Clear and grub excavation area. • Demolish concrete pads within the excavation area for repurposing onsite or for offsite disposal. • Remove soil in excavation areas to meet RELs; transport for disposal at Subtitle D landfill. • Backfill to design grade. • Install fence and/or signs as needed to limit site trespassing. • Record an environmental covenant for the property.	• Clear and grub excavation area. • Demolish concrete pads within the excavation area for repurposing onsite or for offsite disposal. • Remove soil in excavation areas to meet CULs; transport for disposal at Subtitle D landfill. • Backfill to design grade.
Protection of human health and the environment	**Yes –** Alternative will protect human health and the environment through a combination of excavation, containment (aggregate cap), cap monitoring/ maintenance, and ICs.	Same as Alternative SL-1.	Same as Alternative SL-1.	**Yes –** Alternative will protect human health and the environment through a combination of excavation with offsite disposal and ICs.	**Yes –** Alternative will protect human health and the environment through excavation with offsite disposal.
Compliance with cleanup standards	**Yes –** Alternative is expected to comply with cleanup standards.	Same as Alternative SL-1.	Same as Alternative SL-1.	Same as Alternative SL-1.	Same as Alternative SL-1.
Compliance with applicable state and federal regulations	**Yes –** Alternative will comply with applicable state and federal regulations.	Same as Alternative SL-1.	Same as Alternative SL-1.	Same as Alternative SL-1.	Same as Alternative SL-1.
Provision for compliance monitoring	**Yes –** Alternative will include provision for compliance monitoring.	Same as Alternative SL-1.	Same as Alternative SL-1.	Same as Alternative SL-1.	Same as Alternative SL-1.
Restoration time frame*	**No more than 7 years** Restoration time frame will include design, permitting, contracting and construction of the remedy, and implementation of ICs. Exposure pathways will be eliminated once construction has been completed and ICs have been implemented. The anticipated restoration time frame is considered to be reasonable.	Same as Alternative SL-1.	Same as Alternative SL-1.	Same as Alternative SL-1.	Same as Alternative SL-1.

Criteria	Alternative SL-1 Cover	Alternative SL-2 Consolidation with RELs	Alternative SL-3 Consolidation	Alternative SL-4 Excavation with RELs	Alternative SL-5 Excavation
Protectiveness	**Score = 8** Meets residential standards with reliance on containment (cover) and ICs (environmental covenant).	**Score = 6** Protective for any reasonable exposure scenario. Meets RELs with reliance on containment (cover) and ICs (environmental covenant).	**Score = 9** Meets residential standards with reliance on containment (cover) and ICs (environmental covenant). More excavation and smaller cover than SL-1.	**Score = 7** Protective for any reasonable exposure scenario; soil exceeding RELs removed from Site.	**Score = 10** Most protective – meets residential standards throughout site.
Permanence	**Score = 5** Requires maintenance of large covers and ICs for permanence.	**Score = 6** Requires maintenance of cover and ICs for permanence. Land use change could require additional action.	**Score = 7** Requires maintenance of cover and ICs for permanence. Most of site meets unrestricted criteria at standard POC.	**Score = 8** Permanent unless land use changed to require additional action.	**Score = 9** Most permanent. Returns site to uncontaminated condition (soil), provided regulatory limits do not become stricter.
Management of short-term risks	**Score = 9** Construction methods and safety protocols for excavation and cover are well established and associated short-term risks are expected to be low. Chemical hazards associated with potential exposure to contaminants during construction also are expected to be low because appropriate health and safety procedures and BMPs will be used.	**Score = 8** This alternative ranks between Alternatives SL-1 and SL-3 because it requires handling more contaminated soil than SL-1, but not as much as SL-3.	**Score = 7** This alternative ranks lower than Alternatives SL-1 and SL-2 because it requires handling more contaminated soil.	**Score = 6** This alternative ranks lower than Alternatives SL-1, SL-2, and SL-3 because it will include the excavation, handling, and offsite transport of contaminated soil.	**Score = 5** This alternative ranks lower than Alternative SL-4 because it will include additional excavation and the handling and offsite transport of a larger volume of contaminated soil.
Technical and administrative implementability	**Score = 9** Construction methods for excavation and covers are well established; significant technical and administrative obstacles to implementation are not anticipated.	**Score = 9** Same as Alternative SL-1.	**Score = 9** Same as Alternative SL-1	**Score = 6** This alternative ranks lower than Alternatives SL-1, SL-2, and SL-3 because it will include the offsite transport and disposal.	**Score = 6** Same as Alternative SL-4.
Consideration of public concerns	**Score = 4** As determined by Ecology following public comment on the Public Review Draft of Volume III.	**Score = 1** As determined by Ecology following public comment on the Public Review Draft of Volume III.	**Score = 5** As determined by Ecology following public comment on the Public Review Draft of Volume III.	**Score = 1** As determined by Ecology following public comment on the Public Review Draft of Volume III.	**Score = 10** As determined by Ecology following public comment on the Public Review Draft of Volume III.
Long-term effectiveness	**Score = 6** Alternative effectiveness depends on cover maintenance and maintenance of ICs.	**Score = 7** Smaller cover than SL-1 increases the expected long-term effectiveness.	**Score = 8** Larger excavation area than SL-2 increases the expected long-term effectiveness.	**Score = 8** More protective than SL-2 because uses excavation throughout area that exceeds RELs.	**Score = 10** Most effective in long term because contamination removed from site.

*Restoration time frame is a MTCA-defined criterion.
BMP – best management practice
CUL – cleanup level
IC – institutional control
MTCA – Model Toxics Control Act

Table 5-2. Summary of the Groundwater Remediation Alternatives Evaluation

Criteria	Alternative G-1 Sparging	Alternative G-2 Funnel and Gate	Alternative G-3 In-Situ Treatment
Alternative components	• Perform pilot testing in MW-56 area to determine effectiveness and determine design parameters. • Install sparge wells (30 ft spacing assumed) highest priority area. Operate for 3 months, observe potential rebound for 1 month. Repeat two additional times. (Timing assumed.) • Expand air sparging system as needed to meet cleanup standards at the CPOC. • Operate as needed to attain CULs consistently; assumed 3 years. • Perform post-remediation performance and confirmational groundwater monitoring for 30 years. • Record an environmental covenant for the property.	• Perform bench-scale testing to confirm effectiveness of treatment media and determine design parameters for full-scale implementation. • Clear and grub construction areas. • Demolish concrete pads within the construction areas for repurposing onsite or for offsite disposal. • Excavate soil for installation of "gate" sections in East and West Mill Areas. • Pre-trench "funnel" sections (sheet pile walls) to remove subsurface obstructions. • Transport excavated soil from gate and funnel sections to Subtitle D landfill. • Install sheet pile walls to depth of 40 ft in East and West Mill Areas (10-ft key-in to till layer). • Install temporary shoring (sheet piles) for reactive media installation in gate sections. • Install five reactive media gates. • Install groundwater monitoring wells for performance and confirmational monitoring. • Perform post-construction performance and confirmational groundwater monitoring for 30 years. • Record an environmental covenant for the property.	• Perform bench- and pilot-scale testing to identify effective ISCO/ISCF reagents and determine design parameters for full-scale implementation. • Install injection wells for reagent delivery (30-ft spacing between injection wells along treatment transects assumed). • Assume two reagents required for treatment of organics and metals. • Assume three injection events per reagent per treatment area will be required to achieve CULs. • Perform process monitoring during each injection event to assess reagent injection concentrations, volumes, flow rates, and radius of influence. • Perform performance and confirmational groundwater monitoring for 5 years. • Record an environmental covenant for the property.
Protection of human health and the environment	**Yes –** Alternative will be protective of human health and the environment.	**Yes –** Alternative will be protective of human health and the environment.	**Yes –** Alternative will be protective of human health and the environment.
Compliance with cleanup standards	**Yes –** Alternative is expected to comply with cleanup standards. This alternative will use air sparging to reduce contaminant concentrations below CULs in conjunction with ICs to prevent potable uses of groundwater and restrict future actions that could reduce effectiveness of the remedy. **Compliance will rely on long-term monitoring and ICs. Conditional POC** required.	**Yes –** Alternative is expected to comply with cleanup standards. This alternative will use PRBs to reduce contaminant concentrations below CULs in conjunction with ICs and monitoring as described in Alternative G-2. Maintenance of the PRB, and possible replacement would be required. Conditional POC required.	**Yes –** Alternative is expected to comply with cleanup standards. This alternative will use ISCO to reduce contaminant concentrations below CULs in conjunction with ICs to prevent potable uses of groundwater. Compliance will rely on ICs. Standard POC.
Compliance with applicable state and federal regulations	**Yes**.	**Yes.**	**Yes.**
Provision for compliance monitoring	**Yes –** Alternative will include a provision for compliance monitoring.	**Yes –** Alternative will include a provision for compliance monitoring.	**Yes –** Alternative will include a provision for compliance monitoring.
Restoration time frame*	**No more than 10 years.**	**No more than 10 years.**	**No more than 10 years.**
Protectiveness	**Score = 7** Will use air sparging of upland groundwater to protect the groundwater to marine surface water/sediment pathway. Limited area action requires long- term monitoring.	**Score = 8** Will use *in situ* treatment of upland groundwater (PRBs) to protect the groundwater to marine surface water/sediment pathway. Limited area action requires long-term monitoring.	**Score = 9** Will use *in situ* treatment of upland groundwater (ISCO/ISCF) to protect the groundwater to marine surface water/sediment pathway. Full Upland Study Area actively addressed.

Criteria	Alternative G-1 Sparging	Alternative G-2 Funnel and Gate	Alternative G-3 In-Situ Treatment
Permanence	**Score = 7** Would use active air sparging treatment to permanently reduce contaminant mass in selected locations where contaminants would otherwise have greatest likelihood of reaching marine environment at concentrations in excess of CULs.	**Score = 8** Would use passive *in situ* groundwater treatment to permanently reduce contaminant mobility near the upland margin.	**Score = 9** Would use active *in situ* groundwater treatment to permanently reduce contaminant mass throughout the upland in locations where contaminants exceeded CULs.
Long-term effectiveness	**Score = 4** Would use active treatment in specified locations and would require long term monitoring.	**Score = 6** Would use passive *in situ* groundwater treatment to permanently reduce contaminant mobility near the upland margin. Long-term monitoring and potential maintenance would be required.	**Score = 9** Would use active *in situ* groundwater treatment to permanently reduce contaminant mass throughout the upland in locations where contaminants exceeded CULs.
Management of short-term risks	**Score = 8** Ranks higher than the other alternatives because the construction methods for air sparging will be less complicated than required for PRBs and ISCO/ISCF and will not involve the use of reactive media or industrial chemicals.	**Score = 5** The construction methods for PRB installation in an upland setting with relic subsurface structures will be more complicated than the methods required for air sparging.	**Score = 3** Would use large quantities of oxidants and/or other industrial chemicals for *in situ* groundwater treatment.
Technical and administrative implementability	**Score = 8** Ranks higher than the other alternatives because the construction methods for air sparging will be less complicated than methods required for PRBs and ISCO/ISCF.	**Score = 3** The construction methods for PRB installation in an upland setting with relic subsurface structures will be more complicated than the methods required for air sparging.	**Score = 2** Ranks lower than the other alternatives due to the technical challenges of working with large quantities of oxidants and/or other industrial chemicals.
Consideration of public concerns	**Score = 5** As determined by Ecology following public comment on the Public Review Draft of Volume III.	**Score = 5** As determined by Ecology following public comment on the Public Review Draft of Volume III.	**Score = 10** As determined by Ecology following public comment on the Public Review Draft of Volume III.

*Restoration time frame is the MTCA-defined criterion.
CULs – cleanup levels
IC – institutional control
ISCF – in situ chemical fixation
ISCO – in situ chemical oxidation
MTCA – Model Toxics Control Act
PRB – permeable reactive barrier

Table 5-3. Summary of Sediment Remediation Alternatives Evaluation

Criteria	Alternative S-1	Alternative S-2	Alternative S-3	Alternative S-4	Alternative S-5
Alternative Components	• Dredge/excavate log pond intertidal and dock landing (3.8 acres) • Apply ENR in remainder (47.8 acres)	• Dredge/excavate log pond intertidal and dock landing (3.8 acres) • Fill/apply ENR in berths (6.1 acres) • Apply ENR in remainder (41.7 acres)	• Dredge/excavate log pond intertidal and dock landing (3.8 acres) • Cap in log pond subtidal (5.7 acres) • Dredge under the mill dock (3.9 acres) • Fill and apply ENR in berths (6.1 acres) • Apply ENR in remainder (32.1 acres)	• Dredge/excavate entire log pond and dock landing (9.5 acres) • Fill/apply ENR in berths (6.1 acres) • Apply ENR in remainder (36 acres)	• Dredge/excavate all subareas (51.6 acres)
1. Compliance with MTCA Threshold Criteria					
Protection of human health and the environment	**Yes.** This alternative will protect human health and the environment through the attenuation of contaminant concentrations within the sediment depth of compliance. Monitoring and, if needed, maintenance will be implemented to ensure long-term protection.	**Yes.** See Alternative S-1. Filling and applying ENR in the berths will further enhance protection of remaining contaminated sediment.	**Yes**. See Alternative S-1. Capping subtidal log pond, dredging under the mill dock, and filling and application of ENR in the berths will further enhance protection of remaining contaminated sediment.	**Yes.** See Alternative S-1. Removal in the entire log pond and filling and applying ENR in the berths will further enhance protection of remaining contaminated sediment.	**Yes.** This alternative will protect human health and the environment through the removal of contaminated sediment in all SRSs.
Compliance with cleanup standards	**Yes.** This alternative is expected to comply with SMS and applicable CULs identified for the sediment remediation area. This alternative will use ENR to attenuate contaminants and achieve CULs.	**Yes.** See Alternative S-1. This alternative is expected to comply with SMS and applicable CULs identified for the sediment remediation area.	See Alternative S-1. In addition, this alternative is expected to comply with SMS and applicable cleanup levels by capping of sediment from subtidal log pond and removal under the mill dock in areas with higher concentrations of COCs.	See Alternative S-1. In addition, this alternative is expected to comply with SMS and applicable cleanup levels by removal of sediment from subtidal log pond in areas with higher concentrations of COCs.	**Yes.** This alternative is expected to comply with SMS and applicable CULs identified for the sediment remediation area. This alternative will use removal of contaminated sediments to achieve CULs.
Compliance with applicable state and federal regulations	**Yes.** This alternative will comply with applicable federal and state regulations.	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.
Provision for compliance monitoring	**Yes.** This alternative will include provisions for compliance monitoring and maintenance, if needed.	See Alternative S-1.	See Alternative S-1. Capped area will require a more robust long term monitoring program to verify protectiveness and permanence.	See Alternative S-1.	See Alternative S-1.
2. Compliance with Other MTCA and SMS Requirements (Ecology 2013c)					
Permanent solutions to the maximum extent practicable	Permanence will rely on proper application of ENR and maintenance, if needed. Limited area to be excavated/dredged will be permanently remediated.	Permanence will rely on proper application of ENR, design and placement of fill/ENR, and maintenance, if needed. Excavated/dredged subareas will be permanently remediated.	See Alternative S-2. Cap area will be monitored and maintained to ensure permanency.	See Alternative S-2.	Excavated/dredged subareas will be permanently remediated.
Restoration time frame*	The time frame for this alternative will be < 10 years.	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.
Preference for most effective source control measures	Offsite contaminant sources will be addressed, to the extent practicable, through cleanup/source control actions by others. This criterion is therefore not applicable.	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.
Issuance of SRZ	Not necessary. The alternative is expected to achieve applicable CULs within a time period ≤ 10 years.	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.
Compliance with ICs	This alternative will not interfere with any existing IC compliance. No additional ICs are required.	See Alternative S-1.	See Alternative S-1 in terms of compliance with existing ICs. Additional ICs are required to protect cap.	See Alternative S-1.	See Alternative S-1.
Provisions for public review	**Yes.** The Cleanup Action Plan will include provisions for public review.	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.
	Periodic review by Ecology is anticipated	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.	See Alternative S-1.

Criteria	Alternative S-1	Alternative S-2	Alternative S-3	Alternative S-4	Alternative S-5
3. Disproportionate Cost Analysis Relative Benefits Ranking (scored from lowest [1] to highest [10])					
Protectiveness	**Score = 6** Alternative will meet IAOs upon completion based on proper placement of ENR layer.	**Score = 7** Alternative will meet IAOs upon completion based on proper placement of ENR layer. Alternative will be slightly more protective than Alternative S-1 because berths will be filled.	**Score = 8** Level of protectiveness will be higher than Alternative S-2 due to cap in the subtidal long pond and dredging under the mill dock.	**Score = 8** Same level of protectiveness is expected as in Alternative S-3.	**Score = 10** Higher level of protectiveness is expected as a result of contaminated sediment removal in all SRSs.
Permanence	**Score = 6** Score is based on the potential need to replenish the ENR material.	**Score = 7** Similar to Alternative S-1. Some incremental additional permanence will be associated with fill and ENR placement in the berths.	**Score = 8** Achieves a permanent risk reduction (reduction in mass, toxicity, and mobility) in the areas by capping and dredging; other areas similar to Alternative S-2	**Score = 8** Same level of permanence as in Alternative S-3. Achieves a permanent risk reduction (reduction in mass, toxicity and mobility) in the areas by dredging subtidal log pond; other areas are similar to Alternative S-2	**Score = 9** Higher level of permanence will result from area-wide dredging.
Long-term effectiveness	**Score = 4** Long-term effectiveness will depend on ENR performance and long-term maintenance.	**Score = 6** Long-term effectiveness is higher than Alternative 1 due to fill/ENR in berths.	**Score = 7** Long-term effectiveness is higher than Alternative S-2 due to capping in the log pond and dredging under the mill dock.	**Score = 8** Total dredge area is slightly higher than Alternative S-3.	**Score = 10** This alternative achieves the highest score because the maximum volume of contaminated sediment will be removed.
Management of short-term risks†	**Score = 9** ENR represents the least intrusive remediation technology and will have the lowest risk to benthic habitat. ENR will also have the lowest risk of contaminant dispersion during implementation. Potential exposure of workers and the public to contaminated sediment will also be minimized. Remedial action is estimated to be completed in one construction season.	**Score = 8** Same as Alternative S-1. Some redistribution of contaminated sediment from the berths during filling might occur, representing a short-term risk to adjacent sediment quality and biota. Remedial action is estimated to be completed in 1.5 construction seasons.	**Score = 5** This alternative will include capping in the log pond (5.7 acres) and dredging under the mill dock (3.9 acres), , which will result in some incremental additional short-term impacts . Total dredge area is 7.7 acres. Dredging is the most intrusive of the remedial technologies and can generate dredging residuals that may have short-term impacts. Transfer, processing, staging, and transport of dredged materials also represents a possible risk to workers and the public. Remedial action is estimated to be completed in 2 construction seasons.	**Score = 4** Similar to Alternative S-3 but has more dredging. Total dredge area is 9.5 acres. Remedial action is estimated to be completed in 2 construction seasons.	**Score = 1** Total dredge area is 51.6 acres. Dredging is the most intrusive of the remedial technologies and can generate dredging residuals that may have short-term impacts. Transfer, processing, staging, and transport of dredged materials also represents a possible risk to workers and the public. Remedial action is estimated to be completed in 4 construction seasons.
Technical and administrative implementability	**Score = 8** ENR can be readily implemented. Post placement monitoring would be required to ensure proper coverage and application.	**Score = 7** ENR can be readily implemented (see Alternative S-1). Filling/ENR of the berths would be feasible because they consist of formerly dredged areas (depressions) that would contain fill placement without the need for perimeter or toe armoring. Administrative challenges could include coordination with DNR to place fill on state-owned tidelands.	**Score = 4** Fill/ENR of the berth can be readily implemented. Capping requires additional administrative concurrence with the landowner but technically, can be readily implemented. Dredging under the dock is more intrusive and requires management of dredged materials that will require successful sediment dewatering, processing and final disposition. Dependent upon availability of disposal options. Administrative challenges could include coordination with DNR to place fill/cap on state-owned tidelands.	**Score = 5** Similar to Alternative S-3 but has more dredging (additional 1.8 acres) but does not include capping. ENR and filling of the berth and approach can be readily implemented. More intrusive remediation and management of dredged materials will require successful sediment dewatering, processing and final disposition.	**Score = 3** More intrusive remediation and management of large quantities of dredged materials will require large amounts of sediment dewatering, processing, and final disposition. Technical implementability will be governed by the availability of disposal options, which can periodically change.
Consideration of public concerns	**Score = 1** As determined by Ecology following public comment on the Public Review Draft of Volume III.	**Score = 2** As determined by Ecology following public comment on the Public Review Draft of Volume III.	**Score = 4** As determined by Ecology following public comment on the Public Review Draft of Volume III.	**Score = 6** As determined by Ecology following public comment on the Public Review Draft of Volume III.	**Score = 10** As determined by Ecology following public comment on the Public Review Draft of Volume III.

* Restoration time frame is the MTCA-defined criterion.
† Construction duration was estimated by assuming the following production rates: Dredging in the log pond – 300 cy/day; Dredging/excavation elsewhere – 400 cy/day; ENR, cap, residual management layer placement – 400 cy/day; Fill – 500 cy/day.

CAP – cleanup action plan
CUL – cleanup level
cy – cubic yard
DNR – Washington State Department of Natural Resources
ENR – enhanced natural recovery
IAO – interim action objectives
IC – institutional control
MTCA – Model Toxics Control Act
SMS – Washington State Sediment Management Standards
SRS – sediment remediation subarea
SRZ – sediment recovery zone

Table 5-4. Disproportionate Cost Analysis for the Soil Remediation Alternatives

Criteria	Criterion Weighting (%)	Alternative SL-1 Cover	Alternative SL-2 Consolidation with RELs	Alternative SL-3 Consolidation	Alternative SL-4 Excavation with RELs	Alternative SL-5 Excavation
1. Compliance with MTCA threshold criteria	NA	Yes	Yes	Yes	Yes	Yes
2. Reasonable restoration time frame	NA	Yes	Yes	Yes	Yes	Yes
3. DCA relative benefits score						
Protectiveness	30%	8	6	9	7	10
Permanence	20%	5	6	7	8	9
Long-Term effectiveness	20%	6	7	8	8	10
Management of short-term risks	10%	9	8	7	6	5
Technical and administrative implementability	10%	9	9	9	6	6
Consideration of public concerns	10%	4	1	5	1	10
Total benefits score		**6.8**	**6.2**	**7.8**	**6.6**	**8.9**
4. Disproportionate cost analysis						
Estimated cost (+50%/-30%, rounded)	NA	$11,000,000	$7,400,000	$10,000,000	$28,000,000	$37,000,000
Ratio of cost to lowest-cost alternative	NA	1.5	1.0	1.4	3.8	5.0
Ratio of relative benefits to cost (total benefits/cost [$M] x 10)	NA	6.2	8.4	7.8	2.4	2.4
Overall Ranking		**3rd**	**1st**	**2nd**	**T-4th**	**T-4th**

Table 5-5. Disproportionate Cost Analysis for the Groundwater Remediation Alternatives

Criteria	Criterion Weighting (%)	Alternative G-1 Sparging	Alternative G-2 Funnel and Gate	Alternative G-3 In-Situ Treatment
1. Compliance with MTCA threshold criteria	NA	Yes	Yes	Yes
2. Reasonable restoration time frame	NA	Yes	Yes	Yes
3. DCA relative benefits score				
Protectiveness	30%	7	8	9
Permanence	20%	7	8	9
Long-Term effectiveness	20%	4	6	9
Management of short-term risks	10%	8	5	3
Technical and administrative implementability	10%	8	3	2
Consideration of public concerns	10%	5	5	10
Total benefits score		**6.4**	**6.5**	**7.8**
4. Disproportionate cost analysis				
Estimated cost (+50%/-30%, rounded)	NA	$5,700,000*	$23,000,000	$35,000,000
Ratio of cost to lowest-cost alternative	NA	1.0	4.0	6.1
Ratio of relative benefits to cost (total benefits/cost [$M] x 10)	NA	11.2	2.8	2.2
Overall Ranking		**1st**	**2nd**	**3rd**

* This assumes full implementation of sparging. Estimated cost range is $2,138,000 to $5,714,000 depending on whether the full system is needed to meet CULs at the POC.

Table 5-6. Disproportionate Cost Analysis for the Sediment Remediation Alternatives

Criteria	Criterion Weighting (%)	Alternative S-1	Alternative S-2	Alternative S-3	Alternative S-4	Alternative S-5
1. Compliance with MTCA threshold criteria	NA	Yes	Yes	Yes	Yes	Yes
2. Reasonable restoration time frame	NA	Yes	Yes	Yes	Yes	Yes
3. DCA relative benefits score						
Protectiveness	30%	6	7	8	8	10
Permanence	20%	6	7	8	8	10
Long-Term effectiveness	20%	4	6	7	8	10
Management of short-term risks	10%	10	8	5	4	1
Technical and administrative implementability	10%	8	7	4	5	3
Consideration of public concerns	10%	1	2	4	6	10
Total benefits score		**5.7**	**6.4**	**6.7**	**7.1**	**8.4**
4. Disproportionate cost analysis						
Estimated cost (+50%/-30%, rounded)	NA	$9,953,000	$10,872,000	$15,213,000	$18,023,000	$55,343,000
Ratio of relative benefits to cost (total benefits/cost [$M] x 100)	NA	57.3	58.9	44.0	39.4	15.2
Overall Ranking		**2nd**	**1st**	**3rd**	**4th**	**5th**

Table 6-1. Decision Framework Outline for Benthic Protection

Erosion Modeling Results[1, 2]	Surface Sediment Chemistry[3]	Subsurface Chemistry Results	Potential Remedial Consideration[4]
Erosive	Surface Sediment Chemistry ≥SCO	NA	Dredging[5]
	Surface Sediment Chemistry < SCO	Subsurface[5] > SCO	Dredging or thin layer cap[6]
		Subsurface < SCO	No action
Non-Erosive	Surface Sediment Chemistry ≥3X SCO (subtidal) or 1.5X SCO (intertidal)[7]	NA	Dredging
	3X SCO (subtidal) or 1.5X SCO (intertidal) >Surface Sediment Chemistry ≥ SCO	Subsurface > surface	EMNR or Dredging[8]
		Subsurface < surface	EMNR
	Surface Sediment Chemistry< SCO	Subsurface > surface	No action or EMNR[9]
		Subsurface < surface	No action

Notes:

1. Erosive is defined as a net annual loss of sediment following removal of structures.
2. Non-erosive is defined as a static equilibrium or net annual deposition of sediment following removal of structures.
3. The surface sediment point of compliance for benthic protection is 10 cm.
4. Remedy preference order based on permanence: 1. dredging, 2. thin-layer capping, 3. EMNR.
5. Potential new surface after erosion.
6. Erosive. EMNR not appropriate in erosive areas; a thin layer cap may be considered an appropriate remedy if the cap material creates a non-erosive surface overlying the in-situ subsurface sediments.
7. This is a site-specific remediation level. The 3X SCO applies only to subtidal sediment areas. For intertidal areas use 1.5X SCO. EPA 2014.
8. If higher contamination at depth will remain buried below the biologically active zone, then EMNR. If higher contamination at depth may be exposed or carried upwards through bioturbation or other disturbance, then dredging.
9. If higher contamination at depth may be exposed or carried upwards through bioturbation or other disturbance, then EMNR

SCO – Sediment Cleanup Objective for benthic protection
EMNR – Enhanced Monitored Natural Recovery
NA – Not Applicable

Table 6-2. Decision Framework Outline for Human Health Protection

Erosion Modeling Results[1,2]	SMA SWAC[4] compared to SCU SWAC[5]	Subsurface Chemistry Results	Potential Remedial Consideration[6]
Erosive	SMA SWAC ≥ SCU SWAC[7]	NA	Dredging[8]
	SMA SWAC < SCU SWAC	Subsurface > Surface	Dredging or thin layer cap[9]
		Surface > Subsurface > Clean	Dredging or thin layer cap[9]
		Clean Subsurface	Dredging or thin layer cap[9]
Non-Erosive	SMA SWAC ≥ SCU SWAC	Subsurface > Surface	Dredging[10] or EMNR
		Surface > Subsurface > Clean	Dredging[10] or EMNR
		Clean Subsurface	Dreding[10] or EMNR
	SMA SWAC < SCU SWAC	Subsurface > Surface	EMNR
		Surface > Subsurface > Clean	EMNR
		Clean Subsurface	EMNR

Notes:

[1] Erosive is defined as a net annual loss of sediment following remedial activities.
[2] Non-erosive is defined as a static equilibrium or net annual deposition of sediment following remedial activities.
[3] The surface sediment point of compliance for intertidal areas is 45 cm and 10 cm for subtidal areas.
[4] SMA SWAC is SWAC of sediment management areas (e.g., under-dock footprint or nearshore areas)
[5] SCU SWAC is SWAC of sediment cleanup unit
[6] Remedy preference order based on permanence: 1. dredging, 2. thin-layer capping, 3. EMNR.
[7] SMA SWAC is statistically significantly higher than SCU SWAC; statistical difference is to be determined by comparison between the two populations of data used to develop the SWAC.
[8] Erosive. EMNR not appropriate in erosive areas.
[9] Thin layer cap may be appropriate given the SMA SWAC is less than the SCU SWAC, and deeper sediments are less contaminated than the surface sediments. Thin layer cap material must be proven to be non-erosive, effective over the long-term, and appropriate habitat.
[10] Dredging may be more appropriate to reduce SCU SWAC below Cleanup Levels in reasonable restoration timeframe.

SWAC – Spatially Weighted Average Concentration
EMNR – Enhanced Monitored Natural Recovery
NA – Not Applicable

Table 6-3. Applicable or Relevant and Appropriate Requirements (ARARS)

Medium	Standard/Criterion	Citation	Comments and Substantive Requirements
ARARs			
Sediment	Criteria used to identify sediments that have no adverse effects on biological resources and correspond to no significant health risk to humans	Sediment Management Standards (SMS) (WAC 173-204)	SMS cleanup levels serve as ARARs for the development of CULs.
Soil and groundwater	State cleanup levels for soils	Model Toxics Control Act (MTCA) (WAC 173-340-740 and -745)	Applicable for soil within the Upland Study Area.
	State cleanup levels for groundwater	Model Toxics Control Act (WAC 173-340-720)	Potentially applicable to groundwater as necessary to protect adjacent surface water.
Other Requirements to be Considered			
Surface water	Ambient water quality criteria for the protection of aquatic organisms and human health	Federal Water Pollution Control Act/Clean Water Act (33 USC 1251-1376; 40 CFR 100-149) Water Quality Standards (40 CFR 131)	MTCA requires the attainment of water quality criteria where relevant to the circumstances of the release. Remediation plans will include measures to comply with surface water standards during implementation.
	State water quality standards; conventional water quality parameters and toxic criteria	Washington Water Pollution Control Act (RCW 90.48) State Water Quality Standards for Surface Water (WAC 173-201A-130)	Narrative and quantitative limitations for surface water protection. Remediation plans will include measures to be taken to comply with surface water standards during implementation. Parts I – IV and Part VI of the SMS (WAC 173-204) were adopted, in part, under RCW 90.48.

CFR – Code of Federal Regulations
CUL – cleanup level
RCW – Revised Code of Washington
USC – United States Code
WAC – Washington Administrative Code

Table 6-4. Other Requirements to be Considered—Construction, Treatment, and Disposal

Activity	Requirement	Citation	Comments and Substantive Requirements
In-water sediment disposal or capping	USACE permitting requirements	Sections 401 and 404 of the Clean Water Act (40 CFR 230; 33 CFR320, 323, 325, and 328)	Permitting requirements for discharges into waters of the United States.
		Section 10 of the Rivers and Harbors Act (33 CFR 320 and 322)	Permitting requirements for dredging or disposal in navigable waters of the United States. Project implementation will include USACE permitting.
	State HPA permitting	Washington Hydraulic Code Rules (WAC 220-110)	Permitting for work that would use, divert, obstruct or change the natural flow or bed of any salt or fresh waters. Project implementation and permitting will include coordination with Washington State Department of Fish and Wildlife staff. This coordination will address all substantive requirements of the HPA permitting process, including evaluation of potential mitigation requirements and definition of work procedures and timing. Dredging, capping, and other in-water work activities will be performed at appropriate times of the year to comply with fisheries protection requirements.
	PSDDA characterization and permitting procedures	Dredged Material Management Program guidelines (RCW 79.90; WAC 332-30)	Characterization and permitting process for sediments destined for unconfined open-water disposal (not anticipated under the remediation alternatives). Selected sediments from the site may be characterized and authorized for PSDDA disposal and/or beneficial reuse. Project implementation will follow PSDDA procedures, including obtaining DNR use authorization for sediment disposal at the PSDDA site. Additional sediment re-characterization may be

Activity	Requirement	Citation	Comments and Substantive Requirements
			required to comply with PSDDA standards depending on dates of sediment dredging and disposal.
	Multi-user disposal site operating agreements	Typically the use of multi-user disposal sites is governed by site-specific permits and/or agreements.	Use of a multi-user disposal site for sediment disposal is not anticipated as part of a remedial alternative.
In-water sediment disposal or capping	Rules for management of state-owned aquatic lands	State aquatic land management laws (RCW 79.90 through 79.96; WAC 332-30) State constitution (Articles XV, XVII, XXVII) Public trust doctrine	Sediment disposal, if performed on state-owned aquatic lands, must not be in conflict with state regulations. Project implementation for PSDDA sediment disposal will follow PSDDA procedures, including procurement of DNR use authorization for sediment disposal at the PSDDA site. If beneficial reuse of sediment is performed on state-owned lands, a sediment use authorization must be obtained. Sediment capping on state-owned lands, if performed as part of the remedy, must consider rules for management of state-owned aquatic lands.
Upland disposal of excavated soil and dredged sediment	State criteria for dangerous waste (which are broader than federal hazardous waste criteria)	Washington Dangerous Waste Regulations (WAC 173-303) Designation procedures (WAC 173-303-070)	State and federal laws prohibit land disposal of certain hazardous or dangerous wastes. Soil and sediment managed by upland disposal will comply with disposal site criteria. The need for additional waste profiling will be addressed as part of the engineering design for the project.
	Requirements for solid waste management	Solid Waste Disposal Act (42 USC Sec. 325103259, 6901-6991), as administered under 40 CFR 257 and 258 Minimum Functional Standards for Solid Waste Handling (WAC 173-304) Solid Waste Handling Standards. (WAC 173-350)	Applicable to non-hazardous waste generated during remedial activities and disposed offsite unless wastes meet recycling exemptions. Soil and sediment managed by upland disposal will comply with disposal site criteria. Remediation alternatives are based on existing permitted facilities that are compliant with these regulations and are permitted to accept impacted materials.

Activity	Requirement	Citation	Comments and Substantive Requirements
			Upland beneficial reuse of sediments would be regulated under WAC 173- 350.
Air emissions	State implementation of ambient air quality standards. Northwest Clean Air Agency ambient and emission standards. Regional emission standards for toxic air pollutants (Source of toxic air contaminant requires a notice of construction.)	Washington State Clean Air Act (70.94 RCW) General Requirements for Air Pollution Sources (WAC 173-400)	Potentially applicable to alternatives involving sediment treatment or upland handling. Onsite treatment of dredged materials using methods that may require an air pollution control permit is not contemplated in the removal action alternatives. Offsite sediment handling and/or treatment/disposal facilities that would be contemplated for use under the removal action alternatives would need to comply with applicable air regulations and maintain appropriate permits.
	Olympic Region Clean Air Agency regulations controlling dust emissions	Olympic Region Clean Air Agency regulations adopted by the Board of Directors December 3, 1969	To be considered – requirements would be addressed.
Wastewater	Permitting and treatment requirements for direct discharges into surface water.	NPDES (40 CFR 122, 125) State Discharge Permit Program; NPDES Program (WAC 173-216 and -220)	Anticipated to be relevant only if collected waters are discharged to surface water. Discharges must comply with requirements of the NPDES permit. Applicable for offsite discharges. Construction stormwater requirements will be satisfied for upland handling of soil and sediment, including development of a storm water pollution prevention plan and implementation of best management practices. NPDES program requirements will be reviewed as part of project final design.
	Permitting and pre-treatment requirements for discharges to a POTW	National Pretreatment Standards (40 CFR 403)	Discharges to POTWs may require pre-treatment, and permitting requirements would be applicable. If alternatives include water pretreatment and POTW discharge, such work would be subject to

Activity	Requirement	Citation	Comments and Substantive Requirements
			POTW permitting and pre-treatment standards. Project design and implementation must incorporate waste characterization, pretreatment and permitting. Permitting requirements will be reviewed as part of project final design.

DNR – Department of Natural Resources
HPA – hydraulic project approval
NPDES – National Pollutant Discharge Elimination System
POTW – publicly owned treatment works
PSDDA – Puget Sound Dredged Disposal Analysis
RCW – Revised Code of Washington
USACE – US Army Corps of Engineers
WAC – Washington Administrative Code

Table 6-5. Other Requirements to be Considered—Project Permitting and Implementation

Activity	Requirement/Prerequisite	Citation	Comments and Substantive Requirements
Evaluation of environmental impacts	Evaluation of project environmental impacts and definition of appropriate measures for impact mitigation	State Environmental Policy Act (WAC 197-11) National Environmental Policy Act (42 USC 4321 et seq.)	SEPA/NEPA checklist will be prepared in conjunction with design and permitting to evaluate SEPA/NEPA requirements.
Construction activities within 200 ft of shoreline	Construction near shorelines of statewide significance, including marine waters and wetlands	Shoreline Management Act (WAC 173-14) Coastal Zone Management Act (16 USC 1451 et seq)	Applicable for construction; is performed in upland areas adjacent to shorelines.
Construction in state waters	Requirements for construction and development projects for the protection of fish and shellfish in state waters.	Construction Projects in State Waters, Hydraulic Code Rules (RCW 75.20; WAC 220-1101)	Requirements will be considered and addressed as appropriate. Project implementation and permitting will include coordination with Washington State Department of Fish and Wildlife staff. Coordination will address requirements of the HPA permitting process, including information submittals, evaluation of potential mitigation requirements, and definition of work procedures and timing. Dredging, capping, and other in-water work activities will be performed at appropriate times of the year to comply with fisheries protection requirements.
Construction activities within waterways and wetlands	Regulates discharge of dredged or fill material into navigable waters, as well as incidental deposition resulting from shoreline construction/excavation	Rivers and Harbors Appropriation Act (33 USC 401; 40 CFR 230; 33 CFR320, 322, 323, and 325)	USACE Section 404 Permit or Nationwide Permit requirements will be evaluated.
Activities within/adjacent to wetlands	Actions must be performed so as to minimize the destruction, loss, or degradation of wetlands as defined by Executive Order 11990, Section 7, requirement for no net loss of remaining wetlands.	Executive Order 11990, Protection of Wetlands (40 CFR 6, Appendix A) EPA wetland actions plan (EPA 1989)	Removal action alternatives will not result in net loss of any wetland areas.

Activity	Requirement/Prerequisite	Citation	Comments and Substantive Requirements
Endangered and threatened species	Actions must be performed so as to conserve endangered or threatened species, including consultation with the US Department of the Interior.	Endangered Species Act of 1973 (16 USC 1531 et seq.; 50 CFR Parts200 and 402)	Chinook salmon listed as threatened species. Implementing entity must confer with National Oceanic and Atmospheric Administration Fisheries on any action that may impact listed species. Project permitting will include compliance with Endangered Species Act requirements, as necessary, including consultation with state and federal permitting agencies and incorporation of appropriate measures to avoid adverse impacts to endangered or threatened species.
Habitat impacts and mitigation	Policies and procedures have been established by state and federal agencies to evaluate and mitigate habitat impacts.	Memorandum of Agreement between EPA and USACE (Mitigation under Clean Water Act Section 404(b)(1)) US Fish and Wildlife Mitigation Policy (46 FR 7644) US Fish and Wildlife Coordination Act (16 USC 661 et seq.) Washington State Department of Fisheries Habitat Management Policy (Washington Department of Fisheries Policy 410) Compensatory Mitigation Policy for Aquatic Resources (RCW 75.20 and 90.48)	Mitigation requirements for projects are defined in project permitting and vary with the type of work conducted. Project final design will include evaluation of project impacts and definition of any mitigation required or appropriate to the work being performed.
Health and safety	Development of a health and safety plan with appropriate controls, worker certifications, and monitoring	WISHA (WAC 296-62) OSHA (29 CFR 1910.120)	Relevant requirement for environmental remediation operations. All work activities performed at the site will comply with OSHA/WISHA requirements. Project final design will include definition of

Activity	Requirement/Prerequisite	Citation	Comments and Substantive Requirements
			contractor safety requirements, including preparation and compliance with a project health and safety plan, worker training and record-keeping requirements, and other applicable measures.
Noise control	Maximum noise levels	Noise Control Act of 1974 (RCW 70.107; WAC 173-60) Port Angeles Municipal Code	Potentially relevant depending on removal activities and equipment selected. Construction activities will be limited to normal working hours, to the extent possible, to minimize noise impacts.
Within 100-year flood plain	RCRA hazardous waste facility designed, operated, maintained to avoid washout	40 CFR 257 40 CFR 264.18(b) 40 CFR 761.75	Onsite RCRA hazardous waste facility is not considered under any remediation alternative.
Grading activities	Any upland grading activity that may need to be performed.	Port Angeles Municipal Code	To be considered where grading activities are anticipated.
Stormwater	Ensure that permanent stormwater system meets current city codes.	Port Angeles Municipal Code	Applicable stormwater control regulations relating to stormwater, grading, and drainage control.

CFR – Code of Federal Regulations
EPA – US Environmental Protection Agency
FR – Federal Register
NEPA – National Environmental Policy Act
OSHA – Occupational Safety and Health Administration
RCRA – Resource Conservation and Recovery Act
RCW – Revised Code of Washington
SEPA – State Environmental Policy Act
WISHA – Washington Industrial Safety and Health Act

Figures

TITLE:

Site Map

LOCATION:

Port Angeles Rayonier Mill Study Area
Port Angeles, Washington

TETRA TECH

APPROVED	GC	FIGURE
DRAFTED	LMG	
PROJECT#	117-7403019	1-1
DATE	6/27/2019	

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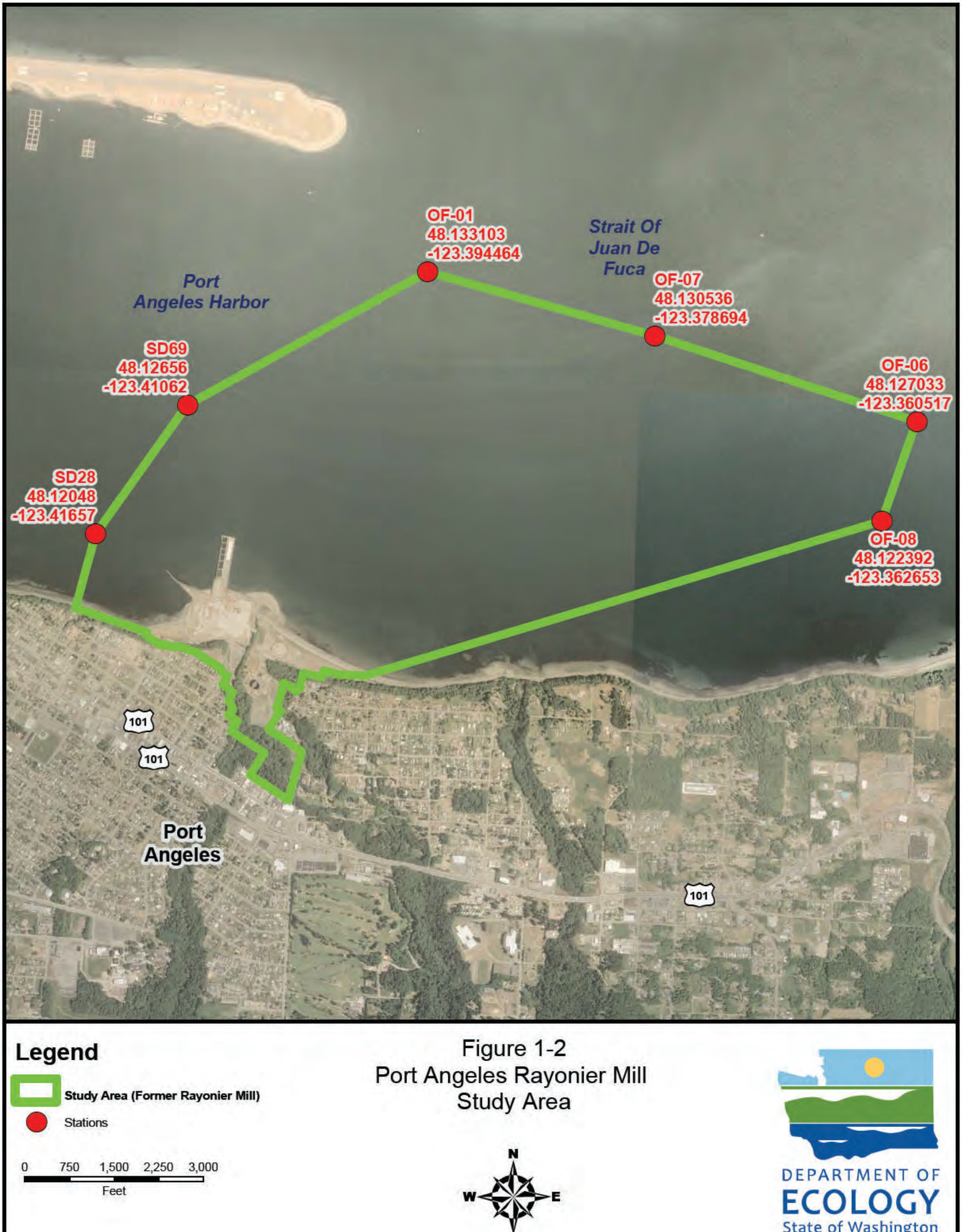


Figure 1-2
Port Angeles Rayonier Mill
Study Area

DEPARTMENT OF
ECOLOGY
State of Washington

Legend

Data sources: Base data from "RAYO0903 _MILL_TOPO.dwg" (Northwestern Territories, Inc. 2000). Aerial photo from Google Earth.

- Pipeline Easement
- Trail Easement
- Ennis Creek Restoration Area
- Bulkhead
- Existing Structure
- Shoreline Protection Area
- City Purchase Area
- DNR Lease Area
- Upland Study Area Boundary
- Concrete Pad
- Concrete Rubble
- Rip rap
- Old Pilings

N

0 250 500 1,000
Feet

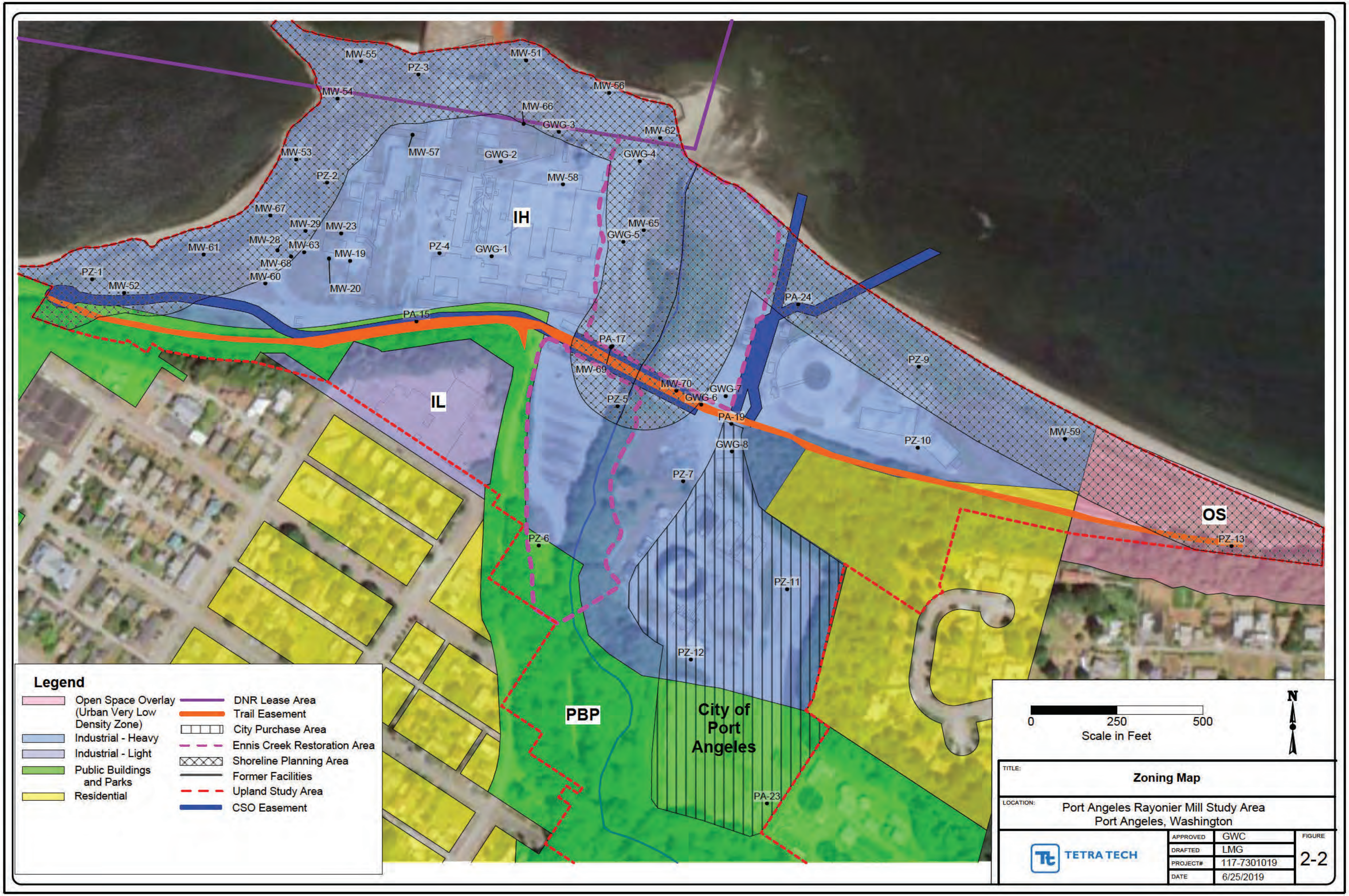
TITLE: Current Study Area Conditions

LOCATION: Port Angeles Rayonier Mill Study Area
Port Angeles, Washington

TETRA TECH

APPROVED	LMG	FIGURE
DRAFTED	GC	2-1
PROJECT#	117-7304019	
DATE	6/27/2019	

Document Path: P:\7304 Rayonier\AM019 Port Angeles FS\GIS\MXDs\CurrentStudy_Fig2_3_Ver2.mxd


MW-55
PZ-3
MW-51
MW-54
MW-56
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MW-57
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PZ-2
MW-58
IH
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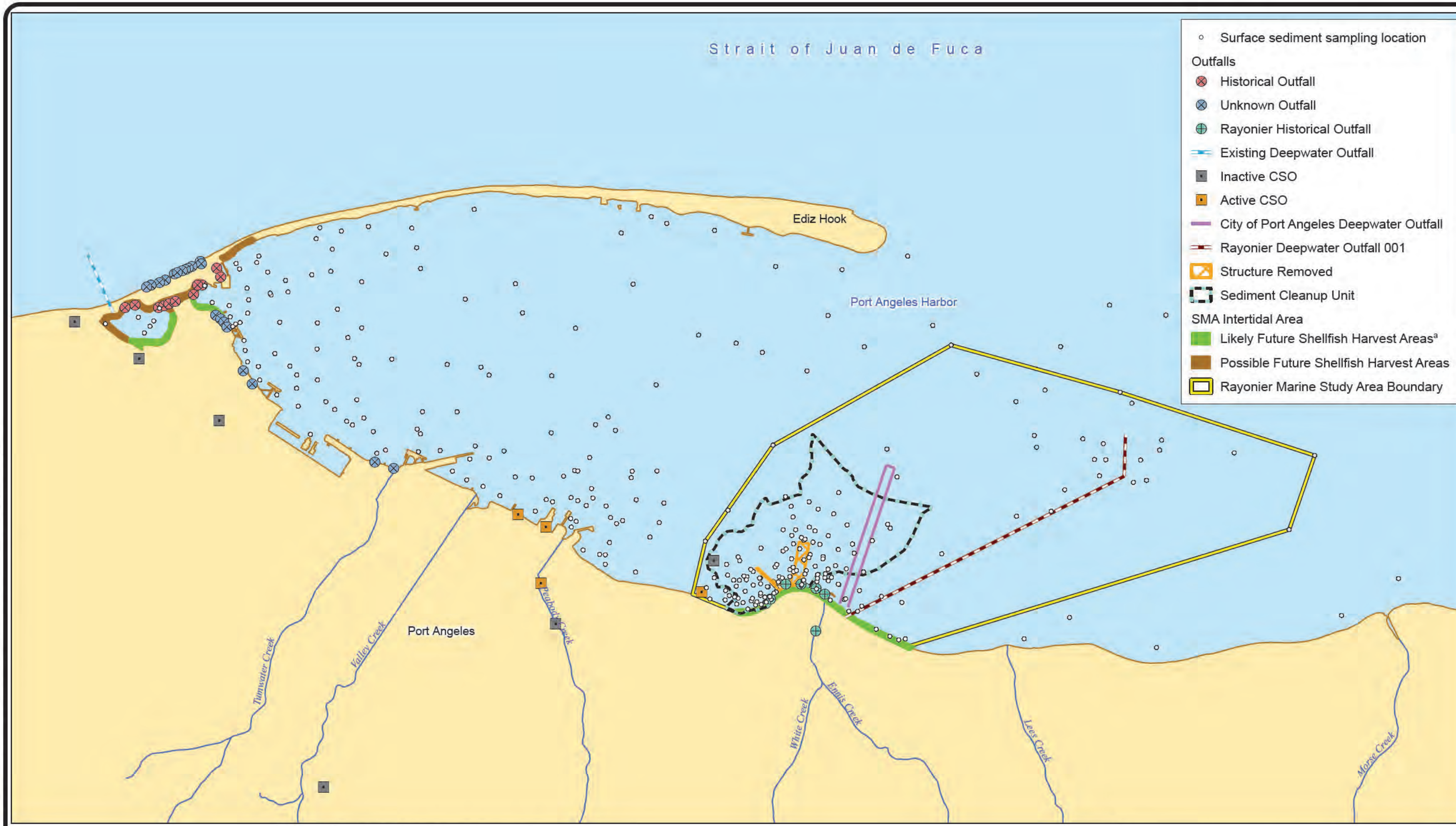
PA-19
MW-59
PZ-10
GWG-8
PZ-7
OS
PZ-13
PZ-6
PZ-11
PZ-12
PBP
City of Port Angeles
PA-23
Legend
Open Space Overlay (Urban Very Low Density Zone)
Industrial - Heavy
Industrial - Light
Public Buildings and Parks
Residential
DNR Lease Area
Trail Easement
City Purchase Area
Ennis Creek Restoration Area
Shoreline Planning Area
Former Facilities
Upland Study Area
CSO Easement
0
250
500
Scale in Feet
N
TITLE:
Zoning Map
LOCATION:
Port Angeles Rayonier Mill Study Area
Port Angeles, Washington
TETRA TECH
APPROVED GWC
DRAFTED LMG
PROJECT# 117-7301019
DATE 6/25/2019
FIGURE
2-2



Disclaimer: The locations of all features shown are approximate.

[a]Ecology has designated sediment management areas (SMAs) within Port Angeles Harbor and near the former Mill (Ecology 2017b). Near the former mill, the SMA is limited to intertidal areas within the SCU where there is, or may be in the future, reasonable access to the shoreline for shellfish harvest by the public.

Windward environmental LLC

TITLE: Sediment Cleanup Unit and Study Area Boundaries with Surface Sediment Sampling Locations from Port Angeles Harbor

LOCATION: Rayonier Mill Marine Study Area

TETRA TECH

APPROVED	App
DRAFTED	M.Y.
PROJECT#	194-9029
DATE	6/28/2019

FIGURE 2-3

W:\Projects\Rayonier PA Volume III\Data\GIS\Maps_and_Analysis\Volume_III_revised\TetraTech_Layout\6040c_Remediation and study area boundaries_V3.mxd

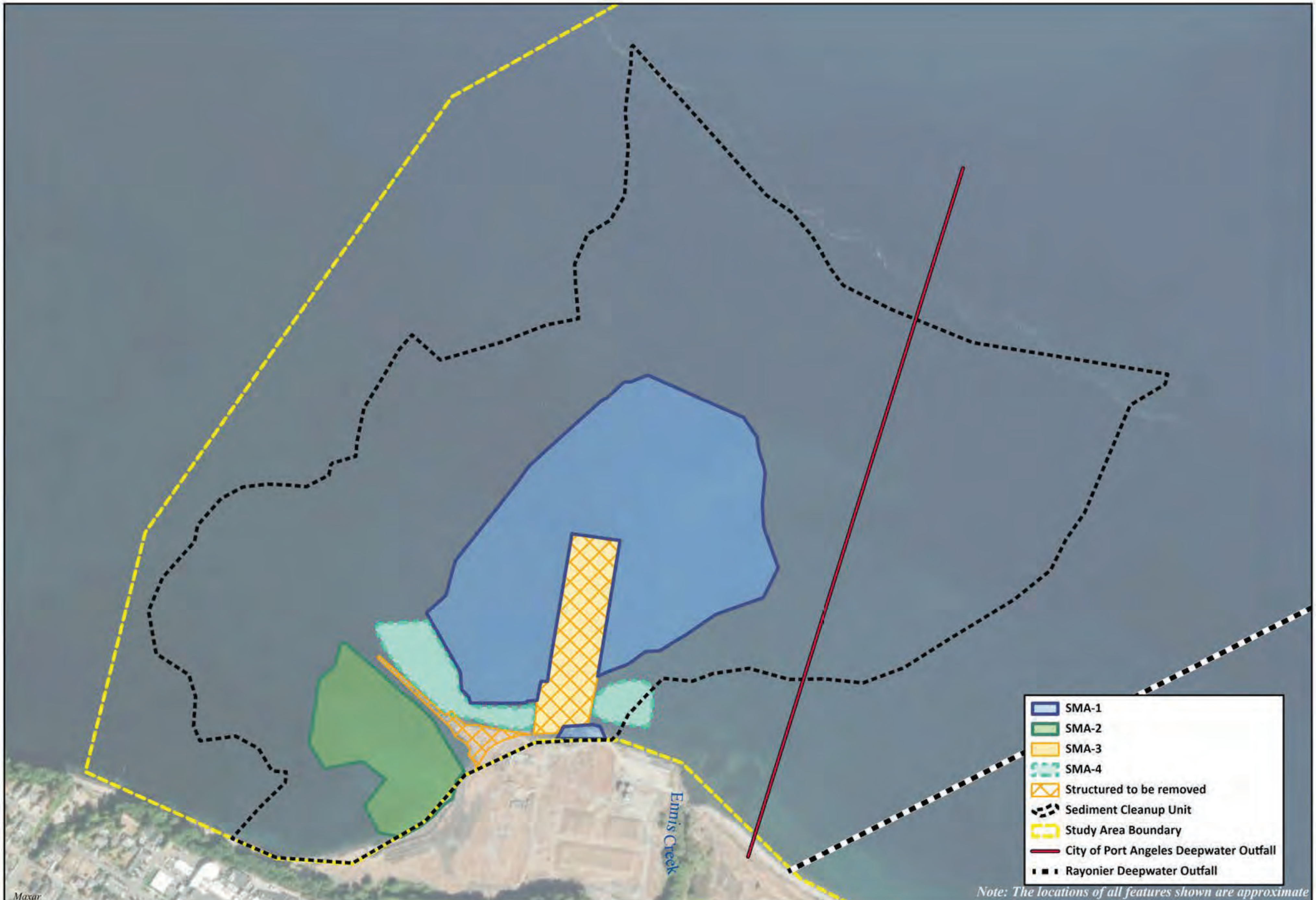
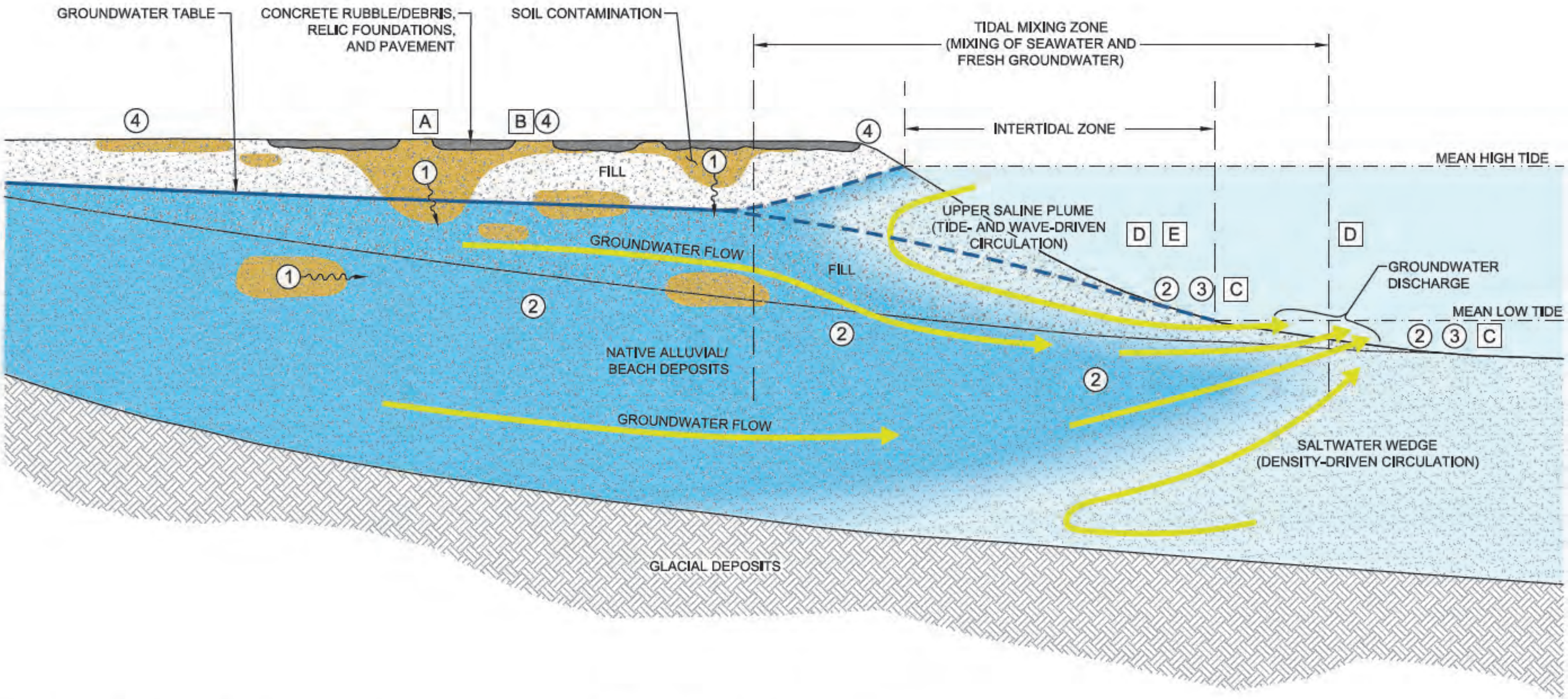


Figure 2-4. Rayonier Mill Sediment Cleanup Unit and Sediment Management Areas

N

0 500 1,000 2,000 Feet

NewFields



Potential Contaminant Transport Mechanisms

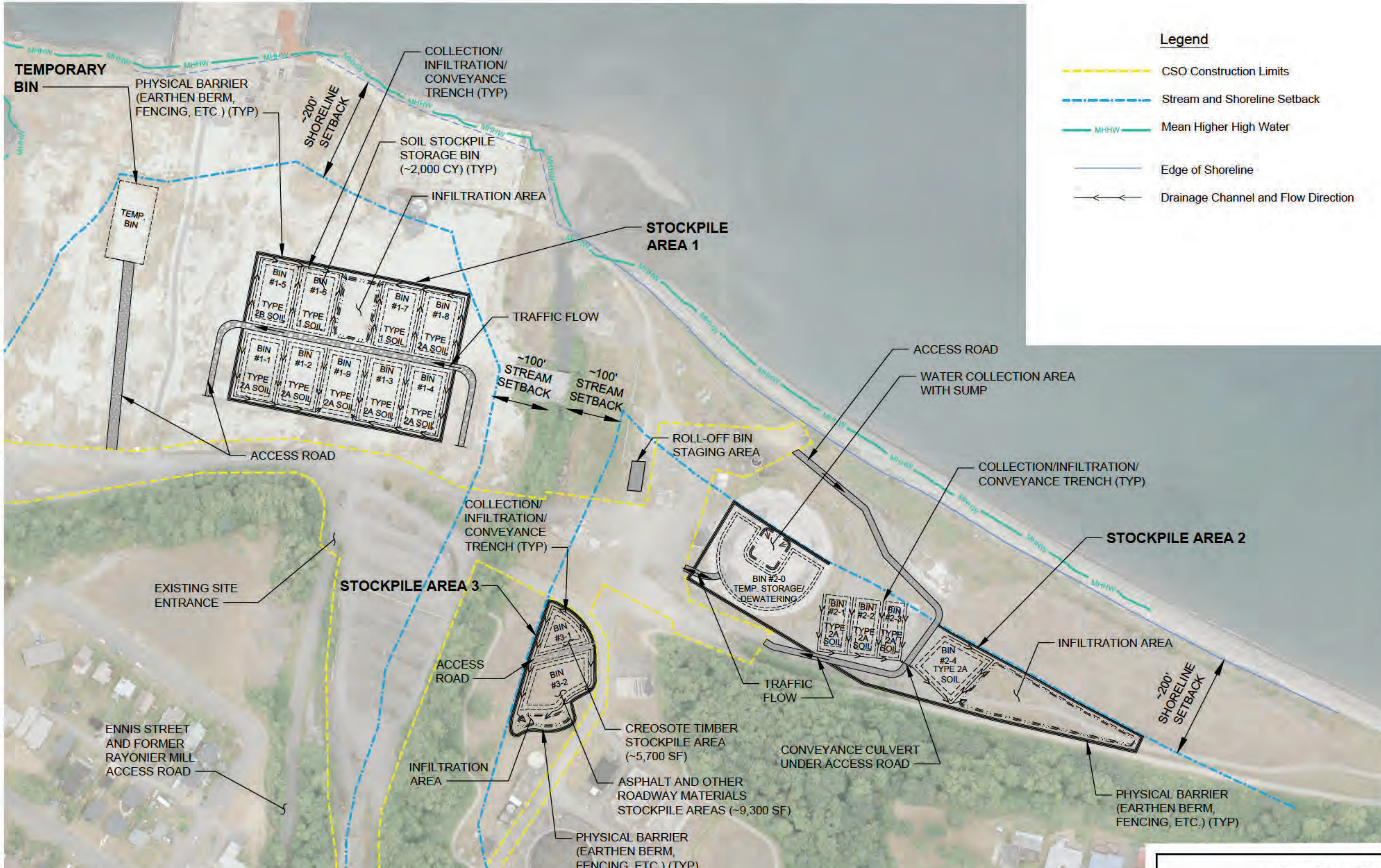
1. Leaching from soil to groundwater
2. Migration in groundwater and discharge of groundwater to marine surface water/sediment
3. Transport of sediments via scouring/currents
4. Erosion of contaminated soil/fill

Exposure Pathways of Potential Concern

- A Direct contact with soil by humans
- B Direct contact with soil by soil biota, plants, or wildlife; ingestion of biota or plants by wildlife
- C Direct contact with sediment or surface water by aquatic organisms
- D Ingestion of aquatic organisms by higher order species (humans/mammals, fish, birds, etc.) - food chain/bioaccumulation exposures
- E Direct contact with sediment and surface water by humans

Disclaimer:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. and Windward cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and Windward, and will serve as the official record of this communication.

TITLE:	CONCEPTUAL SITE MODEL		
LOCATION:	Port Angeles Rayonier Mill Study Area Port Angeles, Washington		
TETRA TECH	APPROVED	GC	FIGURE
	DRAFTED	CP	3-1
	PROJECT#	117-7304019	
	DATE	3-25-19	



Notes

1. Soil types shown for each bin except Bin #1-9 are based on chemical analytical results from the pilot stockpile sampling event (April 2013). Soil type shown for Bin #1-9 is based on pre-construction soil evaluation contained in the Final Materials Management Plan; see report text. No soil was stored in Stockpile Area 3.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Reference: Base Map Source: Google Earth. Layout of Storage Bins and Associated Notes Provided by Landua Associates, Figure 3, Non-Surveyed As-Built Conditions Product Staging/Storage Areas.

N W E S

0 200 400
Scale in Feet

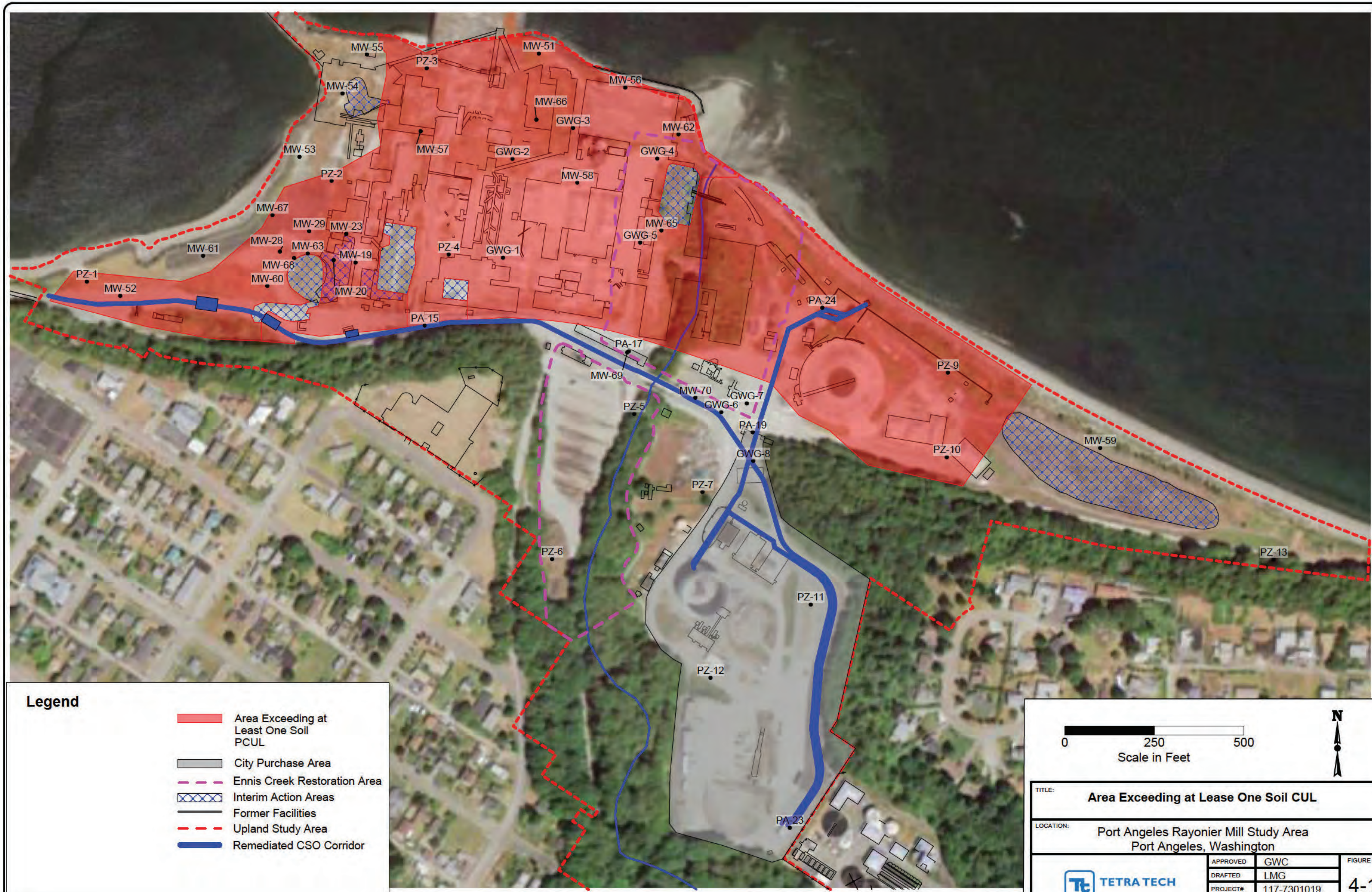
Stockpile Areas

Port Angeles Rayonier Mill Study Area
Port Angeles, Washington

GeoEngineers

Figure 3-2

\\SEA\PROJECTS\0\0370015\03\PROJECT COMPLETION REPORT - FIGURE 3 ITEMS\FIGURE 3 MHHW ASBUILT - STANDARD\FIGURE 3 MHHW ASBUILT.DWG\TAB:FIGURE 3 MODIFIED BY MFORMOLO ON AUG 29, 2013 - 13:39



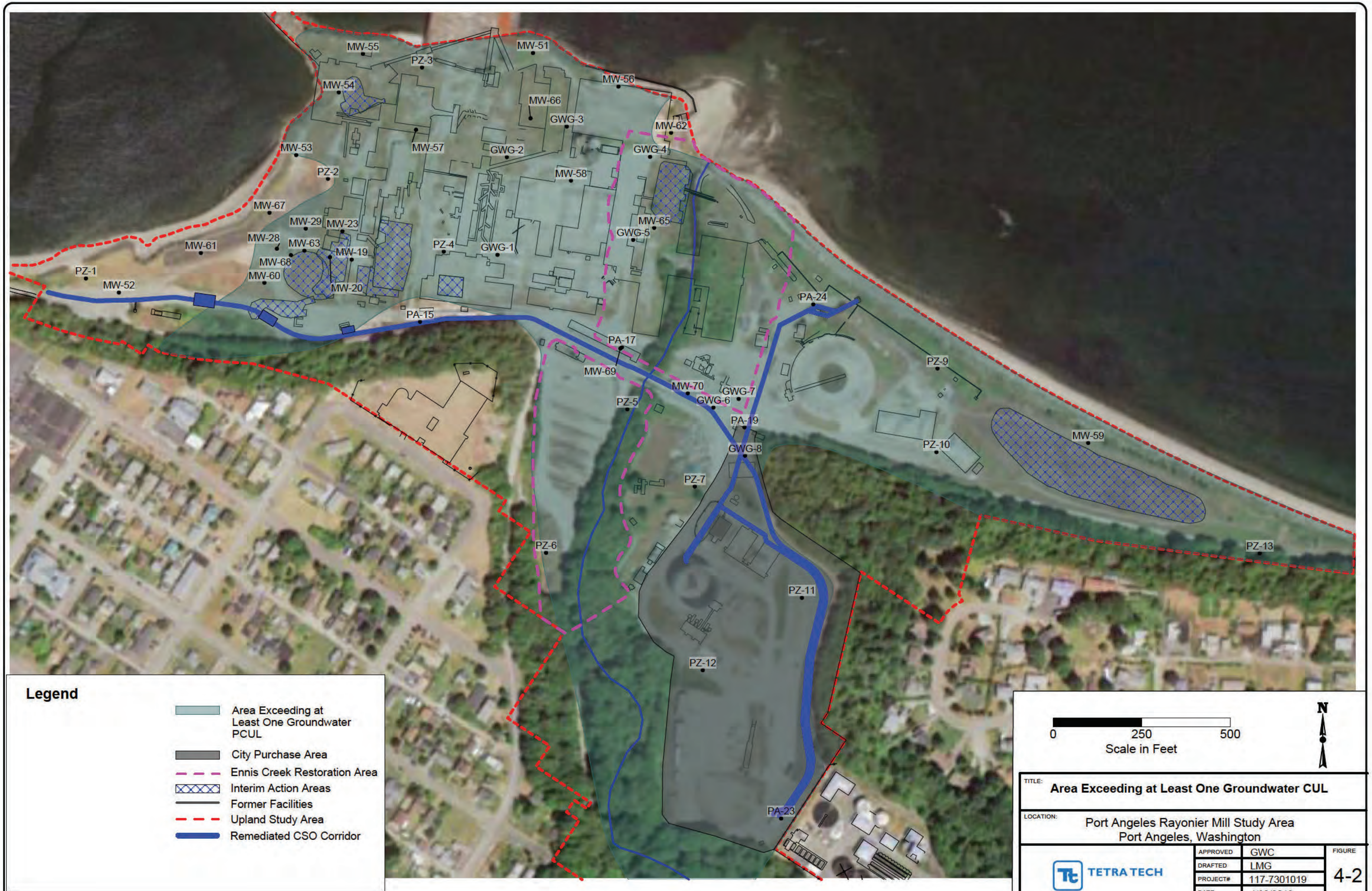
TITLE: **Area Exceeding at Lease One Soil CUL**

LOCATION: Port Angeles Rayonier Mill Study Area
Port Angeles, Washington

TETRA TECH

APPROVED	GWC
DRAFTED	LMG
PROJECT#	117-7301019
DATE	4/30/2019

FIGURE 4-1



TITLE: **Area Exceeding at Least One Groundwater CUL**

LOCATION: Port Angeles Rayonier Mill Study Area
Port Angeles, Washington

TETRA TECH

APPROVED	GWC	FIGURE	4-2
DRAFTED	LMG		
PROJECT#	117-7301019		
DATE	4/30/2019		

Prepared by mikey, 6/27/2019; W:\Projects\Rayonier PA Volume III\Data\GIS\Maps_and_Analysis\Volume_III_revised\TetraTech_Layout\6042a_Preferred alternatives applied to future use scenario 1_No InWater Remed_inline 8x11.mxd

Data sources: 0.5-foot 2016 imagery from DigitalGlobe and ESRI City of Port Angeles, Rayonier

Disclaimer: The locations of all features shown are approximate.

N

0 250 500 1,000
Feet

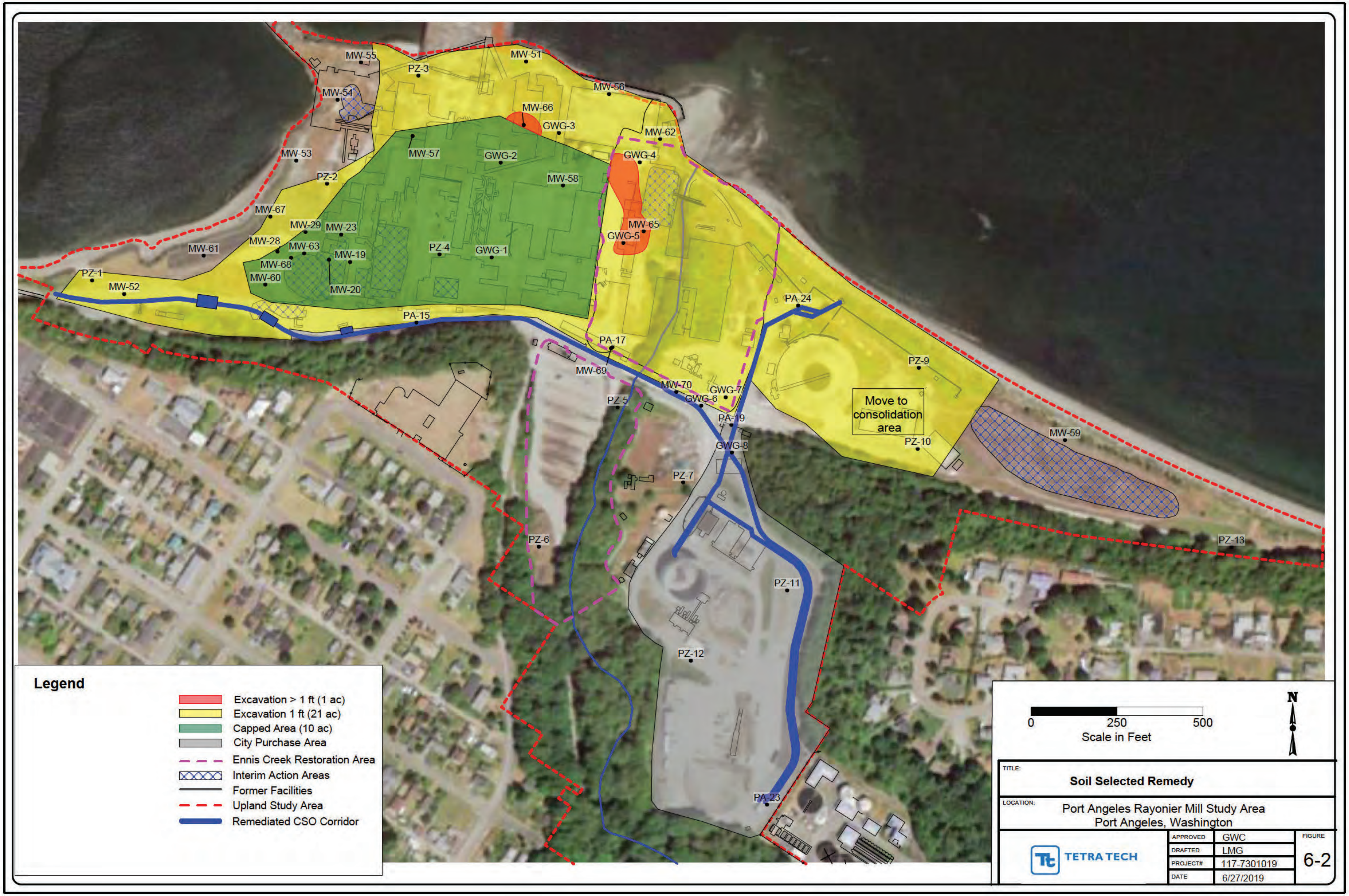
Windward environmental LLC

TITLE: **Coordination of Remedy, Removal of In-Water Structures, and Potential Restoration**

LOCATION: **Rayonier Mill Study Area Port Angeles, Washington**

TETRA TECH

APPROVED	APPROVED	FIGURE
DRAFTED	M.Y.	6-1
PROJECT#	194–9029	
DATE	6/27/2019	



MW-55
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MW-54
MW-66
GWG-3
MW-62
MW-57
GWG-2
GWG-4
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MW-58
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MW-29
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GWG-1
GWG-5
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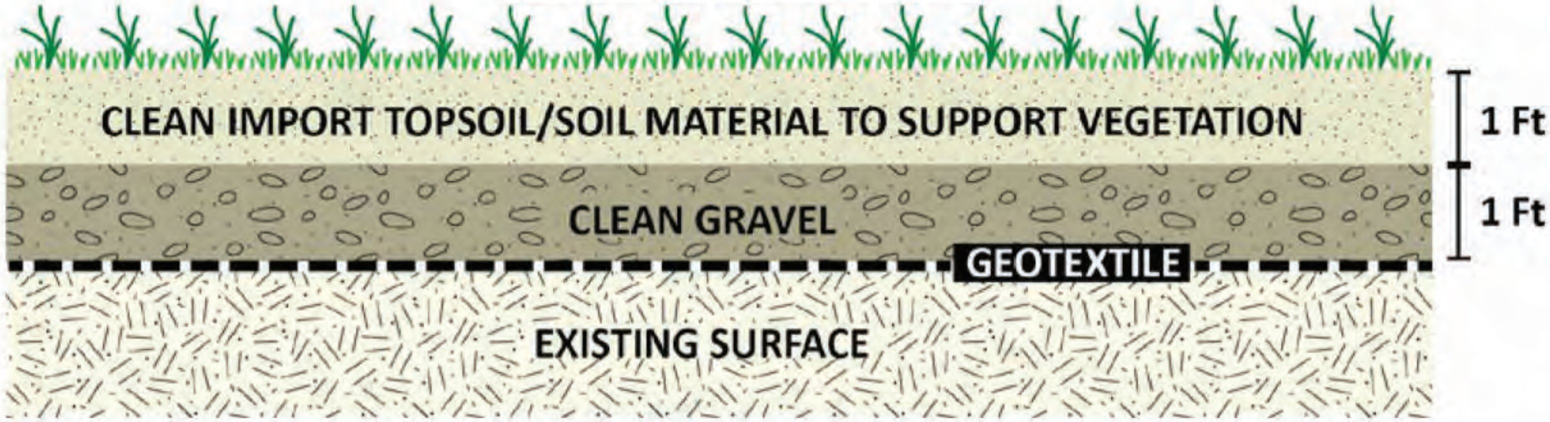
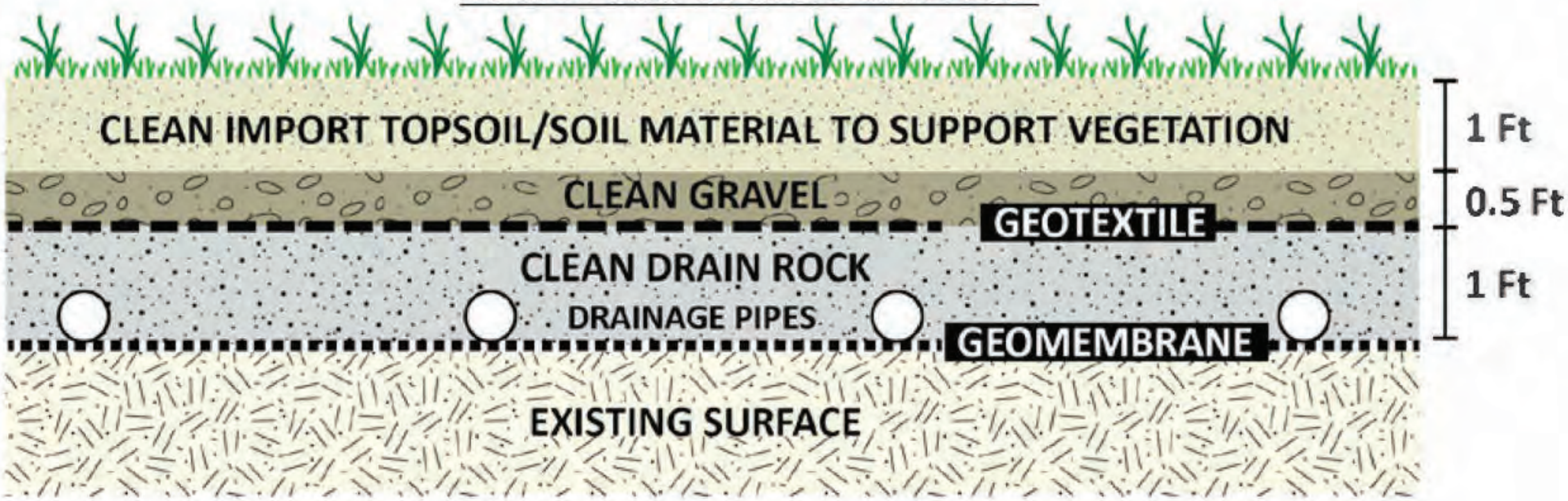
MW-60
MW-52
MW-20
PA-24
PA-15
PA-17
MW-69
PZ-9
MW-70
GWG-7
PZ-5
GWG-6
Move to consolidation area
PA-19
PZ-10
MW-59
GWG-8
PZ-7
PZ-6
PZ-13
PZ-11
PZ-12
PA-23
Legend
Excavation > 1 ft (1 ac)
Excavation 1 ft (21 ac)
Capped Area (10 ac)
City Purchase Area
Ennis Creek Restoration Area
Interim Action Areas
Former Facilities
Upland Study Area
Remediated CSO Corridor
0
250
500
Scale in Feet
N
TITLE:
Soil Selected Remedy
LOCATION:
Port Angeles Rayonier Mill Study Area
Port Angeles, Washington
TETRA TECH
APPROVED GWC
DRAFTED LMG
PROJECT# 117-7301019
DATE 6/27/2019
FIGURE
6-2

P:\ACAD\7304-019-RAYO\7304019007A.DWG

PERMEABLE SOIL COVER



LOW-PERMEABILITY SOIL CAP



TITLE:	SOIL CAP DETAILS		
LOCATION:	Port Angeles Rayonier Mill Study Area Port Angeles, Washington		
TETRA TECH	APPROVED	GC	FIGURE
	DRAFTED	CP	6-3
	PROJECT#	117-7304019	
	DATE	3-25-19	

Legend

- Initial Sparging System
- Additional Sparging Wells
- City Purchase Area
- Ennis Creek Restoration Area
- Interim Action Areas
- Former Facilities
- Upland Study Area
- Remediated CSO Corridor

TITLE: **Groundwater** Selected Remedy

LOCATION: Port Angeles Rayonier Mill Study Area
Port Angeles, Washington

TETRA TECH

APPROVED	GWC
DRAFTED	LMG
PROJECT#	117-7301019
DATE	6/28/2019
FIGURE	6-4

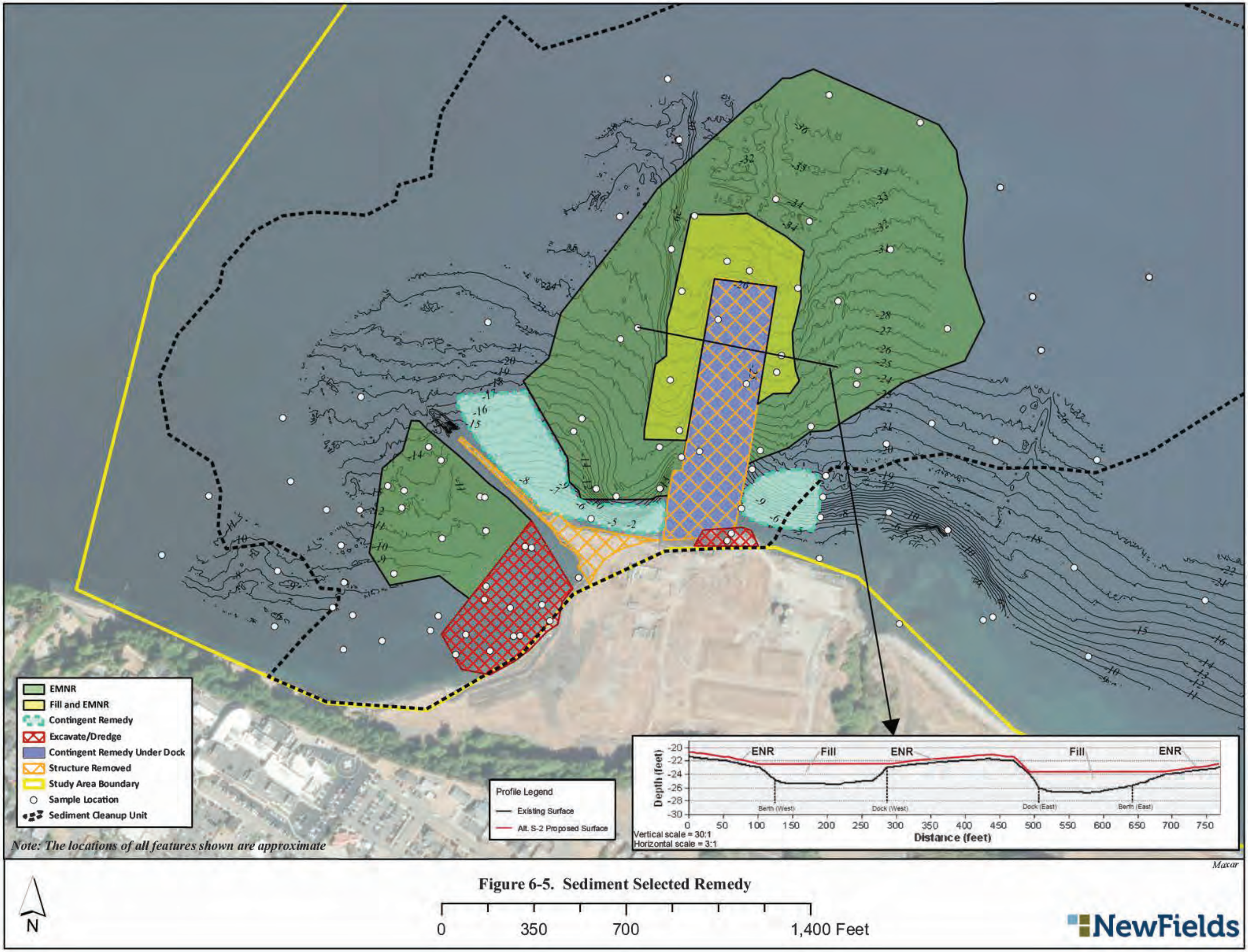
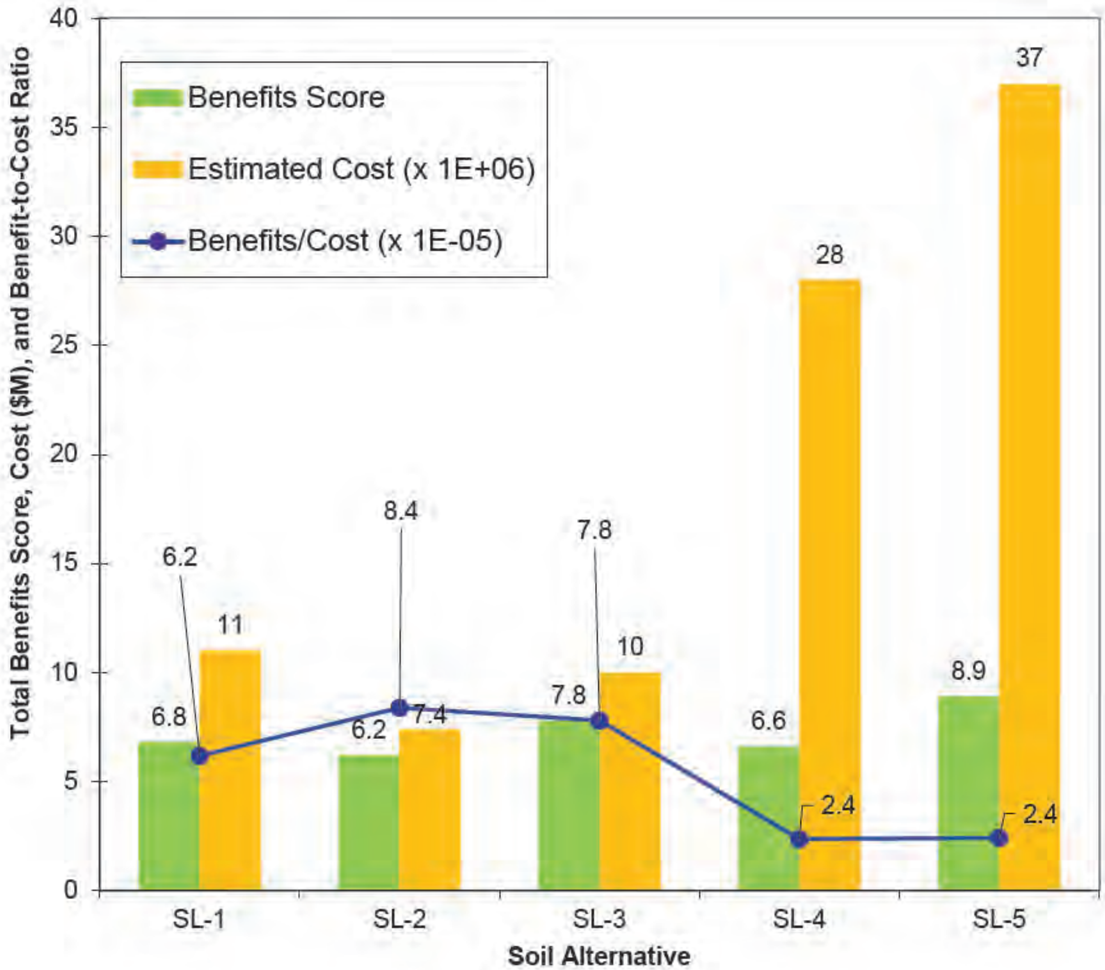


Figure 6-5. Sediment Selected Remedy

NewFields



TITLE: **Disproportionate Cost Analysis for the Soil Remediation Alternatives**

LOCATION: **Rayonier Mill Study Area, Port Angeles, WA**

TETRA TECH

CHECKED:	GWC	FIGURE:	
DRAFTED:	LMG		**6-6**
PROJ:	7304023		
DATE:	5/13/2021		

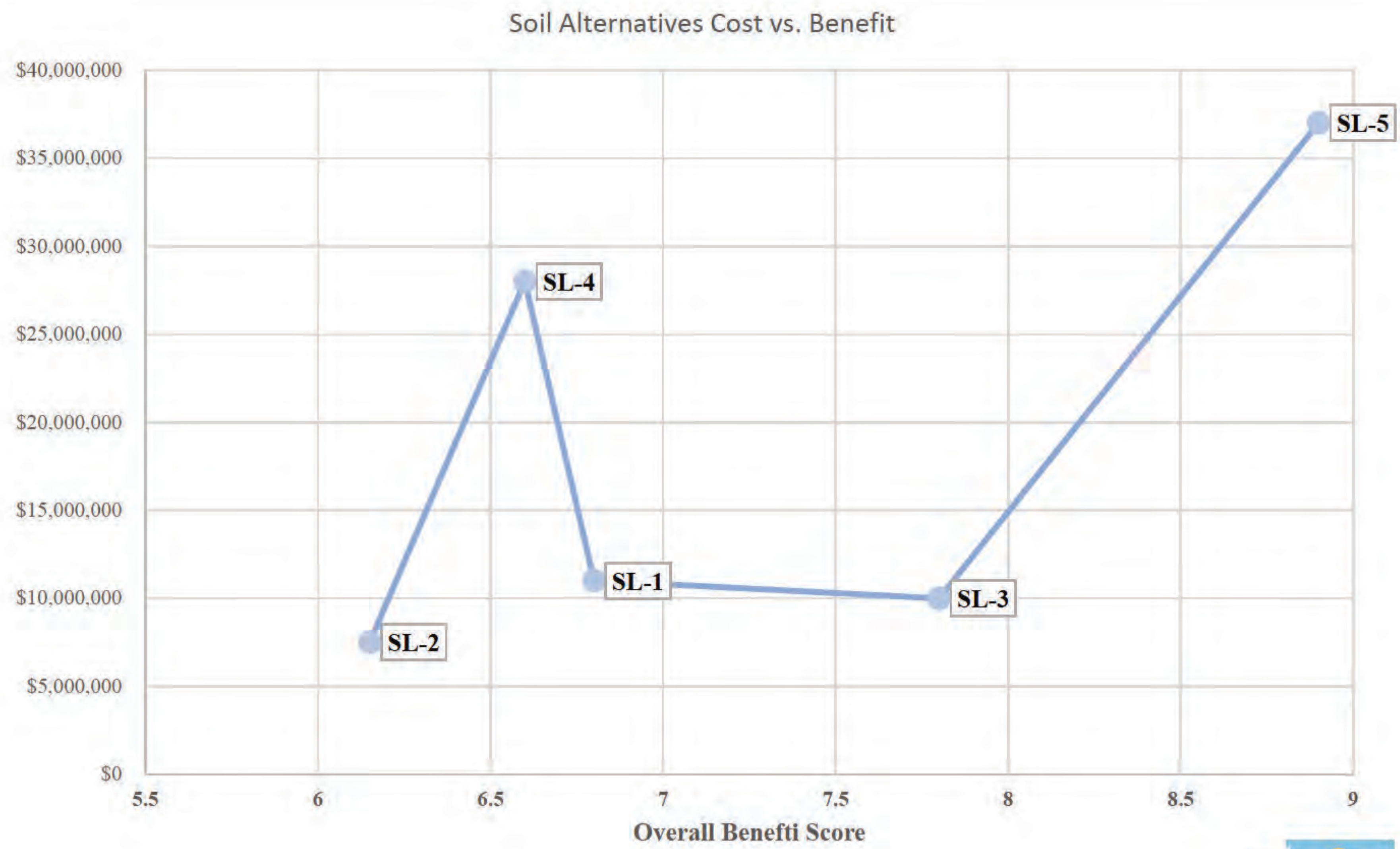
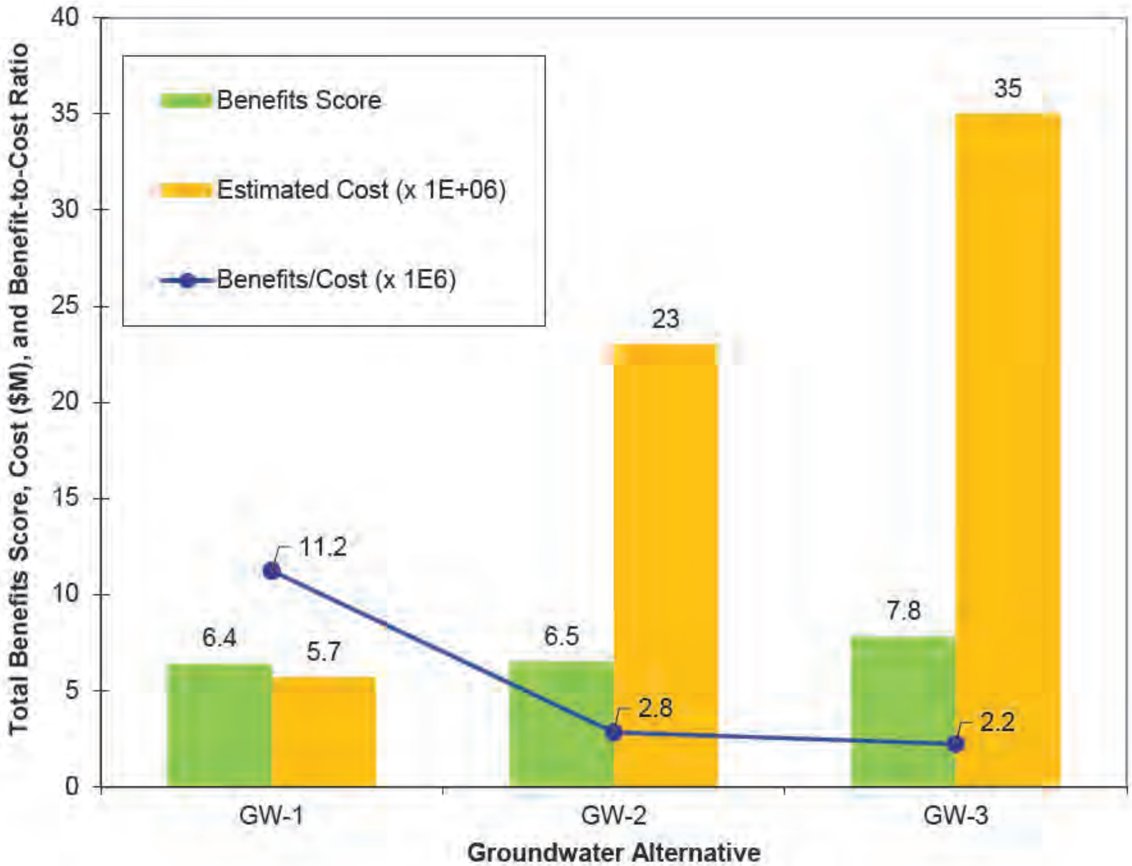
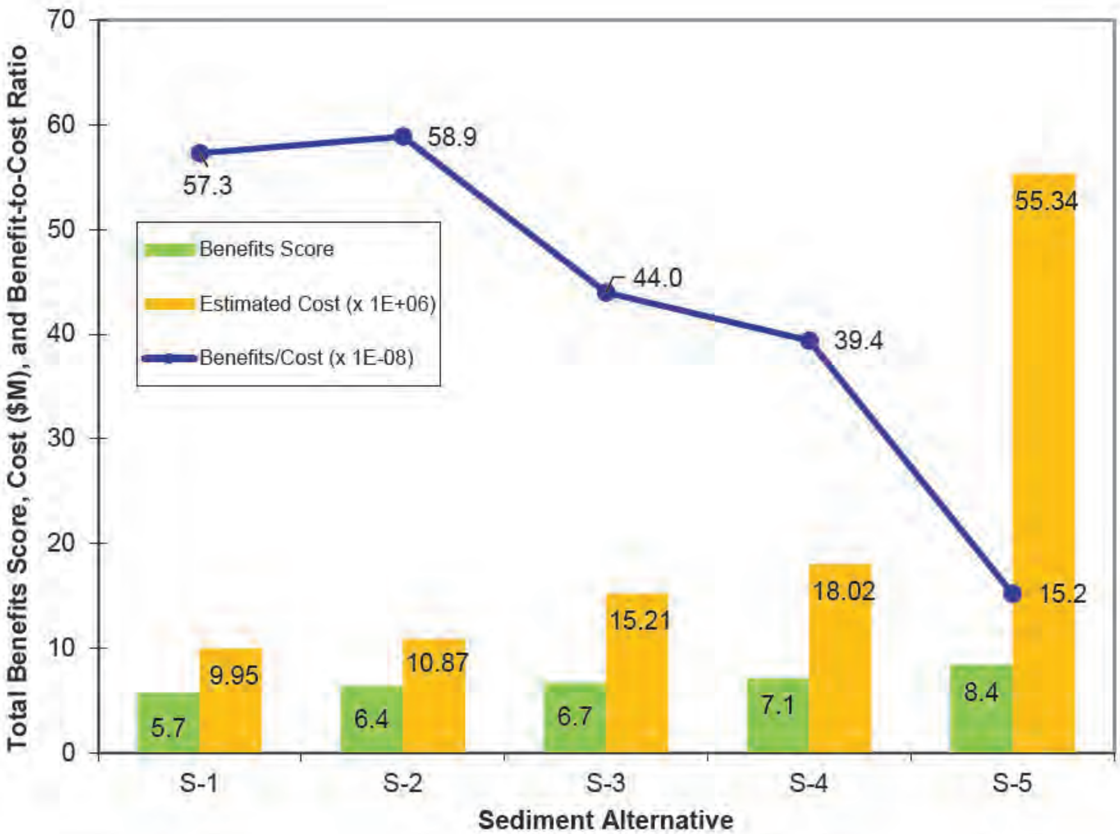


Figure 6-7 Overall Benefit versus Cost for Soil

DEPARTMENT OF ECOLOGY
State of Washington



TITLE:	Disproportionate Cost Analysis for the Groundwater Remediation Alternatives		
LOCATION:	Rayonier Mill Study Area, Port Angeles, WA		
TETRA TECH	CHECKED:	GWC	FIGURE:
	DRAFTED:	LMG	6-8
	PROJ:	7304023	
	DATE:	5/13/2021	



TITLE:	**Disproportionate Cost Analysis for the Sediment Remediation Alternatives**		
LOCATION:	**Rayonier Mill Study Area, Port Angeles, WA**		
TETRA TECH	CHECKED: GWC		FIGURE:
	DRAFTED: SO		**6-9**
	PROJ: 7304023		
	DATE: 5/13/2021		

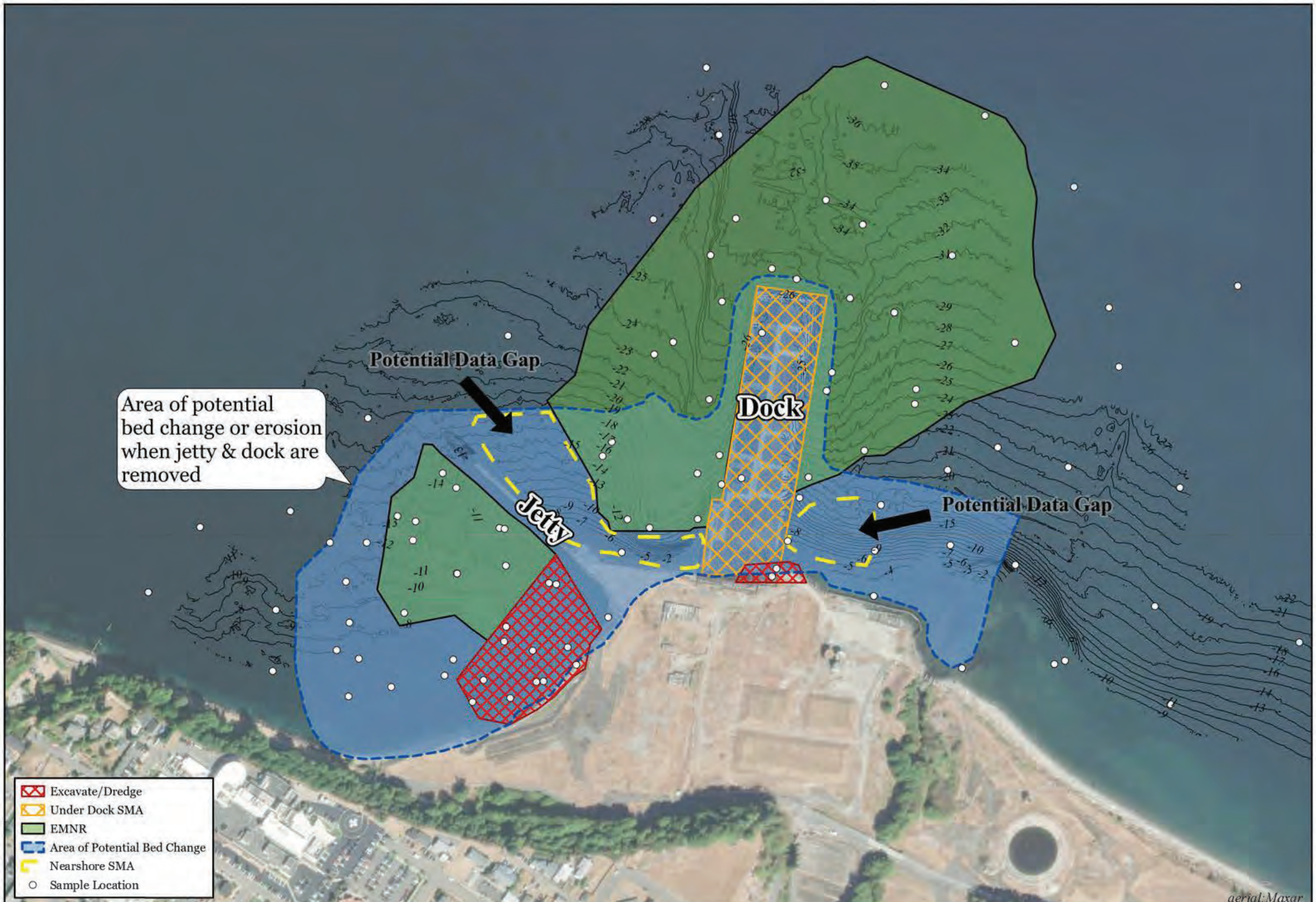


Figure 6-10. Potential Data Gaps and Proposed Remedial Design

NewFields

Appendix A

Port Angeles Rayonier Mill Site: Under-Dock and Nearshore Areas Pre-Remedial Design Analysis and Decision Framework, dated March 2024

DEPARTMENT OF ECOLOGY
State of Washington

Port Angeles Rayonier Mill Site: Under-dock and Nearshore Areas Pre-Remedial Design Analysis and Decision Framework

To: Rayonier Mill Site Potentially Liable Persons

From: Rebecca S. Lawson, P.E., LHG
Section Manager
Southwest Regional Office
Toxics Cleanup Program

Date: November 2023

1.0 Purpose

Pre-remedial design data will be used to determine whether dredging, thin layer capping, enhanced monitored natural recovery (EMNR), or no action will be a sufficiently protective remedy for the under-dock and nearshore areas of the Rayonier Mill site.

The purpose of this decision framework memorandum is to:

1) **identify pre-remedial design sediment data needs** in the under-dock and nearshore areas
    a. **to inform best management practices** for removing in-water structures (i.e., dock, jetty, treated timbers and pilings), and
    b. **to inform remedy selection** for the under-dock and nearshore areas after structure removal
2) **outline a process for collecting the pre-remedial design data**
3) **provide a decision framework** using new data collected to determine appropriate remedies for the under-dock and nearshore areas that are effective after structure removal

A site visit conducted by Ecology, NewFields, and Moffatt & Nichol on June 15, 2022 informed this decision framework memorandum. Attachment A provides a summary of the site visit.

While not the intended purpose, the decision framework may also support design decisions for other sediment remediation areas within the sediment cleanup unit based on remedial design data. Remedial design data needs are not identified in this decision framework memorandum.

2.0 Background

The recommended remedy included in the Interim Action Report Volume III: Alternatives Evaluation Report (Volume III) includes EMNR[1] for sediments under the dock, and no remedy is recommended for sediments in the nearshore areas. There is uncertainty in the effectiveness of these recommended remedies due to limited sediment chemistry characterization (both lateral and vertical) and limited modeling of sediment bed movement post removal of the in-water structures (i.e., dock, jetty, treated timbers, and pilings). Figure 1 shows the Volume III recommended alternative and the limited extent of sampling data under the dock and in the nearshore data gap area outlined in yellow.

In a January 13, 2022 letter, Ecology proposed selecting the Volume III recommended alternative with the modification of dredging the under-dock sediments. The Ecology proposed remedy for contaminated sediments included:

- Dredge intertidal and nearshore portion of sediment management area (SMA)-2 (the log pond)
- Dredge shoreline portion of SMA-1 (the Mill Dock Landing on the shoreline adjacent to the dock)
- Dredge sediments in the under-dock area (Proposed by Ecology in place of EMNR recommended in Volume III)
- Fill previously dredged berth and approach areas with clean fill to surrounding substrate depth gradient.
- EMNR in the remainder (i.e., subtidal portion) of SMA-2 (the log pond) and the remainder of SMA-1

Figure 3 shows the sediment management areas (SMAs).

Ecology proposed dredging the under-dock sediments as a more protective remedy as it reduces the potential for contaminated sediments to spread to other areas of the harbor and ensures the cleanup levels in the sediment cleanup unit are achieved in a reasonable restoration timeframe.

Sediments in the under-dock area (surface or at depth) may be potentially contaminated due to the presence of approximately 4000 creosote pilings and the discharge from former outfalls beneath the dock of untreated wastewater for decades. The numerous dock pilings have protected the underlying sediments from erosional forces. Once the dock is removed, there is a potential that the underlying contaminated sediments will erode and possibly spread contamination to other areas of the harbor.

[1] Enhanced Monitored Natural Recovery and Enhanced Natural Recovery refer to the same remedial technique. Rayonier's Volume III report used the terminology Enhanced Natural Recovery. Ecology prefers to use Enhanced Monitored Natural Recovery because it highlights the monitoring component which is an integral part of this remedy regardless of which terminology is used.

Ecology and Rayonier held several meetings in 2022. To support selecting an effective remedy (e.g., dredging, EMNR, thin-layer capping), additional sediment data and modeling is needed. Ecology agreed to identify pre-remedial design data needs and develop a decision framework for using new data collected to determine appropriate remedies for the under-dock area that are effective after removal of the large in-water structures. In developing this decision framework, Ecology determined the nearshore area should be included as there is limited data in the nearshore area and no remedy was recommended (Figure 1).

3.0 Proposed Remedial Design

Ecology's proposed remedy (Figure 2) for contaminated sediments now includes:

- Remove any treated timbers and pilings in contact with marine water or sediment
- Dredge intertidal and nearshore portion of SMA-2 (the log pond)
- Dredge shoreline portion of SMA-1 (the Mill Dock Landing on the shoreline adjacent to the dock)
- Contingent remedy for SMA-3 (under-dock area) and SMA-4 (nearshore areas) will include EMNR, thin-layer cap, dredge, no-action, or a combination of these remedial options.
- Fill previously dredged berth and approach areas with clean fill to surrounding substrate depth gradient to create suitable benthic habitat and eliminate prominent bottom features that could affect localized deposition (i.e., suppressions) or erosion (i.e., slopes or mounds).
- EMNR in the non-dredged areas of SMA-2 (the log pond) and outside of the dock berths and approaches of SMA-1

This decision framework will be integrated into the Interim Action Plan for the Study Area. As outlined in this decision framework, the pre-remedial design data collection, hydrodynamic/sediment transport modeling, and pre-remedial design data analysis and application of the framework to select the appropriate remedy must be completed before any structures are removed. The decision framework will be used to determine the appropriate remedies for the under-dock and nearshores areas that meet the requirements of the Model Toxics Control Act (WAC 173-340).

4.0 Definitions

The following definitions are set for the purposes of this decision framework memorandum.

Dredging is the removal of contaminated sediment from the aquatic environment. Removal of subtidal sediment is typically conducted with a barge-mounted clamshell dredge, while intertidal sediment can be excavated under lower-tide conditions using upland-based equipment. Dredging can be conducted in erosive or non-erosive environments.

Enhanced monitored natural recovery (EMNR) involves active measures, such as the placement of a thin layer of suitable sand or sediment, to accelerate the natural recovery process. EMNR is often applied in areas where natural recovery may appear to be an appropriate remedy, yet the rate of sedimentation or other natural processes is insufficient to reduce potentially unacceptable risks within an acceptable timeframe. EMNR can only be used in non-erosive environments.

Erosive is defined as a net annual loss of sediment following removal of structures.

In-water structures includes the dock, jetty, treated timbers and pilings.

Nearshore areas are defined as areas where: 1) no remedy is proposed; 2) there is limited sampling data; and 3) removal of existing structures (i.e., dock and jetty) will likely cause sediment bed changes.

Non-erosive is defined as a static equilibrium or net annual deposition of sediment following removal of structures.

Pre-remedial design data – data collected to support decision making. This decision framework memorandum identifies the pre-remedial design data needs for determining appropriate remedies in the under-dock and nearshore areas.

Remedial design data – data collected to design a remedy. Remedial design data requirements are not discussed in this decision framework memorandum.

Sediment Management Area (SMA) – an area within the larger site that can be managed differently in terms of the remedy and monitoring.

Thin-layer capping is the placement of a thin layer (e.g., 6 inches) of clean sediment to physically isolate the underlying contaminated sediment. The cap must be designed to contain contaminants and prevent migration via pore water or bioturbation. The cap must support a productive benthic community and provide adequate isolation from the material contained by the cap. Thin-layer capping can be used in non-erosive or erosive environments if designed to withstand the erosive forces.

5.0 Identified Pre-Remedial Design Data Needs

The following pre-remedial design data needs were identified for sediment under the dock (both intertidal and subtidal) and in the nearshore areas. As noted in Section 7 below, these areas may be impacted after the in-water structures are removed. Figure 2 shows the under-dock and nearshore areas. The nearshore areas include the areas east of the jetty along the shoreline and east of the dock.

5.1 Sediment Characterization

- Pre-removal of in-water structures:
    - Surface and subsurface sediment chemistry including the SMS benthic suite, Total Organic Carbon, PCB congener (sum TEQ), cPAHs (sum TEQ), and dioxins/furans (sum TEQ)

        - Chemical characterization to support the structure and piling removal plan.
    - Depth of depositional sediment overlying native substrate beneath the dock
        - To assess sediments with potential for erosion, subsequent redistribution of contaminated sediment, and inform appropriate remedies.
    - Grain size distribution of sediments (surface and subsurface)
        - To assess sediment with potential for erosion, subsequent redistribution of contaminated sediment, and inform appropriate remedies.

5.2 Hydrodynamics & Sediment Transport of Post Removal Conditions

- Site assessment & physical processes conceptual site model (CSM) that evaluates the localized system with the structures removed and incorporates the shoreline regrade and stabilization planned.
- Scour/erosion and deposition analysis.
- Fate of existing bed material.
- Remedy analysis.

6.0 Filling Identified Pre-Remedial Design Data Needs

The following section includes recommendations for data collection and analyses to fill the identified pre-remedial design data needs before removal of the in-water structures. Specific sampling details will need to be developed in workplans for Ecology review and approval prior to proceeding.

6.1 Sediment Characterization

Removal of the in-water structures including the approximately 4000 pilings will disturb surface and subsurface sediment and alter current sediment conditions both under the dock (e.g., sediment chemistry, grain size, erosion potential) and surrounding environment (sediment deposition and chemistry in subtidal and nearshore, and nearshore processes). The surface and subsurface sediments in the under-dock and nearshore areas must be adequately characterized to inform best management practices to remove the in-water structures, to minimize redistribution of contaminated sediment, and to inform appropriate remedies. In addition, the susceptibility of increased erosion once the structures and pilings are removed is unknown and must be understood to determine the appropriate protective remedy.

The removal of the in-water structures and remediation of contaminated sediments must be a part of the same project. Ecology must select and approve the design of a protective remedy before the structures are removed. Therefore, the pre-removal sediment sampling will be used to prepare a piling removal plan, as well as select protective remedies for the under-dock area and nearshore areas.

Pre-removal of structures and pilings

Prior to removal of the in-water structures, surface sediment grab samples (0 to 10 cm; 0-45 cm in intertidal areas) and subsurface sediment cores (0 to 8 feet) should be collected from representative and spatially distributed locations from the under-dock area, including intertidal and subtidal locations, and nearshore areas (see Figure 2). Approximately nine to twelve grab samples and collocated sediment core samples should be sufficient to address pre-remedial design data needs in the under-dock area, and six to eight locations west of the dock and three locations east of the dock in the nearshore areas. The surface sediment samples should be submitted for chemical analysis (Table 1) to assess potential risk for benthic receptors and human health.

Subsurface cores should be advanced to a minimum of eight feet below the sediment surface (or refusal) to determine the depth and nature of sediment deposition. Collect sediment samples at 6”, 12”, and 18” of depth at coring locations to characterize material physical properties (grain size distribution) which will support a scour assessment. Subsurface sediment cores should also be collected and sampled in one-foot interval composites (e.g., 0-1’, 1-2’, 2-3’, and 3-4’) for the first four feet, and two-foot intervals for the remainder of the core (e.g., 4-6’ and 6-8’). The depth of depositional material (surface to native material) should be determined for each core collected.

The upper two subsurface sediment core intervals (0-1’ and 1-2’) and any subsurface intervals within the depositional horizon, as well as any intervals with visual indications that potential contaminants may be present (e.g., sheen), should be submitted for chemical analysis. The deeper intervals below the depositional horizon will be archived for potential chemical analysis as needed to determine extent of vertical contamination. The chemical analysis for subsurface sediment will consist of the same chemistry as the surface sediment samples (Table 1). If either of the upper two core intervals have higher concentrations of contaminants than one or both of the surface samples at the same location or exceed the Sediment Management Standards Sediment Cleanup Objective (SMS SCO) benthic criteria, additional intervals may need to be analyzed.

6.2 Hydrodynamics & Sediment Transport

A site visit was conducted on June 15, 2022, during an extreme low tide to observe the intertidal areas within the project site. Active movement of gravelly-sand material within the upper intertidal area was observed within most of the project site. The under-dock area had varying size and type of material depending on exposure to waves and currents. Fine sand was observed within the interior of the dock; the finest material observed anywhere on the project site within the intertidal areas. A summary of the site visit is outlined in Attachment A.

The previously conducted coastal engineering and geomorphologic analysis (Integral Consulting, Inc March 1, 2019, Hydrodynamics & Sediment Transport Investigation) should be reviewed to supplement the future grain size data set and understand post-removal conditions.

The existing nearshore system experiences seasonal beach profile changes and longshore transport of large gravely sand material, which was observed and noted as part of our site visit and review of historical photos. Once the in-water structures are removed, the sediment accumulated within the footprint of the dock and areas of reduced wave energy will have higher erosion potential. A more refined evaluation of the nearshore intertidal areas with a focus on shoreline change relative to nearshore processes (e.g., erosion, sediment transport and deposition, wave action, storm events) is needed to understand post removal impacts.

The numerical model area and grid scale covers an area greater than 7,000 ft of shoreline. Model resolution and input parameters (detailed upper intertidal beach contour survey, sediment grain sizes for existing conditions) should be reviewed relative to the focused, smaller areas being evaluated. The review should include the intertidal and shallow subtidal zones of the dock and jetty (See Figure 1). A higher resolution nearshore model or other analytic tool is needed for a more refined analysis in these areas to assess post structure removal scour potential (erosive versus non erosive).

The removal of the in-water structures will result in changes in nearshore littoral processes, which could result in the following:

1. Scour of fine sand under the dock.
2. Scour of upper beach and berm.
3. Sediment transport of eroded under-dock and nearshore sediment.

The nearshore areas that have a potential risk of scour post-removal are lacking sediment data at depth to understand the potential risks of redistribution of contaminated sediment. It is unknown if there are finer-grained materials underlying the naturally armored surface that could create a potential for increased erosion or whether clean sand or gravel covers any contaminants of concern. For example, a 3-inch layer of clean fine sand over contaminated sediment represents a different risk profile than a 3-inch layer of sandy gravel over a contaminated layer in an area proposed for no action or EMNR.

An area of potential bed change resulting from removal of nearshore structures including the shoreline regrade and stabilization has not been documented. An assessment of littoral processes and evaluation of the corresponding proposed changes would assist in outlining those areas of potential risk of scour or shoreline change.

Climate change should be considered during the evaluation and selection of appropriate remedies. Sea level rise is projected to increase the severity of storm events which can exacerbate effects from wave action in both the subtidal and intertidal zones, therefore increasing erosion potential.

To address the issues above, conduct the following hydrodynamic modeling:

6.2.1 Nearshore Analysis

- A conceptual site model for project site physical processes (nearshore coastal geomorphology) needs to be developed for both existing and the post modification conditions.
- Evaluate and determine the extent of potential bed change as a result of the proposed action within a boundary area. Assess scour risks and extents within that boundary area.
- Conduct additional coastal engineering analysis and assessment work to evaluate scour potential and post project shoreline change with consideration of the

variability of sediment size on the project site and post project geomorphologic processes.

- Confirm if a nested, more refined model was used for the nearshore assessment work. If not, develop a higher resolution model to evaluate pre- and post- project changes to evaluate shoreline change and bed scour using grain size data that is representative of the material present in the nearshore zone.
- Evaluate climate change impacts including sea level rise and severe storm events in accordance with Ecology's Publication 17-09-052 – Sustainable Remediation: Climate Change Resiliency and Green Remediation.
- Several areas shown in the upper intertidal do not have a proposed remedy to address potential for scour due to changes in the littoral system. Further analysis is needed to determine a remedy in the Nearshore SMA.

6.2.2 Geomorphologic Analysis

- Assess nearshore coastal processes (longshore sediment transport, influence of existing structures, etc.) to aid in explaining existing conditions and the current littoral processes/system.
- Evaluate the degree to which anthropogenic change (installation of jetty, dock, dredged berth, beach nourishment, etc…) has occurred within the drift cell(s) to be a basis for assessing the expected post structure removal and shoreline regrade and stabilization equilibrium conditions.
- Evaluate long term (multiyear) changes to the upper intertidal littoral processes for post shoreline removal.
- Develop a summary assessment and conceptual estimates (Conceptual Site Model) of shoreline/beach planform and profile changes relative to proposed alterations (removal of jetty, dock, shoreline regrade and stabilization).

6.2.3 Wave Analysis

- Conduct nearshore numerical wave modeling to demonstrate outcomes planned for remedial design and representative of post-shoreline structure removal nearshore littoral processes. Demonstrate relationship to the geomorphologic analysis results.
- Numerical analysis without shoreline structures (dock or jetty) for any proposed remedy. Those scenarios should be evaluated for a 2- and 100-year return period event at varying water levels that includes sea level rise (e.g., MLLW, MHHW) and increased severity of storm events.
- Assess changes to the conceptual site model. This could include a change in long shore sediment transport to evaluate potential for undermining of existing revetments or scour of existing bed material (exposing unknown underlying material) or scour of an EMNR (if proposed). Assess the potential for shoreline change (upper intertidal, prior to implementing cap material).
- Assess scour potential for fine sand substrate within interior of the dock and nearshore upper beach berm.
- Evaluate changes to the upper intertidal littoral processes – not an event analysis but a long-term morphologic analysis.

- Update Conceptual Site Model based on results of hydrodynamic and geomorphologic analysis and sediment grain size data analysis. A recommendation based on the results of a conceptual site model for the changes to the littoral system with supporting analysis results.

7.0 Decision Framework for Identifying Remedial Action Options

The removal of the in-water structures and remediation of contaminated sediments must be a part of the same project. We must select and design a protective remedy before the structures are removed. The data results from the pre-removal sediment sampling and the modeling efforts will be used to inform the best management practices for removal of in-water structures, and the selection of protective remedies. This includes the area under the current dock structure, as well as any nearshore areas that may be subject to significant changes in shoreline morphology, specifically due to increased erosion. While the data may be useful for the remedial design, that is not the intended purpose of the data. Additional data may be necessary to complete the remedial design.

Guidance for best management practices recommended for removal of in-water structures is included in Chapter 16 of Ecology's Sediment Cleanup User's Manual (SCUM) – Removal of Creosote-Treated Pilings and In-Water Structures.

The decision framework for the protection of benthic organisms and human health is outlined in Tables 2 and 3, respectively, based on the pre-remedial design sampling results. The order of preference for the potential remedial options, based on permanence, is 1. dredging, 2. thin-layer capping, 3. EMNR. For example, if the potential remedial option for benthic considerations is dredging, but the potential remedial option for human health considerations is EMNR, then dredging would be the overall recommended remedial option.

Potential remedial options include:

- Dredging – removal of sediment through excavation or barge-mounted dredge with disposal at appropriate facility.
- Thin-layer Cap – isolation of contaminated sediment with a thin layer (e.g., nominal 6 inches) of clean material that is proven to be non-erosive, effective over the long-term, and appropriate habitat.
- EMNR – placement of thin layer of suitable material to accelerate the natural recovery process.

7.1 Under-dock SMA

The under-dock sediments should be treated as their own SMA for the purposes of this decision evaluation. The under-dock environment differs from surrounding sediments due to the long-term presence of the dock structure and pilings. The berth areas adjacent to the dock were deepened by dredging to accommodate ship access, and the deeper, subtidal substrate further afield from the dock was largely left undisturbed from physical disruptions. However, the area under the dock was potentially impacted by the large number of creosote-preserved pilings, changes in offshore currents and wave energy that would have created a different depositional regime than the berths and undisturbed offshore sediments. Therefore, the under-dock area should be assessed as its own SMA for sediment chemistry to inform the best management practices for piling removal and the potential for erosion and redistribution of contaminated sediment.

Benthic Protection

The results of the hydrodynamic modeling and pre-removal surface sediment chemistry will be used to determine the appropriate remedy to protect the benthic community (Table 2). If the hydrodynamic modeling indicates the potential for erosion after removal of the in-water structures, a sediment dredging remedy is appropriate. EMNR is not an appropriate remedy in erosional areas. EMNR may be an appropriate remedy for areas predicted to be non-erosional and where the surface sediment chemistry is less than 1.5 times the SMS SCO benthic criteria for intertidal sediments, or 3 times the SMS SCO benthic criteria for subtidal sediments. In non-erosional areas where surface sediment chemistry is greater than 1.5 times the SMS SCO benthic criteria for intertidal sediments, or 3 times the SMS SCO benthic criteria for subtidal sediments, then dredging is the appropriate remedy.

Human Health Protection

The results of the hydrodynamic modeling and surface sediment chemistry for cPAHs, dioxins/furans congeners, and PCB congeners will be used to determine the appropriate remedy for protecting human receptors (Table 3). Surface sediment chemistry should be evaluated using spatially weighted average concentration (SWAC) for these chemicals within the SMA.

If the hydrodynamic modeling indicates the potential for erosion after removal of the in-water structures, and the SMA SWAC is statistically significantly higher than the sediment cleanup unit (SCU) SWAC, then a sediment dredging remedy is appropriate. If the SMA SWAC is not higher than the SCU SWAC, then dredging or thin layer capping are appropriate remedies. A thin layer cap may be appropriate if effective over the long-term and the cap-material used is proven to be non-erosive and provides appropriate habitat. EMNR is not an appropriate remedy in erosional areas.

If the hydrodynamic modeling indicates the SMA is not erosional and the SMA SWAC is statistically significantly higher than the SCU SWAC, then dredging or EMNR are appropriate remedies. Dredging may be more appropriate to reduce SCU SWAC below the cleanup levels in a reasonable restoration timeframe. If surface sediment chemistry SWAC within the SMA footprint is similar to the SCU SWAC, then EMNR should be considered as an appropriate remedy.

7.2 Nearshore SMA

The nearshore areas, as defined above and shown on Figure 1, should be treated as a SMA. The same decision criteria for benthic protection and human health protection apply to the nearshore SMA.

Table 1. Sediment Chemistry Analytes

Analytes			
Conventional Parameters			
Grain Size Distribution	Total Solids (%)	Total Sulfides	Total organic carbon (%)
Metals (mg/kg DW)			
Arsenic	Cadmium	Chromium	Copper
Lead	Mercury	Selenium	Silver
Zinc			
cPAHs (µg/kg DW)			
Benzo(a)pyrene	Benz(a)anthracene	Benzo(b)fluoranthene	Benzo(k)fluoranthene
Chrysene	Dibenz(a,h)anthracene	Indeno(1,2,3-cd)pyrene	
PAHs (µg/kg DW)			
Total LPAH	Napthalene	Acenaphthylene	Acenaphthene
Fluorene	Phenanthrene	Anthracene	2-Methylnaphthalene
Total HPAH	Fluoranthene	Pyrene	Benzo(a)anthracene
Chrysene	Total Benzofluoranthenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene
Benzo(a)pyrene	Benzo(g,h,i)perylene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)anthracene
Dioxins/Furans Congeners (ng/kg DW)			
2,3,7,8-TCDD	1,2,3,7,8-PeCDD	1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD	1,2,3,4,6,7,8-HpCDD	OCDD	
2,3,7,8-TCDF	1,2,3,7,8-PeCDF	2,3,4,7,8-PeCDF	1,2,3,4,7,8-HxCDF
1,2,3,6,7,8-HxCDF	1,2,3,7,8,9-HxCDF	2,3,4,6,7,8-HxCDF	1,2,3,4,6,7,8-HpCDF
1,2,3,4,7,8,9-HpCDF	OCDF		
PCB Congeners and Congener Pairs (ng/kg DW)			
PCB-1	PCB-48	PCB-110/115	PCB-164
PCB-2	PCB-50/53	PCB-111	PCB-165
PCB-3	PCB-52	PCB-112	PCB-167
PCB-4	PCB-54	PCB-113/90/101	PCB-169
PCB-5	PCB-55	PCB-114	PCB-170
PCB-6	PCB-56	PCB-117/116/85	PCB-171/173
PCB-7	PCB-57	PCB-118	PCB-172
PCB-8	PCB-58	PCB-120	PCB-174
PCB-9	PCB-59/62/75	PCB-121	PCB-175
PCB-10	PCB-60	PCB-122	PCB-176
PCB-11	PCB-61/70/74/76	PCB-123	PCB-177
PCB-12/13	PCB-63	PCB-126	PCB-178
PCB-14	PCB-64	PCB-127	PCB-179
PCB-15	PCB-66	PCB-128/166	PCB-180/193
PCB-16	PCB-67	PCB-130	PCB-181
PCB-17	PCB-68	PCB-131	PCB-182
PCB-19	PCB-69/49	PCB-132	PCB-183/185
PCB-21/33	PCB-72	PCB-133	PCB-184
PCB-22	PCB-73	PCB-134/143	PCB-186
PCB-23	PCB-77	PCB-136	PCB-187
PCB-24	PCB-78	PCB-137	PCB-188
PCB-25	PCB-79	PCB-138/163/129/160	PCB-189
PCB-26/29	PCB-80	PCB-139/140	PCB-190
PCB-27	PCB-81	PCB-141	PCB-191

Analytes			
PCB-28/20	PCB-82	PCB-142	PCB-192
PCB-30/18	PCB-83/99	PCB-144	PCB-194
PCB-31	PCB-84	PCB-145	PCB-195
PCB-32	PCB-88/91	PCB-146	PCB-196
PCB-34	PCB-89	PCB-147/149	PCB-197/200
PCB-35	PCB-92	PCB-148	PCB-198/199
PCB-36	PCB-94	PCB-150	PCB-201
PCB-37	PCB-95/100/93/102/98	PCB-151/135/154	PCB-202
PCB-38	PCB-96	PCB-152	PCB-203
PCB-39	PCB-103	PCB-153/168	PCB-204
PCB-41/40/71	PCB-104	PCB-155	PCB-205
PCB-42	PCB-105	PCB-156/157	PCB-206
PCB-43	PCB-106	PCB-158	PCB-207
PCB-44/47/65	PCB-107/124	PCB-159	PCB-208
PCB-45/51	PCB-108/119/86/97/125/87	PCB-161	PCB-209
PCB-46	PCB-109	PCB-162	--

Table 2. Decision Framework Outline for Benthic Protection

<table>
<tr><th colspan="4">Benthic Protection</th></tr>
<tr><th>Erosion Modeling Results[1, 2]</th><th>Surface Sediment Chemistry[3]</th><th>Subsurface Chemistry Results</th><th>Potential Remedial Consideration[4]</th></tr>
<tr><td rowspan="3">Erosive</td><td>Surface Sediment Chemistry ≥SCO</td><td>NA</td><td>Dredging[5]</td></tr>
<tr><td rowspan="2">Surface Sediment Chemistry < SCO</td><td>Subsurface[5] > SCO</td><td>Dredging[6]</td></tr>
<tr><td>Subsurface < SCO</td><td>No action</td></tr>
<tr><td rowspan="5">Non-Erosive</td><td>Surface Sediment Chemistry ≥ 3X SCO (subtidal) or 1.5X SCO (intertidal)[7]</td><td>NA</td><td>Dredging</td></tr>
<tr><td rowspan="2">3X SCO (subtidal) or 1.5X SCO (intertidal) > Surface Sediment Chemistry ≥ SCO</td><td>Subsurface > surface</td><td>EMNR or Dredging[8]</td></tr>
<tr><td>Subsurface < surface</td><td>EMNR</td></tr>
<tr><td rowspan="2">Surface Sediment Chemistry < SCO</td><td>Subsurface > surface</td><td>No action or EMNR[9]</td></tr>
<tr><td>Subsurface < surface</td><td>No action</td></tr>
</table>

Notes:
1: Erosive is defined as a net annual loss of sediment following removal of structures.
2: Non-erosive is defined as a static equilibrium or net annual deposition of sediment following removal of structures.
3: The surface sediment point of compliance for benthic protection is 10 cm.
4: Remedy preference order based on permanence: 1. dredging, 2. thin-layer capping, 3.EMNR
5: Potential new surface after erosion.
6: Erosive. EMNR not appropriate in erosive areas.
7: This is a site-specific remediation level. The 3X SCO applies only to subtidal sediment areas. For intertidal areas use 1.5X SCO.
8: If higher contamination at depth will remain buried below the biologically active zone, then EMNR. If higher contamination at depth may be exposed or carried upwards through bioturbation or other disturbance, then dredging.
9: If higher contamination at depth may be exposed or carried upwards through bioturbation or other disturbance, then EMNR

SCO: Sediment Cleanup Objective for benthic protection
EMNR: Enhanced Monitored Natural Recovery
NA: Not Applicable

Table 3. Decision Framework Outline for Human Health Protection

Human Health Protection[3]			
Erosion Modeling Results[1,2]	**SMA SWAC[4] compared to SCU SWAC[5]**	**Subsurface Chemistry Results**	**Potential Remedial Consideration[6]**
Erosive	SMA SWAC ≥ SCU SWAC[7]	NA	Dredging[8]
	SMA SWAC < SCU SWAC	Subsurface > Surface	Dredging or thin layer cap[9]
		Surface > Subsurface > Clean	Dredging or thin layer cap[9]
		Clean Subsurface	Dredging or thin layer cap[9]
Non-Erosive	SMA SWAC ≥ SCU SWAC	Subsurface > Surface	Dredging[10] or EMNR
		Surface > Subsurface > Clean	Dredging[10] or EMNR
		Clean Subsurface	Dreding[10] or EMNR
	SMA SWAC < SCU SWAC	Subsurface > Surface	EMNR
		Surface > Subsurface > Clean	EMNR
		Clean Subsurface	EMNR

Notes:
1: Erosive is defined as a net annual loss of sediment following remedial activities.
2: Non-erosive is defined as a static equilibrium or net annual deposition of sediment following remedial activities.
3: The surface sediment point of compliance for intertidal areas is 45 cm and 10 cm for subtidal areas.
4: SMA SWAC is SWAC of sediment management areas (e.g., under-dock footprint or nearshore areas)
5: SCU SWAC is SWAC of sediment cleanup unit
6: Remedy preference order based on permanence: 1. dredging, 2. thin-layer capping, 3. EMNR
7: SMA SWAC is statistically significantly higher than SCU SWAC
8: Erosive. EMNR not appropriate in erosive areas.
9: Thin layer cap may be appropriate given the SMA SWAC is less than the SCU SWAC, and deeper sediments are less contaminated than the surface sediments. Thin layer cap material must be proven to be non-erosive, effective over the long-term, and appropriate habitat.
10: Dredging may be more appropriate to reduce SCU SWAC below Cleanup Levels in reasonable restoration timeframe.

SWAC: Spatially Weighted Average Concentration
EMNR: Enhanced Monitored Natural Recovery
NA: Not Applicable

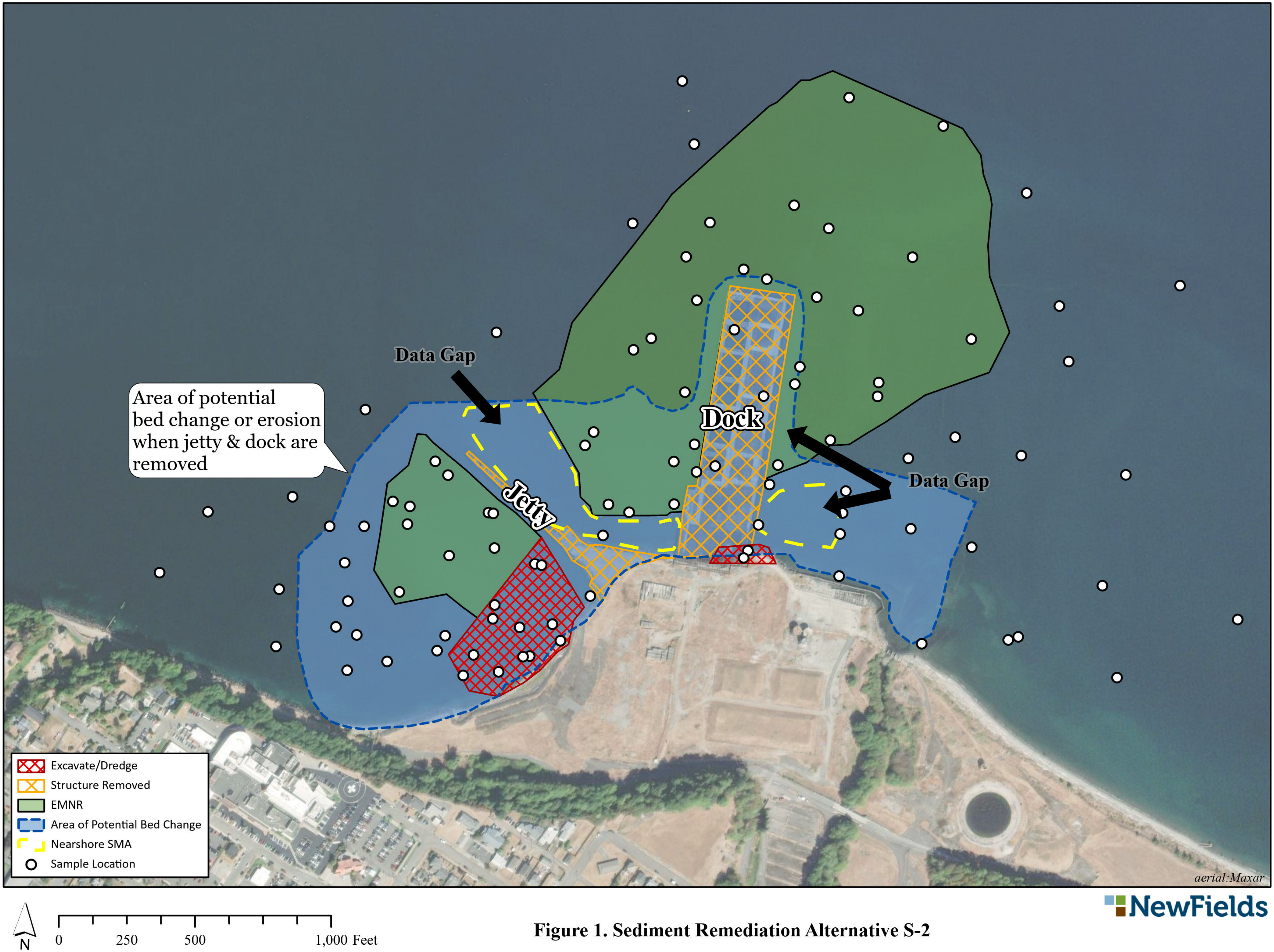


Figure 1. Sediment Remediation Alternative S-2

Path: D:\Projects\Rayonier_Mill\Rayonier_Mill.aprx

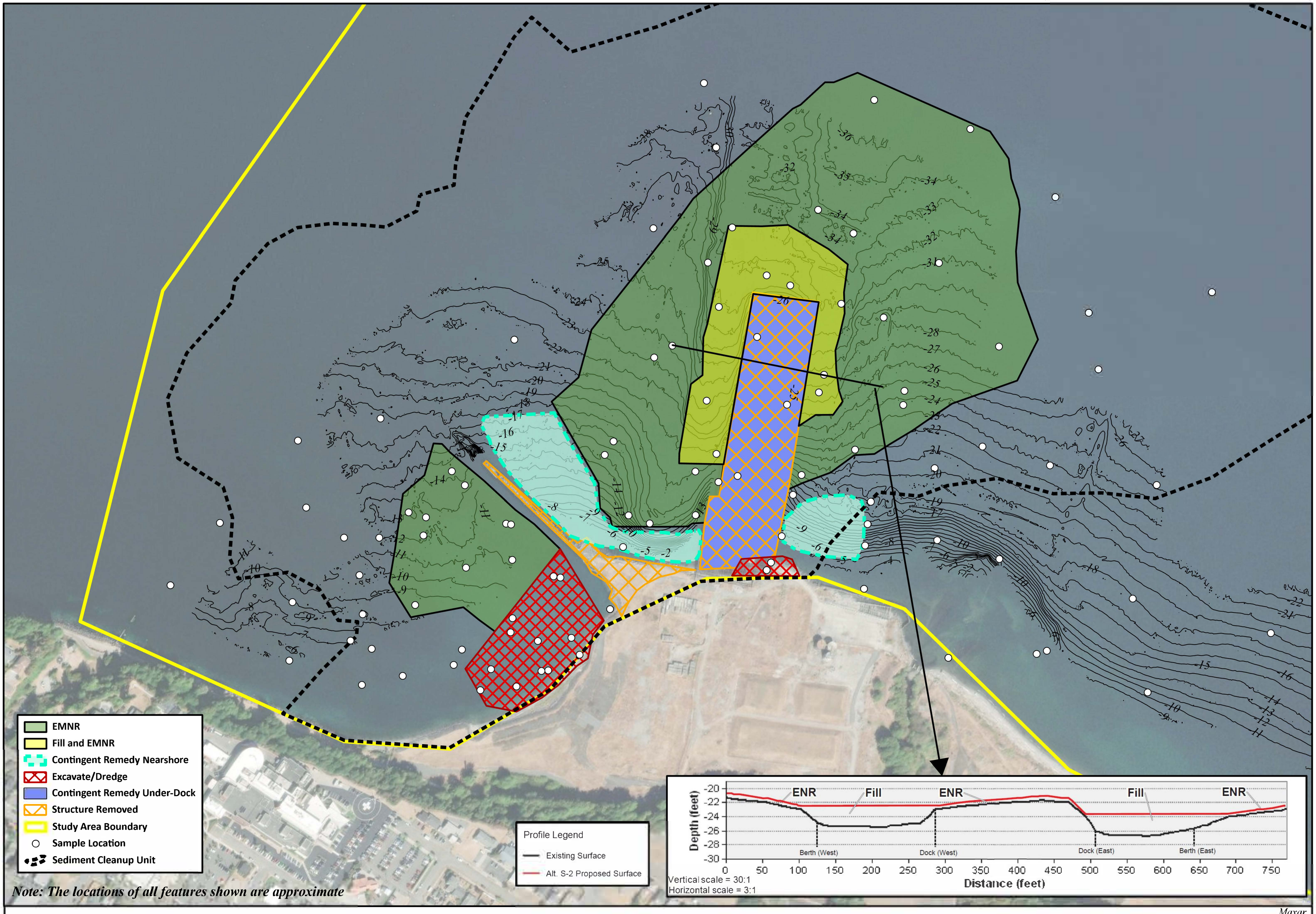


Figure 2 Sediment Selected Remedy

0 350 700 1,400 Feet

N

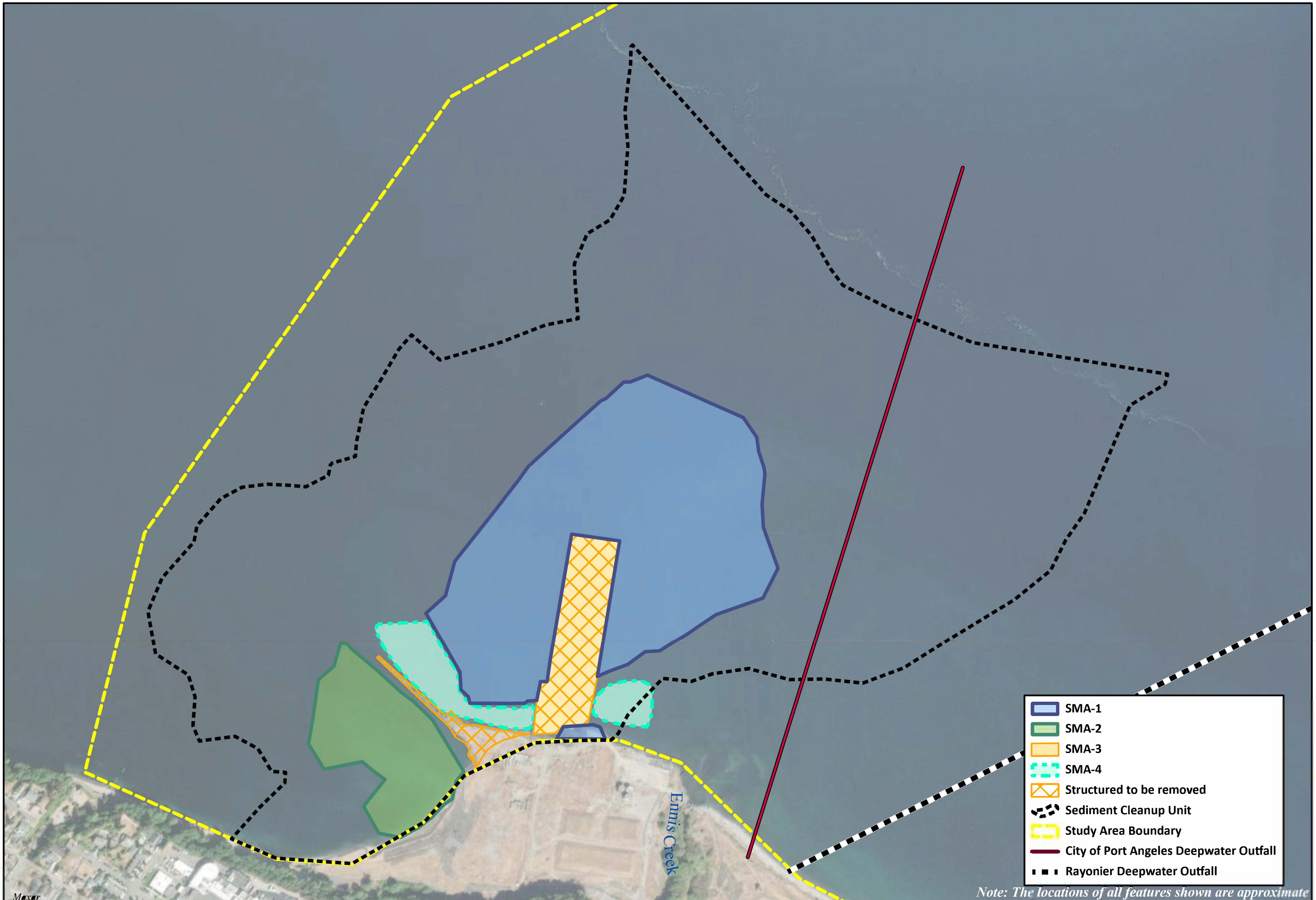


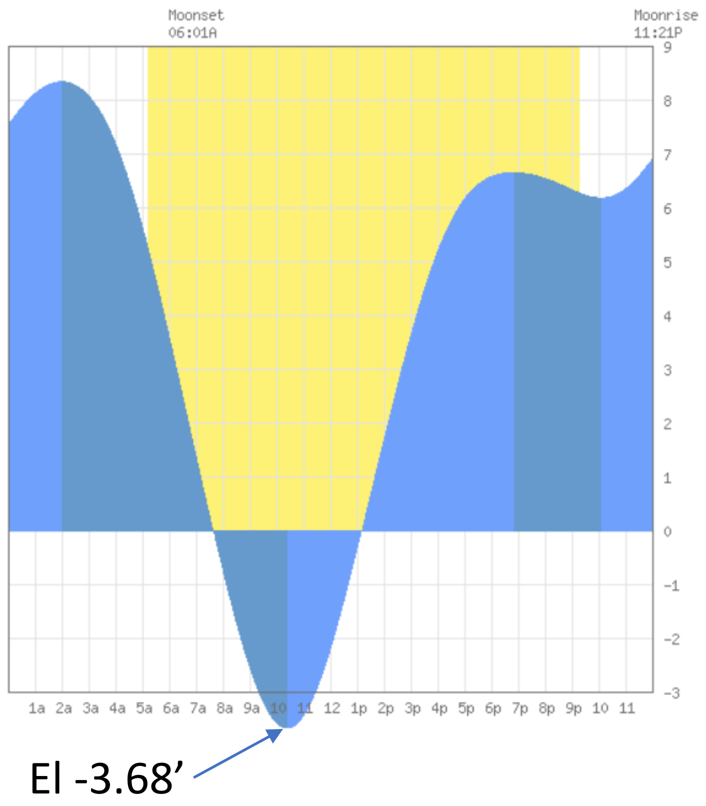
Figure 3. Rayonier Mill Sediment Cleanup Unit and Sediment Management Areas

NewFields

Attachment A: Site Visit Summary
June 28,2022
Moffatt & Nichol

SITE VISIT – JUNE 15, 2022

- Purpose. Review site conditions during low tide to observe substrate variability on the site with the remedial action area.
- Time of Site Assessment. 9:30 to 11:30 am; time of low tide (-3.68').



SITE OBSERVATIONS – JUNE 15, 2022

LEGEND

Sandy Gravel
Gravel Cobble
Large Rock & Cobble
Fine Sand w/ Silt

Photo # & Orientation 1

At extreme low tide (-3.6’; lowest tide in >10 years), intertidal beach outside of pier was observed to be either sandy gravel or gravel cobble. Only location of observed fine sand w/ silt was on the interior of the pier where waves are partially attenuated by the pile field.

SITE OBSERVATIONS – JUNE 15, 2022

1 East Sandy Gravel Beach at toe of revetment

Longshore Sediment flow thru and under the pier

2 Longshore Sediment in upper profile **"A"** and coarser "B"

Coarser Lower Beach – 3" minus gravel/sand

Gravely Sand Upper Beach

Coarser Lower Beach – 5" minus Gravel, Cobble

SITE OBSERVATIONS – JUNE 15, 2022

3 Fine Sand interior to coarse rock bands on the outer edges of the pier

SITE OBSERVATIONS – JUNE 15, 2022

4 Upper Intertidal Beach Berm under pier (nearshore zone only) – gravelly sand

SITE OBSERVATIONS – JUNE 15, 2022

5 Upper Intertidal Beach Berm under pier (nearshore zone only) – gravelly sand, looking west